AbortProc (3.1)

BOOL CALLBACK AbortProc(*hdc, error***)**

```
HDC hdc;      /* handle of device context */
int error;    /* error value              */
```

The **AbortProc** function is an application-defined callback function that is called when a print job is to be canceled during spooling.

Parameter	Description
hdc	Identifies the device context.
error	Specifies whether an error has occurred. This parameter is zero if no error has occurred; it is **SP_OUTOFDISK** if Print Manager is currently out of disk space and more disk space will become available if the application waits. If this parameter is SP_OUTOFDISK, the application need not cancel the print job. If it does not cancel the job, it must yield to Print Manager by calling the **PeekMessage** or **GetMessage** function.

Returns

The callback function should return TRUE to continue the print job or FALSE to cancel the print job.

Comments

An application installs this callback function by calling the **SetAbortProc** function. **AbortProc** is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition file.

See Also

GetMessage, **PeekMessage**, **SetAbortProc**

CallWndProc (3.1)

LRESULT CALLBACK CallWndProc(*code, wParam, lParam***)**

```
int code;          /* process-message flag                 */
WPARAM wParam;     /* current-task flag                    */
LPARAM lParam;     /* address of structure with message data */
```

The **CallWndProc** function is a library-defined callback function that the system calls whenever the **SendMessage** function is called. The system passes the message to the callback function before passing the message to the destination window procedure.

Parameter	Description
code	Specifies whether the callback function should process the message or call the **CallNextHookEx** function. If the *code* parameter is less than zero, the callback function should pass the message to **CallNextHookEx** without further processing.
wParam	Specifies whether the message is sent by the current task. This parameter is nonzero if the message is sent; otherwise, it is NULL.
lParam	Points to a structure that contains details about the message. The following shows the order, type, and description of each member of the structure:

Member	Description
lParam	Contains the *lParam* parameter of the message.
wParam	Contains the *wParam* parameter of the message.
uMsg	Specifies the message.
hWnd	Identifies the window that will receive the message.

Returns

The callback function should return zero.

Comments

The **CallWndProc** callback function can examine or modify the message as necessary. Once the function returns control to the system, the message, with any modifications, is passed on to the window procedure.

This callback function must be in a dynamic-link library.

An application must install the callback function by specifying the **WH_CALLWNDPROC** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHookEx** function.

CallWndProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition file.

See Also

CallNextHookEx, **SendMessage**, **SetWindowsHookEx**

CBTProc (3.1)

LRESULT CALLBACK CBTProc(*code, wParam, lParam***)**

```
int code;          /* CBT hook code                  */
WPARAM wParam;     /* depends on the code parameter  */
LPARAM lParam;     /* depends on the code parameter  */
```

The **CBTProc** function is a library-defined callback function that the system calls before activating, creating, destroying, minimizing, maximizing, moving, or sizing a window; before completing a system command; before removing a mouse or keyboard event from the system message queue; before setting the input focus; or before synchronizing with the system message queue.

The value returned by the callback function determines whether to allow or prevent one of these operations.

Parameter	Description
code	Specifies a computer-based-training (CBT) hook code that identifies the operation about to be carried out, or a value less than zero if the callback function should pass the *code, wParam,* and *lParam* parameters to the **CallNextHookEx** function. The *code* parameter can be one of the following:

Code	Meaning
HCBT_ACTIVATE	Indicates that the system is about to activate a window.
HCBT_CLICKSKIPPED	Indicates that the system has removed a mouse message from the system message queue. A CBT application that must install a journaling playback filter in response to the mouse message should do so when it receives this hook code.
HCBT_CREATEWND	Indicates that a window is about to be created. The system calls the callback function before sending the **WM_CREATE** or **WM_NCCREATE** message to the window. If the callback function returns TRUE, the system destroys the window--the **CreateWindow** function returns NULL, but the **WM_DESTROY** message is not sent to the window. If the callback function returns FALSE, the window is created normally. At the time of the HCBT_CREATEWND notification, the window has been created, but its final size and position may not have been determined, nor has its parent window been established. It is possible to send messages to the newly created window, although the window has not yet received **WM_NCCREATE** or **WM_CREATE** messages. It is possible to change the Z-order of the newly created window by modifying the **hwndInsertAfter** member of the **CBT_CREATEWND** structure.
HCBT_DESTROYWND	Indicates that a window is about to be destroyed.
HCBT_KEYSKIPPED	Indicates that the system has removed a keyboard message from the system message queue. A CBT application that must install a journaling playback filter in response to the keyboard message should do so when it receives this hook code.
HCBT_MINMAX	Indicates that a window is about to be minimized or maximized.

	HCBT_MOVESIZE	Indicates that a window is about to be moved or sized.
	HCBT_QS	Indicates that the system has retrieved a **WM_QUEUESYNC** message from the system message queue.
	HCBT_SETFOCUS	Indicates that a window is about to receive the input focus.
	HCBT_SYSCOMMAND	Indicates that a system command is about to be carried out. This allows a CBT application to prevent task switching by hot keys.
wParam	This parameter depends on the *code* parameter. See the following Comments section for details.	
lParam	This parameter depends on the *code* parameter. See the following Comments section for details.	

Returns

For operations corresponding to the following CBT hook codes, the callback function should return zero to allow the operation, or 1 to prevent it:

HCBT_ACTIVATE
HCBT_CREATEWND
HCBT_DESTROYWND
HCBT_MINMAX
HCBT_MOVESIZE
HCBT_SYSCOMMAND

The return value is ignored for operations corresponding to the following CBT hook codes:

HCBT_CLICKSKIPPED
HCBT_KEYSKIPPED
HCBT_QS

Comments

The callback function should not install a playback hook except in the situations described in the preceding list of hook codes.

This callback function must be in a dynamic-link library.

An application must install the callback function by specifying the **WH_CBT** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHookEx** function.

CBTProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition file.

The following table describes the *wParam* and *lParam* parameters for each HCBT_ constant.

Constant	wParam	lParam
HCBT_ACTIVATE	Specifies the handle of the window about to be activated.	Specifies a long pointer to a **CBTACTIVATESTRUCT** structure that contains the handle of the currently active window and specifies whether the activation is changing because of a mouse click.
HCBT_CLICKSKIPPED	Identifies the mouse message removed from the system message queue.	Specifies a long pointer to a **MOUSEHOOKSTRUCT** structure that contains the hit-test code and the handle of the window for which the mouse

		message is intended. For a list of hit-test codes, see the description of the WM_NCHITTEST message.
HCBT_CREATEWND	Specifies the handle of the new window.	Specifies a long pointer to a **CBT_CREATEWND** data structure that contains initialization parameters for the window.
HCBT_DESTROYWND	Specifies the handle of the window about to be destroyed.	This parameter is undefined and should be set to 0L.
HCBT_KEYSKIPPED	Identifies the virtual key code.	Specifies the repeat count, scan code, key-transition code, previous key state, and context code. For more information, see the description of the WM_KEYUP or WM_KEYDOWN message.
HCBT_MINMAX	Specifies the handle of the window being minimized or maximized.	The low-order word specifies a show-window value (SW_) that specifies the operation. For a list of show-window values, see the description of the **ShowWindow** function. The high-order word is undefined.
HCBT_MOVESIZE	Specifies the handle of the window to be moved or sized.	Specifies a long pointer to a **RECT** structure that contains the coordinates of the window.
HCBT_QS	This parameter is undefined; it should be set to 0.	This parameter is undefined and should be set to 0L.
HCBT_SETFOCUS	Specifies the handle of the window gaining the input focus.	The low-order word specifies the handle of the window losing the input focus. The high-order word is undefined.
HCBT_SYSCOMMAND	Specifies a system-command value (SC_) that specifies the systemcommand. For more information about system command values, see the description of the WM_SYSCOMMAND message.	If *wParam* is SC_HOTKEY, the low-order word of *lParam* contains the handle of the window that task switching will bring to the foreground. If *wParam* is not SC_HOTKEY and a System-menu command is chosen with the mouse, the low-order word of *lParam* contains the x-coordinate of the cursor and the high-order word contains the y-coordinate. If neither of these conditions is true, *lParam* is undefined.

See Also

CallNextHookEx, **SetWindowsHookEx**, **CBTACTIVATESTRUCT**, **CBT_CREATEWND**, **RECT**

CPlApplet (3.1)

LONG CALLBACK* CPlApplet(*hwndCPl, msg, lParam1, lParam2***)**

```
HWND hwndCPl;       /* handle of Control Panel window */
UINT msg;           /* message                        */
LPARAM lParam1;     /* first message parameter        */
LPARAM lParam2;     /* second message parameter       */
```

The **CPlApplet** function serves as the entry point for a Control Panel dynamic-link library (DLL). This function is supplied by the application.

Parameter	Description
hwndCPl	Identifies the main Control Panel window.
msg	Specifies the message being sent to the DLL.
lParam1	Specifies 32 bits of additional message-dependent information.
lParam2	Specifies 32 bits of additional message-dependent information.

Returns

The return value depends on the message.

Comments

Use the *hwndCPl* parameter for dialog boxes or other windows that require a handle of a parent window.

DdeCallback (3.1)

#include <ddeml.h>

HDDEDATA CALLBACK DdeCallback(*type, fmt, hconv, hsz1, hsz2, hData, dwData1, dwData2***)**

```
UINT type;          /* transaction type                 */
UINT fmt;           /* clipboard data format            */
HCONV hconv;        /* handle of conversation           */
HSZ hsz1;           /* handle of string                 */
HSZ hsz2;           /* handle of string                 */
HDDEDATA hData;     /* handle of global memory object   */
DWORD dwData1;      /* transaction-specific data        */
DWORD dwData2;      /* transaction-specific data        */
```

The **DdeCallback** function is an application-defined dynamic data exchange (DDE) callback function that processes DDE transactions sent to the function as a result of DDE Management Library (**DDEML**) calls by other applications.

Parameter	Description
type	Specifies the type of the current transaction. This parameter consists of a combination of transaction-class flags and transaction-type flags. The following table describes each of the transaction classes and provides a list of the transaction types in each class.

Value	Meaning
XCLASS_BOOL	A DDE callback function should return TRUE or FALSE when it finishes processing a transaction that belongs to this class. Following are the XCLASS_BOOL transaction types: **XTYP_ADVSTART** **XTYP_CONNECT**
XCLASS_DATA	A DDE callback function should return a DDE data handle, CBR_BLOCK, or NULL when it finishes processing a transaction that belongs to this class. Following are the XCLASS_DATA transaction types: **XTYP_ADVREQ** **XTYP_REQUEST** **XTYP_WILDCONNECT**
XCLASS_FLAGS	A DDE callback function should return DDE_FACK, DDE_FBUSY, or DDE_FNOTPROCESSED when it finishes processing a transaction that belongs to this class. Following are the XCLASS_FLAGS transaction types: **XTYP_ADVDATA** **XTYP_EXECUTE** **XTYP_POKE**
XCLASS_NOTIFICATION	The transaction types that belong to this class are for notification purposes only. The return value from the callback function is ignored. Following are the XCLASS_NOTIFICATION transaction types:

XTYP_ADVSTOP
XTYP_CONNECT_CONFIRM
XTYP_DISCONNECT
XTYP_ERROR
XTYP_MONITOR
XTYP_REGISTER
XTYP_XACT_COMPLETE
XTYP_UNREGISTER

fmt	Specifies the format in which data is to be sent or received.
hconv	Identifies the conversation associated with the current transaction.
hsz1	Identifies a string. The meaning of this parameter depends on the type of the current transaction. For more information, see the description of the transaction type.
hsz2	Identifies a string. The meaning of this parameter depends on the type of the current transaction. For more information, see the description of the transaction type.
hData	Identifies DDE data. The meaning of this parameter depends on the type of the current transaction. For more information, see the description of the transaction type.
dwData1	Specifies transaction-specific data. For more information, see the description of the transaction type.
dwData2	Specifies transaction-specific data. For more information, see the description of the transaction type.

Returns
The return value depends on the transaction class.

Comments
The callback function is called asynchronously for transactions that do not involve creating or terminating conversations. An application that does not frequently accept incoming messages will have reduced DDE performance because **DDEML** uses messages to initiate transactions.

An application must register the callback function by specifying its address in a call to the **DdeInitialize** function. **DdeCallback** is a placeholder for the application- or library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition file.

See Also
DdeEnableCallback, **DdeInitialize**

DebugProc (3.1)

LRESULT CALLBACK DebugProc(*code, wParam, lParam***)**

```
int code;          /* hook code                                    */
WPARAM wParam;     /* type of hook about to be called              */
LPARAM lParam;     /* address of structure with debugging information */
```

The **DebugProc** function is a library-defined callback function that the system calls before calling any other filter installed by the **SetWindowsHookEx** function. The system passes information about the filter about to be called to the **DebugProc** callback function. The callback function can examine the information and determine whether to allow the filter to be called.

Parameter	Description
code	Specifies the hook code. Currently, HC_ACTION is the only positive valid value. If this parameter is less than zero, the callback function must call the **CallNextHookEx** function without any further processing.
wParam	Specifies the task handle of the task that installed the filter about to be called.
lParam	Contains a long pointer to a **DEBUGHOOKINFO** structure.

Returns

The callback function should return TRUE to prevent the system from calling another filter. Otherwise, the callback function must pass the filter information to the **CallNextHookEx** function.

Comments

An application must install this callback function by specifying the **WH_DEBUG** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHookEx** function.

CallWndProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition file.

See Also

CallNextHookEx, **SetWindowsHookEx**, **DEBUGHOOKINFO**

DialogProc (2.x)

BOOL CALLBACK DialogProc(*hwndDlg, msg, wParam, lParam***)**

```
HWND hwndDlg;       /* handle of dialog box          */
UINT msg;           /* message                       */
WPARAM wParam;      /* first message parameter       */
LPARAM lParam;      /* second message parameter      */
```

The **DialogProc** function is an application-defined callback function that processes messages sent to a modeless dialog box.

Parameter	Description
hwndDlg	Identifies the dialog box.
msg	Specifies the message.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

Except in response to the **WM_INITDIALOG** message, the dialog box procedure should return nonzero if it processes the message, and zero if it does not. In response to a WM_INITDIALOG message, the dialog box procedure should return zero if it calls the **SetFocus** function to set the focus to one of the controls in the dialog box. Otherwise, it should return nonzero, in which case the system will set the focus to the first control in the dialog box that can be given the focus.

Comments

The dialog box procedure is used only if the dialog box class is used for the dialog box. This is the default class and is used if no explicit class is given in the dialog box template. Although the dialog box procedure is similar to a window procedure, it must not call the **DefWindowProc** function to process unwanted messages. Unwanted messages are processed internally by the dialog box window procedure.

DialogProc is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition file.

See Also

CreateDialog, **CreateDialogIndirect**, **CreateDialogIndirectParam**, **CreateDialogParam**, **DefWindowProc**, **SetFocus**, **WM_INITDIALOG**

DriverProc (3.1)

LRESULT CALLBACK DriverProc(*dwDriverIdentifier, hDriver, msg, lParam1, lParam2***)**

```
DWORD dwDriverIdentifier;   /* identifies installable driver    */
HDRVR hDriver;              /* handle of installable driver     */
UINT msg;                   /* message                          */
LPARAM lParam1;             /* first message parameter          */
LPARAM lParam2;             /* second message parameter         */
```

The **DriverProc** function processes the specified message.

Parameter	Description
dwDriverIdentifier	Specifies an identifier of the installable driver.
hDriver	Identifies the installable driver. This parameter is a unique handle that Windows assigns to the driver.
msg	Identifies a message that the driver must process. Following are the messages that Windows or an application can send to an installable driver:

Message	Description
DRV_CLOSE	Notifies the driver that it should decrement (decrease by one) its usage count and unload the driver if the count is zero.
DRV_CONFIGURE	Notifies the driver that it should display a custom-configuration dialog box. (This message should be sent only if the driver returns a nonzero value when the **DRV_QUERYCONFIGURE** message is processed.)
DRV_DISABLE	Notifies the driver that its allocated memory is about to be freed.
DRV_ENABLE	Notifies the driver that it has been loaded or reloaded, or that Windows has been enabled.
DRV_FREE	Notifies the driver that it will be discarded.
DRV_INSTALL	Notifies the driver that it has been successfully installed.
DRV_LOAD	Notifies the driver that it has been successfully loaded.
DRV_OPEN	Notifies the driver that it is about to be opened.
DRV_POWER	Notifies the driver that the device's power source is about to be turned off or turned on.
DRV_QUERYCONFIGURE	Determines whether the driver supports the **DRV_CONFIGURE** message. The message displays a private configuration dialog box.
DRV_REMOVE	Notifies the driver that it is about to be removed from the system.

lParam1	Specifies the first message parameter.
lParam2	Specifies the second message parameter.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **DriverProc** function is the main function within a Windows installable driver; it is supplied by the

driver developer.

When the *msg* parameter is **DRV_OPEN**, *lParam1* is the string following the driver filename from the SYSTEM.INI file and *lParam2* is the value given as the *lParam* parameter in the call to the **OpenDriver** function.

When the *msg* parameter is **DRV_CLOSE**, *lParam1* and *lParam2* are the same values as the *lParam1* and *lParam2* parameters in the call to the **CloseDriver** function.

See Also
CloseDriver, **OpenDriver**

EnumChildProc (2.x)

BOOL CALLBACK EnumChildProc(*hwnd, lParam***)**

```
HWND hwnd;          /* handle of child window     */
LPARAM lParam;      /* application-defined value  */
```

The **EnumChildProc** function is an application-defined callback function that receives child window handles as a result of a call to the **EnumChildWindows** function.

Parameter	Description
hwnd	Identifies a child window of the parent window specified in the **EnumChildWindows** function.
lParam	Specifies the application-defined value specified in the **EnumChildWindows** function.

Returns

The callback function must return nonzero to continue enumeration; to stop enumeration, it must return zero.

Comments

The callback function can carry out any desired task.

An application must register this callback function by passing its address to the **EnumChildWindows** function. The **EnumChildProc** function is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

EnumChildWindows

EnumFontFamProc (3.1)

int CALLBACK EnumFontFamProc(*lpnlf, lpntm, FontType, lParam***)**

```
LOGFONT FAR* lpnlf;        /* address of structure with logical-font data  */
TEXTMETRIC FAR* lpntm;     /* address of structure with physical-font data*/
int FontType;              /* type of font                                 */
LPARAM lParam;             /* address of application-defined data          */
```

The **EnumFontFamProc** function is an application-defined callback function that retrieves information about available fonts.

Parameter	Description
lpnlf	Points to a NEWLOGFONT structure that contains information about the logical attributes of the font. This structure is locally-defined and is identical to the Windows **LOGFONT** structure except for two new members. The NEWLOGFONT structure has the following form:

```
struct tagNEWLOGFONT {                  /* nlf */
    int   lfHeight;
    int   lfWidth;
    int   lfEscapement;
    int   lfOrientation;
    int   lfWeight;
    BYTE  lfItalic;
    BYTE  lfUnderline;
    BYTE  lfStrikeOut;
    BYTE  lfCharSet;
    BYTE  lfOutPrecision;
    BYTE  lfClipPrecision;
    BYTE  lfQuality;
    BYTE  lfPitchAndFamily;
    BYTE  lfFaceName[LF_FACESIZE];
    BYTE  lfFullName[2 * LF_FACESIZE]; /* TrueType only */
    BYTE  lfStyle[LF_FACESIZE];        /* TrueType only */
} NEWLOGFONT;
```

The **lfFullName** and **lfStyle** members are appended to a **LOGFONT** structure when a TrueType font is enumerated in the **EnumFontFamProc** function.

The **lfFullName** member is a character array specifying the full name for the font. This name contains the font name and style name.

The **lfStyle** member is a character array specifying the style name for the font.

For example, when bold italic Arial® is enumerated, the last three members of the NEWLOGFONT structure contain the following strings:

lfFaceName = "Arial";
lfFullName = "Arial Bold Italic";
lfStyle = "Bold Italic";

See the description of the **LOGFONT** structure for a description of the other members of the structure.

lpntm	Points to a **NEWTEXTMETRIC** structure that contains information about the physical attributes of the font, if the font is a TrueType font. If the font is not a TrueType font, this parameter points to a **TEXTMETRIC** structure.
FontType	Specifies the type of the font. This parameter can be a combination of the following masks:

DEVICE_FONTTYPE
RASTER_FONTTYPE
TRUETYPE_FONTTYPE

lParam Points to the application-defined data passed by **EnumFontFamilies**.

Returns

This function must return a nonzero value to continue enumeration; to stop enumeration, it must return zero.

Comments

An application must register this callback function by passing its address to the **EnumFontFamilies** function. The **EnumFontFamProc** function is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

The AND (&) operator can be used with the RASTER_FONTTYPE, DEVICE_FONTTYPE, and TRUETYPE_FONTTYPE constants to determine the font type. If the RASTER_FONTTYPE bit is set, the font is a raster font. If the TRUETYPE_FONTTYPE bit is set, the font is a TrueType font. If neither bit is set, the font is a vector font. A third mask, DEVICE_FONTTYPE, is set when a device (for example, a laser printer) supports downloading TrueType fonts or when the font is a device-resident font; it is zero if the device is a display adapter, dot-matrix printer, or other raster device. An application can also use the DEVICE_FONTTYPE mask to distinguish GDI-supplied raster fonts from device-supplied fonts. GDI can simulate bold, italic, underline, and strikeout attributes for GDI-supplied raster fonts, but not for device-supplied fonts.

See Also

EnumFontFamilies, **EnumFonts**, **LOGFONT**, **NEWTEXTMETRIC**, **OUTLINETEXTMETRIC**, **TEXTMETRIC**

EnumFontsProc (3.1)

int CALLBACK EnumFontsProc(*lplf, lpntm, FontType, lpData***)**

```
LOGFONT FAR* lplf;          /* address of logical-font data structure   */
NEWTEXTMETRIC FAR* lpntm;   /* address of physical-font data structure */
int FontType;               /* type of font                             */
LPARAM lpData;              /* address of application-defined data      */
```

The **EnumFontsProc** function is an application-defined callback function that processes font data from the **EnumFonts** function.

Parameter	Description
lplf	Points to a **LOGFONT** structure that contains information about the logical attributes of the font.
lpntm	Points to a **NEWTEXTMETRIC** structure that contains information about the physical attributes of the font, if the font is a TrueType font. If the font is not a TrueType font, this parameter points to a **TEXTMETRIC** structure. The **TEXTMETRIC** structure is identical to **NEWTEXTMETRIC** except that it does not include the last four members.
FontType	Specifies the type of the font. This parameter can be a combination of the following masks: DEVICE_FONTTYPE RASTER_FONTTYPE TRUETYPE_FONTTYPE
lpData	Points to the application-defined data passed by the **EnumFonts** function.

Returns

This function must return a nonzero value to continue enumeration; to stop enumeration, it must return zero.

Comments

An application must register this callback function by passing its address to the **EnumFonts** function. The **EnumFontsProc** function is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

The AND (&) operator can be used with the RASTER_FONTTYPE, DEVICE_FONTTYPE, and TRUETYPE_FONTTYPE constants to determine the font type. If the RASTER_FONTTYPE bit is set, the font is a raster font. If the TRUETYPE_FONTTYPE bit is set, the font is a TrueType font. If neither bit is set, the font is a vector font. A third mask, DEVICE_FONTTYPE, is set when a device (for example, a laser printer) supports downloading TrueType fonts or when the font is a device-resident font; it is zero if the device is a display adapter, dot-matrix printer, or other raster device. An application can also use the DEVICE_FONTTYPE mask to distinguish GDI-supplied raster fonts from device-supplied fonts. GDI can simulate bold, italic, underline, and strikeout attributes for GDI-supplied raster fonts, but not for device-supplied fonts.

See Also

EnumFonts, **EnumFontFamilies**, **LOGFONT**, **NEWTEXTMETRIC**, **OUTLINETEXTMETRIC**, **TEXTMETRIC**

EnumMetaFileProc (3.1)

int CALLBACK EnumMetaFileProc(*hdc, lpht, lpmr, cObj, lParam***)**

```
HDC hdc;                    /* handle of device context              */
HANDLETABLE FAR* lpht;      /* address of table of object handles    */
METARECORD FAR* lpmr;       /* address of metafile record            */
int cObj;                   /* number of objects in handle table     */
LPARAM lParam;              /* address of application-defined data   */
```

The **EnumMetaFileProc** function is an application-defined callback function that processes metafile data from the **EnumMetaFile** function.

Parameter	Description
hdc	Identifies the special device context that contains the metafile.
lpht	Points to a table of handles associated with the objects (pens, brushes, and so on) in the metafile.
lpmr	Points to a metafile record contained in the metafile.
cObj	Specifies the number of objects with associated handles in the handle table.
lParam	Points to the application-defined data.

Returns

The callback function must return a nonzero value to continue enumeration; to stop enumeration, it must return zero.

Comments

An application must register this callback function by passing its address to the **EnumMetaFile** function.

The **EnumMetaFileProc** function is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

EnumMetaFile

EnumObjectsProc (3.1)

int CALLBACK EnumObjectsProc(*lpLogObject, lpData***)**

void FAR* *lpLogObject;* /* address of object */
LPARAM *lpData;* /* address of application-defined data */

The **EnumObjectsProc** function is an application-defined callback function that processes object data from the **EnumObjects** function.

Parameter	Description
lpLogObject	Points to a **LOGPEN** or **LOGBRUSH** structure that contains information about the attributes of the object.
lpData	Points to the application-defined data passed by the **EnumObjects** function.

Returns

This function must return a nonzero value to continue enumeration; to stop enumeration, it must return zero.

Comments

An application must register this callback function by passing its address to the **EnumObjects** function. The **EnumObjectsProc** function is a placeholder for the application-supplied function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

Example

The following example retrieves the number of horizontally hatched brushes and fills **LOGBRUSH** structures with information about each of them:

```
#define MAXBRUSHES 50

GOBJENUMPROC lpProcCallback;
HGLOBAL hglbl;
LPBYTE lpbCountBrush;

lpProcCallback = (GOBJENUMPROC) MakeProcInstance(
    (FARPROC) Callback, hinst);

hglbl = GlobalAlloc(GMEM_FIXED, sizeof(LOGBRUSH)
    * MAXBRUSHES);
lpbCountBrush = (LPBYTE) GlobalLock(hglbl);
*lpbCountBrush = 0;
EnumObjects(hdc, OBJ_BRUSH, lpProcCallback,
    (LPARAM) lpbCountBrush);

FreeProcInstance((FARPROC) lpProcCallback);

int FAR PASCAL Callback(LPLOGBRUSH lpLogBrush, LPBYTE pbData)
{
    /*
     * The pbData parameter contains the number of horizontally
     * hatched brushes; the lpDest parameter is set to follow the
     * byte reserved for pbData and the LOGBRUSH structures that
     * have been filled with brush information.
     */

    LPLOGBRUSH lpDest =
        (LPLOGBRUSH) (pbData + 1 + (*pbData * sizeof(LOGBRUSH)));
```

```
    if (lpLogBrush->lbStyle ==
            BS_HATCHED && /* if horiz hatch */
            lpLogBrush->lbHatch == HS_HORIZONTAL) {
        *lpDest++ = *lpLogBrush; /* fills structure with brush info */
        (*pbData) ++;            /* increments brush count          */
        if (*pbData >= MAXBRUSHES)
            return 0;
    }

    return 1;
}
```

See Also

EnumObjects, **FreeProcInstance**, **GlobalAlloc**, **GlobalLock**, **MakeProcInstance**, **LOGBRUSH**, **LOGPEN**

EnumPropFixedProc (2.x)

BOOL CALLBACK EnumPropFixedProc(*hwnd, lpsz, hData***)**

```
HWND hwnd;        /* handle of window with property      */
LPCSTR lpsz;      /* address of property string or atom  */
HANDLE hData;     /* handle data of property data        */
```

The **EnumPropFixedProc** function is an application-defined callback function that receives a window's property data as a result of a call to the **EnumProps** function.

Parameter	Description
hwnd	Identifies the handle of the window that contains the property list.
lpsz	Points to the null-terminated string associated with the property data identified by the *hData* parameter. The application specified the string and data in a previous call to the **SetProp** function. If the application passed an atom instead of a string to **SetProp**, the *lpsz* parameter contains the atom in the low-order word and zero in the high-order word.
hData	Identifies the property data.

Returns

The callback function must return TRUE to continue enumeration; it must return FALSE to stop enumeration.

Comments

This form of the property-enumeration callback function should be used in applications and dynamic-link libraries with fixed data segments and in dynamic libraries with movable data segments that do not contain a stack.

The following restrictions apply to the callback function:

- The callback function must not yield control or do anything that might yield control to other tasks.
- The callback function can call the **RemoveProp** function. However, **RemoveProp** can remove only the property passed to the callback function through the callback function's parameters.
- The callback function should not attempt to add properties.

The **EnumPropFixedProc** function is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

EnumPropMovableProc, **EnumProps**, **RemoveProp**, **SetProp**

EnumPropMovableProc (2.x)

BOOL CALLBACK EnumPropMovableProc(*hwnd, lpsz, hData***)**

```
HWND hwnd;        /* handle of window with property      */
LPCSTR lpsz;      /* address of property string or atom  */
HANDLE hData;     /* handle of property data             */
```

The **EnumPropMovableProc** function is an application-defined callback function that receives a window's property data as a result of a call to the **EnumProps** function.

Parameter	Description
hwnd	Identifies the handle of the window that contains the property list.
lpsz	Points to the null-terminated string associated with the data identified by the *hData* parameter. The application specified the string and data in a previous call to the **SetProp** function. If the application passed an atom instead of a string to **SetProp**, the *lpsz* parameter contains the atom.
hData	Identifies the property data.

Returns

The callback function must return TRUE to continue enumeration; to stop enumeration, it must return FALSE.

Comments

This form of the property-enumeration callback function should be used in applications with movable data segments and in dynamic libraries whose movable data segments also contain a stack. This form is required since movement of the data will invalidate any long pointer to a variable on the stack, such as the *lpsz* parameter. The data segment typically moves if the callback function allocates more space in the local heap than is currently available.

The following restrictions apply to the callback function:

- The callback function must not yield control or do anything that might yield control to other tasks.
- The callback function can call the **RemoveProp** function. However, **RemoveProp** can remove only the property passed to the callback function through the callback function's parameters.
- The callback function should not attempt to add properties.

The **EnumPropMovableProc** function is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

EnumPropFixedProc, **EnumProps**, **RemoveProp**, **SetProp**

EnumTaskWndProc (2.x)

BOOL CALLBACK EnumTaskWndProc(*hwnd, lParam***)**

```
HWND hwnd;          /* handle of a window          */
LPARAM lParam;      /* application-defined value   */
```

The **EnumTaskWndProc** function is an application-defined callback function that receives the window handles associated with a task as a result of a call to the **EnumTaskWindows** function.

Parameter	Description
hwnd	Identifies a window associated with the task specified in the **EnumTaskWindows** function.
lParam	Specifies the application-defined value specified in the **EnumTaskWindows** function.

Returns

The callback function must return TRUE to continue enumeration; to stop enumeration, it must return FALSE.

Comments

The callback function can carry out any desired task.

The **EnumTaskWndProc** function is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

EnumTaskWindows

EnumWindowsProc (2.x)

BOOL CALLBACK EnumWindowsProc(*hwnd, lParam***)**

```
HWND hwnd;          /* handle of parent window   */
LPARAM lParam;      /* application-defined value  */
```

The **EnumWindowsProc** function is an application-defined callback function that receives parent window handles as a result of a call to the **EnumWindows** function.

Parameter	Description
hwnd	Identifies a parent window.
lParam	Specifies the application-defined value specified in the **EnumWindows** function.

Returns

The callback function must return nonzero to continue enumeration; to stop enumeration, it must return zero.

Comments

The callback function can carry out any desired task.

The **EnumWindowsProc** function is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

EnumWindows

GetMsgProc (3.1)

LRESULT CALLBACK GetMsgProc(*code, wParam, lParam***)**

```
int code;          /* process-message flag  */
WPARAM wParam;     /* undefined             */
LPARAM lParam;     /* pointer to MSG structure  */
```

The **GetMsgProc** function is a library-defined callback function that the system calls whenever the **GetMessage** function has retrieved a message from an application queue. The system passes the retrieved message to the callback function before passing the message to the destination window procedure.

Parameter	Description
code	Specifies whether the callback function should process the message or call the **CallNextHookEx** function. If this parameter is less than zero, the callback function should pass the message to **CallNextHookEx** without further processing.
wParam	Specifies a NULL value.
lParam	Points to an **MSG** structure that contains information about the message.

Returns

The callback function should return zero.

Comments

The **GetMsgProc** callback function can examine or modify the message as desired. Once the callback function returns control to the system, the **GetMessage** function returns the message, with any modifications, to the application that originally called it. The callback function does not require a return value.

This callback function must be in a dynamic-link library (DLL).

An application must install the callback function by specifying the **WH_GETMESSAGE** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHookEx** function.

GetMsgProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition (.DEF) file.

See Also

CallNextHookEx, **GetMessage**, **SetWindowsHookEx**

GrayStringProc (2.x)

BOOL CALLBACK GrayStringProc(*hdc, lpData, cch***)**

```
HDC hdc;          /* handle of device context       */
LPARAM lpData;    /* address of string to be drawn */
int cch;          /* length of string to be drawn   */
```

The **GrayStringProc** function is an application-defined callback function that draws a string as a result of a call to the **GrayString** function.

Parameter	Description
hdc	Identifies a device context with a bitmap of at least the width and height specified by the *cx* and *cy* parameters passed to the **GrayString** function.
lpData	Points to the string to be drawn.
cch	Specifies the length, in characters, of the string.

Returns

The callback function should return TRUE to indicate success. Otherwise it should return FALSE.

Comments

The callback function must draw an image relative to the coordinates (0,0).

GrayStringProc is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

GrayString

HardwareProc (3.1)

LRESULT CALLBACK HardwareProc(*code, wParam, lParam***)**

```
int code;       /* hook code                                  */
WPARAM wParam;  /* undefined                                  */
LPARAM lParam;  /* address of structure with event information*/
```

The **HardwareProc** function is an application-defined callback function that the system calls whenever the application calls the **GetMessage** or **PeekMessage** function and there is a hardware event to process. Mouse events and keyboard events are not processed by this hook.

Parameter	Description
code	Specifies whether the callback function should process the message or call the **CallNextHookEx** function. If this value is less than zero, the callback function should pass the message to **CallNextHookEx** without further processing. If this value is HC_NOREMOVE, the application is using the **PeekMessage** function with the **PM_NOREMOVE** option, and the message will not be removed from the system queue.
wParam	Specifies a NULL value.
lParam	Points to a **HARDWAREHOOKSTRUCT** structure.

Returns

The callback function should return zero to allow the system to process the message; it should be 1 if the message is to be discarded.

Comments

This callback function should not install a playback hook because the function cannot use the **GetMessageExtraInfo** function to get the extra information associated with the message.

The callback function must use the Pascal calling convention and must be declared **FAR**. An application must install the callback function by specifying the **WH_HARDWARE** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHookEx** function.

HardwareProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition (.DEF) file.

See Also

CallNextHookEx, **GetMessageExtraInfo**, **SetWindowsHookEx**, **HARDWAREHOOKSTRUCT**

JournalPlaybackProc (3.1)

LRESULT CALLBACK JournalPlaybackProc(*code, wParam, lParam***)**

```
int code;          /* process-message flag          */
WPARAM wParam;     /* undefined                     */
LPARAM lParam;     /* address of structure for message */
```

The **JournalPlaybackProc** function is a library-defined callback function that a library can use to insert mouse and keyboard messages into the system message queue. Typically, a library uses this function to play back a series of mouse and keyboard messages that were recorded earlier by using the **JournalRecordProc** function. Regular mouse and keyboard input is disabled as long as a **JournalPlaybackProc** function is installed.

Parameter	Description
code	Specifies whether the callback function should process the message or call the **CallNextHookEx** function. If this parameter is less than zero, the callback function should pass the message to **CallNextHookEx** without further processing.
wParam	Specifies a NULL value.
lParam	Points to an **EVENTMSG** structure that represents the message being processed by the callback function.

Returns

The callback function should return a value that represents the amount of time, in clock ticks, that the system should wait before processing the message. This value can be computed by calculating the difference between the **time** members of the current and previous input messages. If the function returns zero, the message is processed immediately.

Comments

The **JournalPlaybackProc** function should copy an input message to the *lParam* parameter. The message must have been recorded by using a **JournalRecordProc** callback function, which should not modify the message.

Once the function returns control to the system, the message continues to be processed. If the *code* parameter is HC_SKIP, the filter function should prepare to return the next recorded event message on its next call.

This callback function should reside in a dynamic-link library.

An application must install the callback function by specifying the **WH_JOURNALPLAYBACK** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHookEx** function.

JournalPlaybackProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition file.

See Also

CallNextHookEx, **JournalRecordProc**, **SetWindowsHookEx**, **EVENTMSG**

JournalRecordProc (3.1)

LRESULT CALLBACK JournalRecordProc(*code, wParam, lParam***)**

```
int code;          /* process-message flag          */
WPARAM wParam;     /* undefined                     */
LPARAM lParam;     /* address of structure for message */
```

The **JournalRecordProc** function is a library-defined callback function that records messages that the system removes from the system message queue. Later, a library can use a **JournalPlaybackProc** function to play back the messages.

Parameter	Description
code	Specifies whether the callback function should process the message or call the **CallNextHookEx** function. If this parameter is less than zero, the callback function should pass the message to **CallNextHookEx** without further processing.
wParam	Specifies a NULL value.
lParam	Points to an **MSG** structure.

Returns

The callback function should return zero.

Comments

A **JournalRecordProc** callback function should copy but not modify the messages. After control returns to the system, the message continues to be processed. The callback function does not require a return value.

This callback function must be in a dynamic-link library.

An application must install the callback function by specifying the **WH_JOURNALRECORD** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHookEx** function.

JournalRecordProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition file.

See Also

CallNextHookEx, **JournalPlaybackProc**, **SetWindowsHookEx**

KeyboardProc (3.1)

LRESULT CALLBACK KeyboardProc(*code, wParam, lParam***)**

```
int code;          /* process-message flag          */
WPARAM wParam;     /* virtual-key code              */
LPARAM lParam;     /* keyboard-message information  */
```

The **KeyboardProc** function is a library-defined callback function that the system calls whenever the application calls the **GetMessage** or **PeekMessage** function and there is a **WM_KEYUP** or **WM_KEYDOWN** keyboard message to process.

Parameter	Description
code	Specifies whether the callback function should process the message or call the **CallNextHookEx** function. If this value is HC_NOREMOVE, the application is using the **PeekMessage** function with the **PM_NOREMOVE** option, and the message will not be removed from the system queue. If this value is less than zero, the callback function should pass the message to **CallNextHookEx** without further processing.
wParam	Specifies the virtual-key code of the given key.
lParam	Specifies the repeat count, scan code, extended key, previous key state, context code, and key-transition state, as shown in the following table. (Bit 0 is the low-order bit):

Bit	Description
0-15	Specifies the repeat count. The value is the number of times the keystroke is repeated as a result of the user holding down the key.
16-23	Specifies the scan code. The value depends on the original equipment manufacturer (OEM).
24	Specifies whether the key is an extended key, such as a function key or a key on the numeric keypad. The value is 1 if it is an extended key; otherwise, it is 0.
25-26	Not used.
27-28	Used internally by Windows.
29	Specifies the context code. The value is 1 if the ALT key is held down while the key is pressed; otherwise, the value is 0.
30	Specifies the previous key state. The value is 1 if the key is down before the message is sent, or it is 0 if the key is up.
31	Specifies the key-transition state. The value is 1 if the key is being released, or it is 0 if the key is being pressed.

Returns

The callback function should return 0 if the message should be processed by the system; it should return 1 if the message should be discarded.

Comments

This callback function must be in a dynamic-link library.

An application must install the callback function by specifying the **WH_KEYBOARD** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHookEx** function.

KeyboardProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition file.

See Also

CallNextHookEx, **GetMessage**, **PeekMessage**, **SetWindowsHookEx**

LibMain (2.x)

int CALLBACK LibMain(*hinst, wDataSeg, cbHeapSize, lpszCmdLine***)**

HINSTANCE *hinst;* /* handle of library instance */
WORD *wDataSeg;* /* library data segment */
WORD *cbHeapSize;* /* default heap size */
LPSTR *lpszCmdLine;* /* command-line arguments */

The **LibMain** function is called by the system to initialize a dynamic-link library (DLL). A DLL must contain the **LibMain** function if the library is linked with the file LIBENTRY.OBJ.

Parameter	Description
hinst	Identifies the instance of the DLL.
wDataSeg	Specifies the value of the data segment (DS) register.
cbHeapSize	Specifies the size of the heap defined in the module-definition file. (The LibEntry routine in LIBENTRY.OBJ uses this value to initialize the local heap.)
lpszCmdLine	Points to a null-terminated string specifying command-line information. This parameter is rarely used by DLLs.

Returns

The function should return 1 if it is successful. Otherwise, it should return 0.

Comments

The **LibMain** function is called by LibEntry, which is called by Windows when the DLL is loaded. The LibEntry routine is provided in the LIBENTRY.OBJ module. LibEntry initializes the DLL's heap (if a **HEAPSIZE** value is specified in the DLL's module-definition file) before calling the **LibMain** function.

Example

The following example shows a typical **LibMain** function:

```
int CALLBACK LibMain(HINSTANCE hinst, WORD wDataSeg, WORD cbHeap,
    LPSTR lpszCmdLine )
{
    HGLOBAL    hgblClassStruct;
    LPWNDCLASS lpClassStruct;
    static HINSTANCE hinstLib;

    /* Has the library been initialized yet? */

    if (hinstLib == NULL) {
        hgblClassStruct = GlobalAlloc(GHND, sizeof(WNDCLASS));
        if (hgblClassStruct != NULL) {
            lpClassStruct = (LPWNDCLASS) GlobalLock(hgblClassStruct);
            if (lpClassStruct != NULL) {

                /* Define the class attributes. */

                lpClassStruct->style = CS_HREDRAW | CS_VREDRAW |
                    CS_DBLCLKS | CS_GLOBALCLASS;
                lpClassStruct->lpfnWndProc = DllWndProc;
                lpClassStruct->cbWndExtra = 0;
                lpClassStruct->hInstance = hinst;
                lpClassStruct->hIcon = NULL;
                lpClassStruct->hCursor = LoadCursor(NULL, IDC_ARROW);
                lpClassStruct->hbrBackground =
                    (HBRUSH) (COLOR_WINDOW + 1);
```

```
                lpClassStruct->lpszMenuName = NULL;
                lpClassStruct->lpszClassName = "MyClassName";

                hinstLib = (RegisterClass(lpClassStruct)) ?
                    hinst : NULL;

                GlobalUnlock(hgblClassStruct);
            }

            GlobalFree(hgblClassStruct);
        }
    }
    return (hinstLib ? 1 : 0);  /* return 1 = success; 0 = fail */
}
```

See Also

GlobalAlloc, **GlobalFree**, **GlobalLock**, **GlobalUnlock**, **WEP**

LineDDAProc (3.1)

void CALLBACK LineDDAProc(*xPos, yPos, lpData***)**

```
int xPos;          /* x-coordinate of current position      */
int yPos;          /* y-coordinate of current position      */
LPARAM lpData;     /* address of application-defined data   */
```

The **LineDDAProc** function is an application-defined callback function that processes coordinates from the **LineDDA** function.

Parameter	Description
xPos	Specifies the x-coordinate of the current point.
yPos	Specifies the y-coordinate of the current point.
lpData	Points to the application-defined data.

Returns
This function does not return a value.

Comments
An application must register this function by passing its address to the **LineDDA** function.

LineDDAProc is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition file.

See Also
LineDDA

LoadProc (2.x)

HGLOBAL CALLBACK LoadProc(*hglbMem, hinst, hrsrcResInfo***)**

```
HGLOBAL hglbMem;      /* handle of object containing resource */
HINSTANCE hinst;      /* handle of application instance       */
HRSRC hrsrcResInfo;   /* handle of a resource                 */
```

The **LoadProc** function is an application-defined callback function that receives information about a resource to be locked and can process that information as needed.

Parameter	Description
hglbMem	Identifies a memory object that contains a resource. This parameter is NULL if the resource has not yet been loaded.
hinst	Identifies the instance of the module whose executable file contains the resource.
hrsrcResInfo	Identifies the resource. The resource must have been created by using the **FindResource** function.

Returns

The return value is a global memory handle for memory that was allocated using the **GMEM_DDESHARE** flag in the **GlobalAlloc** function.

Comments

If an attempt to lock the memory object identified by the *hglbMem* parameter fails, this means the resource has been discarded and must be reloaded.

LoadProc is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition file.

See Also

FindResource, **GlobalAlloc**, **SetResourceHandler**

MessageProc (3.1)

LRESULT CALLBACK MessageProc(*code, wParam, lParam***)**

```
int code;       /* message type                          */
WPARAM wParam;  /* undefined                             */
LPARAM lParam;  /* address of structure with message data */
```

The **MessageProc** function is an application- or library-defined callback function that the system calls after a dialog box, message box, or menu has retrieved a message, but before the message is processed. The callback function can process or modify the messages.

Parameter	Description
code	Specifies the type of message being processed. This parameter can be one of the following values:

Value	Meaning
MSGF_DIALOGBOX	Messages inside a dialog box or message box procedure are being processed.
MSGF_MENU	Keyboard and mouse messages in a menu are being processed.

If the *code* parameter is less than zero, the callback function must pass the message to **CallNextHookEx** without further processing and return the value returned by **CallNextHookEx**.

wParam	Specifies a NULL value.
lParam	Points to an **MSG** structure.

Returns

The callback function should return a nonzero value if it processes the message; it should return zero if it does not process the message.

Comments

The **WH_MSGFILTER** filter type is the only task-specific filter. A task may install this filter.

An application must install the callback function by specifying the **WH_MSGFILTER** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHookEx** function.

MessageProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition file.

See Also

CallNextHookEx, **SetWindowsHookEx**, **MSG**

MouseProc (3.1)

LRESULT CALLBACK MouseProc(*code, wParam, lParam***)**

```
int code;          /* process-message flag                    */
WPARAM wParam;     /* message identifier                      */
LPARAM lParam;     /* address of MOUSEHOOKSTRUCT structure*/
```

The **MouseProc** function is a library-defined callback function that the system calls whenever an application calls the **GetMessage** or **PeekMessage** function and there is a mouse message to be processed.

Parameter	Description
code	Specifies whether the callback function should process the message or call the **CallNextHookEx** function. If this value is less than zero, the callback function should pass the message to **CallNextHookEx** without further processing. If this value is HC_NOREMOVE, the application is using a **PeekMessage** function with the **PM_NOREMOVE** option, and the message will not be removed from the system queue.
wParam	Specifies the identifier of the mouse message.
lParam	Points to a **MOUSEHOOKSTRUCT** structure containing information about the mouse.

The callback function should return 0 to allow the system to process the message; it should return 1 to discard the message.

Comments

This callback function should not install a **JournalPlaybackProc** callback function.

An application must install the callback function by specifying the **WH_MOUSE** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHookEx** function.

MouseProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an EXPORTS statement in the library's module-definition file.

See Also

CallNextHookEx, **GetMessage**, **PeekMessage**, **SetWindowsHookEx**

NotifyProc (2.x)

BOOL CALLBACK NotifyProc(*hglbl***)**

HGLOBAL *hglbl;* /* handle of global memory object */

The **NotifyProc** function is a library-defined callback function that the system calls whenever it is about to discard a global memory object allocated with the **GMEM_NOTIFY** flag.

Parameter	Description
hglbl	Identifies the global memory object being discarded.

Returns

The callback function should return nonzero if the system is to discard the memory object, or zero if it should not.

Comments

The callback function is not necessarily called in the context of the application that owns the routine. For this reason, the callback function should not assume it is using the stack segment of the application. The callback function should not call any routine that might move memory.

The callback function must be in a fixed code segment of a dynamic-link library.

NotifyProc is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition statement.

See Also

GlobalNotify

ShellProc (3.1)

LRESULT CALLBACK ShellProc(*code, wParam, lParam***)**

```
int code;          /* process-message flag  */
WPARAM wParam;     /* current-task flag     */
LPARAM lParam;     /* undefined             */
```

The **ShellProc** function is a library-defined callback function that a shell application can use to receive useful notifications from the system.

Parameter	Description
code	Specifies a shell-notification code. This parameter can be one of the following values:

Value	Meaning
HSHELL_ACTIVATESHELLWINDOW	The shell application should activate its main window.
HSHELL_WINDOWCREATED	A top-level, unowned window was created. The window exists when the system calls a **ShellProc** function.
HSHELL_WINDOWDESTROYED	A top-level, unowned window is about to be destroyed. The window still exists when the system calls a **ShellProc** function.

Parameter	Description
wParam	Specifies additional information the shell application may need. The interpretation of this parameter depends on the value of the *code* parameter, as follows:

code	***wParam***
HSHELL_ACTIVATESHELLWINDOW	Not used.
HSHELL_WINDOWCREATED	Specifies the handle of the window being created.
HSHELL_WINDOWDESTROYED	Specifies the handle of the window being destroyed.

Parameter	Description
lParam	Reserved; not used.

Returns

The return value should be zero.

Comments

An application must install this callback function by specifying the **WH_SHELL** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHook** function.

ShellProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition file.

See Also

DefHookProc, **SendMessage**, **SetWindowsHook**

SysMsgProc (3.1)

LRESULT CALLBACK SysMsgProc(*code, wParam, lParam***)**

```
int code;          /* message type                */
WPARAM wParam;     /* undefined                   */
LPARAM lParam;     /* pointer to an MSG structure */
```

The **SysMsgProc** function is a library-defined callback function that the system calls after a dialog box, message box, or menu has retrieved a message, but before the message is processed. The callback function can process or modify messages for any application in the system.

Parameter	Description
code	Specifies the type of message being processed. This parameter can be one of the following values:

Value	Meaning
MSGF_DIALOGBOX	Messages inside a dialog box or message box procedure are being processed.
MSGF_MENU	Keyboard and mouse messages in a menu are being processed.

If the *code* parameter is less than zero, the callback function must pass the message to the **CallNextHookEx** function without further processing and return the value returned by **CallNextHookEx**.

wParam	Must be NULL.
lParam	Points to the **MSG** structure to contain the message. The **MSG** structure has the following form:

Returns

The return value should be nonzero if the function processes the message. Otherwise, it should be zero.

Comments

This callback function must be in a dynamic-link library (DLL).

An application must install this callback function by specifying the **WH_SYSMSGFILTER** filter type and the procedure-instance address of the callback function in a call to the **SetWindowsHookEx** function.

SysMsgProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition file.

See Also

CallNextHookEx, **MessageBox**, **SetWindowsHookEx**

TimerProc (2.x)

void CALLBACK TimerProc(*hwnd, msg, idTimer, dwTime***)**

```
HWND hwnd;      /* handle of window for timer messages */
UINT msg;       /* WM_TIMER message                    */
UINT idTimer;   /* timer identifier                    */
DWORD dwTime;   /* current system time                 */
```

The **TimerProc** function is an application-defined callback function that processes **WM_TIMER** messages.

Parameter	Description
hwnd	Identifies the window associated with the timer.
msg	Specifies the **WM_TIMER** message.
idTimer	Specifies the timer's identifier.
dwTime	Specifies the current system time.

Returns

This function does not return a value.

Comments

TimerProc is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition file.

See Also

KillTimer, **SetTimer**, **WM_TIMER**

WEP (3.0)

int CALLBACK WEP(*nExitType***)**

int *nExitType;* /* type of exit */

The **WEP** (Windows exit procedure) callback function performs cleanup for a dynamic-link library (DLL) before the library is unloaded. This function is called by Windows. Although a **WEP** function was required for every dynamic-link library in previous versions of the Windows operating system, for version 3.1 the **WEP** function is optional. Most dynamic-link libraries use the **WEP** function.

Parameter	Description
nExitType	Specifies whether all of Windows is shutting down or only the individual library. This parameter can be either WEP_FREE_DLL or WEP_SYSTEM_EXIT.

Returns

The return value should be 1 if the function is successful.

Comments

For Windows version 3.1, **WEP** is called on the stack of the application that is terminating. This enables **WEP** to call Windows functions. In Windows version 3.0, however, **WEP** is called on a KERNEL stack that is too small to process most calls to Windows functions. These calls, including calls to global-memory functions, should be avoided in a **WEP** function for Windows 3.0. Calls to MS-DOS functions go through a KERNEL intercept and can also overflow the stack in Windows 3.0. There is no general reason to free memory from the global heap in a **WEP** function, because the kernel frees this kind of memory automatically.

In some low-memory conditions, **WEP** can be called before the library initialization function is called and before the library's DGROUP data-segment group has been created. A **WEP** function that relies on the library initialization function should verify that the initialization function has been called. Also, **WEP** functions that rely on the validity of DGROUP should check for this. The following procedure is recommended for dynamic-link libraries in Windows 3.0; for Windows 3.1, only step 3 is necessary.

1. Verify that the data segment is present by using a **lar** instruction and checking the present bit. This will indicate whether DS has been loaded. (The DS register always contains a valid selector.)
2. Set a flag in the data segment when the library initialization is performed. Once the **WEP** function has verified that the data segment exists, it should test this flag to determine whether initialization has occurred.
3. Declare **WEP** in the **EXPORTS** section of the module-definition file for the DLL. Following is an example declaration:

   ```
   WEP  @1  RESIDENTNAME
   ```

   The keyword **RESIDENTNAME** makes the name of the function (**WEP**) resident at all times. (It is not necessary to use the ordinal reference 1.) The name listed in the **LIBRARY** statement of the module-definition file must be in uppercase letters and must match the name of the DLL file.

Windows calls the **WEP** function by name when it is ready to remove the DLL. Under low-memory conditions, it is possible for the DLL's nonresident-name table to be discarded from memory. If this occurs, Windows must load the table to determine whether a **WEP** function was declared for the DLL. Under low-memory conditions, this method could fail, causing a fatal exit. Using the **RESIDENTNAME** option forces Windows to keep the name entry for **WEP** in memory whenever the DLL is in use.

In Windows 3.0, **WEP** must be placed in a fixed code segment. If it is placed instead in a discardable segment, under low-memory conditions Windows must load the **WEP** segment from disk so that the **WEP** function can be called before the DLL is discarded. Under certain low-memory conditions, attempting to load the segment containing **WEP** can cause a fatal exit. When **WEP** is in a fixed segment, this situation cannot occur. (Because fixed DLL code is also page-locked, you should minimize the

amount of fixed code.)

If a DLL is explicitly loaded by calling the **LoadLibrary** function, its **WEP** function is called when the DLL is freed by a call to the **FreeLibrary** function. (The **FreeLibrary** function should not be called from within a **WEP** function.) If the DLL is implicitly loaded, **WEP** is also called, but some debugging applications will indicate that the application has been terminated before **WEP** is called.

The **WEP** functions of dependent DLLs can be called in any order. This order depends on the order in which the usage counts for the DLLs reach zero.

See Also
FreeLibrary, **LibMain**, **RegisterClass**, **UnRegisterClass**

WindowProc (2.x)

LRESULT CALLBACK WindowProc(*hwnd, msg, wParam, lParam***)**

```
HWND hwnd;          /* handle of window          */
UINT msg;           /* message                   */
WPARAM wParam;      /* first message parameter   */
LPARAM lParam;      /* second message parameter  */
```

The **WindowProc** function is an application-defined callback function that processes messages sent to a window.

Parameter	Description
hwnd	Identifies the window.
msg	Specifies the message.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value is the result of the message processing. The value depends on the message being processed.

Comments

The **WindowProc** name is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition file.

See Also

DefWindowProc, **RegisterClass**, **WNDCLASS**

WinMain (2.x)

int PASCAL WinMain(*hinstCurrent, hinstPrevious, lpCmdLine, nCmdShow***)**

```
HINSTANCE hinstCurrent;     /* handle of current instance      */
HINSTANCE hinstPrevious;    /* handle of previous instance     */
LPSTR lpszCmdLine;          /* address of command line         */
int nCmdShow;               /* show-window type (open/icon)    */
```

The **WinMain** function is called by the system as the initial entry point for a Windows application.

Parameter	Description
hinstCurrent	Identifies the current instance of the application.
hinstPrevious	Identifies the previous instance of the application.
lpszCmdLine	Points to a null-terminated string specifying the command line for the application.
nCmdShow	Specifies how the window is to be shown. This parameter can be one of the following values:

Value	Meaning
SW_HIDE	Hides the window and passes activation to another window.
SW_MINIMIZE	Minimizes the specified window and activates the top-level window in the system's list.
SW_RESTORE	Activates and displays a window. If the window is minimized or maximized, Windows restores it to its original size and position (same as SW_SHOWNORMAL).
SW_SHOW	Activates a window and displays it in its current size and position.
SW_SHOWMAXIMIZED	Activates a window and displays it as a maximized window.
SW_SHOWMINIMIZED	Activates a window and displays it as an icon.
SW_SHOWMINNOACTIVE	Displays a window as an icon. The window that is currently active remains active.
SW_SHOWNA	Displays a window in its current state. The window that is currently active remains active.
SW_SHOWNOACTIVATE	Displays a window in its most recent size and position. The window that is currently active remains active.
SW_SHOWNORMAL	Activates and displays a window. If the window is minimized or maximized, Windows restores it to its original size and position (same as SW_RESTORE).

Returns

The return value is the return value of the **PostQuitMessage** function if the function is successful. This function returns NULL if it terminates before entering the message loop.

Comments

The **WinMain** function calls the instance-initialization function and, if no other instance of the program is running, the application-initialization function. It then performs a message retrieval-and-dispatch loop that is the top-level control structure for the remainder of the application's execution. The loop is terminated when a **WM_QUIT** message is received, at which time this function exits the application instance by returning the value passed by the **PostQuitMessage** function.

Example

The following example uses the **WinMain** function to initialize the application (if necessary), initialize the instance, and establish a message loop:

```
int PASCAL WinMain(HINSTANCE hinstCurrent, HINSTANCE hinstPrevious,
    LPSTR lpszCmdLine, int nCmdShow)
{
    MSG msg;

    if (hinstPrevious == NULL)                /* other instances?      */
        if (!InitApplication(hinstCurrent))   /* shared items          */
            return FALSE;                     /* initialization failed */

    /* Perform initializations for this instance. */

    if (!InitInstance(hinstCurrent, nCmdShow))
        return FALSE;

    /* Get and dispatch messages until WM_QUIT message. */


    while (GetMessage(&msg, NULL, 0, 0)) {
        TranslateMessage(&msg); /* translates virtual key codes    */
        DispatchMessage(&msg);  /* dispatches message to window    */
    }
    return (int) msg.wParam;    /* return value of PostQuitMessage */
}
```

See Also
DispatchMessage, **GetMessage**, **PostQuitMessage**, **TranslateMessage**

WordBreakProc (3.1)

int CALLBACK WordBreakProc(*lpszEditText, ichCurrentWord, cbEditText, action***)**

```
LPSTR lpszEditText;     /* address of edit text    */
int ichCurrentWord;     /* index of starting point */
int cbEditText;         /* length of edit text     */
int action;             /* action to take          */
```

The **WordBreakProc** function is an application-defined callback function that the system calls whenever a line of text in a multiline edit control must be broken.

Parameter	Description
lpszEditText	Points to the text of the edit control.
ichCurrentWord	Specifies an index to a word in the buffer of text that identifies the point at which the function should begin checking for a word break.
cbEditText	Specifies the number of bytes in the text.
action	Specifies the action to be taken by the callback function. This parameter can be one of the following values:

Value	Action
WB_LEFT	Look for the beginning of a word to the left of the current position.
WB_RIGHT	Look for the beginning of a word to the right of the current position.
WB_ISDELIMITER	Check whether the character at the current position is a delimiter.

Returns

If the *action* parameter specifies WB_ISDELIMITER, the return value is non zero (TRUE) if the character at the current position is a delimiter, or zero if it is not. Otherwise, the return value is an index to the begining of a word in the buffer of text.

Comments

A carriage return (CR) followed by a linefeed (LF) must be treated as a single word by the callback function. Two carriage returns followed by a linefeed also must be treated as a single word.

An application must install the callback function by specifying the procedure-instance address of the callback function in a **EM_SETWORDBREAKPROC** message.

WordBreakProc is a placeholder for the library-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the library's module-definition file.

See Also

SendMessage, **EM_SETWORDBREAKPROC**

Callback functions (3.1)

AbortProc	Processes a canceled print job
CallWndProc	Filters messages sent by the SendMessage function
CBTProc	Allows a CBT application to prevent an operation
CPlApplet	Processes messages for a Control Panel DLL
DdeCallback	Processes **DDEML** transactions
DebugProc	Examines data before it is sent to a hook
DialogProc	Processes messages sent to a modeless dialog box
DriverProc	Processes messages for an installable driver
EnumChildProc	Receives child window handles during enumeration
EnumFontFamProc	Retrieves information about available fonts
EnumFontsProc	Retrieves information about available fonts
EnumMetaFileProc	Processes metafile data
EnumObjectsProc	Processes object data
EnumPropFixedProc	Receives enumerated property data for a window
EnumPropMovableProc	Receives enumerated property data for a window
EnumTaskWndProc	Processes task window handles during enumeration
EnumWindowsProc	Receives parent window handles during enumeration
GetMsgProc	Filters messages retrieved by the GetMessage function
GrayStringProc	Outputs text for the GrayString function
HardwareProc	Filters nonstandard hardware messages
JournalPlaybackProc	Places recorded events into the system queue
JournalRecordProc	Records event messages
KeyboardProc	Filters keyboard messages
LibMain	Initializes a dynamic-link library
LineDDAProc	Processes line data
LoadProc	Receives and processes resource information
MessageProc	Filters dialog box, message box, or menu messages
MouseProc	Filters mouse messages
NotifyProc	Determines whether to discard a global memory object
ShellProc	Receives notifications from the system
SysMsgProc	Filters dialog box, message box, or menu messages
TimerProc	Processes **WM_TIMER** messages
WEP	Cleans up and exits a dynamic-link library
WindowProc	Processes messages sent to a window
WinMain	Initializes an application and processes message loop
WordBreakProc	Determines line breaks in an edit control

CommDlgExtendedError (3.1)

#include commdlg.h

DWORD CommDlgExtendedError(void)

The **CommDlgExtendedError** function identifies the cause of the most recent error to have occurred during the execution of one of the following common dialog box procedures:

- **ChooseColor**
- **ChooseFont**
- **FindText**
- **GetFileTitle**
- **GetOpenFileName**
- **GetSaveFileName**
- **PrintDlg**
- **ReplaceText**

Returns

The return value is zero if the prior call to a common dialog box procedure was successful. The return value is CDERR_DIALOGFAILURE if the dialog box could not be created. Otherwise, the return value is a nonzero integer that identifies an error condition.

Comments

Following are the possible **CommDlgExtendedError** return values and the meaning of each:

Value	Meaning
CDERR_FINDRESFAILURE	Specifies that the common dialog box procedure failed to find a specified resource.
CDERR_INITIALIZATION	Specifies that the common dialog box procedure failed during initialization. This error often occurs when insufficient memory is available.
CDERR_LOADRESFAILURE	Specifies that the common dialog box procedure failed to load a specified resource.
CDERR_LOCKRESFAILURE	Specifies that the common dialog box procedure failed to lock a specified resource.
CDERR_LOADSTRFAILURE	Specifies that the common dialog box procedure failed to load a specified string.
CDERR_MEMALLOCFAILURE	Specifies that the common dialog box procedure was unable to allocate memory for internal structures.
CDERR_MEMLOCKFAILURE	Specifies that the common dialog box procedure was unable to lock the memory associated with a handle.
CDERR_NOHINSTANCE	Specifies that the ENABLETEMPLATE flag was set in the **Flags** member of a structure for the corresponding common dialog box but that the application failed to provide a corresponding instance handle.
CDERR_NOHOOK	Specifies that the ENABLEHOOK flag was set in the **Flags** member of a structure for the corresponding common dialog box but that the application failed to provide a pointer to a corresponding hook function.
CDERR_NOTEMPLATE	Specifies that the ENABLETEMPLATE flag was set in the **Flags** member of a structure for the corresponding common dialog box but that the application failed to provide a corresponding template.
CDERR_REGISTERMSGFAIL	Specifies that the **RegisterWindowMessage** function returned

	an error value when it was called by the common dialog box procedure.
CDERR_STRUCTSIZE	Specifies as invalid the **lStructSize** member of a structure for the corresponding common dialog box.
CFERR_NOFONTS	Specifies that no fonts exist.
CFERR_MAXLESSTHANMIN	Specifies that the size specified in the **nSizeMax** member of the **CHOOSEFONT** structure is less than the size specified in the **nSizeMin** member.
FNERR_BUFFERTOOSMALL	Specifies that the buffer for a filename is too small. (This buffer is pointed to by the **lpstrFile** member of the structure for a common dialog box.)
FNERR_INVALIDFILENAME	Specifies that a filename is invalid.
FNERR_SUBCLASSFAILURE	Specifies that an attempt to subclass a list box failed due to insufficient memory.
FRERR_BUFFERLENGTHZERO	Specifies that a member in a structure for the corresponding common dialog box points to an invalid buffer.
PDERR_CREATEICFAILURE	Specifies that the **PrintDlg** function failed when it attempted to create an information context.
PDERR_DEFAULTDIFFERENT	Specifies that an application has called the **PrintDlg** function with the DN_DEFAULTPRN flag set in the **wDefault** member of the **DEVNAMES** structure, but the printer described by the other structure members does not match the current default printer. (This happens when an application stores the **DEVNAMES** structure and the user changes the default printer by using Control Panel.) To use the printer described by the **DEVNAMES** structure, the application should clear the DN_DEFAULTPRN flag and call the **PrintDlg** function again. To use the default printer, the application should replace the **DEVNAMES** structure (and the **DEVMODE** structure, if one exists) with NULL; this selects the default printer automatically.
PDERR_DNDMMISMATCH	Specifies that the data in the **DEVMODE** and **DEVNAMES** structures describes two different printers.
PDERR_GETDEVMODEFAIL	Specifies that the printer driver failed to initialize a **DEVMODE** structure. (This error value applies only to printer drivers written for Windows versions 3.0 and later.)
PDERR_INITFAILURE	Specifies that the **PrintDlg** function failed during initialization.
PDERR_LOADDRVFAILURE	Specifies that the **PrintDlg** function failed to load the device driver for the specified printer.
PDERR_NODEFAULTPRN	Specifies that a default printer does not exist.
PDERR_NODEVICES	Specifies that no printer drivers were found.
PDERR_PARSEFAILURE	Specifies that the **PrintDlg** function failed to parse the strings in the [devices] section of the WIN.INI file.
PDERR_PRINTERNOTFOUND	Specifies that the [devices] section of the WIN.INI file did not contain an entry for the requested printer.
PDERR_RETDEFFAILURE	Specifies that the PD_RETURNDEFAULT flag was set in the **Flags** member of the **PRINTDLG** structure but that either the **hDevMode** or **hDevNames** member was nonzero.
PDERR_SETUPFAILURE	Specifies that the **PrintDlg** function failed to load the required resources.

See Also

ChooseColor, **ChooseFont**, **FindText**, **GetFileTitle**, **GetOpenFileName**, **GetSaveFileName**, **PrintDlg**, **ReplaceText**

CDERR_FINDRESFAILURE

Specifies that the common dialog box procedure failed to find a specified resource.

CDERR_INITIALIZATION

Specifies that the common dialog box procedure failed during initialization. This error often occurs when insufficient memory is available.

CDERR_LOADRESFAILURE

Specifies that the common dialog box procedure failed to load a specified resource.

CDERR_LOCKRESFAILURE

Specifies that the common dialog box procedure failed to lock a specified resource.

CDERR_LOADSTRFAILURE

Specifies that the common dialog box procedure failed to load a specified string.

CDERR_MEMALLOCFAILURE

Specifies that the common dialog box procedure was unable to allocate memory for internal structures.

CDERR_MEMLOCKFAILURE

Specifies that the common dialog box procedure was unable to lock the memory associated with a handle.

CDERR_NOHINSTANCE

Specifies that the ENABLETEMPLATE flag was set in the **Flags** member of a structure for the corresponding common dialog box but that the application failed to provide a corresponding instance handle.

CDERR_NOHOOK

Specifies that the ENABLEHOOK flag was set in the **Flags** member of a structure for the corresponding common dialog box but that the application failed to provide a pointer to a corresponding hook function.

CDERR_NOTEMPLATE

Specifies that the ENABLETEMPLATE flag was set in the **Flags** member of a structure for the corresponding common dialog box but that the application failed to provide a corresponding template.

CDERR_REGISTERMSGFAIL

Specifies that the **RegisterWindowMessage** function returned an error value when it was called by the common dialog box procedure.

CDERR_STRUCTSIZE

Specifies as invalid the **lStructSize** member of a structure for the corresponding common dialog box.

CFERR_NOFONTS

Specifies that no fonts exist.

CFERR_MAXLESSTHANMIN

Specifies that the size specified in the **nSizeMax** member of the **CHOOSEFONT** structure is less than the size specified in the **nSizeMin** member.

FNERR_BUFFERTOOSMALL

Specifies that the buffer for a filename is too small. (This buffer is pointed to by the **lpstrFile** member of the structure for a common dialog box.)

FNERR_INVALIDFILENAME

Specifies that a filename is invalid.

FNERR_SUBCLASSFAILURE

Specifies that an attempt to subclass a list box failed due to insufficient memory.

FRERR_BUFFERLENGTHZERO

Specifies that a member in a structure for the corresponding common dialog box points to an invalid buffer.

PDERR_CREATEICFAILURE

Specifies that the **PrintDlg** function failed when it attempted to create an information context.

PDERR_DEFAULTDIFFERENT

Specifies that an application has called the **PrintDlg** function with the DN_DEFAULTPRN flag set in the **wDefault** member of the **DEVNAMES** structure, but the printer described by the other structure members does not match the current default printer. (This happens when an application stores the **DEVNAMES** structure and the user changes the default printer by using Control Panel.) To use the printer described by the **DEVNAMES** structure, the application should clear the DN_DEFAULTPRN flag and call the **PrintDlg** function again. To use the default printer, the application should replace the **DEVNAMES** structure (and the **DEVMODE** structure, if one exists) with NULL; this selects the default printer automatically.

PDERR_DNDMMISMATCH

Specifies that the data in the **DEVMODE** and **DEVNAMES** structures describes two different printers.

PDERR_GETDEVMODEFAIL

Specifies that the printer driver failed to initialize a **DEVMODE** structure. (This error value applies only to printer drivers written for Windows versions 3.0 and later.)

PDERR_INITFAILURE

Specifies that the **PrintDlg** function failed during initialization.

PDERR_LOADDRVFAILURE

Specifies that the **PrintDlg** function failed to load the device driver for the specified printer.

PDERR_NODEFAULTPRN

Specifies that a default printer does not exist.

PDERR_NODEVICES

Specifies that no printer drivers were found.

PDERR_PARSEFAILURE

Specifies that the **PrintDlg** function failed to parse the strings in the [devices] section of the WIN.INI file.

PDERR_PRINTERNOTFOUND

Specifies that the [devices] section of the WIN.INI file did not contain an entry for the requested printer.

PDERR_RETDEFFAILURE

Specifies that the PD_RETURNDEFAULT flag was set in the **Flags** member of the **PRINTDLG** structure but that either the **hDevMode** or **hDevNames** member was nonzero.

PDERR_SETUPFAILURE

Specifies that the **PrintDlg** function failed to load the required resources.

ChooseColor (3.1)

#include commdlg.h

BOOL ChooseColor(*lpcc***)**

CHOOSECOLOR FAR* *lpcc;* /* address of structure with initialization data*/

The **ChooseColor** function creates a system-defined dialog box from which the user can select a color.

Parameter	Description
lpcc	Points to a **CHOOSECOLOR** structure that initially contains information necessary to initialize the dialog box. When the **ChooseColor** function returns, this structure contains information about the user's color selection.

Returns

The return value is nonzero if the function is successful. It is zero if an error occurs, if the user chooses the Cancel button, or if the user chooses the Close command on the System menu (often called the Control menu) to close the dialog box.

Errors

Use the **CommDlgExtendedError** function to retrieve the error value, which may be one of the following:

CDERR_FINDRESFAILURE
CDERR_INITIALIZATION
CDERR_LOCKRESFAILURE
CDERR_LOADRESFAILURE
CDERR_LOADSTRFAILURE
CDERR_MEMALLOCFAILURE
CDERR_MEMLOCKFAILURE
CDERR_NOHINSTANCE
CDERR_NOHOOK
CDERR_NOTEMPLATE
CDERR_STRUCTSIZE

Comments

The dialog box does not support color palettes. The color choices offered by the dialog box are limited to the system colors and dithered versions of those colors.

If the hook function (to which the **lpfnHook** member of the **CHOOSECOLOR** structure points) processes the **WM_CTLCOLOR** message, this function must return a handle for the brush that should be used to paint the control background.

Example

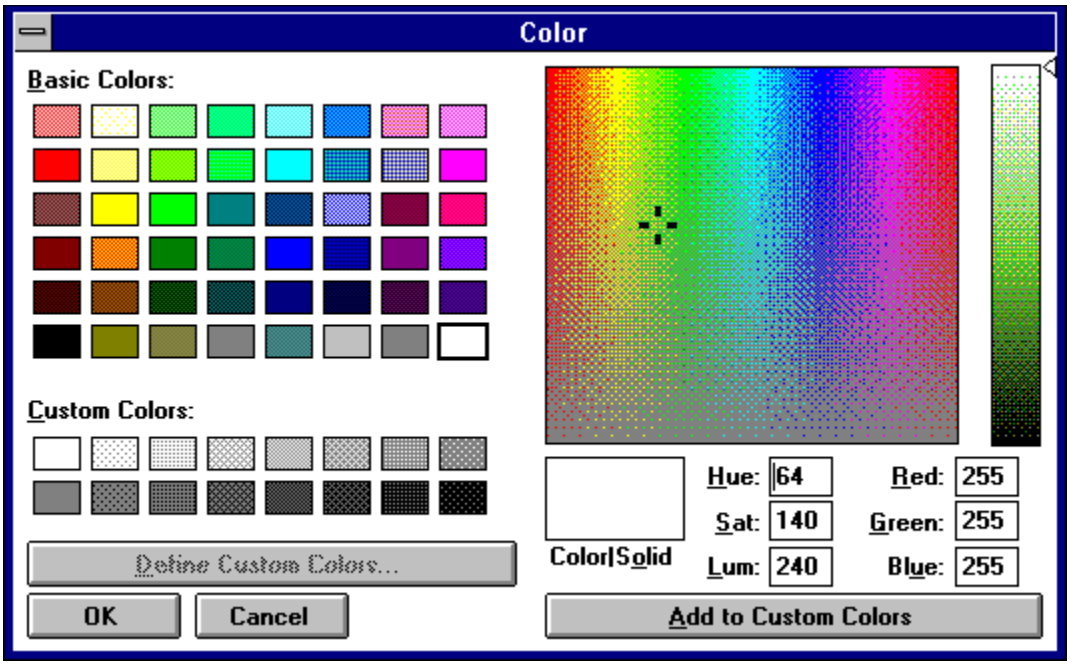
The following example initializes a **CHOOSECOLOR** structure and then creates a color-selection dialog box:

```
/* Color variables */

CHOOSECOLOR cc;
COLORREF clr;
COLORREF aclrCust[16];
int i;

/* Set the custom color controls to white. */

for (i = 0; i < 16; i++)
    aclrCust[i] = RGB(255, 255, 255);
```

```
/* Initialize clr to black. */

clr = RGB(0, 0, 0);

/* Set all structure fields to zero. */

memset(&cc, 0, sizeof(CHOOSECOLOR));

/* Initialize the necessary CHOOSECOLOR members. */

cc.lStructSize = sizeof(CHOOSECOLOR);
cc.hwndOwner = hwnd;
cc.rgbResult = clr;
cc.lpCustColors = aclrCust;
cc.Flags = CC_PREVENTFULLOPEN;

if (ChooseColor(&cc))
    .
    . /* Use cc.rgbResult to select the user-requested color. */
    .
```

See Also
CHOOSECOLOR

The following shows how the dialog box normally appears:



ChooseFont function (3.1)

#include commdlg.h

BOOL ChooseFont(*lpcf***)**

CHOOSEFONT FAR**lpcf;* /* address of structure with initialization data*/

The **ChooseFont** function creates a system-defined dialog box from which the user can select a font, a font style (such as bold or italic), a point size, an effect (such as strikeout or underline), and a color.

Parameter	Description
lpcf	Points to a **CHOOSEFONT** structure that initially contains information necessary to initialize the dialog box. When the **ChooseFont** function returns, this structure contains information about the user's font selection.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Errors

Use the **CommDlgExtendedError** function to retrieve the error value, which may be one of the following:

CDERR_FINDRESFAILURE
CDERR_INITIALIZATION
CDERR_LOCKRESFAILURE
CDERR_LOADRESFAILURE
CDERR_LOADSTRFAILURE
CDERR_MEMALLOCFAILURE
CDERR_MEMLOCKFAILURE
CDERR_NOHINSTANCE
CDERR_NOHOOK
CDERR_NOTEMPLATE
CDERR_STRUCTSIZE
CFERR_MAXLESSTHANMIN
CFERR_NOFONTS

Example

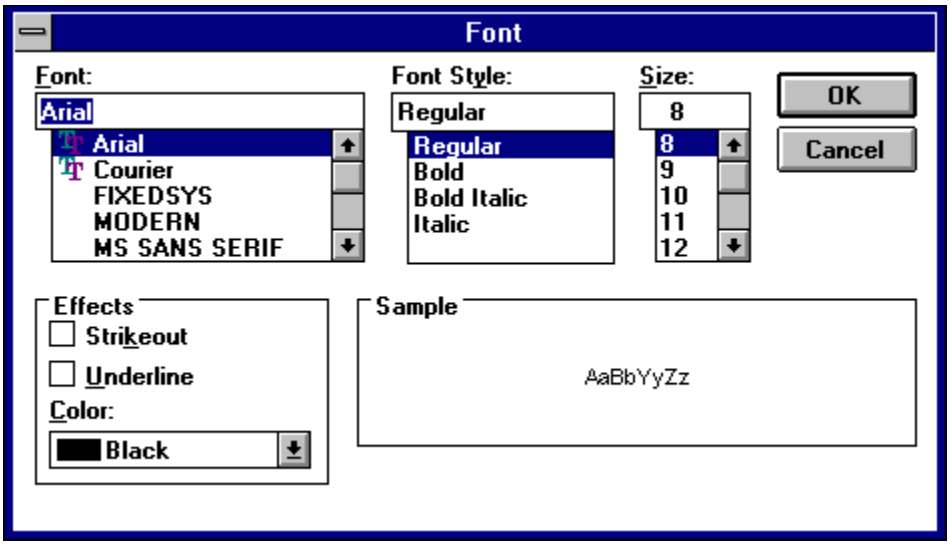
The following example initializes a **CHOOSEFONT** structure and then displays a font dialog box:

```
LOGFONT lf;
CHOOSEFONT cf;

/* Set all structure fields to zero. */

memset(&cf, 0, sizeof(CHOOSEFONT));

cf.lStructSize = sizeof(CHOOSEFONT);
cf.hwndOwner = hwnd;
cf.lpLogFont = &lf;
cf.Flags = CF_SCREENFONTS | CF_EFFECTS;
cf.rgbColors = RGB(0, 255, 255); /* light blue */
cf.nFontType = SCREEN_FONTTYPE;

ChooseFont(&cf);
```

See Also

CHOOSEFONT

The following shows how the dialog box normally appears:



FindText (3.1)

#include commdlg.h

HWND FindText(*lpfr***)**

FINDREPLACE FAR* *lpfr;* /* address of structure with initialization data*/

The **FindText** function creates a system-defined modeless dialog box that makes it possible for the user to find text within a document. The application must perform the search operation.

Parameter	Description
lpfr	Points to a **FINDREPLACE** structure that contains information used to initialize the dialog box. When the user makes a selection in the dialog box, the system fills this structure with information about the user's selection and then sends a message to the application. This message contains a pointer to the **FINDREPLACE** structure.

Returns

The return value is the window handle of the dialog box if the function is successful. Otherwise, it is NULL. An application can use this window handle to communicate with or to close the dialog box.

Errors

Use the **CommDlgExtendedError** function to retrieve the error value, which may be one of the following values:

CDERR_FINDRESFAILURE
CDERR_INITIALIZATION
CDERR_LOCKRESFAILURE
CDERR_LOADRESFAILURE
CDERR_LOADSTRFAILURE
CDERR_MEMALLOCFAILURE
CDERR_MEMLOCKFAILURE
CDERR_NOHINSTANCE
CDERR_NOHOOK
CDERR_NOTEMPLATE
CDERR_STRUCTSIZE
FRERR_BUFFERLENGTHZERO

Comments

The dialog box procedure for the Find dialog box passes user requests to the application through special

messages. The *lParam* parameter of each of these messages contains a pointer to a **FINDREPLACE** structure. The procedure sends the messages to the window identified by the **hwndOwner** member of the **FINDREPLACE** structure. An application can register the identifier for these messages by specifying the "commdlg_FindReplace" string in a call to the **RegisterWindowMessage** function.

For the TAB key to function correctly, any application that calls the **FindText** function must also call the **IsDialogMessage** function in its main message loop. (The **IsDialogMessage** function returns a value that indicates whether messages are intended for the Find dialog box.)

If the hook function (to which the **lpfnHook** member of the **FINDREPLACE** structure points) processes the **WM_CTLCOLOR** message, this function must return a handle of the brush that should be used to paint the control background.

Example

The following example initializes a **FINDREPLACE** structure and calls the **FindText** function to display the Find dialog box:

```
FINDREPLACE fr;

/* Set all structure fields to zero. */

memset(&fr, 0, sizeof(FINDREPLACE));

fr.lStructSize = sizeof(FINDREPLACE);
fr.hwndOwner = hwnd;
fr.lpstrFindWhat = szFindWhat;
fr.wFindWhatLen = sizeof(szFindWhat);

hDlg = FindText(&fr);

break;
```

In addition to initializing the members of the **FINDREPLACE** structure and calling the **FindText** function, an application must register the special FINDMSGSTRING message and process messages from the dialog box.

The following example registers the message by using the **RegisterWindowMessage** function:

```
UINT uFindReplaceMsg;

/* Register the FindReplace message. */

uFindReplaceMsg = RegisterWindowMessage(FINDMSGSTRING);
```

After the application registers the FINDMSGSTRING message, it can process messages by using the **RegisterWindowMessage** return value. The following example processes messages for the Find dialog box and then calls its own SearchFile function to locate the string of text. If the user is closing the dialog box (that is, if the **Flags** member of the **FINDREPLACE** structure is FR_DIALOGTERM), the handle is invalidated and the procedure returns zero.

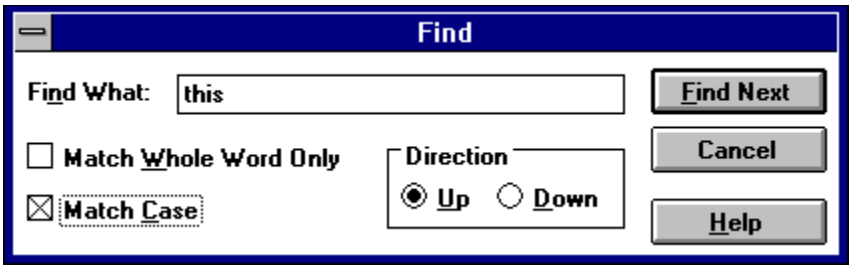
```
LRESULT CALLBACK MainWndProc(HWND hwnd, UINT msg, WPARAM wParam,
    LPARAM lParam)
{
    FINDREPLACE FAR* lpfr;

    if (msg == uFindReplaceMsg) {
        lpfr = (FINDREPLACE FAR*) lParam;
        if (lpfr->Flags & FR_DIALOGTERM) {
            hDlg = NULL;
```

```
            return 0;
        }
        SearchFile((BOOL) (lpfr->Flags & FR_DOWN),
            (BOOL) (lpfr->Flags & FR_MATCHCASE));
        return 0;
    }
```

See Also

IsDialogMessage, **RegisterWindowMessage**, **ReplaceText**, **FINDREPLACE**

The following shows how the find dialog box appears:



GetFileTitle (3.1)

#include commdlg.h

int GetFileTitle(*lpszFile, lpszTitle, cbBuf***)**

LPCSTR *lpszFile;* /* pointer to filename (including drive and directory) */
LPSTR *lpszTitle;* /* address of buffer that receives filename */
UINT *cbBuf;* /* length of buffer */

The **GetFileTitle** function returns the title of the file identified by the *lpszFile* parameter.

Parameter	Description
lpszFile	Points to the name and location of an MS-DOS file.
lpszTitle	Points to a buffer into which the function is to copy the name of the file.
cbBuf	Specifies the length, in bytes, of the buffer to which the *lpszTitle* parameter points.

Returns

The return value is zero if the function is successful. The return value is a negative number if the filename is invalid. The return value is a positive integer that specifies the required buffer size, in bytes, if the buffer to which the *lpszTitle* parameter points is too small.

Comments

The function returns an error value if the buffer pointed to by the *lpszFile* parameter contains any of the following:

- An empty string
- A string containing a wildcard (*), opening bracket ([), or closing bracket (])
- A string that ends with a colon (:), slash mark (/), or backslash (\)
- A string whose length exceeded the length of the buffer
- An invalid character (for example, a space or unprintable character).

The required buffer size includes the terminating null character.

GetOpenFileName (3.1)

#include commdlg.h

BOOL GetOpenFileName(*lpofn***)**

OPENFILENAME FAR* *lpofn;* /* address of initialization data structure */

The **GetOpenFileName** function creates a system-defined dialog box that makes it possible for the user to select a file to open.

Parameter	Description
lpofn	Points to an **OPENFILENAME** structure that contains information used to initialize the dialog box. When the **GetOpenFileName** function returns, this structure contains information about the user's file selection.

Returns

The return value is nonzero if the user selects a file to open. It is zero if an error occurs, if the user chooses the Cancel button, if the user chooses the Close command on the System menu to close the dialog box, or if the buffer identified by the **lpstrFile** member of the **OPENFILENAME** structure is too small to contain the string that specifies the selected file.

Errors

The **CommDlgExtendedError** function retrieves the error value, which may be one of the following values:

CDERR_FINDRESFAILURE
CDERR_INITIALIZATION
CDERR_LOCKRESFAILURE
CDERR_LOADRESFAILURE
CDERR_LOADSTRFAILURE
CDERR_MEMALLOCFAILURE
CDERR_MEMLOCKFAILURE
CDERR_NOHINSTANCE
CDERR_NOHOOK
CDERR_NOTEMPLATE
CDERR_STRUCTSIZE
FNERR_BUFFERTOOSMALL
FNERR_INVALIDFILENAME
FNERR_SUBCLASSFAILURE

Comments

If the hook function (to which the **lpfnHook** member of the **OPENFILENAME** structure points) processes the **WM_CTLCOLOR** message, this function must return a handle of the brush that should be used to paint the control background.

Example

The following example copies file-filter strings into a buffer, initializes an **OPENFILENAME** structure, and then creates an Open dialog box.

The file-filter strings are stored in the resource file in the following form:

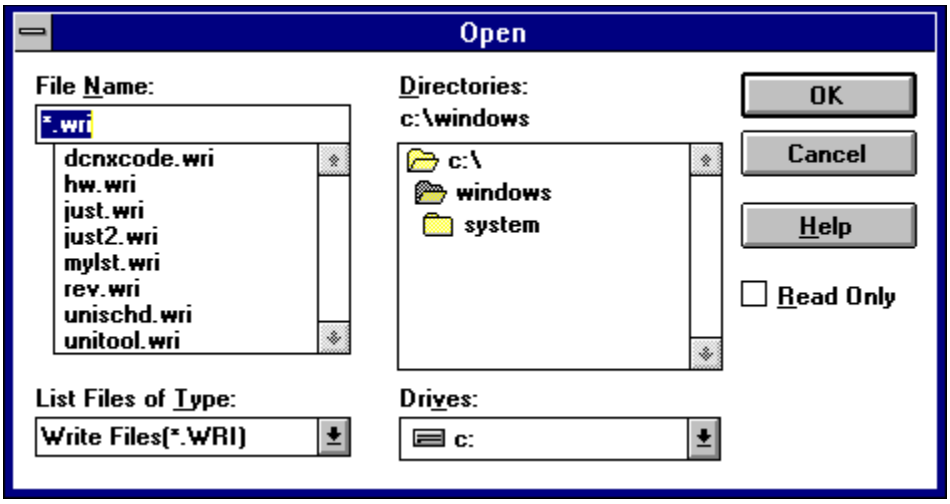
```
STRINGTABLE
BEGIN
  IDS_FILTERSTRING  "Write Files(*.WRI)|*.wri|Word Files(*.DOC)|*.doc|"
END
```

The replaceable character at the end of the string is used to break the entire string into separate strings, while still guaranteeing that all the strings are continguous in memory.

```
OPENFILENAME ofn;
char szDirName[256];
char szFile[256], szFileTitle[256];
UINT  i, cbString;
char  chReplace;    /* string separator for szFilter */
char  szFilter[256];
HFILE hf;

/* Get the system directory name, and store in szDirName */

GetSystemDirectory(szDirName, sizeof(szDirName));
szFile[0] = '\0';

if ((cbString = LoadString(hinst, IDS_FILTERSTRING,
        szFilter, sizeof(szFilter))) == 0) {
    ErrorHandler();
    return 0L;
}
chReplace = szFilter[cbString - 1]; /* retrieve wildcard */

for (i = 0; szFilter[i] != '\0'; i++) {
    if (szFilter[i] == chReplace)
       szFilter[i] = '\0';
}

/* Set all structure members to zero. */

memset(&ofn, 0, sizeof(OPENFILENAME));

ofn.lStructSize = sizeof(OPENFILENAME);
ofn.hwndOwner = hwnd;
ofn.lpstrFilter = szFilter;
ofn.nFilterIndex = 1;
ofn.lpstrFile= szFile;
ofn.nMaxFile = sizeof(szFile);
ofn.lpstrFileTitle = szFileTitle;
ofn.nMaxFileTitle = sizeof(szFileTitle);
ofn.lpstrInitialDir = szDirName;
ofn.Flags = OFN_SHOWHELP | OFN_PATHMUSTEXIST | OFN_FILEMUSTEXIST;

if (GetOpenFileName(&ofn)) {
    hf = _lopen(ofn.lpstrFile, OF_READ);
        .
        . /* Perform file operations. */
        .
}
else
    ErrorHandler();
```

See Also
GetSaveFileName, **OPENFILENAME**

The following shows how the open dialog box normally appears:



GetSaveFileName (3.1)

#include commdlg.h

BOOL GetSaveFileName(*lpofn***)**

OPENFILENAME FAR* *lpofn;* /* address of initialization data */

The **GetSaveFileName** function creates a system-defined dialog box that makes it possible for the user to select a file to save.

Parameter	Description
lpofn	Points to an **OPENFILENAME** structure that contains information used to initialize the dialog box. When the **GetSaveFileName** function returns, this structure contains information about the user's file selection.

Returns

The return value is nonzero if the user selects a file to save. It is zero if an error occurs, if the user clicks the Cancel button, if the user chooses the Close command on the System menu to close the dialog box, or if the buffer identified by the **lpstrFile** member of the **OPENFILENAME** structure is too small to contain the string that specifies the selected file.

Errors

The **CommDlgExtendedError** retrieves the error value, which may be one of the following values:

CDERR_FINDRESFAILURE
CDERR_INITIALIZATION
CDERR_LOCKRESFAILURE
CDERR_LOADRESFAILURE
CDERR_LOADSTRFAILURE
CDERR_MEMALLOCFAILURE
CDERR_MEMLOCKFAILURE
CDERR_NOHINSTANCE
CDERR_NOHOOK
CDERR_NOTEMPLATE
CDERR_STRUCTSIZE
FNERR_BUFFERTOOSMALL
FNERR_INVALIDFILENAME
FNERR_SUBCLASSFAILURE

Comments

If the hook function (to which the **lpfnHook** member of the **OPENFILENAME** structure points)

processes the **WM_CTLCOLOR** message, this function must return a handle for the brush that should be used to paint the control background.

Example

The following example copies file-filter strings (filename extensions) into a buffer, initializes an **OPENFILENAME** structure, and then creates a Save As dialog box.

The file-filter strings are stored in the resource file in the following form:

```
STRINGTABLE
BEGIN
  IDS_FILTERSTRING  "Write Files(*.WRI)|*.wri|Word Files(*.DOC)|*.doc|"
END
```

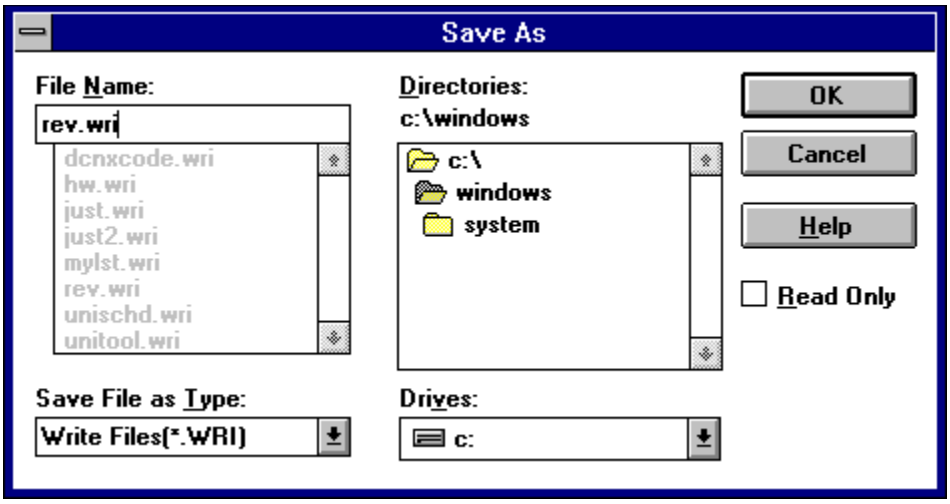
The replaceable character at the end of the string is used to break the entire string into separate strings, while still guaranteeing that all the strings are continguous in memory.

```
OPENFILENAME ofn;
char szDirName[256];
char szFile[256], szFileTitle[256];
UINT  i, cbString;
char  chReplace;    /* string separator for szFilter */
char  szFilter[256];
HFILE hf;

/*
 * Retrieve the system directory name, and store it in
 * szDirName.
 */

GetSystemDirectory(szDirName, sizeof(szDirName));

if ((cbString = LoadString(hinst, IDS_FILTERSTRING,
        szFilter, sizeof(szFilter))) == 0) {
    ErrorHandler();
    return 0;
}

chReplace = szFilter[cbString - 1]; /* retrieve wildcard */

for (i = 0; szFilter[i] != '\0'; i++) {
    if (szFilter[i] == chReplace)
       szFilter[i] = '\0';
}

/* Set all structure members to zero. */

memset(&ofn, 0, sizeof(OPENFILENAME));

/* Initialize the OPENFILENAME members. */

szFile[0] = '\0';

ofn.lStructSize = sizeof(OPENFILENAME);
ofn.hwndOwner = hwnd;
ofn.lpstrFilter = szFilter;
ofn.lpstrFile= szFile;
```

```
ofn.nMaxFile = sizeof(szFile);
ofn.lpstrFileTitle = szFileTitle;
ofn.nMaxFileTitle = sizeof(szFileTitle);
ofn.lpstrInitialDir = szDirName;
ofn.Flags = OFN_SHOWHELP | OFN_OVERWRITEPROMPT;

if (GetSaveFileName(&ofn)) {
    .
    . /* Perform file operations. */
    .
}
else
    ErrorHandler();
```

See Also
GetOpenFileName, **OPENFILENAME**

The following shows how the save dialog box appears:



PrintDlg function (3.1)

#include commdlg.h

BOOL PrintDlg(*lppd***)**

PRINTDLG FAR* *lppd;* /* address of structure with initialization data*/

The **PrintDlg** function displays a Print dialog box or a Print Setup dialog box. The Print dialog box makes it possible for the user to specify the properties of a particular print job. The Print Setup dialog box makes it possible for the user to select additional job properties and configure the printer.

Parameter	Description
lppd	Points to a **PRINTDLG** structure that contains information used to initialize the dialog box. When the **PrintDlg** function returns, this structure contains information about the user's selections.

Returns

The return value is nonzero if the function successfully configures the printer. The return value is zero if an error occurs, if the user chooses the Cancel button, or if the user chooses the Close command on the System menu to close the dialog box. (The return value is also zero if the user chooses the Setup button to display the Print Setup dialog box, chooses the OK button in the Print Setup dialog box, and then chooses the Cancel button in the Print dialog box.)

Errors

Use the **CommDlgExtendedError** function to retrieve the error value, which may be one of the following:

CDERR_FINDRESFAILURE	PDERR_CREATEICFAILURE
CDERR_INITIALIZATION	PDERR_DEFAULTDIFFERENT
CDERR_LOADRESFAILURE	PDERR_DNDMMISMATCH
CDERR_LOADSTRFAILURE	PDERR_GETDEVMODEFAIL
CDERR_LOCKRESFAILURE	PDERR_INITFAILURE
CDERR_MEMALLOCFAILURE	PDERR_LOADDRVFAILURE
CDERR_MEMLOCKFAILURE	PDERR_NODEFAULTPRN
CDERR_NOHINSTANCE	PDERR_NODEVICES
CDERR_NOHOOK	PDERR_PARSEFAILURE
CDERR_NOTEMPLATE	PDERR_PRINTERNOTFOUND

CDERR_STRUCTSIZE	PDERR_RETDEFFAILURE
	PDERR_SETUPFAILURE

Example

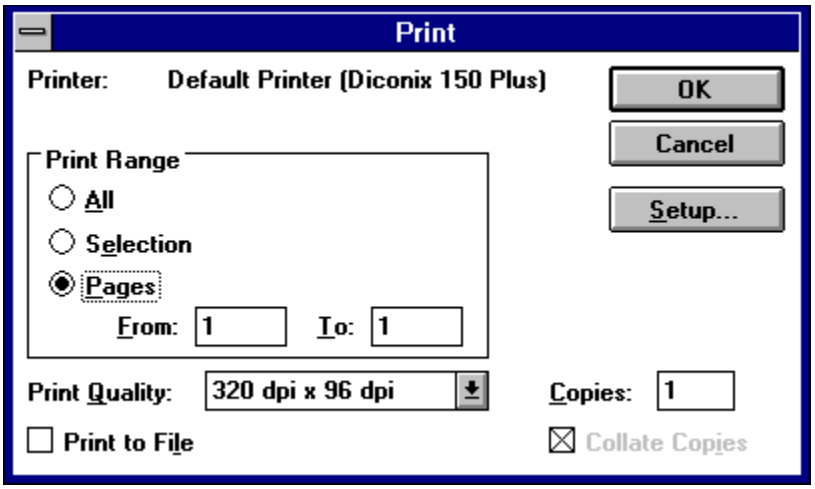
The following example initializes the **PRINTDLG** structure, calls the **PrintDlg** function to display the Print dialog box, and prints a sample page of text if the return value is nonzero:

```
PRINTDLG pd;

/* Set all structure members to zero. */

memset(&pd, 0, sizeof(PRINTDLG));

/* Initialize the necessary PRINTDLG structure members. */

pd.lStructSize = sizeof(PRINTDLG);
pd.hwndOwner = hwnd;
pd.Flags = PD_RETURNDC;

/* Print a test page if successful */

if (PrintDlg(&pd) != 0) {
    Escape(pd.hDC, STARTDOC, 8, "Test-Doc", NULL);

    /* Print text and rectangle */

    TextOut(pd.hDC, 50, 50, "Common Dialog Test Page", 23);
    Rectangle(pd.hDC, 50, 90, 625, 105);
    Escape(pd.hDC, NEWFRAME, 0, NULL, NULL);
    Escape(pd.hDC, ENDDOC, 0, NULL, NULL);
    DeleteDC(pd.hDC);
    if (pd.hDevMode != NULL)
       GlobalFree(pd.hDevMode);
    if (pd.hDevNames != NULL)
       GlobalFree(pd.hDevNames);
}
else
    ErrorHandler();
```

See Also

PRINTDLG

The following shows how the print dialog box normally appears:



ReplaceText (3.1)

#include commdlg.h

HWND ReplaceText(*lpfr***)**

FINDREPLACE FAR* *lpfr;* /* address of structure with initialization data*/

The **ReplaceText** function creates a system-defined modeless dialog box that makes it possible for the user to find and replace text within a document. The application must perform the actual find and replace operations.

Parameter	Description
lpfr	Points to a **FINDREPLACE** structure that contains information used to initialize the dialog box. When the user makes a selection in the dialog box, the system fills this structure with information about the user's selection and then sends a message to the application. This message contains a pointer to the **FINDREPLACE** structure.

Returns

The return value is the window handle of the dialog box, or it is NULL if an error occurs. An application can use this handle to communicate with or to close the dialog box.

Errors

Use the **CommDlgExtendedError** function to retrieve the error value, which may be one of the following:

CDERR_FINDRESFAILURE
CDERR_INITIALIZATION
CDERR_LOADRESFAILURE
CDERR_LOADSTRFAILURE
CDERR_LOCKRESFAILURE
CDERR_MEMALLOCFAILURE
CDERR_MEMLOCKFAILURE
CDERR_NOHINSTANCE
CDERR_NOHOOK
CDERR_NOTEMPLATE
CDERR_STRUCTSIZE
FRERR_BUFFERLENGTHZERO

Comments

The dialog box procedure for the **ReplaceText** function passes user requests to the application through special messages. The *lParam* parameter of each of these messages contains a pointer to a

FINDREPLACE structure. The procedure sends the messages to the window identified by the **hwndOwner** member of the **FINDREPLACE** structure. An application can register the identifier for these messages by specifying the commdlg_FindReplace string in a call to the **RegisterWindowMessage** function.

For the TAB key to function correctly, any application that calls the **ReplaceText** function must also call the **IsDialogMessage** function in its main message loop. (The **IsDialogMessage** function returns a value that indicates whether messages are intended for the Replace dialog box.)

Example

This example initializes a **FINDREPLACE** structure and calls the **ReplaceText** function to display the Replace dialog box:

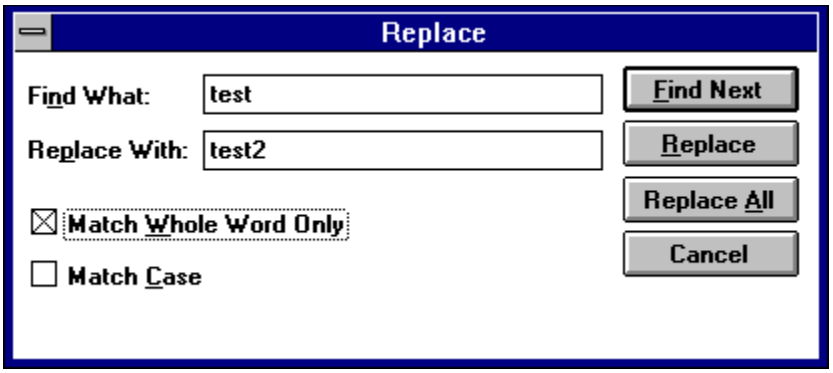
```
FINDREPLACE fr;
char szFindWhat[256] = "";      /* string to find    */
char szReplaceWith[256] = "";   /* string to replace */

/* Set all structure fields to zero. */

memset(&fr, 0, sizeof(FINDREPLACE));

fr.lStructSize = sizeof(FINDREPLACE);
fr.hwndOwner = hwnd;
fr.lpstrFindWhat = szFindWhat;
fr.wFindWhatLen = sizeof(szFindWhat);
fr.lpstrReplaceWith = szReplaceWith;
fr.wReplaceWithLen = sizeof(szReplaceWith);

hDlg = ReplaceText(&fr);
```

In addition to initializing the members of the **FINDREPLACE** structure and calling the **ReplaceText** function, an application must register the special FINDMSGSTRING message and process messages from the dialog box. Refer to the description of the **FindText** function for an example that shows how an application registers and processes a message.

See Also

FindText, **IsDialogMessage**, **RegisterWindowMessage**, **FINDREPLACE**

The following shows how the replace dialog box appears:



Common dialog box functions (3.1)

CommDlgExtendedError	Retrieves error data for common dialog box procedure
ChooseColor	Creates a color-selection dialog box
ChooseFont function	Creates a font-selection dialog box
FindText	Creates a find-text dialog box
GetFileTitle	Retrieves a filename
GetOpenFileName	Creates an open-filename dialog box
GetSaveFileName	Creates a save-filename dialog box
PrintDlg function	Creates a print-text dialog box
ReplaceText	Creates a replace-text dialog box

DdeAbandonTransaction (3.1)

#include <ddeml.h>

BOOL DdeAbandonTransaction(*idInst, hConv, idTransaction***)**

```
DWORD idInst;          /* instance identifier       */
HCONV hConv;           /* handle of conversation    */
DWORD idTransaction;   /* transaction identifier    */
```

The **DdeAbandonTransaction** function abandons the specified asynchronous transaction and releases all resources associated with the transaction.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.
hConv	Identifies the conversation in which the transaction was initiated. If this parameter is NULL, all transactions are abandoned (the *idTransaction* parameter is ignored).
idTransaction	Identifies the transaction to terminate. If this parameter is NULL, all active transactions in the specified conversation are abandoned.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_INVALIDPARAMETER
DMLERR_NO_ERROR
DMLERR_UNFOUND_QUEUE_ID

Comments

Only a dynamic data exchange (**DDE**) client application should call the **DdeAbandonTransaction** function. If the server application responds to the transaction after the client has called **DdeAbandonTransaction**, the system discards the transaction results. This function has no effect on synchronous transactions.

See Also

DdeClientTransaction, **DdeGetLastError**, **DdeInitialize**, **DdeQueryConvInfo**

DdeAccessData (3.1)

#include <ddeml.h>

BYTE FAR* DdeAccessData(*hData, lpcbData***)**

HDDEDATA *hData;* /* handle of global memory object */
DWORD FAR* *lpcbData;* /* pointer to variable that receives data length */

The **DdeAccessData** function provides access to the data in the given global memory object. An application must call the **DdeUnaccessData** function when it is finished accessing the data in the object.

Parameter	Description
hData	Identifies the global memory object to access.
lpcbData	Points to a variable that receives the size, in bytes, of the global memory object identified by the *hData* parameter. If this parameter is NULL, no size information is returned.

Returns

The return value points to the first byte of data in the global memory object if the function is successful. Otherwise, the return value is NULL.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_INVALIDPARAMETER
DMLERR_NO_ERROR

Comments

If the *hData* parameter has not been passed to a Dynamic Data Exchange Management Library (**DDEML**) function, an application can use the pointer returned by **DdeAccessData** for read-write access to the global memory object. If *hData* has already been passed to a DDEML function, the pointer can only be used for read-only access to the memory object.

Example

The following example uses the **DdeAccessData** function to obtain a pointer to a global memory object, uses the pointer to copy data from the object to a local buffer, then frees the pointer:

```
HDDEDATA hData;
LPBYTE lpszAdviseData;
DWORD cbDataLen;
DWORD i;
char szData[128];

lpszAdviseData = DdeAccessData(hData, &cbDataLen);
for (i = 0; i < cbDataLen; i++)
    szData[i] = *lpszAdviseData++;
DdeUnaccessData(hData);
```

See Also

DdeAddData, **DdeCreateDataHandle**, **DdeFreeDataHandle**, **DdeGetLastError**, **DdeUnaccessData**

DdeAddData (3.1)

#include <ddeml.h>

HDDEDATA DdeAddData(*hData, lpvSrcBuf, cbAddData, offObj***)**

HDDEDATA *hData;* /* handle of global memory object */
void FAR* *lpvSrcBuf;* /* address of source buffer */
DWORD *cbAddData;* /* length of data */
DWORD *offObj;* /* offset within global memory object */

The **DdeAddData** function adds data to the given global memory object. An application can add data beginning at any offset from the beginning of the object. If new data overlaps data already in the object, the new data overwrites the old data in the bytes where the overlap occurs. The contents of locations in the object that have not been written to are undefined.

Parameter	Description
hData	Identifies the global memory object that receives additional data.
lpvSrcBuf	Points to a buffer containing the data to add to the global memory object.
cbAddData	Specifies the length, in bytes, of the data to be added to the global memory object.
offObj	Specifies an offset, in bytes, from the beginning of the global memory object. The additional data is copied to the object beginning at this offset.

Returns

The return value is a new handle of the global memory object if the function is successful. The new handle should be used in all references to the object. The return value is zero if an error occurs.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_INVALIDPARAMETER
DMLERR_MEMORY_ERROR
DMLERR_NO_ERROR

Comments

After a data handle has been used as a parameter in another Dynamic Data Exchange Management Library (**DDEML**) function or returned by a **DDE** callback function, the handle may only be used for read access to the global memory object identified by the handle.

If the amount of global memory originally allocated is not large enough to hold the added data, the **DdeAddData** function will reallocate a global memory object of the appropriate size.

Example

The following example creates a global memory object, uses the **DdeAddData** function to add data to the object, and then passes the data to a client with an **XTYP_POKE** transaction:

```
DWORD idInst;           /* instance identifier     */
HDDEDATA hddeStrings;   /* data handle             */
HSZ hszMyItem;          /* item-name string handle */
DWORD offObj = 0;       /* offset in global object */
char szMyBuf[16];       /* temporary string buffer */
HCONV hconv;            /* conversation handle     */
DWORD dwResult;         /* transaction results     */
BOOL fAddAString;       /* TRUE if strings to add  */

/* Create a global memory object. */

hddeStrings = DdeCreateDataHandle(idInst, NULL, 0, 0,
```

```
    hszMyItem, CF_TEXT, 0);

/*
 * If a string is available, the application-defined function
 * IsThereAString() copies it to szMyBuf and returns TRUE. Otherwise,
 * it returns FALSE.
 */

while ((fAddAString = IsThereAString())) {

    /* Add the string to the global memory object. */

    DdeAddData(hddeStrings,             /* data handle        */
        &szMyBuf,                       /* string buffer      */
        (DWORD) strlen(szMyBuf) + 1,    /* character count    */
        offObj);                        /* offset in object   */

    offObj = (DWORD) strlen(szMyBuf) + 1; /* adjust offset */
}

/* No more data to add, so poke it to the server. */

DdeClientTransaction((void FAR*) hddeStrings, -1L, hconv, hszMyItem,
    CF_TEXT, XTYP_POKE, 1000, &dwResult);
```

See Also

DdeAccessData, **DdeCreateDataHandle**, **DdeGetLastError**, **DdeUnaccessData**

DdeClientTransaction (3.1)

#include <ddeml.h>

HDDEDATA DdeClientTransaction(*lpvData, cbData, hConv, hszItem, uFmt, uType, uTimeout, lpuResult***)**

```
void FAR* lpvData;      /* address of data to pass to server  */
DWORD cbData;           /* length of data                     */
HCONV hConv;            /* handle of conversation             */
HSZ hszItem;            /* handle of item-name string         */
UINT uFmt;              /* clipboard data format              */
UINT uType;             /* transaction type                   */
DWORD uTimeout;         /* timeout duration                   */
DWORD FAR* lpuResult;   /* points to transaction result       */
```

The **DdeClientTransaction** function begins a data transaction between a client and a server. Only a dynamic data exchange (**DDE**) client application can call this function, and only after establishing a conversation with the server.

Parameter	Description
lpvData	Points to the beginning of the data that the client needs to pass to the server. Optionally, an application can specify the data handle (HDDEDATA) to pass to the server, in which case the *cbData* parameter should be set to -1. This parameter is required only if the *uType* parameter is **XTYP_EXECUTE** or XTYP_POKE. Otherwise, this parameter should be NULL.
cbData	Specifies the length, in bytes, of the data pointed to by the *lpvData* parameter. A value of -1 indicates that *lpvData* is a data handle that identifies the data being sent.
hConv	Identifies the conversation in which the transaction is to take place.
hszItem	Identifies the data item for which data is being exchanged during the transaction. This handle must have been created by a previous call to the **DdeCreateStringHandle** function. This parameter is ignored (and should be set to NULL) if the *uType* parameter is XTYP_EXECUTE.
uFmt	Specifies the standard clipboard format in which the data item is being submitted or requested. For more information about standard clipboard formats, see the **Clipboard formats** topic.
uType	Specifies the transaction type. This parameter can be one of the following values:

Value	Meaning
XTYP_ADVSTART	Begins an advise loop. Any number of distinct advise loops can exist within a conversation. An application can alter the advise loop type by combining the **XTYP_ADVSTART** transaction type with one or more of the following flags:

Value	Meaning
XTYPF_NODATA	Instructs the server to notify the client of any data changes without actually sending the data. This flag gives the client the option of ignoring the notification or requesting the changed data from the server.
XTYPF_ACKREQ	Instructs the server to wait until the client acknowledges that it received the previous data item before sending the next data item. This flag

prevents a fast server from sending data faster than the client can process it.

XTYP_ADVSTOP	Ends an advise loop.
XTYP_EXECUTE	Begins an execute transaction.
XTYP_POKE	Begins a poke transaction.
XTYP_REQUEST	Begins a request transaction.

uTimeout Specifies the maximum length of time, in milliseconds, that the client will wait for a response from the server application in a synchronous transaction. This parameter should be set to TIMEOUT_ASYNC for asynchronous transactions.

lpuResult Points to a variable that receives the result of the transaction. An application that does not check the result can set this value to NULL. For synchronous transactions, the low-order word of this variable will contain any applicable DDE_ flags resulting from the transaction. This provides support for applications dependent on DDE_APPSTATUS bits. (It is recommended that applications no longer use these bits because they may not be supported in future versions of the **DDE** Management Library.) For asynchronous transactions, this variable is filled with a unique transaction identifier for use with the **DdeAbandonTransaction** function and the **XTYP_XACT_COMPLETE** transaction.

Returns

The return value is a data handle that identifies the data for successful synchronous transactions in which the client expects data from the server. The return value is TRUE for successful asynchronous transactions and for synchronous transactions in which the client does not expect data. The return value is FALSE for all unsuccessful transactions.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_ADVACKTIMEOUT
DMLERR_BUSY
DMLERR_DATAACKTIMEOUT
DMLERR_DLL_NOT_INITIALIZED
DMLERR_EXECACKTIMEOUT
DMLERR_INVALIDPARAMETER
DMLERR_MEMORY_ERROR
DMLERR_NO_CONV_ESTABLISHED
DMLERR_NO_ERROR
DMLERR_NOTPROCESSED
DMLERR_POKEACKTIMEOUT
DMLERR_POSTMSG_FAILED
DMLERR_REENTRANCY
DMLERR_SERVER_DIED
DMLERR_UNADVACKTIMEOUT

Comments

When the application is finished using the data handle returned by the **DdeClientTransaction** function, the application should free the handle by calling the **DdeFreeDataHandle** function.

Transactions can be synchronous or asynchronous. During a synchronous transaction, the **DdeClientTransaction** function does not return until the transaction completes successfully or fails. Synchronous transactions cause the client to enter a modal loop while waiting for various asynchronous events. Because of this, the client application can still respond to user input while waiting on a synchronous transaction but cannot begin a second synchronous transaction because of the activity associated with the first. The **DdeClientTransaction** function fails if any instance of the same task has a synchronous transaction already in progress.

During an asynchronous transaction, the **DdeClientTransaction** function returns after the transaction is

begun, passing a transaction identifier for reference. When the server's **DDE** callback function finishes processing an asynchronous transaction, the system sends an **XTYP_XACT_COMPLETE** transaction to the client. This transaction provides the client with the results of the asynchronous transaction that it initiated by calling the **DdeClientTransaction** function. A client application can choose to abandon an asynchronous transaction by calling the **DdeAbandonTransaction** function.

Example

The following example requests an advise loop with a **DDE** server application:

```
HCONV hconv;
HSZ hszNow;
HDDEDATA hData;
DWORD dwResult;

hData = DdeClientTransaction(
    (LPBYTE) NULL, /* pass no data to server */
    0,             /* no data                */
    hconv,         /* conversation handle    */
    hszNow,        /* item name              */
    CF_TEXT,       /* clipboard format       */
    XTYP_ADVSTART, /* start an advise loop   */
    1000,          /* time-out in one second */
    &dwResult);    /* points to result flags */
```

See Also

DdeAbandonTransaction, **DdeAccessData**, **DdeConnect**, **DdeConnectList**, **DdeCreateStringHandle**

DdeCmpStringHandles (3.1)

#include <ddeml.h>

int DdeCmpStringHandles(*hsz1, hsz2***)**

HSZ *hsz1;* /* handle of first string */
HSZ *hsz2;* /* handle of second string */

The **DdeCmpStringHandles** function compares the values of two string handles. The value of a string handle is not related to the case of the associated string.

Parameter	Description
hsz1	Specifies the first string handle.
hsz2	Specifies the second string handle.

Returns

The return value can be one of the following:

Value	Meaning
-1	The value of *hsz1* is either 0 or less than the value of *hsz2.*
0	The values of *hsz1* and *hsz2* are equal (both can be 0).
1	The value of *hsz2* is either 0 or less than the value of *hsz1.*

Comments

An application that needs to do a case-sensitive comparison of two string handles should compare the string handles directly. An application should use **DdeCompStringHandles** for all other comparisons to preserve the case-sensitive nature of dynamic data exchange (**DDE**).

The **DdeCompStringHandles** function cannot be used to sort string handles alphabetically.

Example

This example compares two service-name string handles and, if the handles are the same, requests a conversation with the server, then issues an **XTYP_ADVSTART** transaction:

```
HSZ hszClock;   /* service name */
HSZ hszTime;    /* topic name   */
HSZ hsz1;       /* unknown server          */
HCONV hConv;    /* conversation handle     */
DWORD dwResult; /* result flags            */
DWORD idInst;   /* instance identifier     */

/*
 * Compare unknown service name handle with the string handle
 * for the clock application.
 */

if (!DdeCmpStringHandles(hsz1, hszClock)) {

    /*
     * If this is the clock application, start a conversation
     * with it and request an advise loop.
     */

    hConv = DdeConnect(idInst, hszClock, hszTime, NULL);
    if (hConv != (HCONV) NULL)
        DdeClientTransaction(NULL, 0, hConv, hszNow,
            CF_TEXT, XTYP_ADVSTART, 1000, &dwResult);
```

```
}
```

See Also
DdeAccessData, **DdeCreateStringHandle**, **DdeFreeStringHandle**

DdeConnect (3.1)

#include <ddeml.h>

HCONV DdeConnect(*idInst, hszService, hszTopic, pCC***)**

DWORD *idInst;*	/* instance identifier */
HSZ *hszService;*	/* handle of service-name string */
HSZ *hszTopic;*	/* handle of topic-name string */
CONVCONTEXT FAR* *pCC;*	/* address of structure with context data*/

The **DdeConnect** function establishes a conversation with a server application that supports the specified service name and topic name pair. If more than one such server exists, the system selects only one.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.
hszService	Identifies the string that specifies the service name of the server application with which a conversation is to be established. This handle must have been created by a previous call to the **DdeCreateStringHandle** function. If this parameter is NULL, a conversation will be established with any available server.
hszTopic	Identifies the string that specifies the name of the topic on which a conversation is to be established. This handle must have been created by a previous call to the **DdeCreateStringHandle** function. If this parameter is NULL, a conversation on any topic supported by the selected server will be established.
pCC	Points to the **CONVCONTEXT** structure that contains conversation-context information. If this parameter is NULL, the server receives the default **CONVCONTEXT** structure during the **XTYP_CONNECT** or **XTYP_WILDCONNECT** transaction.

Returns

The return value is the handle of the established conversation if the function is successful. Otherwise, it is NULL.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_INVALIDPARAMETER
DMLERR_NO_CONV_ESTABLISHED
DMLERR_NO_ERROR

Comments

The client application should not make assumptions regarding which server will be selected. If an instance-specific name is specified in the *hszService* parameter, a conversation will be established only with the specified instance. Instance-specific service names are passed to an application's dynamic data exchange callback function during the **XTYP_REGISTER** and **XTYP_UNREGISTER** transactions.

All members of the default **CONVCONTEXT** structure are set to zero except **cb**, which specifies the size of the structure, and **iCodePage**, which specifies CP_WINANSI (the default code page).

Example

The following example creates a service-name string handle and a topic-name string handle, then attempts to establish a conversation with a server that supports the service name and topic name. If the attempt fails, the example retrieves an error value identifying the reason for the failure.

```
DWORD idInst = 0L;
HSZ hszClock;
```

```
HSZ hszTime;
HCONV hconv;
UINT uError;

hszClock = DdeCreateStringHandle(idInst, "Clock", CP_WINANSI);
hszTime = DdeCreateStringHandle(idInst, "Time", CP_WINANSI);

if ((hconv = DdeConnect(
    idInst,                 /* instance identifier              */
    hszClock,               /* server's service name            */
    hszTime,                /* topic name                       */
    NULL)) == NULL) {       /* use default CONVCONTEXT          */
    uError = DdeGetLastError(idInst);
}
```

See Also

DdeConnectList, **DdeCreateStringHandle**, **DdeDisconnect**, **DdeDisconnectList**, **DdeInitialize**, **CONVCONTEXT**, **XTYP_CONNECT**, **XTYP_REGISTER**, **XTYP_UNREGISTER**

DdeConnectList (3.1)

#include <ddeml.h>

HCONVLIST DdeConnectList(*idInst, hszService, hszTopic, hConvList, pCC***)**

```
DWORD idInst;                   /* instance identifier                 */
HSZ hszService;                 /* handle of service-name string       */
HSZ hszTopic;                   /* handle of topic-name string         */
HCONVLIST hConvList;            /* handle of conversation list         */
CONVCONTEXT FAR* pCC;           /* address of structure with context data*/
```

The **DdeConnectList** function establishes a conversation with all server applications that support the specified service/topic name pair. An application can also use this function to enumerate a list of conversation handles by passing the function an existing conversation handle. During enumeration, the Dynamic Data Exchange Management Library (**DDEML**) removes the handles of any terminated conversations from the conversation list. The resulting conversation list contains the handles of all conversations currently established that support the specified service name and topic name.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.
hszService	Identifies the string that specifies the service name of the server application with which a conversation is to be established. If this parameter is NULL, the system will attempt to establish conversations with all available servers that support the specified topic name.
hszTopic	Identifies the string that specifies the name of the topic on which a conversation is to be established. This handle must have been created by a previous call to the **DdeCreateStringHandle** function. If this parameter is NULL, the system will attempt to establish conversations on all topics supported by the selected server (or servers).
hConvList	Identifies the conversation list to be enumerated. This parameter should be set to NULL if a new conversation list is to be established.
pCC	Points to the **CONVCONTEXT** structure that contains conversation-context information. If this parameter is NULL, the server receives the default **CONVCONTEXT** structure during the **XTYP_CONNECT** or **XTYP_WILDCONNECT** transaction.

Returns

The return value is the handle of a new conversation list if the function is successful. Otherwise, it is NULL. The handle of the old conversation list is no longer valid.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_INVALID_PARAMETER
DMLERR_NO_CONV_ESTABLISHED
DMLERR_NO_ERROR
DMLERR_SYS_ERROR

Comments

An application must free the conversation-list handle returned by this function, regardless of whether any conversation handles within the list are active. To free the handle, an application can call the **DdeDisconnectList** function.

All members of the default **CONVCONTEXT** structure are set to zero except **cb**, which specifies the size of the structure, and **iCodePage**, which specifies CP_WINANSI (the default code page).

Example

The following example uses the **DdeConnectList** function to establish a conversation with all servers

that support the System topic, counts the servers, allocates a buffer for storing the server's service-name string handles, and then copies the handles to the buffer:

```
HCONVLIST hconvList; /* conversation list       */
DWORD idInst;        /* instance identifier     */
HSZ hszSystem;       /* System topic            */
HCONV hconv = NULL;  /* conversation handle     */
CONVINFO ci;         /* holds conversation data */
UINT cConv = 0;      /* count of conv. handles  */
HSZ *pHsz, *aHsz;    /* point to string handles */

/* Connect to all servers that support the System topic. */

hconvList = DdeConnectList(idInst, NULL, hszSystem, NULL, NULL);

/* Count the number of handles in the conversation list. */

while ((hconv = DdeQueryNextServer(hconvList, hconv)) != NULL) cConv++;

/* Allocate a buffer for the string handles. */

hconv = NULL;
aHsz = (HSZ *) LocalAlloc(LMEM_FIXED, cConv * sizeof(HSZ));

/* Copy the string handles to the buffer. */

pHsz = aHsz;
while ((hconv = DdeQueryNextServer(hconvList, hconv)) != NULL) {
    DdeQueryConvInfo(hconv, QID_SYNC, (PCONVINFO) &ci);
    DdeKeepStringHandle(idInst, ci.hszSvcPartner);
    *pHsz++ = ci.hszSvcPartner;
}

.
. /* Use the handles; converse with servers. */
.

/* Free the memory, and terminate conversations. */

LocalFree((HANDLE) aHsz);
DdeDisconnectList(hconvList);
```

See Also

DdeConnect, **DdeCreateStringHandle**, **DdeDisconnect**, **DdeDisconnectList**, **DdeInitialize**, **DdeQueryNextServer**, **CONVCONTEXT**, **XTYP_CONNECT**

DdeCreateDataHandle (3.1)

#include <ddeml.h>

HDDEDATA DdeCreateDataHandle(*idInst, lpvSrcBuf, cbInitData, offSrcBuf, hszItem, uFmt, afCmd***)**

```
DWORD idInst;       /* instance identifier                    */
void FAR* lpvSrcBuf;/* address of source buffer               */
DWORD cbInitData;   /* length of global memory object         */
DWORD offSrcBuf;    /* offset from beginning of source buffer */
HSZ hszItem;        /* handle of item-name string             */
UINT uFmt;          /* clipboard data format                  */
UINT afCmd;         /* creation flags                         */
```

The **DdeCreateDataHandle** function creates a global memory object and fills the object with the data pointed to by the *lpvSrcBuf* parameter. A dynamic data exchange (**DDE**) application uses this function during transactions that involve passing data to the partner application.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.
lpvSrcBuf	Points to a buffer that contains data to be copied to the global memory object. If this parameter is NULL, no data is copied to the object.
cbInitData	Specifies the amount, in bytes, of memory to allocate for the global memory object. If this parameter is zero, the *lpvSrcBuf* parameter is ignored.
offSrcBuf	Specifies an offset, in bytes, from the beginning of the buffer pointed to by the *lpvSrcBuf* parameter. The data beginning at this offset is copied from the buffer to the global memory object.
hszItem	Identifies the string that specifies the data item corresponding to the global memory object. This handle must have been created by a previous call to the **DdeCreateStringHandle** function. If the data handle is to be used in an **XTYP_EXECUTE** transaction, this parameter must be set to NULL.
uFmt	Specifies the standard clipboard format of the data.
afCmd	Specifies the creation flags. This parameter can be HDATA_APPOWNED, which specifies that the server application that calls the **DdeCreateDataHandle** function will own the data handle that this function creates. This makes it possible for the server to share the data handle with multiple clients instead of creating a separate handle for each request. If this flag is set, the server must eventually free the shared memory object associated with this handle by using the **DdeFreeDataHandle** function. If this flag is not set, after the data handle is returned by the server's **DDE** callback function or used as a parameter in another DDE Management Library function, the handle becomes invalid in the application that creates the handle.

Returns

The return value is a data handle if the function is successful. Otherwise, it is NULL.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_INVALIDPARAMETER
DMLERR_MEMORY_ERROR
DMLERR_NO_ERROR

Comments

Any locations in the global memory object that are not filled are undefined.

After a data handle has been used as a parameter in another **DDEML** function or has been returned by a **DDE** callback function, the handle may be used only for read access to the global memory object identified by the handle.

If the application will be adding data to the global memory object (using the **DdeAddData** function) so that the object exceeds 64K in length, then the application should specify a total length (*cbInitData* + *offSrcData*) that is equal to the anticipated maximum length of the object. This avoids unnecessary data copying and memory reallocation by the system.

Example

The following example processes the **XTYP_WILDCONNECT** transaction by returning a data handle to an array of **HSZPAIR** structures--one for each topic name supported:

```
#define CTOPICS 2

UINT type;
UINT fmt;
HSZPAIR ahp[(CTOPICS + 1)];
HSZ ahszTopicList[CTOPICS];
HSZ hszServ, hszTopic;
WORD i, j;

if (type == XTYP_WILDCONNECT) {

     /*
      * Scan the topic list, and create array of HSZPAIR
      * structures.
      */

    j = 0;
    for (i = 0; i < CTOPICS; i++) {
        if (hszTopic == (HSZ) NULL ||
                hszTopic == ahszTopicList[i]) {
            ahp[j].hszSvc = hszServ;
            ahp[j++].hszTopic = ahszTopicList[i];
        }
    }

    /*
     * End the list with an HSZPAIR structure that contains NULL
     * string handles as its members.
     */

    ahp[j].hszSvc = NULL;
    ahp[j++].hszTopic = NULL;

    /*
     * Return a handle to a global memory object containing the
     * HSZPAIR structures.
     */

    return DdeCreateDataHandle(
        idInst,          /* instance identifier     */
        &ahp,            /* points to HSZPAIR array */
        sizeof(HSZ) * j, /* length of the array     */
        0,               /* start at the beginning  */
        NULL,            /* no item-name string     */
```

```
        fmt,              /* return the same format  */
        0);               /* let the system own it   */
}
```

See Also

DdeAccessData, **DdeFreeDataHandle**, **DdeGetData**, **DdeInitialize**, **XTYP_EXECUTE**

DdeCreateStringHandle (3.1)

#include <ddeml.h>

HSZ DdeCreateStringHandle(*idInst, lpszString, codepage***)**

DWORD *idInst;* /* instance identifier */
LPCSTR *lpszString;* /* address of null-terminated string */
int *codepage;* /* code page */

The **DdeCreateStringHandle** function creates a handle that identifies the string pointed to by the *lpszString* parameter. A dynamic data exchange (**DDE**) client or server application can pass the string handle as a parameter to other DDE Management Library functions.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.
lpszString	Points to a buffer that contains the null-terminated string for which a handle is to be created. This string may be any length.
codepage	Specifies the code page used to render the string. This value should be either CP_WINANSI or the value returned by the **GetKBCodePage** function. A value of zero implies CP_WINANSI.

Returns

The return value is a string handle if the function is successful. Otherwise, it is NULL.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_INVALIDPARAMETER
DMLERR_NO_ERROR
DMLERR_SYS_ERROR

Comments

Two identical strings always correspond to the same string handle. String handles are unique across all tasks that use the DDEML. That is, when an application creates a handle for a string and another application creates a handle for an identical string, the string handles returned to both applications are identical--regardless of case.

The value of a string handle is not related to the case of the string it identifies.

When an application has either created a string handle or received one in the callback function and has used the **DdeKeepStringHandle** function to keep it, the application must free that string handle when it is no longer needed.

An instance-specific string handle is not mappable from string handle to string to string handle again. This is shown in the following example, in which the **DdeQueryString** function creates a string from a string handle and then **DdeCreateStringHandle** creates a string handle from that string, but the two handles are not the same:

```
DWORD idInst;
DWORD cb;
HSZ hszInst, hszNew;
PSZ pszInst;

DdeQueryString(idInst, hszInst, pszInst, cb, CP_WINANSI);
hszNew = DdeCreateStringHandle(idInst, pszInst, CP_WINANSI);
/* hszNew != hszInst ! */
```

Example

The following example creates a service-name string handle and a topic-name string handle and then attempts to establish a conversation with a server that supports the service name and topic name. If the attempt fails, the example obtains an error value identifying the reason for the failure.

```
DWORD idInst = 0L;
HSZ hszClock;
HSZ hszTime;
HCONV hconv;
UINT uError;

hszClock = DdeCreateStringHandle(idInst, "Clock", CP_WINANSI);
hszTime = DdeCreateStringHandle(idInst, "Time", CP_WINANSI);

if ((hconv = DdeConnect(
    idInst,                 /* instance identifier                */
    hszClock,               /* server's service name              */
    hszTime,                /* topic name                         */
    NULL)) == NULL) {       /* use default CONVCONTEXT            */

    uError = DdeGetLastError(idInst);
}
```

See Also

DdeAccessData, **DdeCmpStringHandles**, **DdeFreeStringHandle**, **DdeInitialize**, **DdeKeepStringHandle**, **DdeQueryString**

DdeDisconnect (3.1)

#include <ddeml.h>

BOOL DdeDisconnect(*hConv***)**

HCONV *hConv;* /* handle of conversation */

The **DdeDisconnect** function terminates a conversation started by either the **DdeConnect** or **DdeConnectList** function and invalidates the given conversation handle.

Parameter	Description
hConv	Identifies the active conversation to be terminated.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_NO_CONV_ESTABLISHED
DMLERR_NO_ERROR

Comments

Any incomplete transactions started before calling **DdeDisconnect** are immediately abandoned. The **XTYP_DISCONNECT** transaction type is sent to the dynamic data exchange (**DDE**) callback function of the partner in the conversation. Generally, only client applications need to terminate conversations.

See Also

DdeConnect, **DdeConnectList**, **DdeDisconnectList**, **XTYP_DISCONNECT**

DdeDisconnectList (3.1)

#include <ddeml.h>

BOOL DdeDisconnectList(*hConvList***)**

HCONVLIST *hConvList;* /* handle of conversation list */

The **DdeDisconnectList** function destroys the given conversation list and terminates all conversations associated with the list.

Parameter	Description
hConvList	Identifies the conversation list. This handle must have been created by a previous call to the **DdeConnectList** function.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_INVALIDPARAMETER
DMLERR_NO_ERROR

Comments

An application can use the **DdeDisconnect** function to terminate individual conversations in the list.

See Also

DdeConnect, **DdeConnectList**, **DdeDisconnect**, **XTYP_DISCONNECT**

DdeEnableCallback (3.1)

#include <ddeml.h>

BOOL DdeEnableCallback(*idInst, hConv, uCmd***)**

DWORD *idInst;* /* instance identifier */
HCONV *hConv;* /* handle of conversation */
UINT *uCmd;* /* the enable/disable function code */

The **DdeEnableCallback** function enables or disables transactions for a specific conversation or for all conversations that the calling application currently has established.

After disabling transactions for a conversation, the system places the transactions for that conversation in a transaction queue associated with the application. The application should reenable the conversation as soon as possible to avoid losing queued transactions.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.
hConv	Identifies the conversation to enable or disable. If this parameter is NULL, the function affects all conversations.
uCmd	Specifies the function code. This parameter can be one of the following values:

Value	Meaning
EC_ENABLEALL	Enables all transactions for the specified conversation.
EC_ENABLEONE	Enables one transaction for the specified conversation.
EC_DISABLE	Disables all blockable transactions for the specified conversation. A server application can disable the following transactions: **XTYP_ADVSTART** **XTYP_ADVSTOP** **XTYP_EXECUTE** **XTYP_POKE** **XTYP_REQUEST** A client application can disable the following transactions: **XTYP_ADVDATA** **XTYP_XACT_COMPLETE**

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_NO_ERROR
DMLERR_INVALIDPARAMETER

Comments

An application can disable transactions for a specific conversation by returning CBR_BLOCK from its dynamic data exchange (**DDE**) callback function. When the conversation is reenabled by using the **DdeEnableCallback** function, the system generates the same transaction as was in process when the conversation was disabled.

See Also

DdeConnect, **DdeConnectList**, **DdeDisconnect**, **DdeInitialize**

DdeFreeDataHandle (3.1)

#include <ddeml.h>

BOOL DdeFreeDataHandle(*hData***)**

HDDEDATA *hData;* /* handle of global memory object */

The **DdeFreeDataHandle** function frees a global memory object and deletes the data handle associated with the object.

Parameter	Description
hData	Identifies the global memory object to be freed. This handle must have been created by a previous call to the **DdeCreateDataHandle** function or returned by the **DdeClientTransaction** function.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_INVALIDPARAMETER
DMLERR_NO_ERROR

Comments

An application must call **DdeFreeDataHandle** under the following circumstances:

- To free a global memory object that the application allocated by calling the **DdeCreateDataHandle** function if the object's data handle was never passed by the application to another Dynamic Data Exchange Management Library (**DDEML**) function
- To free a global memory object that the application allocated by specifying the HDATA_APPOWNED flag in a call to the **DdeCreateDataHandle** function
- To free a global memory object whose handle the application received from the **DdeClientTransaction** function

The system automatically frees an unowned object when its handle is returned by a dynamic data exchange (**DDE**) callback function or used as a parameter in a **DDEML** function.

Example

The following example creates a global memory object containing help information, then frees the object after passing the object's handle to the client application:

```
DWORD idInst;
HSZ hszItem;
HDDEDATA hDataHelp;

char szDdeHelp[] = "DDEML test server help:\r\n"\
    "\tThe 'Server' (service) and 'Test' (topic) names may change.\r\n"\
    "Items supported under the 'Test' topic are:\r\n"\
    "\tCount:\tThis value increments on each data change.\r\n"\
    "\tRand:\tThis value is changed after each data change. \r\n"\
    "\t\tIn Runaway mode, the above items change after a request.\r\n"\
    "\tHuge:\tThis is randomly generated text data >64k that the\r\n"\
    "\t\ttest client can verify. It is recalculated on each\r\n"\
    "\t\trequest. This also verifies huge data poked or executed\r\n"\
    "\t\tfrom the test client.\r\n"\
    "\tHelp:\tThis help information.  This data is APPOWNED.\r\n";

    /* Create global memory object containing help information. */
```

```
if (!hDataHelp) {
    hDataHelp = DdeCreateDataHandle(idInst, szDdeHelp,
        strlen(szDdeHelp) + 1, 0, hszItem, CF_TEXT, HDATA_APPOWNED);
}

.
. /* Pass help information to client application. */
.

/* Free the global memory object. */

if (hDataHelp)
    DdeFreeDataHandle(hDataHelp);
```

See Also

DdeAccessData, **DdeCreateDataHandle**

DdeFreeStringHandle (3.1)

#include <ddeml.h>

BOOL DdeFreeStringHandle(*idInst, hsz***)**

DWORD *idInst;* /* instance identifier */
HSZ *hsz;* /* handle of string */

The **DdeFreeStringHandle** function frees a string handle in the calling application.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.
hsz	Identifies the string handle to be freed. This handle must have been created by a previous call to the **DdeCreateStringHandle** function.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

An application can free string handles that it creates with the **DdeCreateStringHandle** function but should not free those that the system passed to the application's dynamic data exchange (**DDE**) callback function or those returned in the **CONVINFO** structure by the **DdeQueryConvInfo** function.

Example

The following example frees string handles during the **XTYP_DISCONNECT** transaction:

```
DWORD idInst = 0L;
HSZ hszClock;
HSZ hszTime;
HSZ hszNow;
UINT type;

if (type == XTYP_DISCONNECT) {

    DdeFreeStringHandle(idInst, hszClock);
    DdeFreeStringHandle(idInst, hszTime);
    DdeFreeStringHandle(idInst, hszNow);

    return (HDDEDATA) NULL;
}
```

See Also

DdeCmpStringHandles, **DdeCreateStringHandle**, **DdeInitialize**, **DdeKeepStringHandle**, **DdeQueryString**

DdeGetData (3.1)

#include <ddeml.h>

DWORD DdeGetData(*hData, pDest, cbMax, offSrc***)**

HDDEDATA *hData;*	/* handle of global memory object */
void FAR* *pDest;*	/* address of destination buffer */
DWORD *cbMax;*	/* amount of data to copy */
DWORD *offSrc;*	/* offset to beginning of data */

The **DdeGetData** function copies data from the given global memory object to the specified local buffer.

Parameter	Description
hData	Identifies the global memory object that contains the data to copy.
pDest	Points to the buffer that receives the data. If this parameter is NULL, the **DdeGetData** function returns the amount, in bytes, of data that would be copied to the buffer.
cbMax	Specifies the maximum amount, in bytes, of data to copy to the buffer pointed to by the *pDest* parameter. Typically, this parameter specifies the length of the buffer pointed to by *pDest.*
offSrc	Specifies an offset within the global memory object. Data is copied from the object beginning at this offset.

Returns

If the *pDest* parameter points to a buffer, the return value is the size, in bytes, of the memory object associated with the data handle or the size specified in the *cbMax* parameter, whichever is lower.

If the *pDest* parameter is NULL, the return value is the size, in bytes, of the memory object associated with the data handle.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_INVALID_HDDEDATA
DMLERR_INVALIDPARAMETER
DMLERR_NO_ERROR

Example

The following example copies data from a global memory object to a local buffer and then fills the **TIME** structure with data from the buffer:

```
HDDEDATA hData;
char szBuf[32];

typedef struct {
    int hour;
    int minute;
    int second;
} TIME;

DdeGetData(hData, (LPBYTE) szBuf, 32L, 0L);
sscanf(szBuf, "%d:%d:%d", &nTime.hour, &nTime.minute,
    &nTime.second);
```

See Also

DdeAccessData, **DdeCreateDataHandle**, **DdeFreeDataHandle**

DdeGetLastError (3.1)

#include <ddeml.h>

UINT DdeGetLastError(*idInst***)**

DWORD *idInst;* /* instance identifier */

The **DdeGetLastError** function returns the most recent error value set by the failure of a Dynamic Data Exchange Management Library (**DDEML**) function and resets the error value to DMLERR_NO_ERROR.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.

Returns

The return value is the last error value. Following are the possible **DDEML** error values:

Value	Meaning
DMLERR_ADVACKTIMEOUT	A request for a synchronous advise transaction has timed out.
DMLERR_BUSY	The response to the transaction caused the DDE_FBUSY bit to be set.
DMLERR_DATAACKTIMEOUT	A request for a synchronous data transaction has timed out.
DMLERR_DLL_NOT_INITIALIZED	A **DDEML** function was called without first calling the **DdeInitialize** function, or an invalid instance identifier was passed to a DDEML function.
DMLERR_DLL_USAGE	An application initialized as APPCLASS_MONITOR has attempted to perform a **DDE** transaction, or an application initialized as APPCMD_CLIENTONLY has attempted to perform server transactions.
DMLERR_EXECACKTIMEOUT	A request for a synchronous execute transaction has timed out.
DMLERR_INVALIDPARAMETER	A parameter failed to be validated by the DDEML. Some of the possible causes are as follows: The application used a data handle initialized with a different item-name handle than that required by the transaction. The application used a data handle that was initialized with a different clipboard data format than that required by the transaction. The application used a client-side conversation handle with a server-side function or vise versa. The application used a freed data handle or string handle. More than one instance of the application used the same object.
DMLERR_LOW_MEMORY	A **DDEML** application has created a prolonged race condition (where the server application outruns the client), causing large amounts of memory to be consumed.
DMLERR_MEMORY_ERROR	A memory allocation failed.
DMLERR_NO_CONV_ESTABLISHED	A client's attempt to establish a conversation has failed.
DMLERR_NOTPROCESSED	A transaction failed.

DMLERR_POKEACKTIMEOUT	A request for a synchronous poke transaction has timed out.
DMLERR_POSTMSG_FAILED	An internal call to the **PostMessage** function has failed.
DMLERR_REENTRANCY	An application instance with a synchronous transaction already in progress attempted to initiate another synchronous transaction, or the **DdeEnableCallback** function was called from within a **DDEML** callback function.
DMLERR_SERVER_DIED	A server-side transaction was attempted on a conversation that was terminated by the client, or the server terminated before completing a transaction.
DMLERR_SYS_ERROR	An internal error has occurred in the DDEML.
DMLERR_UNADVACKTIMEOUT	A request to end an advise transaction has timed out.
DMLERR_UNFOUND_QUEUE_ID	An invalid transaction identifier was passed to a **DDEML** function. Once the application has returned from an **XTYP_XACT_COMPLETE** callback, the transaction identifier for that callback is no longer valid.

Example

The following example calls the **DdeGetLastError** function if the **DdeCreateDataHandle** function fails:

```
DWORD idInst;
HDDEDATA hddeMyData;
HSZPAIR ahszp[2];
HSZ hszClock, hszTime;

/* Create string handles. */

hszClock = DdeCreateStringHandle(idInst, (LPSTR) "Clock",
    CP_WINANSI);
hszTime = DdeCreateStringHandle(idInst, (LPSTR) "Time",
    CP_WINANSI);

/* Copy handles to an HSZPAIR structure. */

ahszp[0].hszSvc   = hszClock;
ahszp[0].hszTopic = hszTime;
ahszp[1].hszSvc   = (HSZ) NULL;
ahszp[1].hszTopic = (HSZ) NULL;

/* Create a global memory object. */

hddeMyData = DdeCreateDataHandle(idInst, ahszp,
        sizeof(ahszp), 0, NULL, CF_TEXT, 0);
    if (hddeMyData == NULL)

        /*
         * Pass error value to application-defined error handling
         * function.
         */

        HandleError(DdeGetLastError(idInst));
```

See Also

DdeInitialize

DdeInitialize (3.1)

#include <ddeml.h>

UINT DdeInitialize(*lpidInst, pfnCallback, afCmd, uRes***)**

```
DWORD FAR* lpidInst;        /* address of instance identifier      */
PFNCALLBACK pfnCallback;    /* address of callback function        */
DWORD afCmd;                /* array of command and filter flags */
DWORD uRes;                 /* reserved                            */
```

The **DdeInitialize** function registers an application with the Dynamic Data Exchange Management Library (**DDEML**). An application must call this function before calling any other DDEML function.

Parameter	Description
lpidInst	Points to the application-instance identifier. At initialization, this parameter should point to 0L. If the function is successful, this parameter points to the instance identifier for the application. This value should be passed as the *idInst* parameter in all other **DDEML** functions that require it. If an application uses multiple instances of the DDEML dynamic link library, the application should provide a different callback function for each instance. If *lpidInst* points to a nonzero value, this implies a reinitialization of the DDEML. In this case, *lpidInst* must point to a valid application-instance identifier.
pfnCallback	Points to the application-defined **DDE** callback function. This function processes DDE transactions sent by the system. For more information, see the description of the **DdeCallback** callback function.
afCmd	Specifies an array of APPCMD_ and CBF_ flags. The APPCMD_ flags provide special instructions to the **DdeInitialize** function. The CBF_ flags set filters that prevent specific types of transactions from reaching the callback function. Using these flags enhances the performance of a **DDE** application by eliminating unnecessary calls to the callback function. This parameter can be a combination of the following flags:

Flag	Meaning
APPCLASS_MONITOR	Makes it possible for the application to monitor **DDE** activity in the system. This flag is for use by DDE monitoring applications. The application specifies the types of DDE activity to monitor by combining one or more monitor flags with the APPCLASS_MONITOR flag. For details, see the following Comments section.
APPCLASS_STANDARD	Registers the application as a standard (nonmonitoring) **DDEML** application.
APPCMD_CLIENTONLY	Prevents the application from becoming a server in a **DDE** conversation. The application can be only a client. This flag reduces resource consumption by the DDEML. It includes the functionality of the CBF_FAIL_ALLSVRXACTIONS flag.
APPCMD_FILTERINITS	Prevents the **DDEML** from sending **XTYP_CONNECT** and **XTYP_WILDCONNECT** transactions to the application until the application has created its string handles and registered its service names or has turned off filtering by

	a subsequent call to the **DdeNameService** or **DdeInitialize** function. This flag is always in effect when an application calls **DdeInitialize** for the first time, regardless of whether the application specifies this flag. On subsequent calls to **DdeInitialize**, not specifying this flag turns off the application's service-name filters; specifying this flag turns on the application's service-name filters.
CBF_FAIL_ALLSVRXACTIONS	Prevents the callback function from receiving server transactions. The system will return DDE_FNOTPROCESSED to each client that sends a transaction to this application. This flag is equivalent to combining all CBF_FAIL_ flags.
CBF_FAIL_ADVISES	Prevents the callback function from receiving **XTYP_ADVSTART** and **XTYP_ADVSTOP** transactions. The system will return DDE_FNOTPROCESSED to each client that sends an XTYP_ADVSTART or XTYP_ADVSTOP transaction to the server.
CBF_FAIL_CONNECTIONS	Prevents the callback function from receiving **XTYP_CONNECT** and **XTYP_WILDCONNECT** transactions.
CBF_FAIL_EXECUTES	Prevents the callback function from receiving **XTYP_EXECUTE** transactions. The system will return DDE_FNOTPROCESSED to a client that sends an XTYP_EXECUTE transaction to the server.
CBF_FAIL_POKES	Prevents the callback function from receiving **XTYP_POKE** transactions. The system will return DDE_FNOTPROCESSED to a client that sends an XTYP_POKE transaction to the server.
CBF_FAIL_REQUESTS	Prevents the callback function from receiving **XTYP_REQUEST** transactions. The system will return DDE_FNOTPROCESSED to a client that sends an XTYP_REQUEST transaction to the server.
CBF_FAIL_SELFCONNECTIONS	Prevents the callback function from receiving **XTYP_CONNECT** transactions from the application's own instance. This prevents an application from establishing a **DDE** conversation with its own instance. An application should use this flag if it needs to communicate with other instances of itself but not with itself.
CBF_SKIP_ALLNOTIFICATIONS	Prevents the callback function from

		receiving any notifications. This flag is equivalent combining all CBF_SKIP_ flags.
	CBF_SKIP_CONNECT_CONFIRMS	Prevents the callback function from receiving **XTYP_CONNECT_CONFIRM** notifications.
	CBF_SKIP_DISCONNECTS	Prevents the callback function from receiving **XTYP_DISCONNECT** notifications.
	CBF_SKIP_REGISTRATIONS	Prevents the callback function from receiving **XTYP_REGISTER** notifications.
	CBF_SKIP_UNREGISTRATIONS	Prevents the callback function from receiving **XTYP_UNREGISTER** notifications.
uRes	Reserved; must be set to 0L.	

Returns

The return value is one of the following:

DMLERR_DLL_USAGE
DMLERR_INVALIDPARAMETER
DMLERR_NO_ERROR
DMLERR_SYS_ERROR

Comments

An application that uses multiple instances of the **DDEML** must not pass DDEML objects between instances.

A **DDE** monitoring application should not attempt to perform DDE (establish conversations, issue transactions, and so on) within the context of the same application instance.

A synchronous transaction will fail with a DMLERR_REENTRANCY error if any instance of the same task has a synchronous transaction already in progress.

A **DDE** monitoring application can combine one or more of the following monitor flags with the APPCLASS_MONITOR flag to specify the types of DDE activity to monitor:

Flag	Meaning
MF_CALLBACKS	Notifies the callback function whenever a transaction is sent to any **DDE** callback function in the system.
MF_CONV	Notifies the callback function whenever a conversation is established or terminated.
MF_ERRORS	Notifies the callback function whenever a **DDE** error occurs.
MF_HSZ_INFO	Notifies the callback function whenever a **DDE** application creates, frees, or increments the use count of a string handle or whenever a string handle is freed as a result of a call to the **DdeUninitialize** function.
MF_LINKS	Notifies the callback function whenever an advise loop is started or ended.
MF_POSTMSGS	Notifies the callback function whenever the system or an application posts a **DDE** message.
MF_SENDMSGS	Notifies the callback function whenever the system or an application sends a **DDE** message.

Example

The following example obtains a procedure-instance address for a **DDE** callback function, then initializes the application with the DDEML.

```
DWORD idInst = 0L;
```

```
FARPROC lpDdeProc;

lpDdeProc = MakeProcInstance((FARPROC) DDECallback, hInst);
if (DdeInitialize((LPDWORD) &idInst, (PFNCALLBACK) lpDdeProc,
        APPCMD_CLIENTONLY, 0L))
    return FALSE;
```

See Also

DdeClientTransaction, **DdeConnect**, **DdeCreateDataHandle**, **DdeEnableCallback**, **DdeNameService**, **DdePostAdvise**, **DdeUninitialize**

DdeKeepStringHandle (3.1)

#include <ddeml.h>

BOOL DdeKeepStringHandle(*idInst, hsz***)**

DWORD *idInst;* /* instance identifier */
HSZ *hsz;* /* handle of string */

The **DdeKeepStringHandle** function increments the usage count (increases it by one) associated with the given handle. This function makes it possible for an application to save a string handle that was passed to the application's dynamic data exchange (**DDE**) callback function. Otherwise, a string handle passed to the callback function is deleted when the callback function returns.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.
hsz	Identifies the string handle to be saved.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Example
The following example is a portion of a **DDE** callback function that increases the usage count and saves a local copy of two string handles:

```
HSZ hsz1;
HSZ hsz2;
static HSZ hszServerBase;
static HSZ hszServerInst;
DWORD idInst;

case XTYP_REGISTER:

    /* Keep the handles for later use. */

    DdeKeepStringHandle(idInst, hsz1);
    DdeKeepStringHandle(idInst, hsz2);
    hszServerBase = hsz1;
    hszServerInst = hsz2;
    .
    . /* Finish processing the transaction. */
    .
```

See Also
DdeCreateStringHandle, **DdeFreeStringHandle**, **DdeInitialize**, **DdeQueryString**

DdeNameService (3.1)

#include <ddeml.h>

HDDEDATA DdeNameService(*idInst, hsz1, hszRes, afCmd***)**

```
DWORD idInst;     /* instance identifier              */
HSZ hsz1;         /* handle of service-name string */
HSZ hszRes;       /* reserved                         */
UINT afCmd;       /* service-name flags               */
```

The **DdeNameService** function registers or unregisters the service names that a dynamic data exchange (**DDE**) server supports. This function causes the system to send **XTYP_REGISTER** or **XTYP_UNREGISTER** transactions to other running DDE Management Library (**DDEML**) client applications.

A server application should call this function to register each service name that it supports and to unregister names that it previously registered but no longer supports. A server should also call this function to unregister its service names just before terminating.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.
hsz1	Identifies the string that specifies the service name that the server is registering or unregistering. An application that is unregistering all of its service names should set this parameter to NULL.
hszRes	Reserved; should be set to NULL.
afCmd	Specifies the service-name flags. This parameter can be one of the following values:

Value	Meaning
DNS_REGISTER	Registers the given service name.
DNS_UNREGISTER	Unregisters the given service name. If the *hsz1* parameter is NULL, all service names registered by the server will be unregistered.
DNS_FILTERON	Turns on service-name initiation filtering. This filter prevents a server from receiving **XTYP_CONNECT** transactions for service names that it has not registered. This is the default setting for this filter. If a server application does not register any service names, the application cannot receive **XTYP_WILDCONNECT** transactions.
DNS_FILTEROFF	Turns off service-name initiation filtering. If this flag is set, the server will receive an **XTYP_CONNECT** transaction whenever another **DDE** application calls the **DdeConnect** function, regardless of the service name.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_DLL_USAGE
DMLERR_INVALIDPARAMETER
DMLERR_NO_ERROR

Comments

The service name identified by the *hsz1* parameter should be a base name (that is, the name should contain no instance-specific information). The system generates an instance-specific name and sends it along with the base name during the **XTYP_REGISTER** and **XTYP_UNREGISTER** transactions. The receiving applications can then connect to the specific application instance.

Example

The following example initializes an application with the **DDEML**, creates frequently used string handles, and registers the application's service name:

```
HSZ hszClock;
HSZ hszTime;
HSZ hszNow;
HINSTANCE hinst;
DWORD idInst = 0L;
FARPROC lpDdeProc;

/* Initialize the application for the DDEML. */

lpDdeProc = MakeProcInstance((FARPROC) DdeCallback, hinst);
if (!DdeInitialize((LPDWORD) &idInst, (PFNCALLBACK) lpDdeProc,
        APPCMD_FILTERINITS | CBF_FAIL_EXECUTES, 0L)) {

    /* Create frequently used string handles. */

    hszTime = DdeCreateStringHandle(idInst, "Time", CP_WINANSI);
    hszNow = DdeCreateStringHandle(idInst, "Now", CP_WINANSI);
    hszClock = DdeCreateStringHandle(idInst, "Clock", CP_WINANSI);

    /* Register the service name. */

    DdeNameService(idInst, hszClock, (HSZ) NULL, DNS_REGISTER);

}
```

See Also

DdeConnect, **DdeConnectList**, **DdeInitialize**, **XTYP_REGISTER**, **XTYP_UNREGISTER**

DdePostAdvise (3.1)

#include <ddeml.h>

BOOL DdePostAdvise(*idInst, hszTopic, hszItem***)**

DWORD *idInst;* /* instance identifier */
HSZ *hszTopic;* /* handle of topic-name string */
HSZ *hszItem;* /* handle of item-name string */

The **DdePostAdvise** function causes the system to send an **XTYP_ADVREQ** transaction to the calling (server) application's dynamic data exchange (**DDE**) callback function for each client that has an advise loop active on the specified topic or item name pair. A server application should call this function whenever the data associated with the topic or item name pair changes.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.
hszTopic	Identifies a string that specifies the topic name. To send notifications for all topics with active advise loops, an application can set this parameter to NULL.
hszItem	Identifies a string that specifies the item name. To send notifications for all items with active advise loops, an application can set this parameter to NULL.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Errors
Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_DLL_USAGE
DMLERR_NO_ERROR

Comments
A server that has nonenumerable topics or items should set the *hszTopic* and *hszItem* parameters to NULL so that the system will generate transactions for all active advise loops. The server's **DDE** callback function returns NULL for any advise loops that do not need to be updated.

If a server calls **DdePostAdvise** with a topic/item/format name set that includes the set currently being handled in a **XTYP_ADVREQ** callback, a stack overflow may result.

Example
The following example calls the **DdePostAdvise** function whenever the time changes:

```
typedef struct { /* tm */
    int hour;
    int minute;
    int second;
} TIME;

TIME tmTime;
DWORD idInst;
HSZ hszTime;
HSZ hszNow;
TIME tmCurTime;

    .
    . /* Fill tmCurTime with the current time. */
```

```
    .

/* Check for any change in second, minute, or hour. */

if ((tmCurTime.second != tmTime.second) ||
        (tmCurTime.minute != tmTime.minute) ||
        (tmCurTime.hour   != tmTime.hour)) {

    /* Send the current time to the clients. */

    DdePostAdvise(idInst, hszTime, hszNow);
```

See Also

DdeInitialize, **XTYP_ADVREQ**

DdeQueryConvInfo (3.1)

#include <ddeml.h>

UINT DdeQueryConvInfo(*hConv, idTransaction, lpConvInfo***)**

HCONV *hConv;*	/* handle of conversation	*/
DWORD *idTransaction;*	/* transaction identifier	*/
CONVINFO FAR* *lpConvInfo;*	/* address of structure with conversation data	*/

The **DdeQueryConvInfo** function retrieves information about a dynamic data exchange (**DDE**) transaction and about the conversation in which the transaction takes place.

Parameter	Description
hConv	Identifies the conversation.
idTransaction	Specifies the transaction. For asynchronous transactions, this parameter should be a transaction identifier returned by the **DdeClientTransaction** function. For synchronous transactions, this parameter should be QID_SYNC.
lpConvInfo	Points to the **CONVINFO** structure that will receive information about the transaction and conversation. The **cb** member of the **CONVINFO** structure must specify the length of the buffer allocated for the structure.

Returns

The return value is the number of bytes copied into the **CONVINFO** structure, if the function is successful. Otherwise, it is zero.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_NO_CONV_ESTABLISHED
DMLERR_NO_ERROR
DMLERR_UNFOUND_QUEUE_ID

Example

The following example fills a **CONVINFO** structure with information about a synchronous conversation and then obtains the names of the partner application and topic:

```
DWORD idInst;
HCONV hConv;
CONVINFO ci;
WORD wError;
char szSvcPartner[32];
char szTopic[32];
DWORD cchServ, cchTopic;

if (!DdeQueryConvInfo(hConv, QID_SYNC, &ci))
    wError = DdeGetLastError(idInst);

else {
    cchServ = DdeQueryString(idInst, ci.hszSvcPartner,
        (LPSTR) &szSvcPartner, sizeof(szSvcPartner),
        CP_WINANSI);
    cchTopic =DdeQueryString(idInst, ci.hszTopic,
        (LPSTR) &szTopic, sizeof(szTopic),
        CP_WINANSI);
}
```

See Also
DdeConnect, **DdeConnectList**, **DdeQueryNextServer**, **CONVINFO**

DdeQueryNextServer (3.1)

#include <ddeml.h>

HCONV DdeQueryNextServer(*hConvList, hConvPrev***)**

HCONVLIST *hConvList;* /* handle of conversation list */
HCONV *hConvPrev;* /* previous conversation handle */

The **DdeQueryNextServer** function obtains the next conversation handle in the given conversation list.

Parameter	Description
hConvList	Identifies the conversation list. This handle must have been created by a previous call to the **DdeConnectList** function.
hConvPrev	Identifies the conversation handle previously returned by this function. If this parameter is NULL, this function returns the first conversation handle in the list.

Returns

The return value is the next conversation handle in the list if the list contains any more conversation handles. Otherwise, it is NULL.

Example

The following example uses the **DdeQueryNextServer** function to count the number of conversation handles in a conversation list and to copy the service-name string handles of the servers to a local buffer:

```
HCONVLIST hconvList; /* conversation list       */
DWORD idInst;        /* instance identifier     */
HSZ hszSystem;       /* System topic            */
HCONV hconv = NULL;  /* conversation handle     */
CONVINFO ci;         /* holds conversation data */
UINT cConv = 0;      /* count of conv. handles  */
HSZ *pHsz, *aHsz;    /* point to string handles */

/* Connect to all servers that support the System topic. */

hconvList = DdeConnectList(idInst, NULL, hszSystem, NULL, NULL);

/* Count the number of handles in the conversation list. */

while ((hconv = DdeQueryNextServer(hconvList, hconv)) != NULL) cConv++;

/* Allocate a buffer for the string handles. */

hconv = NULL;
aHsz = (HSZ *) LocalAlloc(LMEM_FIXED, cConv * sizeof(HSZ));

/* Copy the string handles to the buffer. */

pHsz = aHsz;
while ((hconv = DdeQueryNextServer(hconvList, hconv)) != NULL) {
    DdeQueryConvInfo(hconv, QID_SYNC, (PCONVINFO) &ci);
    DdeKeepStringHandle(idInst, ci.hszSvcPartner);
    *pHsz++ = ci.hszSvcPartner;
}

.
. /* Use the handles; converse with servers. */
```

.

```
/* Free the memory, and terminate conversations. */

LocalFree((HANDLE) aHsz);
DdeDisconnectList(hconvList);
```

See Also
DdeConnectList, **DdeDisconnectList**

DdeQueryString (3.1)

#include <ddeml.h>

DWORD DdeQueryString(*idInst, hsz, lpsz, cchMax, codepage***)**

DWORD *idInst;* /* instance identifier */
HSZ *hsz;* /* handle of string */
LPSTR *lpsz;* /* address of destination buffer */
DWORD *cchMax;* /* length of buffer */
int *codepage;* /* code page */

The **DdeQueryString** function copies text associated with a string handle into a buffer.

The string returned in the buffer is always null-terminated. If the string is longer than (*cchMax* - 1), only the first (*cchMax* - 1) characters of the string are copied.

If the *lpsz* parameter is NULL, this function obtains the length, in bytes, of the string associated with the string handle. The length does not include the terminating null character.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.
hsz	Identifies the string to copy. This handle must have been created by a previous call to the **DdeCreateStringHandle** function.
lpsz	Points to a buffer that receives the string. To obtain the length of the string, this parameter should be set to NULL.
cchMax	Specifies the length, in bytes, of the buffer pointed to by the *lpsz* parameter. If the string is longer than (*cchMax* - 1), it will be truncated. If the *lpsz* parameter is set to NULL, this parameter is ignored.
codepage	Specifies the code page used to render the string. This value should be either CP_WINANSI or the value returned by the **GetKBCodePage** function.

Returns

The return value is the length, in bytes, of the returned text (not including the terminating null character) if the *lpsz* parameter specified a valid pointer. The return value is the length of the text associated with the *hsz* parameter (not including the terminating null character) if the *lpsz* parameter specified a NULL pointer. The return value is NULL if an error occurs.

Example

The following example uses the **DdeQueryString** function to obtain a service name and topic name that a server has registered:

```
UINT type;

HSZ hsz1;
HSZ hsz2;
char szBaseName[16];
char szInstName[16];

if (type == XTYP_REGISTER) {

    /* Copy the base service name to a buffer. */

    DdeQueryString(idInst, hsz1, (LPSTR) &szBaseName,
        sizeof(szBaseName), CP_WINANSI);

    /* Copy the instance-specific service name to a buffer. */
```

```
    DdeQueryString(idInst, hsz2, (LPSTR) &szInstName,
        sizeof(szInstName), CP_WINANSI);
    return (HDDEDATA) TRUE;
}
```

See Also

DdeCmpStringHandles, **DdeCreateStringHandle**, **DdeFreeStringHandle**, **DdeInitialize**

DdeReconnect (3.1)

#include <ddeml.h>

HCONV DdeReconnect(*hConv***)**

HCONV *hConv;* /* handle of conversation to reestablish */

The **DdeReconnect** function allows a client Dynamic Data Exchange Management Library (**DDEML**) application to attempt to reestablish a conversation with a service that has terminated a conversation with the client. When the conversation is reestablished, the DDEML attempts to reestablish any preexisting advise loops.

Parameter	Description
hConv	Identifies the conversation to be reestablished. A client must have obtained the conversation handle by a previous call to the **DdeConnect** function.

Returns

The return value is the handle of the reestablished conversation if the function is successful. The return value is NULL if the function fails.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_INVALIDPARAMETER
DMLERR_NO_CONV_ESTABLISHED
DMLERR_NO_ERROR

Example

The following example shows the context within which an application should call the **DdeReconnect** function:

```
HDDEDATA EXPENTRY DdeCallback(wType, wFmt, hConv, hsz1,
    hsz2, hData, dwData1, dwData2)
WORD wType;       /* transaction type                */
WORD wFmt;        /* clipboard format                */
HCONV hConv;      /* handle of the conversation      */
HSZ hsz1;         /* handle of a string              */
HSZ hsz2;         /* handle of a string              */
HDDEDATA hData;   /* handle of a global memory object */
DWORD dwData1;    /* transaction-specific data       */
DWORD dwData2;    /* transaction-specific data       */
{
    BOOL fAutoReconnect;

    switch (wType) {
        case XTYP_DISCONNECT:
            if (fAutoReconnect) {
                DdeReconnect(hConv); /* attempt to reconnect */
            }
            return 0;

        .
        . /* Process other transactions. */
        .
    }
}
```

See Also
DdeConnect, **DdeDisconnect**

DdeSetUserHandle (3.1)

#include <ddeml.h>

BOOL DdeSetUserHandle(*hConv,id, hUser***)**

```
HCONV hConv;      /* handle of conversation     */
DWORD id;         /* transaction identifier     */
DWORD hUser;      /* application-defined value  */
```

The **DdeSetUserHandle** function associates an application-defined 32-bit value with a conversation handle and transaction identifier. This is useful for simplifying the processing of asynchronous transactions. An application can use the **DdeQueryConvInfo** function to retrieve this value.

Parameter	Description
hConv	Identifies the conversation.
id	Specifies the transaction identifier of an asynchronous transaction. An application should set this parameter to QID_SYNC if no asynchronous transaction is to be associated with the *hUser* parameter.
hUser	Identifies the value to associate with the conversation handle.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_INVALIDPARAMETER
DMLERR_NO_ERROR
DMLERR_UNFOUND_QUEUE_ID

See Also

DdeQueryConvInfo

DdeUnaccessData (3.1)

#include <ddeml.h>

BOOL DdeUnaccessData(*hData***)**

HDDEDATA *hData;* /* handle of global memory object */

The **DdeUnaccessData** function frees a global memory object. An application must call this function when it is finished accessing the object.

Parameter	Description
hData	Identifies the global memory object.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Errors

Use the **DdeGetLastError** function to retrieve the error value, which may be one of the following:

DMLERR_DLL_NOT_INITIALIZED
DMLERR_INVALIDPARAMETER
DMLERR_NO_ERROR

Example

The following example obtains a pointer to a global memory object, uses the pointer to copy data from the object to a local buffer, and then uses the **DdeUnaccessData** function to free the object:

```
HDDEDATA hData;
LPBYTE lpszAdviseData;
DWORD cbDataLen;
DWORD i;
char szData[128];

lpszAdviseData = DdeAccessData(hData, &cbDataLen);
for (i = 0; i < cbDataLen; i++)
    szData[i] = *lpszAdviseData++;
DdeUnaccessData(hData);
```

See Also

DdeAccessData, **DdeAddData**, **DdeCreateDataHandle**, **DdeFreeDataHandle**

DdeUninitialize (3.1)

#include <ddeml.h>

BOOL DdeUninitialize(*idInst***)**

DWORD *idInst;* /* instance identifier */

The **DdeUninitialize** function frees all Dynamic Data Exchange Management Library (**DDEML**) resources associated with the calling application.

Parameter	Description
idInst	Specifies the application-instance identifier obtained by a previous call to the **DdeInitialize** function.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **DdeUninitialize** function terminates any conversations currently open for the application. If the partner in a conversation fails to terminate its end of the conversation, the system may enter a modal loop while it waits for the conversation to terminate. A timeout period is associated with this loop. If the timeout period expires before the conversation has terminated, a message box appears that gives the user the choice of waiting for another timeout period (Retry), waiting indefinitely (Ignore), or exiting the modal loop (Abort).

An application should wait until its windows are no longer visible and its message loop has terminated before calling this function.

See Also

DdeDisconnect, **DdeDisconnectList**, **DdeInitialize**

DDE functions (3.1)

DdeAbandonTransaction	Abandons an asynchronous transaction
DdeAccessData	Accesses a **DDE** global memory object
DdeAddData	Adds data to a **DDE** global memory object
DdeClientTransaction	Begins a **DDE** data transaction
DdeCmpStringHandles	Compares two **DDE** string handles
DdeConnect	Establishes a conversation with a server application
DdeConnectList	Establishes multiple **DDE** conversations
DdeCreateDataHandle	Creates a **DDE** data handle
DdeCreateStringHandle	Creates a **DDE** string handle
DdeDisconnect	Terminates a **DDE** conversation
DdeDisconnectList	Destroys a **DDE** conversation list
DdeEnableCallback	Enables or disables one or more **DDE** conversations
DdeFreeDataHandle	Frees a global memory object
DdeFreeStringHandle	Frees a **DDE** string handle
DdeGetData	Copies data from a global memory object to a buffer
DdeGetLastError	Returns an error value set by a **DDEML** function
DdeInitialize	Registers an application with the **DDEML**
DdeKeepStringHandle	Increments the usage count for a string handle
DdeNameService	Registers or unregisters a service name
DdePostAdvise	Prompts a server to send advise data to a client
DdeQueryConvInfo	Retrieves information about a **DDE** conversation
DdeQueryNextServer	Obtains the next handle in a **DDE** conversation list
DdeQueryString	Copies string-handle text into a buffer
DdeReconnect	Reestablishes a **DDE** conversation
DdeSetUserHandle	Associates a user-defined handle with a transaction
DdeUnaccessData	Frees a **DDE** global memory object
DdeUninitialize	Frees **DDEML** resources associated with an application

XTYP_ADVDATA (3.1)

```
#include <ddeml.h>

XTYP_ADVDATA
hszTopic = hsz1;     /* handle of topic-name string */
hszItem = hsz2;      /* handle of item-name string  */
hDataAdvise = hData; /* handle of the advise data   */
```

A client's **DDE** callback function can receive this transaction after the client has established an advise loop with a server. This transaction informs the client that the value of the data item has changed.

Parameter	Description
hszTopic	Value of *hsz1.* Identifies the topic name.
hszItem	Value of *hsz2.* Identifies the item name.
hDataAdvise	Value of *hData.* Identifies the data associated with the topic/item name pair. If the client specified the XTYPF_NODATA flag when it requested the advise loop, this parameter is NULL.

Returns

A **DDE** callback function should return DDE_FACK if it processes this transaction, DDE_FBUSY if it is too busy to process this transaction, or DDE_FNOTPROCESSED if it denies this transaction.

Comments

An application need not free the data handle obtained during this transaction. If the application needs to process the data after the callback function returns, however, it must copy the data associated with the data handle. An application can use the **DdeGetData** function to copy the data.

See Also

DdeClientTransaction, **DdePostAdvise**, **XTYP_ADVREQ**, **XTYP_ADVSTART**, **XTYP_ADVSTOP**

XTYP_ADVREQ (3.1)

```
#include <ddeml.h>

XTYP_ADVREQ
hszTopic = hsz1;           /* handle of topic-name string     */
hszItem = hsz2;            /* handle of item-name string      */
cAdvReq = LOWORD(dwData1); /* count of remaining transactions */
```

The system sends this transaction to a server after the server calls the **DdePostAdvise** function. This transaction informs the server that an advise transaction is outstanding on the specified topic/item name pair and that data corresponding to the topic/item name pair has changed.

Parameter	Description
hszTopic	Value of *hsz1.* Identifies the topic name.
hszItem	Value of *hsz2.* Identifies the item name that has changed.
cAdvReq	Value of the low-order word of *dwData1.* Specifies the count of XTYP_ADVREQ transactions that remain to be processed on the same topic/item/format name set, within the context of the current call to the **DdePostAdvise** function. If the current XTYP_ADVREQ transaction is the last one, the count is zero. A server can use this count to determine whether to create an HDATA_APPOWNED data handle for the advise data. If the **DDEML** issued the XTYP_ADVREQ transaction because of a late-arriving DDE_FACK transaction flag from a client, the low-order word is set to CADV_LATEACK. The DDE_FACK transaction flag arrives late when a server is sending information faster than a client can process it.

Returns

The server should call the **DdeCreateDataHandle** function to create a data handle that identifies the changed data and then should return the handle. If the server is unable to complete the transaction, it should return NULL.

Comments

A server cannot block this transaction type; the CBR_BLOCK return value is ignored.

See Also

DdeCreateDataHandle, **DdeInitialize**, **DdePostAdvise**, **XTYP_ADVSTART**, **XTYP_ADVSTOP**, **XTYP_ADVDATA**

XTYP_ADVSTART (3.1)

```
#include <ddeml.h>

XTYP_ADVSTART
hszTopic = hsz1;     /* handle of topic-name string */
hszItem = hsz2;      /* handle of item-name string  */
```

A server's **DDE** callback function receives this transaction when a client specifies XTYP_ADVSTART for the *wType* parameter of the **DdeClientTransaction** function. A client uses this transaction to establish an advise loop with a server.

Parameter	Description
hszTopic	Value of *hsz1.* Identifies the topic name.
hszItem	Value of *hsz2.* Identifies the item name.

Returns

To allow an advise loop on the specified topic/item name pair, a server's **DDE** callback function should return a nonzero value. To deny the advise loop, it should return zero. If the callback function returns a nonzero value, any subsequent call by the server to the **DdePostAdvise** function on the same topic/item name pair will cause the system to send a **XTYP_ADVREQ** transaction to the server.

Comments

If a client requests an advise loop on a topic/item/format name set for which an advise loop is already established, the **DDEML** does not create a duplicate advise loop. Instead, the DDEML alters the advise loop flags (XTYPF_ACKREQ and XTYPF_NODATA) to match the latest request.

If the server application specified the CBF_FAIL_ADVISES flag in the **DdeInitialize** function, this transaction is filtered.

See Also

DdeClientTransaction, **DdeInitialize**, **DdePostAdvise**, **XTYP_ADVREQ**, **XTYP_ADVSTOP**

XTYP_ADVSTOP (3.1)

```
#include <ddeml.h>

XTYP_ADVSTOP
hszTopic = hsz1;     /* handle of topic-name string */
hszItem = hsz2;      /* handle of item-name string  */
```

A server's **DDE** callback function receives this transaction when a client specifies XTYP_ADVSTOP for the *wType* parameter of the **DdeClientTransaction** function. A client uses this transaction to end an advise loop with a server.

Parameter	Description
hszTopic	Value of *hsz1.* Identifies the topic name.
hszItem	Value of *hsz2.* Identifies the item name.

Returns

This transaction does not return a value.

Comments

If the server application specified the CBF_FAIL_ADVISES flag in the **DdeInitialize** function, this transaction is filtered.

See Also

DdeClientTransaction, **DdeInitialize**, **DdePostAdvise**, **XTYP_ADVREQ**, **XTYP_ADVSTART**

XTYP_CONNECT (3.1)

```
#include <ddeml.h>

XTYP_CONNECT
hszTopic = hsz1;                  /* handle of topic-name string      */
hszService = hsz2;                /* handle of service-name string    */
pcc = (CONVCONTEXT FAR *)dwData1; /* address of CONVCONTEXT structure */
fSameInst = (BOOL) dwData2;       /* same instance flag               */
```

A server's **DDE** callback function receives this transaction when a client specifies a service name that the server supports and a topic name that is not set to NULL in a call to the **DdeConnect** function.

Parameter	Description
hszTopic	Value of *hsz1.* Identifies the topic name.
hszService	Value of *hsz2.* Identifies the service name.
pcc	Value of *dwData1.* Points to a **CONVCONTEXT** data structure that contains context information for the conversation. If the client is not a **DDEML** application, this parameter should be set to zero.
fSameInst	Value of *dwData2.* Specifies whether the client is the same application instance as the server. If this parameter is TRUE, the client is the same instance; if this parameter is FALSE, the client is a different instance.

Returns

To allow the client to establish a conversation on the specified service/topic name pair, a server's **DDE** callback function should return a nonzero value. To deny the conversation, it should return zero. If the callback function returns a nonzero value and a conversation is successfully established, the system passes the conversation handle to the server by issuing an **XTYP_CONNECT_CONFIRM** transaction to the server's DDE callback function (unless the server specified the CBF_FAIL_CONNECT_CONFIRMS flag in the **DdeInitialize** function).

Comments

If the server application specified the CBF_FAIL_CONNECTIONS flag in the **DdeInitialize** function, this transaction is filtered.

A server cannot block this transaction type; the CBR_BLOCK return value is ignored.

See Also

DdeConnect, **DdeInitialize**, **CONVCONTEXT**, **XTYP_CONNECT_CONFIRM**

XTYP_CONNECT_CONFIRM (3.1)

```
#include <ddeml.h>

XTYP_CONNECT_CONFIRM
hszTopic = hsz1;            /* handle of topic-name string   */
hszService = hsz2;          /* handle of service-name string */
fSameInst = (BOOL) dwData2; /* same instance flag            */
```

A server's **DDE** callback function receives this transaction to confirm that a conversation has been established with a client and to provide the server with the conversation handle. The system sends this transaction as a result of a previous **XTYP_CONNECT** or **XTYP_WILDCONNECT** transaction.

Parameter	Description
hszTopic	Value of *hsz1.* Identifies the topic name on which the conversation has been established.
hszService	Value of *hsz2.* Identifies the service name on which the conversation has been established.
fSameInst	Value of *dwData2.* Specifies whether the client is the same application instance as the server. If this parameter is a nonzero value, the client is the same instance. If this parameter is zero, the client is a different instance.

Returns

This transaction does not return a value.

Comments

If the server application specified the CBF_FAIL_CONFIRMS flag in the **DdeInitialize** function, this transaction is filtered.

A server cannot block this transaction type; the CBR_BLOCK return value is ignored.

See Also

DdeConnect, **DdeConnectList**, **DdeInitialize**, **XTYP_CONNECT**, **XTYP_WILDCONNECT**

XTYP_DISCONNECT (3.1)

```
#include <ddeml.h>

XTYP_DISCONNECT
fSameInst = (BOOL) dwData2;  /* same instance flag */
```

An application's **DDE** callback function receives this transaction when the application's partner in a conversation uses the **DdeDisconnect** function to terminate the conversation.

Parameter	Description
fSameInst	Value of *dwData2.* Specifies whether the partners in the conversation are the same application instance. If this parameter is TRUE, the partners are the same instance. If this parameter is FALSE, the partners are different instances.

Returns

This transaction does not return a value.

Comments

If the application specified the CBF_SKIP_DISCONNECTS flag in the **DdeInitialize** function, this transaction is filtered.

The application can obtain the status of the terminated conversation by calling the **DdeQueryConvInfo** function while processing this transaction. The conversation handle becomes invalid after the callback function returns.

An application cannot block this transaction type; the CBR_BLOCK return value is ignored.

See Also

DdeDisconnect, **DdeQueryConvInfo**

XTYP_ERROR (3.1)

```
#include <ddeml.h>

XTYP_ERROR
wErr = LOWORD(dwData1); /* error value */
```

A **DDE** callback function receives this transaction when a critical error occurs.

Parameter	Description
wErr	Value of *dwData1.* Specifies the error value. Currently, only the DMLERR_LOW_MEMORY error value is supported. It means that memory is low--advise, poke, or execute data may be lost, or the system may fail.

Returns

This transaction does not return a value.

Comments

An application cannot block this transaction type; the CBR_BLOCK return value is ignored. The **DDEML** attempts to free memory by removing noncritical resources. An application that has blocked conversations should unblock them.

XTYP_EXECUTE (3.1)

```
#include <ddeml.h>

XTYP_EXECUTE
hszTopic = hsz1;    /* handle of the topic-name string */
hDataCmd = hData;   /* handle of the command string    */
```

A server's **DDE** callback function receives this transaction when a client specifies XTYP_EXECUTE for the *wType* parameter of the **DdeClientTransaction** function. A client uses this transaction to send a command string to the server.

Parameter	Description
hszTopic	Value of *hsz1.* Identifies the topic name.
hDataCmd	Value of *hData.* Identifies the command string.

Returns

A server's **DDE** callback function should return DDE_FACK if it processes this transaction, DDE_FBUSY if it is too busy to process this transaction, or DDE_FNOTPROCESSED if it denies this transaction.

Comments

If the server application specified the CBF_FAIL_EXECUTES flag in the **DdeInitialize** function, this transaction is filtered.

An application need not free the data handle obtained during this transaction. If the application needs to process the string after the callback function returns, however, the application must copy the command string associated with the data handle. An application can use the **DdeGetData** function to copy the data.

See Also

DdeClientTransaction, **DdeInitialize**

XTYP_MONITOR (3.1)

```
#include <ddeml.h>

XTYP_MONITOR
hDataEvent = hData;      /* handle of event data */
fwEvent = dwData2;       /* event flag           */
```

The **DDE** callback function of a DDE debugging application receives this transaction whenever a DDE event occurs in the system. An application can receive this transaction only if it specified the APPCLASS_MONITOR flag when it called the **DdeInitialize** function.

Parameter	Description
hDataEvent	Value of *hData.* Identifies a global memory object that contains information about the **DDE** event. The application should use the **DdeAccessData** function to obtain a pointer to the object.
fwEvent	Value of *dwData2.* Specifies the **DDE** event. This parameter may be one of the following values:

Value	Meaning
MF_CALLBACKS	The system sent a transaction to a **DDE** callback function. The global memory object contains a **MONCBSTRUCT** structure that provides information about the transaction.
MF_CONV	A **DDE** conversation was established or terminated. The global memory object contains a **MONCONVSTRUCT** structure that provides information about the conversation.
MF_ERRORS	A **DDE** error occurred. The global memory object contains a **MONERRSTRUCT** structure that provides information about the error.
MF_HSZ_INFO	A **DDE** application created or freed a string handle or incremented the use count of a string handle, or a string handle was freed as a result of a call to the **DdeUninitialize** function. The global memory object contains a **MONHSZSTRUCT** structure that provides information about the string handle.
MF_LINKS	A **DDE** application started or ended an advise loop. The global memory object contains a **MONLINKSTRUCT** structure that provides information about the advise loop.
MF_POSTMSGS	The system or an application posted a **DDE** message. The global memory object contains a **MONMSGSTRUCT** structure that provides information about the message.
MF_SENDMSGS	The system or an application sent a **DDE** message. The global memory object contains a **MONMSGSTRUCT** structure that provides information about the message.

Returns

The callback function should return zero if it processes this transaction.

See Also

DdeAccessData, **DdeInitialize**, **MONCBSTRUCT**, **MONCONVSTRUCT**, **MONERRSTRUCT**, **MONHSZSTRUCT**, **MONLINKSTRUCT**, **MONMSGSTRUCT**

XTYP_POKE (3.1)

```
#include <ddeml.h>

XTYP_POKE
hszTopic = hsz1;     /* handle of topic-name string */
hszItem = hsz2;      /* handle of item-name string  */
hDataPoke = hData;   /* handle of data for server   */
```

A server's **DDE** callback function receives this transaction when a client specifies XTYP_POKE as the *wType* parameter of the **DdeClientTransaction** function. A client uses this transaction to send unsolicited data to the server.

Parameter	Description
hszTopic	Value of *hsz1.* Identifies the topic name.
hszItem	Value of *hsz2.* Identifies the item name.
hDataPoke	Value of *hData.* Identifies the data that the client is sending to the server.

Returns

A server's **DDE** callback function should return DDE_FACK if it processes this transaction, DDE_FBUSY if it is too busy to process this transaction, or DDE_FNOTPROCESSED if it denies this transaction.

Comments

If the server application specified the CBF_FAIL_POKES flag in the **DdeInitialize** function, this transaction is filtered.

See Also

DdeClientTransaction, **DdeInitialize**

XTYP_REGISTER (3.1)

```
#include <ddeml.h>

XTYP_REGISTER
hszBaseServName = hsz1; /* handle of base service-name string     */
hszInstServName = hsz2; /* handle of instance service-name string */
```

A **DDE** callback function receives this transaction type whenever a **DDEML** server application uses the **DdeNameService** function to register a service name or whenever a non-DDEML application that supports the System topic is started.

Parameter	Description
hszBaseServName	Value of *hsz1.* Identifies the base service name being registered.
hszInstServName	Value of *hsz2.* Identifies the instance-specific service name being registered.

Returns

This transaction does not return a value.

Comments

If the application specified the CBF_SKIP_REGISTRATIONS flag in the **DdeInitialize** function, this transaction is filtered.

An application cannot block this transaction type; the CBR_BLOCK return value is ignored.

An application should use the *hszBaseServName* parameter to add the service name to the list of servers available to the user. An application should use the *hszInstServName* parameter to identify which application instance has started.

See Also

DdeInitialize, **DdeNameService**, **XTYP_UNREGISTER**

XTYP_REQUEST (3.1)

```
#include <ddeml.h>

XTYP_REQUEST
hszTopic = hsz1;     /* handle of topic-name string */
hszItem = hsz2;      /* handle of item-name string  */
```

A **DDE** server callback function receives this transaction when a client specifies XTYP_REQUEST for the *wType* parameter of the **DdeClientTransaction** function. A client uses this transaction to request data from a server.

Parameter	Description
hszTopic	Value of *hsz1.* Identifies the topic name.
hszItem	Value of *hsz2.* Identifies the item name that has changed.

Returns

The server should call the **DdeCreateDataHandle** function to create a data handle that identifies the changed data and then should return the handle. The server should return NULL if it is unable to complete the transaction. If the server returns NULL, the client receives a DDE_FNOTPROCESSED acknowledgment flag.

Comments

If the server application specified the CBF_FAIL_REQUESTS flag in the **DdeInitialize** function, this transaction is filtered.

If responding to this transaction requires lengthy processing, the server can return CBR_BLOCK to suspend future transactions on the current conversation and then process the transaction asynchronously. When the server has finished and the data is ready to pass to the client, the server can call the **DdeEnableCallback** function to resume the conversation.

See Also

DdeClientTransaction, **DdeCreateDataHandle**, **DdeEnableCallback**, **DdeInitialize**

XTYP_UNREGISTER (3.1)

```
#include <ddeml.h>

XTYP_UNREGISTER
hszBaseServName = hsz1; /* handle of base service-name string     */
hszInstServName = hsz2; /* handle of instance service-name string */
```

A **DDE** callback function receives this transaction type whenever a **DDEML** server application uses the **DdeNameService** function to unregister a service name or whenever a non-DDEML application that supports the System topic is terminated.

Parameter	Description
hszBaseServName	Value of *hsz1.* Identifies the base service name being unregistered.
hszInstServName	Value of *hsz2.* Identifies the instance-specific service name being unregistered.

Returns

This transaction does not return a value.

Comments

If the application specified the CBF_SKIP_REGISTRATIONS flag in the **DdeInitialize** function, this transaction is filtered.

An application cannot block this transaction type; the CBR_BLOCK return value is ignored.

An application should use the *hszBaseServName* parameter to remove the service name from the list of servers available to the user. An application should use the *hszInstServName* parameter to identify which application instance has terminated.

See Also

DdeInitialize, **DdeNameService**, **XTYP_REGISTER**

XTYP_WILDCONNECT (3.1)

```
#include <ddeml.h>

XTYP_WILDCONNECT
hszTopic = hsz1;                  /* handle of topic-name string      */
hszService = hsz2;                /* handle of service-name string    */
pcc = (CONVCONTEXT FAR *)dwData1; /* address of CONVCONTEXT structure */
fSameInst = (BOOL) dwData2;       /* same-instance flag               */
```

A server's **DDE** callback function receives this transaction when a client specifies a service name that is set to NULL, a topic name that is set to NULL, or both in a call to the **DdeConnect** function. This transaction allows a client to establish a conversation on each of the server's service/topic name pairs that matches the specified service name and topic name.

Parameter	Description
hszTopic	Value of *hsz1.* Identifies the topic name. If this parameter is NULL, the client is requesting a conversation on all topic names that the server supports.
hszService	Value of *hsz2.* Identifies the service name. If this parameter is NULL, the client is requesting a conversation on all service names that the server supports.
pcc	Value of *dwData1.* Points to a **CONVCONTEXT** data structure that contains context information for the conversation. If the client is not a **DDEML** application, this parameter is set to zero.
fSameInst	Value of *dwData2.* Specifies whether the client is the same application instance as the server. If this parameter is TRUE, the client is same instance. If this parameter is FALSE, the client is a different instance.

Returns

The server should return a data handle that identifies an array of **HSZPAIR** structures. The array should contain one structure for each service/topic name pair that matches the service/topic name pair requested by the client. The array must be terminated by a NULL string handle. The system sends the **XTYP_CONNECT_CONFIRM** transaction to the server to confirm each conversation and to pass the conversation handles to the server. If the server specified the CBF_SKIP_CONNECT_CONFIRMS flag in the **DdeInitialize** function, it cannot receive these confirmations.

To refuse the XTYP_WILDCONNECT transaction, the server should return NULL.

Comments

If the server application specified the CBF_FAIL_CONNECTIONS flag in the **DdeInitialize** function, this transaction is filtered.

A server cannot block this transaction type; the CBR_BLOCK return code is ignored.

See Also

DdeConnect, **DdeInitialize**, **CONVCONTEXT**, **XTYP_CONNECT_CONFIRM**

XTYP_XACT_COMPLETE (3.1)

```
#include <ddeml.h>

XTYP_XACT_COMPLETE
hszTopic = hsz1;       /* handle of topic-name string */
hszItem = hsz2;        /* handle of item-name string  */
hDataXact = hData;     /* handle of transaction data  */
dwXactID = dwData1;    /* transaction identifier      */
fwStatus = dwData2;    /* status flag                 */
```

A **DDE** client callback function receives this transaction when an asynchronous transaction, initiated by a call to the **DdeClientTransaction** function, has concluded.

Parameter	Description
hszTopic	Value of *hsz1.* Identifies the topic name involved in the completed transaction.
hszItem	Value of *hsz2.* Identifies the item name involved in the completed transaction.
hDataXact	Value of *hData.* Identifies the data involved in the completed transaction, if applicable. If the transaction was successful but involved no data, this parameter is TRUE. If the transaction was unsuccessful, this parameter is NULL.
dwXactID	Value of *dwData1.* Contains the transaction identifier of the completed transaction.
fwStatus	Value of *dwData2.* Contains any applicable DDE_ status flags in the low-order word. This provides support for applications dependent on DDE_APPSTATUS bits. It is recommended that applications no longer use these bits--future versions of the **DDEML** may not support them.

Returns

This transaction does not return a value.

Comments

An application need not free the data handle obtained during this transaction. If the application needs to process the data after the callback function returns, however, the application must copy the data associated with the data handle. An application can use the **DdeGetData** function to copy the data.

See Also

DdeClientTransaction

DDE transactions

XTYP_ADVDATA	Passes advise data to a client
XTYP_ADVREQ	Prompts a server to send advise data to a client
XTYP_ADVSTART	Establishes an advise loop with a server
XTYP_ADVSTOP	Ends an advise loop with a server
XTYP_CONNECT	Requests a **DDE** conversation with a client
XTYP_CONNECT_CONFIRM	Confirms a **DDE** conversation with a client
XTYP_DISCONNECT	Terminates a **DDE** conversation
XTYP_ERROR	Notifies a **DDEML** application of a critical error
XTYP_EXECUTE	Executes a server command
XTYP_MONITOR	Informs a **DDE** debugging application of a DDE event
XTYP_POKE	Sends unsolicited data to a server
XTYP_REGISTER	Registers a service name
XTYP_REQUEST	Requests data from a server
XTYP_UNREGISTER	Unregisters a service name
XTYP_WILDCONNECT	Requests multiple **DDE** conversations
XTYP_XACT_COMPLETE	Confirms completion of an asynchronous transaction

DragAcceptFiles (3.1)

#include shellapi.h

void DragAcceptFiles(*hwnd, fAccept***)**

```
HWND hwnd;      /* handle of the registering window          */
BOOL fAccept;   /* flag for whether dropped files are accepted */
```

The **DragAcceptFiles** function registers whether a given window accepts dropped files.

Parameter	Description
hwnd	Identifies the window registering whether it accepts dropped files.
fAccept	Specifies whether the window specified by the *hwnd* parameter accepts dropped files. An application should set this value to TRUE to accept dropped files or FALSE to discontinue accepting dropped files.

Returns

This function does not return a value.

Comments

When an application calls **DragAcceptFiles** with *fAccept* set to TRUE, Windows File Manager (WINFILE.EXE) sends the specified window a **WM_DROPFILES** message each time the user drops a file in that window.

See Also

WM_DROPFILES

DragFinish (3.1)

#include shellapi.h

void DragFinish(*hDrop***)**

HDROP *hDrop;* /* handle of memory to free */

The **DragFinish** function releases memory that Windows allocated for use in transferring filenames to the application.

Parameter	Description
hDrop	Identifies the internal data structure that describes dropped files. This handle is passed to the application in the *wParam* parameter of the **WM_DROPFILES** message.

Returns

This function does not return a value.

See Also

WM_DROPFILES

DragQueryFile (3.1)

#include shellapi.h

UINT DragQueryFile(*hDrop, iFile, lpszFile, cb***)**

```
HDROP hDrop;      /* handle of structure for dropped files      */
UINT iFile;       /* index of file to query                     */
LPSTR lpszFile;   /* address of buffer for returned filename */
UINT cb;          /* size of buffer for filename                */
```

The **DragQueryFile** function retrieves the number of dropped files and their filenames.

Parameter	Description
hDrop	Identifies the internal data structure containing filenames for the dropped files. This handle is passed to the application in the *wParam* parameter of the **WM_DROPFILES** message.
iFile	Specifies the index of the file to query. The index of the first file is 0. If the value of the *iFile* parameter is -1, **DragQueryFile** returns the number of files dropped. If the value of the *iFile* parameter is between zero and the total number of files dropped, **DragQueryFile** copies the filename corresponding to that value to the buffer pointed to by the *lpszFile* parameter.
lpszFile	Points to a null-terminated string that contains the filename of a dropped file when the function returns. If this parameter is NULL and the *iFile* parameter specifies the index for the name of a dropped file, **DragQueryFile** returns the required size, in bytes, of the buffer for that filename.
cb	Specifies the size, in bytes, of the *lpszFile* buffer.

Returns

When the function copies a filename to the *lpszFile* buffer, the return value is the number of bytes copied. If the *iFile* parameter is 0xFFFF, the return value is the number of dropped files. If *iFile* is between zero and the total number of dropped files and if *lpszFile* is NULL, the return value is the required size of the *lpszFile* buffer.

See Also

DragQueryPoint, **WM_DROPFILES**

DragQueryPoint (3.1)

#include shellapi.h

BOOL DragQueryPoint(*hDrop, lppt***)**

HDROP *hDrop;* /* handle of structure for dropped file */
POINT FAR* *lppt;* /* address of structure for cursor coordinates */

The **DragQueryPoint** function retrieves the window coordinates of the cursor when a file is dropped.

Parameter	Description
hDrop	Identifies the internal data structure that describes the dropped file. This structure is returned in the *wParam* parameter of the **WM_DROPFILES** message.
lppt	Points to a **POINT** structure that the function fills with the coordinates of the position at which the cursor was located when the file was dropped.

Returns

The return value is nonzero if the file is dropped in the client area of the window. Otherwise, it is zero.

Comments

The **DragQueryPoint** function fills the **POINT** structure with the coordinates of the position at which the cursor was located when the user released the left mouse button. The window for which coordinates are returned is the window that received the **WM_DROPFILES** message.

See Also

DragQueryFile, **POINT**, **WM_DROPFILES**

Drag-drop functions (3.1)

DragAcceptFiles	Registers whether a window accepts dropped files
DragFinish	Releases memory allocated for dropping files
DragQueryFile	Retrieves the filename of a dropped file
DragQueryPoint	Retrieves the mouse position when a file is dropped

FMExtensionProc (3.1)

#include <wfext.h>

HMENU FAR PASCAL FMExtensionProc(*hwnd, wMsg, lParam***)**

HWND *hwnd;* /* handle of the extension window */
WORD *wMsg;* /* menu-item identifier or message */
LONG *lParam;* /* additional message information */

The **FMExtensionProc** function, an application-defined callback function, processes menu commands and messages sent to a File Manager extension dynamic-link library (DLL).

Parameter	Description
hwnd	Identifies the File Manager window. An extension DLL should use this handle to specify the parent for any dialog boxes or message boxes that the DLL may display and to send request messages to File Manager.
wMsg	Specifies the message. This parameter may be one of the following values:

Value	Meaning
1-99	Identifier for the menu item that the user selected.
FMEVENT_INITMENU	User selected the extension's menu.
FMEVENT_LOAD	File Manager is loading the extension DLL.
FMEVENT_SELCHANGE	Selection in File Manager's directory window, or Search Results window, changed.
FMEVENT_UNLOAD	File Manager is unloading the extension DLL.
FMEVENT_USER_REFRESH	User chose the Refresh command from the Window menu.

lParam	Specifies 32 bits of additional message-dependent information.

Returns
The callback function should return the result of the message processing. The actual return value depends on the message that is processed.

Comments
Whenever File Manager calls the **FMExtensionProc** function, it waits to refresh its directory windows (for changes in the file system) until after the function returns. This allows the extension to perform large numbers of file operations without excessive repainting by the File Manager. The extension does not need to send the **FM_REFRESH_WINDOWS** message to notify File Manager to repaint its windows.

See Also
FM_REFRESH_WINDOWS, **FMS_LOAD**

UndeleteFile

#include <wfext.h>

int CALLBACK UndeleteFile(*hwndParent, lpszDir***)**

HWND *hwndParent;* /* handle of File Manager window */
LPSTR *lpszDir;* /* address of name of initial directory */

The **UndeleteFile** function is an application-defined callback function that File Manager calls when the user chooses the Undelete command from the File Manager File menu.

Parameter	Description
hwndParent	Identifies the File Manager window. An "undelete" dynamic-link library (DLL) should use this handle to specify the parent window for any dialog box or message box the DLL may display.
lpszDir	Points to a null-terminated string that contains the name of the initial directory.

Returns

The return value is one of the following, if the function is successful:

Value	Meaning
-l	An error occurred.
IDOK	A file was undeleted. File Manager will repaint its windows.
IDCANCEL	No file was undeleted.

File Manager Extension Functions (3.1)

FMExtensionProc	Processes messages for a File Manager extension
UndeleteFile	Processes the File Manager Undelete command

FMEVENT_INITMENU

The FMEVENT_INITMENU message is sent to an extension dynamic-link library (DLL) when the user selects the menu for the extension from File Manager's menu bar. The extension can use this notification to initialize menu items in the menu.

Parameter	Description
lParam	Specifies the menu handle in the high-order word. The low-order word specifies the delta value for the menu item.

Returns

This message does not return a value.

Comments

An extension receives this message only when the user selects the top-level menu. If the extension contains submenus, it must initialize them at the same time as the top-level menu.

See Also

FMExtensionProc

FMEVENT_LOAD

The FMEVENT_LOAD message is sent to an extension dynamic-link library (DLL) when File Manager is loading the DLL.

Parameter	Description
lParam	Points to an **FMS_LOAD** structure that specifies the menu-item delta value. An extension DLL should save the menu-item delta value and fill the other structure members with information about the extension.

Returns

This message does not return a value.

Comments

An application should fill the **dwSize**, **szMenuName**, and **hMenu** members. It should also save the value of the **wMenuDelta** member and use it to identify menu items when modifying the menu. For more information, see the description of the **FMS_LOAD** structure.

See Also

FMExtensionProc, **FMS_LOAD**

FMEVENT_SELCHANGE

The FMEVENT_SELCHANGE message is sent to an extension dynamic-link library (DLL) when the user selects a filename in File Manager's directory window or Search Results window.

Parameter	Description
lParam	Not used.

Returns

This message does not return a value.

Comments

Changes in the tree half of the directory window do not produce this message.

Because the user can change the selection many times, the extension DLL must return promptly after processing this message to avoid slowing the selection process for the user.

See Also

FMExtensionProc, **FMEVENT_UNLOAD**

FMEVENT_UNLOAD

The FMEVENT_UNLOAD message is sent to an extension dynamic-link library (DLL) when File Manager is unloading the DLL.

Parameter	Description
lParam	Not used.

Returns

This message does not return a value.

Comments

The *hwnd* and *hMenu* values passed with the **FMEVENT_LOAD** and **FMEVENT_INITMENU** messages may not be valid at the time of this message.

See Also

FMExtensionProc, **FMEVENT_INITMENU**, **FMEVENT_LOAD**

FMEVENT_USER_REFRESH

The FMEVENT_USER_REFRESH message is sent to an extension dynamic-link library (DLL) when the user invokes File Manager's Refresh command in the Window menu. The extension can use this notification to update its menu.

Parameter	Description
lParam	Not used.

Returns

This message does not return a value.

See Also

FMExtensionProc

FM_GETDRIVEINFO

A File Manager extension sends an FM_GETDRIVEINFO message to retrieve drive information from the active File Manager window.

Parameter	Description
wParam	Not used.
lParam	Points to an **FMS_GETDRIVEINFO** structure that receives drive information.

Returns

The return value is always nonzero.

Comments

If a -1 is returned in the **dwTotalSpace** or **dwFreeSpace** members of the **FMS_GETDRIVEINFO** structure, the extension library must compute the value or values.

See Also

FMExtensionProc, **FMS_GETDRIVEINFO**

FM_GETFILESEL

A File Manager extension sends an FM_GETFILESEL message to retrieve information about a selected file from the active File Manager window (either the directory window or the Search Results window).

Parameter	Description
wParam	Specifies the zero-based index of the selected file to retrieve.
lParam	Points to an **FMS_GETFILESEL** structure that receives information about the selection.

Returns

The return value is the zero-based index of the selected file that was retrieved.

Comments

An extension can use the **FM_GETSELCOUNT** message to obtain the count of selected files.

The **szName** member of the **FMS_GETFILESEL** structure consists of an OEM character string. Before displaying this string, an extension should use the **OemToAnsi** function to convert the string to a Windows ANSI character string. If a string is to be passed to the file system (MS-DOS), an extension should not convert it.

See Also

FMExtensionProc, **FM_GETFILESELLFN**, **FM_GETSELCOUNT**, **FM_GETSELCOUNTLFN**, **OemToAnsi**, **FMS_GETFILESEL**

FM_GETFILESELLFN

A File Manager extension sends an FM_GETFILESELLFN message to retrieve information about a selected file from the active File Manager window (either the directory window or the Search Results window). The selected file can have a long filename.

Parameter	Description
wParam	Specifies the zero-based index of the selected file to retrieve.
lParam	Points to an **FMS_GETFILESEL** structure that receives information about the selection.

Returns

The return value is the zero-based index of the selected file that was retrieved.

Comments

Only extensions that support long filenames (for example, network-aware extensions) should use this message.

An extension can use the **FM_GETSELCOUNT** message to obtain the count of selected files.

The **szName** member of the **FMS_GETFILESEL** structure consists of an OEM character string. Before displaying this string, an extension should use the **OemToAnsi** function to convert the string to a Windows ANSI character string. If a string is to be passed to the file system (MS-DOS), an extension should not convert it.

See Also

FMExtensionProc, **FM_GETFILESEL**, **FM_GETSELCOUNT**, **FM_GETSELCOUNTLFN**, **OemToAnsi**, **FMS_GETFILESEL**

FM_GETFOCUS

A File Manager extension sends a FM_GETFOCUS message to retrieve the type of the File Manager window that has the input focus.

Parameter	Description
wParam	Not used.
lParam	Not used.

Returns

The return value indicates the type of File Manager window that has input focus. It can have one of the following values:

Value	Meaning
FMFOCUS_DIR	Directory portion of a directory window
FMFOCUS_TREE	Tree portion of a directory window
FMFOCUS_DRIVES	Drive bar of a directory window
FMFOCUS_SEARCH	Search Results window

FM_GETSELCOUNT

A File Manager extension sends a FM_GETSELCOUNT message to retrieve a count of the selected files in the directory or the Search Results window, depending on which is the active window.

Parameter	Description
wParam	Not used.
lParam	Not used.

Returns

The return value is the number of selected files.

See Also

FM_GETFILESEL, **FM_GETFILESELLFN**, **FM_GETSELCOUNTLFN**

FM_GETSELCOUNTLFN

A File Manager extension sends an FM_GETSELCOUNTLFN message to retrieve the number of selected files in the directory or the Search Results window, depending on which is the active window. The count includes files that have long filenames.

Parameter	Description
wParam	Not used.
lParam	Not used.

Returns

The return value is the number of selected files.

Comments

Only extensions that support long filenames (for example, network-aware extensions) should use this message.

See Also

FM_GETFILESEL, **FM_GETFILESELLFN**, **FM_GETSELCOUNT**

FM_REFRESH_WINDOWS

A File Manager extension sends an FM_REFRESH_WINDOWS message to cause File Manager to repaint either its active window or all of its windows.

Parameter	Description
wParam	Specifies whether File Manager repaints its active window or all of its windows. If this parameter is nonzero, File Manager repaints all of its windows. If this parameter is zero, File Manager repaints only its active window.
lParam	Not used.

Returns

This message does not return a meaningful value.

Comments

File system changes caused by an extension are automatically detected by File Manager. An extension should use this message only in situations where drive connections are made or canceled.

See Also

FMExtensionProc

FM_RELOAD_EXTENSIONS

A File Manager extension (or another application) sends an FM_RELOAD_EXTENSIONS message to cause File Manager to reload all extension dynamic-link libraries (DLLs) listed in the [AddOns] section of the WINFILE.INI file.

Parameter	Description
wParam	Not used.
lParam	Not used.

Returns

This message does not return a meaningful value.

Comments

Other applications can use the **PostMessage** function to send this message to File Manager. To obtain the appropriate File Manager window handle, an application can specify "WFS_Frame" as the *lpszClassName* parameter in a call to the **FindWindow** function.

See Also

FindWindow, **FMExtensionProc**, **PostMessage**

File Manager Extension Messages (3.1)

FMEVENT_INITMENU
FMEVENT_LOAD
FMEVENT_SELCHANGE
FMEVENT_UNLOAD
FMEVENT_USER_REFRESH

FM_GETDRIVEINFO	Retrieves drive data from active window
FM_GETFILESEL	Retrieves data about a selected file
FM_GETFILESELLFN	Retrieves data about a selected file
FM_GETFOCUS	Retrieves the type of the File Manager focus window
FM_GETSELCOUNT	Retrieves the count of selected files
FM_GETSELCOUNTLFN	Retrieves the count of selected files
FM_REFRESH_WINDOWS	Repaints File Manager's windows
FM_RELOAD_EXTENSIONS	Reloads File Manager extension DLLs

AbortDoc (3.1)

int AbortDoc(*hdc***)**

HDC *hdc;* /* handle of device context */

The **AbortDoc** function terminates the current print job and erases everything drawn since the last call to the **StartDoc** function. This function replaces the ABORTDOC printer escape for Windows version 3.1.

Parameter	Description
hdc	Identifies the device context for the print job.

Returns

The return value is greater than or equal to zero if the function is successful. Otherwise, it is less than zero.

Comments

Applications should call the **AbortDoc** function to terminate a print job because of an error or if the user chooses to cancel the job. To end a successful print job, an application should use the **EndDoc** function.

If Print Manager was used to start the print job, calling the **AbortDoc** function erases the entire spool job--the printer receives nothing. If Print Manager was not used to start the print job, the data may have been sent to the printer before **AbortDoc** was called. In this case, the printer driver would have reset the printer (when possible) and closed the print job.

See Also

EndDoc, **SetAbortProc**, **StartDoc**

AddFontResource (2.x)

int AddFontResource(*lpszFilename***)**

LPCSTR *lpszFilename;* /* address of filename */

The **AddFontResource** function adds a font resource to the Windows font table. Any application can then use the font.

Parameter	Description
lpszFilename	Points to a character string that names the font resource file or that contains a handle of a loaded module. If this parameter points to a font resource filename, it must be a valid MS-DOS filename, including an extension, and the string must be null-terminated. The system passes this string to the **LoadLibrary** function if the font resource must be loaded.

Returns

The return value specifies the number of fonts added if the function is successful. Otherwise, it is zero.

Comments

Any application that adds or removes fonts from the Windows font table should send a **WM_FONTCHANGE** message to all top-level windows in the system by using the **SendMessage** function with the *hwnd* parameter set to 0xFFFF.

When font resources added by using **AddFontResource** are no longer needed, you should remove them by using the **RemoveFontResource** function.

Example

The following example uses the **AddFontResource** function to add a font resource from a file, notifies other applications by using the **SendMessage** function, then removes the font resource by using the **RemoveFontResource** function:

```
AddFontResource("fontres.fon");
SendMessage(HWND_BROADCAST, WM_FONTCHANGE, 0, 0);
    .
    . /* Work with the font. */
    .
if (RemoveFontResource("fontres.fon")) {
    SendMessage(HWND_BROADCAST, WM_FONTCHANGE, 0, 0);
    return TRUE;
}
else
    return FALSE;
```

See Also

LoadLibrary, **RemoveFontResource**, **SendMessage**

AnimatePalette (3.0)

void AnimatePalette(*hpal, iStart, cEntries, lppe***)**

```
HPALETTE hpal;                          /* handle of palette            */
UINT iStart;                            /* first palette entry to animate*/
UINT cEntries;                          /* number of entries in palette */
const PALETTEENTRY FAR* lppe;           /* address of color structure   */
```

The **AnimatePalette** function replaces entries in the specified logical palette. An application does not have to update the client area when it calls **AnimatePalette**, because Windows maps the new entries into the system palette immediately.

Parameter	Description
hpal	Identifies the logical palette.
iStart	Specifies the first entry in the palette to be animated.
cEntries	Specifies the number of entries in the palette to be animated.
lppe	Points to the first member of an array of **PALETTEENTRY** structures. These palette entries will replace the palette entries identified by the *iStart* and *cEntries* parameters.

Returns

This function does not return a value.

Comments

The **AnimatePalette** function can change an entry in a logical palette only when the PC_RESERVED flag is set in the corresponding **palPaletteEntry** member of the **LOGPALETTE** structure that defines the current logical palette.

Example

The following example initializes a **LOGPALETTE** structure and an array of **PALETTEENTRY** structures, uses the **CreatePalette** function to retrieve a handle of a logical palette, and then uses the **AnimatePalette** function to map the entries into the system palette:

```
#define NUMENTRIES 128
HPALETTE hpal;
PALETTEENTRY ape[NUMENTRIES];

plgpl = (LOGPALETTE*) LocalAlloc(LPTR,
    sizeof(LOGPALETTE) + cColors * sizeof(PALETTEENTRY));

plgpl->palNumEntries = cColors;
plgpl->palVersion = 0x300;

for (i = 0, red = 0, green = 127, blue = 127; i < NUMENTRIES;
        i++, red += 1, green += 1, blue += 1) {
    ape[i].peRed =
        plgpl->palPalEntry[i].peRed = LOBYTE(red);
    ape[i].peGreen =
        plgpl->palPalEntry[i].peGreen = LOBYTE(green);
    ape[i].peBlue =
        plgpl->palPalEntry[i].peBlue = LOBYTE(blue);
    ape[i].peFlags =
        plgpl->palPalEntry[i].peFlags = PC_RESERVED;
}
hpal = CreatePalette(plgpl);
LocalFree((HLOCAL) plgpl);
AnimatePalette(hpal, 0, NUMENTRIES, (PALETTEENTRY FAR*) &ape);
```

See Also
CreatePalette, **LOGPALETTE**, **PALETTEENTRY**

Arc (2.x)

BOOL Arc(*hdc, nLeftRect, nTopRect, nRightRect, nBottomRect, nXStartArc, nYStartArc, nXEndArc, nYEndArc***)**

```
HDC hdc;          /* handle of device context                          */
int nLeftRect;    /* x-coordinate upper-left corner bounding rectangle */
int nTopRect;     /* y-coordinate upper-left corner bounding rectangle */
int nRightRect;   /* x-coordinate lower-right corner bounding rectangle */
int nBottomRect;  /* y-coordinate lower-right corner bounding rectangle */
int nXStartArc;   /* x-coordinate arc starting point                   */
int nYStartArc;   /* y-coordinate arc starting point                   */
int nXEndArc;     /* x-coordinate arc ending point                     */
int nYEndArc;     /* y-coordinate arc ending point                     */
```

The **Arc** function draws an elliptical arc.

Parameter	Description
hdc	Identifies the device context.
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the bounding rectangle.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the bounding rectangle.
nRightRect	Specifies the logical x-coordinate of the lower-right corner of the bounding rectangle.
nBottomRect	Specifies the logical y-coordinate of the lower-right corner of the bounding rectangle.
nXStartArc	Specifies the logical x-coordinate of the point that defines the arc's starting point. This point need not lie exactly on the arc.
nYStartArc	Specifies the logical y-coordinate of the point that defines the arc's starting point. This point need not lie exactly on the arc.
nXEndArc	Specifies the logical x-coordinate of the point that defines the arc's endpoint. This point need not lie exactly on the arc.
nYEndArc	Specifies the logical y-coordinate of the point that defines the arc's endpoint. This point need not lie exactly on the arc.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The arc drawn by using the **Arc** function is a segment of the ellipse defined by the specified bounding rectangle. The starting point of the arc is the point at which a ray drawn from the center of the bounding rectangle through the specified starting point intersects the ellipse. The end point of the arc is the point at which a ray drawn from the center of the bounding rectangle through the specified end point intersects the ellipse. The arc is drawn in a counterclockwise direction. Since an arc is not a closed figure, it is not filled.

Both the width and the height of a rectangle must be greater than 2 units and less than 32,767 units.

Example

The following example uses a **RECT** structure to store the points defining the bounding rectangle and uses **POINT** structures to store the coordinates that specify the beginning and end of the arc:

```
HDC hdc;

RECT rc = { 10, 10, 180, 140 };
POINT ptStart = {  12,  12 };
POINT ptEnd = { 128, 135 };

Arc(hdc, rc.left, rc.top, rc.right, rc.bottom,
```

```
    ptStart.x, ptStart.y, ptEnd.x, ptEnd.y);
```

See Also
Chord, **POINT**, **RECT**

BitBlt (2.x)

BOOL BitBlt(*hdcDest, nXDest, nYDest, nWidth, nHeight, hdcSrc, nXSrc, nYSrc, dwRop***)**

```
HDC hdcDest;     /* handle of destination device context    */
int nXDest;      /* upper-left corner destination rectangle */
int nYDest;      /* upper-left corner destination rectangle */
int nWidth;      /* bitmap width                            */
int nHeight;     /* bitmap height                           */
HDC hdcSrc;      /* handle of source device context         */
int nXSrc;       /* upper-left corner source bitmap         */
int nYSrc;       /* upper-left corner source bitmap         */
DWORD dwRop;     /* raster operation for copy               */
```

The **BitBlt** function copies a bitmap from a specified device context to a destination device context.

Parameter	Description
hdcDest	Identifies the destination device context.
nXDest	Specifies the logical x-coordinate of the upper-left corner of the destination rectangle.
nYDest	Specifies the logical y-coordinate of the upper-left corner of the destination rectangle.
nWidth	Specifies the width, in logical units, of the destination rectangle and source bitmap.
nHeight	Specifies the height, in logical units, of the destination rectangle and source bitmap.
hdcSrc	Identifies the device context from which the bitmap will be copied. This parameter must be NULL if the *dwRop* parameter specifies a raster operation that does not include a source. This parameter can specify a memory device context.
nXSrc	Specifies the logical x-coordinate of the upper-left corner of the source bitmap.
nYSrc	Specifies the logical y-coordinate of the upper-left corner of the source bitmap.
dwRop	Specifies the raster operation to be performed. Raster operation codes define how the graphics device interface (**GDI**) combines colors in output operations that involve a current brush, a possible source bitmap, and a destination bitmap. This parameter can be one of the following:

Code	Description
BLACKNESS	Turns all output black.
DSTINVERT	Inverts the destination bitmap.
MERGECOPY	Combines the pattern and the source bitmap by using the Boolean AND operator.
MERGEPAINT	Combines the inverted source bitmap with the destination bitmap by using the Boolean OR operator.
NOTSRCCOPY	Copies the inverted source bitmap to the destination.
NOTSRCERASE	Inverts the result of combining the destination and source bitmaps by using the Boolean OR operator.
PATCOPY	Copies the pattern to the destination bitmap.
PATINVERT	Combines the destination bitmap with the pattern by using the Boolean XOR operator.
PATPAINT	Combines the inverted source bitmap with the pattern by using the Boolean OR operator. Combines the result of this operation with the destination bitmap by using the Boolean OR operator.
SRCAND	Combines pixels of the destination and source bitmaps by using the Boolean AND operator.
SRCCOPY	Copies the source bitmap to the destination bitmap.
SRCERASE	Inverts the destination bitmap and combines the result with the

	source bitmap by using the Boolean AND operator.
SRCINVERT	Combines pixels of the destination and source bitmaps by using the Boolean XOR operator.
SRCPAINT	Combines pixels of the destination and source bitmaps by using the Boolean OR operator.
WHITENESS	Turns all output white.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

An application that uses the **BitBlt** function to copy pixels from one window to another window or from a source rectangle in a window into a target rectangle in the same window should set the **CS_BYTEALIGNWINDOW** or **CS_BYTEALIGNCLIENT** flag when registering the window classes. By aligning the windows or client areas on byte boundaries, the application can ensure that the **BitBlt** operations occur on byte-aligned rectangles. **BitBlt** operations on byte-aligned rectangles are considerably faster than **BitBlt** operations on rectangles that are not byte-aligned.

GDI transforms the *nWidth* and *nHeight* parameters, once by using the destination device context, and once by using the source device context. If the resulting extents do not match, GDI uses the **StretchBlt** function to compress or stretch the source bitmap as necessary. If destination, source, and pattern bitmaps do not have the same color format, the **BitBlt** function converts the source and pattern bitmaps to match the destination. The foreground and background colors of the destination bitmap are used in the conversion.

When the **BitBlt** function converts a monochrome bitmap to color, it sets white bits (1) to the background color and black bits (0) to the foreground color. The foreground and background colors of the destination device context are used. To convert color to monochrome, **BitBlt** sets pixels that match the background color to white and sets all other pixels to black. **BitBlt** uses the foreground and background colors of the source (color) device context to convert from color to monochrome.

The foreground color is the current text color for the specified device context, and the background color is the current background color for the specified device context.

Not all devices support the **BitBlt** function. An application can determine whether a device supports **BitBlt** by calling the **GetDeviceCaps** function and specifying the **RASTERCAPS** index.

Example

The following example loads a bitmap, retrieves its dimensions, and displays it in a window:

```
HDC hdc, hdcMemory;
HBITMAP hbmpMyBitmap, hbmpOld;
BITMAP bm;

hbmpMyBitmap = LoadBitmap(hinst, "MyBitmap");
GetObject(hbmpMyBitmap, sizeof(BITMAP), &bm);

hdc = GetDC(hwnd);
hdcMemory = CreateCompatibleDC(hdc);
hbmpOld = SelectObject(hdcMemory, hbmpMyBitmap);

BitBlt(hdc, 0, 0, bm.bmWidth, bm.bmHeight, hdcMemory, 0, 0, SRCCOPY);
SelectObject(hdcMemory, hbmpOld);

DeleteDC(hdcMemory);
ReleaseDC(hwnd, hdc);
```

See Also

GetDeviceCaps, **PatBlt**, **SetTextColor**, **StretchBlt**, **StretchDIBits**

BLACKNESS 0x00000042L

Turns all output black.

BLACKNESS 0x00000042L

DSTINVERT 0x00550009L

Inverts the destination bitmap.

DSTINVERT 0x00550009L

MERGECOPY 0x00C000CAL

Combines the pattern and the source bitmap by using the Boolean AND operator.

MERGECOPY 0x00C000CAL

MERGEPAINT 0x00BB0226L

Combines the inverted source bitmap with the destination bitmap by using the Boolean OR operator.

MERGEPAINT 0x00BB0226L

NOTSRCCOPY 0x00330008L

Copies the inverted source bitmap to the destination.

NOTSRCCOPY 0x00330008L

NOTSRCERASE 0x001100A6L

Inverts the result of combining the destination and source bitmaps by using the Boolean OR operator.

NOTSRCERASE 0x001100A6L

PATCOPY 0x00F00021L

Copies the pattern to the destination bitmap.

PATCOPY 0x00F00021L

PATINVERT 0x005A0049L

Combines the destination bitmap with the pattern by using the Boolean XOR operator.

PATINVERT 0x005A0049L

PATPAINT 0x00FB0A09L

Combines the inverted source bitmap with the pattern by using the Boolean OR operator. Combines the result of this operation with the destination bitmap by using the Boolean OR operator.

PATPAINT 0x00FB0A09L

SRCAND 0x008800C6L

Combines pixels of the destination and source bitmaps by using the Boolean AND operator.

SRCAND 0x008800C6L

SRCCOPY 0x00CC0020L

Copies the source bitmap to the destination bitmap.

SRCCOPY 0x00CC0020L

SRCERASE 0x00440328L

Inverts the destination bitmap and combines the result with the source bitmap by using the Boolean AND operator.

SRCERASE 0x00440328L

SRCINVERT 0x00660046L

Combines pixels of the destination and source bitmaps by using the Boolean XOR operator.

SRCINVERT 0x00660046L

SRCPAINT 0x00EE0086L

Combines pixels of the destination and source bitmaps by using the Boolean OR operator.

SRCPAINT 0x00EE0086L

WHITENESS 0x00FF0062L

Turns all output white.

WHITENESS 0x00FF0062L

Chord (2.x)

BOOL Chord(*hdc, nLeftRect, nTopRect, nRightRect, nBottomRect, nXStartLine, nYStartLine, nXEndLine, nYEndLine***)**

```
HDC hdc;          /* handle of device context                          */
int nLeftRect;    /* x-coordinate upper-left corner bounding rectangle */
int nTopRect;     /* y-coordinate upper-left corner bounding rectangle */
int nRightRect;   /* x-coordinate lower-right corner bounding rectangle */
int nBottomRect;  /* y-coordinate lower-right corner bounding rectangle */
int nXStartLine;  /* x-coordinate line-segment starting point          */
int nYStartLine;  /* y-coordinate line-segment starting point          */
int nXEndLine;    /* x-coordinate line-segment ending point            */
int nYEndLine;    /* y-coordinate line-segment ending point            */
```

The **Chord** function draws a chord (a closed figure bounded by the intersection of an ellipse and a line segment).

Parameter	Description
hdc	Identifies the device context.
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the bounding rectangle.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the bounding rectangle.
nRightRect	Specifies the logical x-coordinate of the lower-right corner of the bounding rectangle.
nBottomRect	Specifies the logical y-coordinate of the lower-right corner of the bounding rectangle.
nXStartLine	Specifies the logical x-coordinate of the starting point of the line segment.
nYStartLine	Specifies the logical y-coordinate of the starting point of the line segment.
nXEndLine	Specifies the logical x-coordinate of the ending point of the line segment.
nYEndLine	Specifies the logical y-coordinate of the ending point of the line segment.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The (*nLeftRect, nTopRect*) and (*nRightRect, nBottomRect*) parameter combinations specify the upper-left and lower-right corners, respectively, of a rectangle bounding the ellipse that is part of the chord. The (*nXStartLine, nYStartLine*) and (*nXEndLine, nYEndLine*) parameter combinations specify the endpoints of a line that intersects the ellipse. The chord is drawn by using the selected pen and is filled by using the selected brush.

The figure the **Chord** function draws extends up to but does not include the right and bottom coordinates. This means that the height of the figure is determined as follows:

nBottomRect - nTopRect

The width of the figure is determined similarly:

nRightRect - nLeftRect

Example

The following example uses a **RECT** structure to store the points defining the bounding rectangle and uses **POINT** structures to store the coordinates that specify the beginning and end of the chord:

```
HDC hdc;

RECT rc = { 10, 10, 180, 140 };
POINT ptStart = {  12,  12 };
POINT ptEnd = { 128, 135 };
```

```
Chord(hdc, rc.left, rc.top, rc.right, rc.bottom,
    ptStart.x, ptStart.y, ptEnd.x, ptEnd.y);
```

See Also
Arc, **POINT**, **RECT**

CloseMetaFile (2.x)

HMETAFILE CloseMetaFile(*hdc***)**

HDC *hdc;* /* handle of device context */

The **CloseMetaFile** function closes a metafile device context and creates a handle of a metafile. An application can use this handle to play the metafile.

Parameter	Description
hdc	Identifies the metafile device context to be closed.

Returns
The return value is the handle of the metafile if the function is successful. Otherwise, it is NULL.

Comments
If a metafile handle created by using the **CloseMetaFile** function is no longer needed, you should remove it (using the **DeleteMetaFile** function).

Example
The following example creates a device-context handle of a memory metafile, draws a line in the device context, retrieves a handle of the metafile, plays the metafile, and finally deletes the metafile.

```
HDC hdcMeta;
HMETAFILE hmf;

hdcMeta = CreateMetaFile(NULL);
MoveTo(hdcMeta, 10, 10);
LineTo(hdcMeta, 100, 100);
hmf = CloseMetaFile(hdcMeta);
PlayMetaFile(hdc, hmf);
DeleteMetaFile(hmf);
```

See Also
CreateMetaFile, **DeleteMetaFile**, **PlayMetaFile**

CombineRgn (2.x)

int CombineRgn(*hrgnDest, hrgnSrc1, hrgnSrc2, fCombineMode***)**

```
HRGN hrgnDest;      /* handle of region to receive combined regions  */
HRGN hrgnSrc1;      /* handle of first source region                 */
HRGN hrgnSrc2;      /* handle of second source region                */
int fCombineMode;   /* mode for combining regions                    */
```

The **CombineRgn** function creates a new region by combining two existing regions.

Parameter	Description
hrgnDest	Identifies an existing region that will be replaced by the new region.
hrgnSrc1	Identifies an existing region.
hrgnSrc2	Identifies an existing region.
fCombineMode	Specifies the operation to use when combining the two source regions. This parameter can be any one of the following values:

Value	Meaning
RGN_AND	Uses overlapping areas of both regions (intersection).
RGN_COPY	Creates a copy of region 1 (identified by the *hrgnSrc1* parameter).
RGN_DIFF	Creates a region consisting of the areas of region 1 (identified by *hrgnSrc1*) that are not part of region 2 (identified by the *hrgnSrc2* parameter).
RGN_OR	Combines all of both regions (union).
RGN_XOR	Combines both regions but removes overlapping areas.

Returns

The return value specifies that the resulting region has overlapping borders (COMPLEXREGION), is empty (NULLREGION), or has no overlapping borders (SIMPLEREGION), if the function is successful. Otherwise, the return value is ERROR.

Comments

The size of a region is limited to 32,000 by 32,000 logical units or 64K of memory, whichever is smaller.

The **CombineRgn** function replaces the region identified by the *hrgnDest* parameter with the combined region. To use **CombineRgn** most efficiently, *hrgnDest* should be a trivial region, as shown in the following example.

Example

The following example creates two source regions and an empty destination region, uses the **CombineRgn** function to create a complex region, selects the region into a device context, and then uses the **PaintRgn** function to display the region:

```
HDC hdc;
HRGN hrgnDest, hrgnSrc1, hrgnSrc2;

hrgnDest = CreateRectRgn(0, 0, 0, 0);
hrgnSrc1 = CreateRectRgn(10, 10, 110, 110);
hrgnSrc2 = CreateRectRgn(90, 90, 200, 150);

CombineRgn(hrgnDest, hrgnSrc1, hrgnSrc2, RGN_OR);
SelectObject(hdc, hrgnDest);
PaintRgn(hdc, hrgnDest);
```

See Also

CreateRectRgn, **PaintRgn**

RGN_AND 1

Uses overlapping areas of both regions (intersection).

RGN_AND 1

RGN_COPY 5

Creates a copy of region 1 (identified by the *hrgnSrc1* parameter).

RGN_COPY 5

RGN_DIFF 4

Creates a region consisting of the areas of region 1 (identified by *hrgnSrc1*) that are not part of region 2 (identified by the *hrgnSrc2* parameter).

RGN_DIFF 4

RGN_OR 2

Combines all of both regions (union).

RGN_OR 2

RGN_XOR 3

Combines both regions but removes overlapping areas.

RGN_XOR 3

CopyMetaFile (2.x)

HMETAFILE CopyMetaFile(*hmfSrc, lpszFile***)**

HMETAFILE *hmfSrc;* /* handle of metafile to copy */
LPCSTR *lpszFile;* /* address of name of copied metafile */

The **CopyMetaFile** function copies a source metafile to a specified file and returns a handle of the new metafile.

Parameter	Description
hmfSrc	Identifies the source metafile to be copied.
lpszFile	Points to a null-terminated string that specifies the filename of the copied metafile. If this value is NULL, the source metafile is copied to a memory metafile.

Returns
The return value is the handle of the new metafile if the function is successful. Otherwise, it is NULL.

Example
The following example copies a metafile to a specified file, plays the copied metafile, retrieves a handle of the copied metafile, changes the position at which the metafile is played 200 logical units to the right, and then plays the metafile at the new location:

```
HANDLE hmf, hmfSource, hmfOld;
LPSTR lpszFile1 = "MFTest";

hmf = CopyMetaFile(hmfSource, lpszFile1);
PlayMetaFile(hdc, hmf);
DeleteMetaFile(hmf);

hmfOld = GetMetaFile(lpszFile1);
SetWindowOrg(hdc, -200, 0);
PlayMetaFile(hdc, hmfOld);

DeleteMetaFile(hmfSource);
DeleteMetaFile(hmfOld);
```

See Also
GetMetaFile, **PlayMetaFile**, **SetWindowOrg**

CreateBitmap (2.x)

HBITMAP CreateBitmap(*nWidth, nHeight, cbPlanes, cbBits, lpvBits***)**

```
int nWidth;                 /* bitmap width                    */
int nHeight;                /* bitmap height                   */
UINT cbPlanes;              /* number of color planes          */
UINT cbBits;                /* number of bits per pixel        */
const void FAR* lpvBits;    /* address of array with bitmap bits */
```

The **CreateBitmap** function creates a device-dependent memory bitmap that has the specified width, height, and bit pattern.

Parameter	Description
nWidth	Specifies the width, in pixels, of the bitmap.
nHeight	Specifies the height, in pixels, of the bitmap.
cbPlanes	Specifies the number of color planes in the bitmap. The number of bits per plane is the product of the plane's width, height, and bits per pixel (*nWidth* ” *nHeight* ” *cbBits*).
cbBits	Specifies the number of color bits per display pixel.
lpvBits	Points to an array of short integers that contains the initial bitmap bit values. If this parameter is NULL, the new bitmap is left uninitialized.

Returns

The return value is the handle of the bitmap if the function is successful. Otherwise, it is NULL.

Comments

The bitmap created by the **CreateBitmap** function can be selected as the current bitmap for a memory device context by using the **SelectObject** function.

For a color bitmap, either the *cbPlanes* or *cbBits* parameter should be set to 1. If both of these parameters are set to 1, **CreateBitmap** creates a monochrome bitmap.

Although a bitmap cannot be copied directly to a display device, the **BitBlt** function can copy it from a memory device context (in which it is the current bitmap) to any compatible device context, including a screen device context.

When it has finished using a bitmap created by **CreateBitmap**, an application should select the bitmap out of the device context and then remove the bitmap by using the **DeleteObject** function.

Example

The following example uses the **CreateBitmap** function to create a bitmap with a zigzag pattern and then uses the **PatBlt** function to fill the client area with that pattern:

```
HDC hdc;
HBITMAP hbmp;
HBRUSH hbr, hbrPrevious;
RECT rc;

int aZigzag[] = { 0xFF, 0xF7, 0xEB, 0xDD, 0xBE, 0x7F, 0xFF, 0xFF };

hbmp = CreateBitmap(8, 8, 1, 1, aZigzag);
hbr = CreatePatternBrush(hbmp);

hdc = GetDC(hwnd);
UnrealizeObject(hbr);
hbrPrevious = SelectObject(hdc, hbr);
GetClientRect(hwnd, &rc);
```

```
PatBlt(hdc, rc.left, rc.top,
    rc.right - rc.left, rc.bottom - rc.top, PATCOPY);
SelectObject(hdc, hbrPrevious);
ReleaseDC(hwnd, hdc);

DeleteObject(hbr);
DeleteObject(hbmp);
```

See Also

BitBlt, **CreateBitmapIndirect**, **CreateCompatibleBitmap**, **CreateDIBitmap**, **CreateDiscardableBitmap**, **DeleteObject**, **SelectObject**

CreateBitmapIndirect (2.x)

HBITMAP CreateBitmapIndirect(*lpbm***)**

BITMAP FAR* *lpbm;* /* address of structure with bitmap information*/

The **CreateBitmapIndirect** function creates a bitmap that has the width, height, and bit pattern specified in a **BITMAP** structure.

Parameter	Description
lpbm	Points to a **BITMAP** structure that contains information about the bitmap.

Returns
The return value is the handle of the bitmap if the function is successful. Otherwise, it is NULL.

Comments
Large bitmaps cannot be displayed on a display device by copying them directly to the device context for that device. Instead, applications should create a memory device context that is compatible with the display device, select the bitmap as the current bitmap for the memory device context, and then use a function such as **BitBlt** or **StretchBlt** to copy it from the memory device context to the display device context. (The **PatBlt** function can copy the bitmap for the current brush directly to the display device context.)

When an application has finished using the bitmap created by the **CreateBitmapIndirect** function, it should select the bitmap out of the device context and then delete the bitmap by using the **DeleteObject** function.

If the **BITMAP** structure pointed to by the *lpbm* parameter has been filled in by using the **GetObject** function, the bits of the bitmap are not specified, and the bitmap is uninitialized. To initialize the bitmap, an application can use a function such as **BitBlt** or **SetDIBits** to copy the bits from the bitmap identified by the first parameter of **GetObject** to the bitmap created by **CreateBitmapIndirect**.

Example
The following example assigns values to the members of a **BITMAP** structure and then calls the **CreateBitmapIndirect** function to create a bitmap handle:

```
BITMAP bm;
HBITMAP hbm;

int aZigzag[] = { 0xFF, 0xF7, 0xEB, 0xDD, 0xBE, 0x7F, 0xFF, 0xFF };

bm.bmType = 0;
bm.bmWidth = 8;
bm.bmHeight = 8;
bm.bmWidthBytes = 2;
bm.bmPlanes = 1;
bm.bmBitsPixel = 1;
bm.bmBits = aZigzag;

hbm = CreateBitmapIndirect(&bm);
```

See Also
BitBlt, **CreateBitmap**, **CreateCompatibleBitmap**, **CreateDIBitmap**, **CreateDiscardableBitmap**, **DeleteObject**, **GetObject**, **BITMAP**

CreateBrushIndirect (2.x)

HBRUSH CreateBrushIndirect(*lplb***)**

LOGBRUSH FAR* *lplb;* /* address of structure with brush attributes */

The **CreateBrushIndirect** function creates a brush that has the style, color, and pattern specified in a **LOGBRUSH** structure. The brush can subsequently be selected as the current brush for any device.

Parameter	Description
lplb	Points to a **LOGBRUSH** structure that contains information about the brush.

Returns

The return value is the handle of the brush if the function is successful. Otherwise, it is NULL.

Comments

A brush created by using a monochrome (one plane, one bit per pixel) bitmap is drawn by using the current text and background colors. Pixels represented by a bit set to 0 are drawn with the current text color, and pixels represented by a bit set to 1 are drawn with the current background color.

When it has finished using a brush created by **CreateBrushIndirect**, an application should select the brush out of the device context in which it was used and then remove the brush by using the **DeleteObject** function.

Example

The following example creates a hatched brush with red diagonal hatch marks and uses that brush to fill a rectangle:

```
LOGBRUSH lb;
HBRUSH hbr, hbrOld;

lb.lbStyle = BS_HATCHED;
lb.lbColor = RGB(255, 0, 0);
lb.lbHatch = HS_BDIAGONAL;

hbr = CreateBrushIndirect(&lb);
hbrOld = SelectObject(hdc, hbr);
Rectangle(hdc, 0, 0, 100, 100);
```

See Also

CreateDIBPatternBrush, **CreatePatternBrush**, **CreateSolidBrush**, **DeleteObject**, **GetStockObject**, **SelectObject**, **LOGBRUSH**, **RGB**

CreateCompatibleBitmap (2.x)

HBITMAP CreateCompatibleBitmap(*hdc, nWidth, nHeight***)**

HDC *hdc;* /* handle of device context */
int *nWidth;* /* bitmap width */
int *nHeight;* /* bitmap height */

The **CreateCompatibleBitmap** function creates a bitmap that is compatible with the given device.

Parameter	Description
hdc	Identifies the device context.
nWidth	Specifies the width, in bits, of the bitmap.
nHeight	Specifies the height, in bits, of the bitmap.

Returns
The return value is the handle of the bitmap if the function is successful. Otherwise, it is NULL.

Comments
The bitmap created by the **CreateCompatibleBitmap** function has the same number of color planes or the same bits-per-pixel format as the given device. It can be selected as the current bitmap for any memory device that is compatible with the one identified by *hdc.*

If *hdc* identifies a memory device context, the bitmap returned has the same format as the currently selected bitmap in that device context. A memory device context is a memory object that represents a screen surface. It can be used to prepare images in memory before copying them to the screen surface of the compatible device.

When a memory device context is created, the graphics device interface (**GDI**) automatically selects a monochrome stock bitmap for it.

Since a color memory device context can have either color or monochrome bitmaps selected, the format of the bitmap returned by the **CreateCompatibleBitmap** function is not always the same; however, the format of a compatible bitmap for a non–memory device context is always in the format of the device.

When it has finished using a bitmap created by **CreateCompatibleBitmap**, an application should select the bitmap out of the device context and then remove the bitmap by using the **DeleteObject** function.

Example
The following example shows a function named DuplicateBitmap that accepts the handle of a bitmap, duplicates the bitmap, and returns a handle of the duplicate. This function uses the **CreateCompatibleDC** function to create source and destination device contexts and then uses the **GetObject** function to retrieve the dimensions of the source bitmap. The **CreateCompatibleBitmap** function uses these dimensions to create a new bitmap. When each bitmap has been selected into a device context, the **BitBlt** function copies the bits from the source bitmap to the new bitmap. (Although an application could use the **GetDIBits** and **SetDIBits** functions to duplicate a bitmap, the method illustrated in this example is much faster.)

```
HBITMAP PASCAL DuplicateBitmap(HBITMAP hbmpSrc)
{
    HBITMAP hbmpOldSrc, hbmpOldDest, hbmpNew;
    HDC     hdcSrc, hdcDest;
    BITMAP  bmp;

    hdcSrc = CreateCompatibleDC(NULL);
    hdcDest = CreateCompatibleDC(hdcSrc);

    GetObject(hbmpSrc, sizeof(BITMAP), &bmp);
```

```
    hbmpOldSrc = SelectObject(hdcSrc, hbmpSrc);

    hbmpNew = CreateCompatibleBitmap(hdcSrc, bmp.bmWidth,
        bmp.bmHeight);

    hbmpOldDest = SelectObject(hdcDest, hbmpNew);

    BitBlt(hdcDest, 0, 0, bmp.bmWidth, bmp.bmHeight, hdcSrc, 0, 0,
        SRCCOPY);

    SelectObject(hdcDest, hbmpOldDest);
    SelectObject(hdcSrc, hbmpOldSrc);

    DeleteDC(hdcDest);
    DeleteDC(hdcSrc);

    return hbmpNew;
}
```

See Also

CreateBitmap, **CreateBitmapIndirect**, **CreateDIBitmap**, **DeleteObject**

CreateCompatibleDC (2.x)

HDC CreateCompatibleDC(*hdc***)**

HDC *hdc;* /* handle of device context */

The **CreateCompatibleDC** function creates a memory device context that is compatible with the given device.

An application must select a bitmap into a memory device context to represent a screen surface. The device context can then be used to prepare images in memory before copying them to the screen surface of the compatible device.

Parameter	Description
hdc	Identifies the device context. If this parameter is NULL, the function creates a memory device context that is compatible with the system screen.

Returns

The return value is the handle of the new memory device context if the function is successful. Otherwise, it is NULL.

Comments

The **CreateCompatibleDC** function can be used only to create compatible device contexts for devices that support raster operations. To determine whether a device supports raster operations, an application can call the **GetDeviceCaps** function with the RC_BITBLT index.

GDI output functions can be used with a memory device context only if a bitmap has been created and selected into that context.

When it has finished using a device context created by **CreateCompatibleDC**, an application should free the device context by calling the **DeleteDC** function. All objects selected into the device context after it was created should be selected out and replaced with the original objects before the device context is removed.

Example

The following example loads a bitmap named Dog, uses the **CreateCompatibleDC** function to create a memory device context that is compatible with the screen, selects the bitmap into the memory device context, and then uses the **BitBlt** function to move the bitmap from the memory device context to the screen device context:

```
HDC hdc, hdcMemory;
HBITMAP hbmpMyBitmap, hbmpOld;
BITMAP bm;

hbmpMyBitmap = LoadBitmap(hinst, "MyBitmap");
GetObject(hbmpMyBitmap, sizeof(BITMAP), &bm);

hdc = GetDC(hwnd);
hdcMemory = CreateCompatibleDC(hdc);
hbmpOld = SelectObject(hdcMemory, hbmpMyBitmap);

BitBlt(hdc, 0, 0, bm.bmWidth, bm.bmHeight, hdcMemory, 0, 0, SRCCOPY);
SelectObject(hdcMemory, hbmpOld);

DeleteDC(hdcMemory);
ReleaseDC(hwnd, hdc);
```

See Also

DeleteDC, **GetDeviceCaps**

CreateDC (2.x)

#include <print.h>

HDC CreateDC(*lpszDriver, lpszDevice, lpszOutput, lpvInitData***)**

```
LPCSTR lpszDriver;          /* address of driver name          */
LPCSTR lpszDevice;          /* address of device name          */
LPCSTR lpszOutput;          /* address of filename or port name */
const void FAR* lpvInitData; /* address of initialization data  */
```

The **CreateDC** function creates a device context for the given device.

Parameter	Description
lpszDriver	Points to a null-terminated string that specifies the MS-DOS filename (without extension) of the device driver (for example, Epson).
lpszDevice	Points to a null-terminated string that specifies the name of the specific device to be supported (for example, Epson FX-80). This parameter is used if the module supports more than one device.
lpszOutput	Points to a null-terminated string that specifies the MS-DOS filename or device name for the physical output medium (file or output port).
lpvInitData	Points to a **DEVMODE** structure that contains device-specific initialization information for the device driver. The **ExtDeviceMode** function retrieves this structure already filled in for a given device. The *lpvInitData* parameter must be NULL if the device driver is to use the default initialization (if any) specified by the user through Windows Control Panel.

Returns

The return value is the handle of the device context for the specified device if the function is successful. Otherwise, it is NULL.

Comments

The PRINT.H header file is required if the **DEVMODE** structure is used.

Device contexts created by using the **CreateDC** function must be deleted by using the **DeleteDC** function. All objects selected into the device context after it was created should be selected out and replaced with the original objects before the device context is deleted.

MS-DOS device names follow MS-DOS conventions; an ending colon (:) is recommended, but optional. Windows strips the terminating colon so that a device name ending with a colon is mapped to the same port as the same name without a colon. The driver and port names must not contain leading or trailing spaces.

Example

The following example uses the **CreateDC** function to create a device context for a printer, using information returned by the **PrintDlg** function in a **PRINTDLG** structure:

```
PRINTDLG   pd;
HDC        hdc;
LPDEVNAMES lpDevNames;
LPSTR      lpszDriverName;
LPSTR      lpszDeviceName;
LPSTR      lpszPortName;

/*
 * PrintDlg displays the common dialog box for printing. The
 * PRINTDLG structure should be initialized with appropriate values.
 */
```

```
PrintDlg(&pd);
lpDevNames = (LPDEVNAMES) GlobalLock(pd.hDevNames);
lpszDriverName = (LPSTR) lpDevNames + lpDevNames->wDriverOffset;
lpszDeviceName = (LPSTR) lpDevNames + lpDevNames->wDeviceOffset;
lpszPortName   = (LPSTR) lpDevNames + lpDevNames->wOutputOffset;
GlobalUnlock(pd.hDevNames);
hdc = CreateDC(lpszDriverName, lpszDeviceName, lpszPortName, NULL);
```

See Also

CreateIC, **DeleteDC**, **ExtDeviceMode**, **PrintDlg**, **DEVMODE**, **PRINTDLG**

CreateDIBitmap (3.0)

HBITMAP CreateDIBitmap(*hdc, lpbmih, dwInit, lpvBits, lpbmi, fnColorUse***)**

```
HDC hdc;                              /* handle of device context          */
BITMAPINFOHEADER FAR* lpbmih;         /* address of structure with header  */
DWORD dwInit;                         /* CBM_INIT to initialize bitmap     */
const void FAR* lpvBits;              /* address of array with bitmap values */
BITMAPINFO FAR* lpbmi;                /* address of structure with bitmap data */
UINT fnColorUse;                      /* RGB or palette indices            */
```

The **CreateDIBitmap** function creates a device-specific memory bitmap from a device-independent bitmap (DIB) specification and optionally sets bits in the bitmap.

Parameter	Description
hdc	Identifies the device context.
lpbmih	Points to a **BITMAPINFOHEADER** structure that describes the size and format of the device-independent bitmap.
dwInit	Specifies whether the memory bitmap is initialized. If this value is CBM_INIT, the function initializes the bitmap with the bits specified by the *lpvBits* and *lpbmi* parameters.
lpvBits	Points to a byte array that contains the initial bitmap values. The format of the bitmap values depends on the **biBitCount** member of the **BITMAPINFOHEADER** structure identified by the *lpbmi* parameter.
lpbmi	Points to a **BITMAPINFO** structure that describes the dimensions and color format of the *lpvBits* parameter. The **BITMAPINFO** structure contains a **BITMAPINFOHEADER** structure and an array of **RGBQUAD** structures specifying the colors in the bitmap.
fnColorUse	Specifies whether the **bmiColors** member of the **BITMAPINFO** structure contains explicit red, green, blue (**RGB**) values or indices into the currently realized logical palette. The *fnColorUse* parameter must be one of the following values:

Value	Meaning
DIB_PAL_COLORS	The color table consists of an array of 16-bit indices into the currently realized logical palette.
DIB_RGB_COLORS	The color table contains literal **RGB** values.

Returns

The return value is the handle of the bitmap if the function is successful. Otherwise, it is NULL.

When it has finished using a bitmap created by **CreateDIBitmap**, an application should select the bitmap out of the device context and then remove the bitmap by using the **DeleteObject** function.

Example

The following example initializes an array of bits and an array of **RGBQUAD** structures, allocates memory for the bitmap header and color table, fills in the required members of a **BITMAPINFOHEADER** structure, and calls the **CreateDIBitmap** function to create a handle of the bitmap:

```
HANDLE hloc;
PBITMAPINFO pbmi;
HBITMAP hbm;

BYTE aBits[] = { 0x00, 0x00, 0x00, 0x00,    /* bottom row */
                 0x01, 0x12, 0x22, 0x11,
                 0x01, 0x12, 0x22, 0x11,
                 0x02, 0x20, 0x00, 0x22,
                 0x02, 0x20, 0x20, 0x22,
                 0x02, 0x20, 0x00, 0x22,
```

```
                0x01, 0x12, 0x22, 0x11,
                0x01, 0x12, 0x22, 0x11 };  /* top row    */

RGBQUAD argbq[] = {{ 255, 0, 0, 0 },        /* blue       */
                  { 0, 255, 0, 0 },         /* green      */
                  { 0, 0, 255, 0 }};        /* red        */

hloc = LocalAlloc(LMEM_ZEROINIT | LMEM_MOVEABLE,
    sizeof(BITMAPINFOHEADER) + (sizeof(RGBQUAD) * 16));
pbmi = (PBITMAPINFO) LocalLock(hloc);

pbmi->bmiHeader.biSize = sizeof(BITMAPINFOHEADER);
pbmi->bmiHeader.biWidth = 8;
pbmi->bmiHeader.biHeight = 8;
pbmi->bmiHeader.biPlanes = 1;
pbmi->bmiHeader.biBitCount = 4;
pbmi->bmiHeader.biCompression = BI_RGB;

memcpy(pbmi->bmiColors, argbq, sizeof(RGBQUAD) * 3);

hbm = CreateDIBitmap(hdcLocal, (BITMAPINFOHEADER FAR*) pbmi, CBM_INIT,
    aBits, pbmi, DIB_RGB_COLORS);
LocalFree(hloc);
    .
    . /* Use the bitmap handle. */
    .
DeleteObject(hbm);
```

See Also

CreateBitmap, **CreateBitmapIndirect**, **CreateCompatibleBitmap**, **CreateDiscardableBitmap**, **DeleteObject**, **BITMAPCOREHEADER**, **BITMAPCOREINFO**, **BITMAPINFO**, **BITMAPINFOHEADER**, **RGBQUAD**

DIB_PAL_COLORS 1

The color table consists of an array of 16-bit indices into the currently realized logical palette.

DIB_PAL_COLORS 1

DIB_RGB_COLORS 0

The color table contains literal **RGB** values.

DIB_RGB_COLORS 0

CreateDIBPatternBrush (3.0)

HBRUSH CreateDIBPatternBrush(*hglbDIBPacked, fnColorSpec***)**

HGLOBAL *hglbDIBPacked;* /* handle of device-independent bitmap */
UINT *fnColorSpec;* /* type of color table */

The **CreateDIBPatternBrush** function creates a brush that has the pattern specified by a device-independent bitmap (DIB). The brush can subsequently be selected for any device that supports raster operations.

Parameter	Description
hglbDIBPacked	Identifies a global memory object containing a packed device-independent bitmap. A packed DIB consists of a **BITMAPINFO** structure immediately followed by the array of bytes that define the pixels of the bitmap.
fnColorSpec	Specifies whether the **bmiColors** member(s) of the **BITMAPINFO** structure contain explicit red, green, blue (**RGB**) values or indices into the currently realized logical palette. This parameter must be one of the following values:

Value	Meaning
DIB_PAL_COLORS	The color table consists of an array of 16-bit indices into the currently realized logical palette.
DIB_RGB_COLORS	The color table contains literal **RGB** values.

Returns
The return value is the handle of the brush if the function is successful. Otherwise, it is NULL.

Comments
To retrieve the handle identified by the *hglbDIBPacked* parameter, an application calls the **GlobalAlloc** function to allocate a global memory object and then fills the memory with the packed DIB.

Bitmaps used as fill patterns should be 8 pixels by 8 pixels. If such a bitmap is larger, Windows creates a fill pattern using only the bits corresponding to the first 8 rows and 8 columns of pixels in the upper-left corner of the bitmap.

When an application selects a two-color DIB pattern brush into a monochrome device context, Windows ignores the colors specified in the DIB and instead displays the pattern brush, using the current text and background colors of the device context. Pixels mapped to the first color (at offset 0 in the DIB color table) of the DIB are displayed using the text color, and pixels mapped to the second color (at offset 1 in the color table) are displayed using the background color.

When it has finished using a brush created by **CreateDIBPatternBrush**, an application should remove the brush by using the **DeleteObject** function.

Example
The following example retrieves a bitmap named DIBit from the application's resource file, uses the bitmap to create a pattern brush in a call to the **CreateDIBPatternBrush** function, selects the brush into a device context, and fills a rectangle by using the new brush:

```
HRSRC hrsrc;
HGLOBAL hglbl;
HBRUSH hbr, hbrOld;

hrsrc = FindResource(hinst, "DIBit", RT_BITMAP);
hglbl = LoadResource(hinst, hrsrc);
LockResource(hglbl);

hbr = CreateDIBPatternBrush(hglbl, DIB_RGB_COLORS);
```

```
hbrOld = SelectObject(hdc, hbr);
Rectangle(hdc, 10, 10, 100, 100);
UnlockResource(hglbl);
```

See Also

CreatePatternBrush, **DeleteObject**, **FindResource**, **GetDeviceCaps**, **GlobalAlloc**, **LoadResource**, **LockResource**, **SelectObject**, **SetBkColor**, **SetTextColor**, **UnlockResource**, **BITMAPINFO**

CreateDiscardableBitmap (2.x)

HBITMAP CreateDiscardableBitmap(*hdc, nWidth, nHeight***)**

```
HDC hdc;        /* handle of device context */
int nWidth;     /* bitmap width             */
int nHeight;    /* bitmap height            */
```

The **CreateDiscardableBitmap** function creates a discardable bitmap that is compatible with the given device. The bitmap has the same number of color planes or the same bits-per-pixel format as the device. An application can select this bitmap as the current bitmap for a memory device that is compatible with the one identified by the *hdc* parameter.

Parameter	Description
hdc	Identifies the device context.
nWidth	Specifies the width, in bits, of the bitmap.
nHeight	Specifies the height, in bits, of the bitmap.

Returns

The return value is the handle of the bitmap if the function is successful. Otherwise, it is NULL.

Comments

Windows can discard a bitmap created by this function only if an application has not selected it into a device context. If Windows discards the bitmap when it is not selected and the application later attempts to select it, the **SelectObject** function will return zero.

Applications should use the **DeleteObject** function to delete the handle returned by the **CreateDiscardableBitmap** function, even if Windows has discarded the bitmap.

See Also

CreateBitmap, **CreateBitmapIndirect**, **CreateDIBitmap**, **DeleteObject**

CreateEllipticRgn (2.x)

HRGN CreateEllipticRgn(*nLeftRect, nTopRect, nRightRect, nBottomRect***)**

```
int nLeftRect;      /* x-coordinate upper-left corner bounding rectangle  */
int nTopRect;       /* y-coordinate upper-left corner bounding rectangle  */
int nRightRect;     /* x-coordinate lower-right corner bounding rectangle */
int nBottomRect;    /* y-coordinate lower-right corner bounding rectangle */
```

The **CreateEllipticRgn** function creates an elliptical region.

Parameter	Description
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the bounding rectangle of the ellipse.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the bounding rectangle of the ellipse.
nRightRect	Specifies the logical x-coordinate of the lower-right corner of the bounding rectangle of the ellipse.
nBottomRect	Specifies the logical y-coordinate of the lower-right corner of the bounding rectangle of the ellipse.

Returns

The return value is the handle of the region if the function is successful. Otherwise, it is NULL.

Comments

The size of a region is limited to 32,767 by 32,767 logical units or 64K of memory, whichever is smaller.

When it has finished using a region created by using the **CreateEllipticRgn** function, an application should remove it by using the **DeleteObject** function.

See Also

CreateEllipticRgnIndirect, **DeleteObject**, **PaintRgn**

CreateEllipticRgnIndirect (2.x)

HRGN CreateEllipticRgnIndirect(*lprc***)**

const RECT FAR* *lprc;* /* address of structure with bounding rectangle */

The **CreateEllipticRgnIndirect** function creates an elliptical region.

Parameter	Description
lprc	Points to a **RECT** structure that contains the logical coordinates of the upper-left and lower-right corners of the bounding rectangle of the ellipse.

Returns
The return value is the handle of the region if the function is successful. Otherwise, it is NULL.

Comments
The size of a region is limited to 32,767 by 32,767 logical units or 64K of memory, whichever is smaller.

When it has finished using a region created by **CreateEllipticRgnIndirect**, an application should remove the region by using the **DeleteObject** function.

Example
The following example assigns values to the members of a **RECT** structure, uses the **CreateEllipticRgnIndirect** function to create an elliptical region, selects the region into a device context, and then uses the **PaintRgn** function to display the region:

```
HDC hdc;
RECT rc;
HRGN hrgn;

SetRect(&rc, 10, 10, 200, 50);

hrgn = CreateEllipticRgnIndirect(&rc);
SelectObject(hdc, hrgn);
PaintRgn(hdc, hrgn);
```

See Also
CreateEllipticRgn, **DeleteObject**, **PaintRgn**, **RECT**

CreateFont (2.x)

HFONT CreateFont(*nHeight, nWidth, nEscapement, nOrientation, fnWeight, fbItalic, fbUnderline, fbStrikeOut, fbCharSet, fbOutputPrecision, fbClipPrecision, fbQuality, fbPitchAndFamily, lpszFace***)**

```
int nHeight;                /* font height                    */
int nWidth;                 /* character width                */
int nEscapement;            /* escapement of line of text     */
int nOrientation;           /* angle of base line and x-axis  */
int fnWeight;               /* font weight                    */
BYTE fbItalic;              /* flag for italic attribute      */
BYTE fbUnderline;           /* flag for underline attribute   */
BYTE fbStrikeOut;           /* flag for strikeout attribute   */
BYTE fbCharSet;             /* character set                  */
BYTE fbOutputPrecision;     /* output precision               */
BYTE fbClipPrecision;       /* clipping precision             */
BYTE fbQuality;             /* output quality                 */
BYTE fbPitchAndFamily;      /* pitch and family               */
LPCSTR lpszFace;            /* address of typeface name       */
```

The **CreateFont** function creates a logical font that has the specified characteristics. The logical font can subsequently be selected as the font for any device.

Parameter	Description
nHeight	Specifies the requested height, in logical units, for the font. If this parameter is greater than zero, it specifies the cell height of the font. If it is less than zero, it specifies the character height of the font. (Character height is the cell height minus the internal leading. Applications that specify font height in points typically use a negative number for this member.) If this parameter is zero, the font mapper uses a default height. The font mapper chooses the largest physical font that does not exceed the requested size (or the smallest font, if all the fonts exceed the requested size). The absolute value of the *nHeight* parameter must not exceed 16,384 after it is converted to device units.
nWidth	Specifies the average width, in logical units, of characters in the font. If this parameter is zero, the font mapper chooses a "closest match" default width for the specified font height. (The default width is chosen by matching the aspect ratio of the device against the digitization aspect ratio of the available fonts. The closest match is determined by the absolute value of the difference.)
nEscapement	Specifies the angle, in tenths of degrees, between the escapement vector and the x-axis of the screen surface. The escapement vector is the line through the origins of the first and last characters on a line. The angle is measured counterclockwise from the x-axis.
nOrientation	Specifies the angle, in tenths of degrees, between the base line of a character and the x-axis. The angle is measured in a counterclockwise direction from the x-axis for left-handed coordinate systems (that is, MM_TEXT, in which the y-direction is down) and in a clockwise direction from the x-axis for right-handed coordinate systems (in which the y-direction is up).
fnWeight	Specifies the font weight. This parameter can be one of the following values:

Constant	Value
FW_DONTCARE	0
FW_THIN	100
FW_EXTRALIGHT	200
FW_ULTRALIGHT	200

FW_LIGHT	300
FW_NORMAL	400
FW_REGULAR	400
FW_MEDIUM	500
FW_SEMIBOLD	600
FW_DEMIBOLD	600
FW_BOLD	700
FW_EXTRABOLD	800
FW_ULTRABOLD	800
FW_BLACK	900
FW_HEAVY	900

The appearance of the font depends on the typeface. Some fonts have only FW_NORMAL, FW_REGULAR, and FW_BOLD weights. If FW_DONTCARE is specified, a default weight is used.

fbItalic Specifies an italic font if set to nonzero.

fbUnderline Specifies an underlined font if set to nonzero.

fbStrikeOut Specifies a strikeout font if set to nonzero.

fbCharSet Specifies the character set of the font. The following values are predefined:

Constant	Value
ANSI_CHARSET	0
DEFAULT_CHARSET	1
SYMBOL_CHARSET	2
SHIFTJIS_CHARSET	128
OEM_CHARSET	255

The DEFAULT_CHARSET value is not used by the font mapper. An application can use this value to allow the name and size of a font to fully describe the logical font. If the specified font name does not exist, a font from any character set can be substituted for the specified font; to avoid unexpected results, applications should use the DEFAULT_CHARSET value sparingly.

The OEM character set is system-dependent.

Fonts with other character sets may exist in the system. If an application uses a font with an unknown character set, it should not attempt to translate or interpret strings that are to be rendered with that font.

fbOutputPrecision Specifies the requested output precision. The output precision defines how closely the output must match the requested font's height, width, character orientation, escapement, and pitch. This parameter can be one of the following values:

OUT_CHARACTER_PRECIS
OUT_DEFAULT_PRECIS
OUT_DEVICE_PRECIS
OUT_RASTER_PRECIS
OUT_STRING_PRECIS
OUT_STROKE_PRECIS
OUT_TT_PRECIS

Applications can use the OUT_DEVICE_PRECIS, OUT_RASTER_PRECIS, and OUT_TT_PRECIS values to control how the font mapper chooses a font when the system contains more than one font with a given name. For example, if a system contained a font named Symbol in raster and TrueType form, specifying

OUT_TT_PRECIS would force the font mapper to choose the TrueType version. (Specifying OUT_TT_PRECIS forces the font mapper to choose a TrueType font whenever the specified font name matches a device or raster font, even when there is no TrueType font of the same name.)

fbClipPrecision Specifies the requested clipping precision. The clipping precision defines how to clip characters that are partially outside the clipping region. This parameter can be one of the following values:

CLIP_CHARACTER_PRECIS
CLIP_DEFAULT_PRECIS
CLIP_ENCAPSULATE
CLIP_LH_ANGLES
CLIP_MASK
CLIP_STROKE_PRECIS
CLIP_TT_ALWAYS

To use an embedded read-only font, applications must specify CLIP_ENCAPSULATE.

To achieve consistent rotation of device, TrueType, and vector fonts, an application can use the OR operator to combine the CLIP_LH_ANGLES value with any of the other *fbClipPrecision* values. If the CLIP_LH_ANGLES bit is set, the rotation for all fonts is dependent on whether the orientation of the coordinate system is left-handed or right-handed. If CLIP_LH_ANGLES is not set, device fonts always rotate counterclockwise, but the rotation of other fonts is dependent on the orientation of the coordinate system. (For more information about the orientation of coordinate systems, see the description of the *nOrientation* parameter.)

fbQuality Specifies the output quality of the font, which defines how carefully the graphics device interface (**GDI**) must attempt to match the attributes of a logical font to those of a physical font. This parameter can be one of the following values:

Value	Meaning
DEFAULT_QUALITY	Appearance of the font does not matter.
DRAFT_QUALITY	Appearance of the font is less important than when the PROOF_QUALITY value is used. For **GDI** raster fonts, scaling is enabled. Bold, italic, underline, and strikeout fonts are synthesized if necessary.
PROOF_QUALITY	Character quality of the font is more important than exact matching of the logical-font attributes. For **GDI** raster fonts, scaling is disabled and the font closest in size is chosen. Bold, italic, underline, and strikeout fonts are synthesized if necessary.

fbPitchAndFamily Specifies the pitch and family of the font. The two low-order bits specify the pitch of the font and can be one of the following values:

DEFAULT_PITCH
FIXED_PITCH
VARIABLE_PITCH

Applications can set bit 2 (0x04) of the **lfPitchAndFamily** member to choose a TrueType font.

The four high-order bits specify the font family and can be one of the following values:

Value	Meaning
FF_DECORATIVE	Novelty fonts. Old English is an example.

	FF_DONTCARE	Don't care or don't know.
	FF_MODERN	Fonts with constant stroke width, with or without serifs. Pica, Elite, and Courier New are examples.
	FF_ROMAN	Fonts with variable stroke width and with serifs. Times New Roman and New Century Schoolbook are examples.
	FF_SCRIPT	Fonts designed to look like handwriting. Script and Cursive are examples.
	FF_SWISS	Fonts with variable stroke width and without serifs. MS Sans Serif is an example.
	An application can specify a value for the *fbPitchAndFamily* parameter by using the Boolean OR operator to join a pitch constant with a family constant.	
	Font families describe the look of a font in a general way. They are intended for specifying fonts when the exact typeface requested is not available.	
lpszFace	Points to a null-terminated string that specifies the typeface name of the font. The length of this string must not exceed LF_FACESIZE - 1. The **EnumFontFamilies** function can be used to enumerate the typeface names of all currently available fonts. If this parameter is NULL, **GDI** uses a device-dependent typeface.	

Returns

The return value is the handle of the logical font if the function is successful. Otherwise, it is NULL.

Comments

The **CreateFont** function creates the handle of a logical font. The font mapper uses this logical font to find the closest match from the fonts available in **GDI**'s pool of physical fonts.

Applications can use the default settings for most of these parameters when creating a logical font. The parameters that should always be given specific values are *nHeight* and *lpszFace.* If *nHeight* and *lpszFace* are not set by the application, the logical font that is created is device-dependent.

Fonts created by using the **CreateFont** function must be selected out of any device context in which they were used and then removed by using the **DeleteObject** function.

Example

The following example sets the mapping mode to MM_TWIPS and then uses the **CreateFont** function to create an 18-point logical font:

```
HFONT hfont, hfontOld;
int MapModePrevious, iPtSize = 18;
PSTR pszFace = "MS Serif";

MapModePrevious = SetMapMode(hdc, MM_TWIPS);
hfont = CreateFont(-iPtSize * 20, 0, 0, 0, 0, /* specify pt size    */
    0, 0, 0, 0, 0, 0, 0, 0, pszFace);         /* and face name only */

hfontOld = SelectObject(hdc, hfont);

TextOut(hdc, 100, -500, pszFace, strlen(pszFace));
SetMapMode(hdc, MapModePrevious);
SelectObject(hdc, hfontOld);
DeleteObject(hfont);
```

See Also

CreateFontIndirect, **DeleteObject**, **EnumFontFamilies**

CreateFontIndirect (2.x)

HFONT CreateFontIndirect(*lplf***)**

const LOGFONT FAR* *lplf;* /* address of struct. with font attributes */

The **CreateFontIndirect** function creates a logical font that has the characteristics given in the specified structure. The font can subsequently be selected as the current font for any device.

Parameter	Description
lplf	Points to a **LOGFONT** structure that defines the characteristics of the logical font.

Returns
The return value is the handle of the logical font if the function is successful. Otherwise, it is NULL.

Comments
The **CreateFontIndirect** function creates a logical font that has the characteristics specified in the **LOGFONT** structure. When the font is selected by using the **SelectObject** function, the graphics device interface (**GDI**) font mapper attempts to match the logical font with an existing physical font. If it cannot find an exact match for the logical font, the font mapper provides an alternative whose characteristics match as many of the requested characteristics as possible.

Fonts created by using the **CreateFontIndirect** function must be selected out of any device context in which they were used and then removed by using the **DeleteObject** function.

Example
The following example uses the **CreateFontIndirect** function to retrieve the handle of a logical font. The nPtSize and pszFace parameters are passed to the function containing this code. The **MulDiv** and **GetDeviceCaps** functions are used to convert the specified point size into the correct point size for the MM_TEXT mapping mode on the current device.

```
HFONT hfont, hfontOld;

PLOGFONT plf = (PLOGFONT) LocalAlloc(LPTR, sizeof(LOGFONT));

plf->lfHeight = -MulDiv(nPtSize, GetDeviceCaps(hdc, LOGPIXELSY), 72);
strcpy(plf->lfFaceName, pszFace);

hfont = CreateFontIndirect(plf);

hfontOld = SelectObject(hdc, hfont);

TextOut(hdc, 10, 50, pszFace, strlen(pszFace));

LocalFree((HLOCAL) plf);
SelectObject(hdc, hfontOld);
DeleteObject(hfont);
```

See Also
CreateFont, **DeleteObject**

CreateHatchBrush (2.x)

HBRUSH CreateHatchBrush(*fnStyle, clrref***)**

int *fnStyle;* /* hatch style of brush */
COLORREF *clrref;* /* color of brush */

The **CreateHatchBrush** function creates a brush that has the specified hatched pattern and color. The brush can subsequently be selected as the current brush for any device.

Parameter	Description
fnStyle	Specifies the hatch style of the brush. This parameter can be one of the following values:

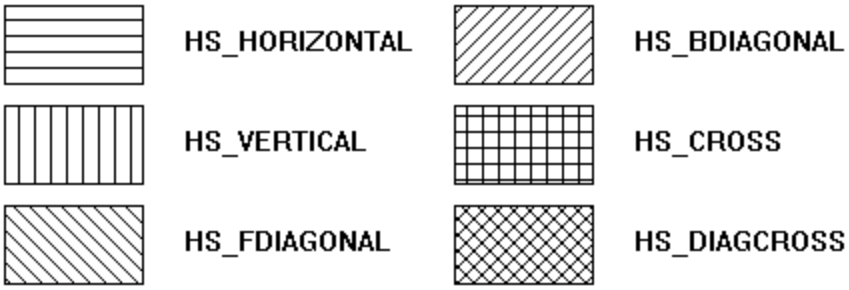
Value	Meaning
HS_BDIAGONAL	45-degree upward hatch (left to right)
HS_CROSS	Horizontal and vertical crosshatch
HS_DIAGCROSS	45-degree crosshatch
HS_FDIAGONAL	45-degree downward hatch (left to right)
HS_HORIZONTAL	Horizontal hatch
HS_VERTICAL	Vertical hatch

clrref	Specifies the foreground color of the brush (the color of the hatches).

Returns
The return value is the handle of the brush if the function is successful. Otherwise, it is NULL.

Comments
When an application has finished using the brush created by the **CreateHatchBrush** function, it should select the brush out of the device context and then delete it by using the **DeleteObject** function.

The following illustration shows how the various hatch brushes appear when used to fill a rectangle:



Example
The following example creates a hatched brush with green diagonal hatch marks and uses that brush to fill a rectangle:

```
HBRUSH hbr, hbrOld;

hbr = CreateHatchBrush(HS_FDIAGONAL, RGB(0, 255, 0));
hbrOld = SelectObject(hdc, hbr);
Rectangle(hdc, 0, 0, 100, 100);
```

See Also
CreateBrushIndirect, **CreateDIBPatternBrush**, **CreatePatternBrush**, **CreateSolidBrush**, **DeleteObject**, **SelectObject**, **RGB**

HS_BDIAGONAL 3

45-degree upward hatch (left to right)

HS_BDIAGONAL 3

HS_CROSS 4

Horizontal and vertical crosshatch

HS_DIAGCROSS 5

45-degree crosshatch

HS_FDIAGONAL 2

45-degree downward hatch (left to right)

HS_FDIAGONAL 2

HS_HORIZONTAL 0

Horizontal hatch

HS_HORIZONTAL 0

HS_VERTICAL 1

Vertical hatch

CreateIC (2.x)

HDC CreateIC(*lpszDriver, lpszDevice, lpszOutput, lpvInitData***)**

LPCSTR *lpszDriver;* /* address of driver name */
LPCSTR *lpszDevice;* /* address of device name */
LPCSTR *lpszOutput;* /* address of filename or port name */
const void FAR* *lpvInitData;* /* address of initialization data */

The **CreateIC** function creates an information context for the specified device. The information context provides a fast way to get information about the device without creating a device context.

Parameter	Description
lpszDriver	Points to a null-terminated string that specifies the MS-DOS filename (without extension) of the device driver (for example, EPSON).
lpszDevice	Points to a null-terminated string that specifies the name of the specific device to be supported (for example, EPSON FX-80). This parameter is used if the module supports more than one device.
lpszOutput	Points to a null-terminated string that specifies the MS-DOS filename or device name for the physical output medium (file or port).
lpvInitData	Points to a **DEVMODE** structure that contains, initially, device-specific information necessary to initialize the device driver. The **ExtDeviceMode** function retrieves this structure filled in for a given device. The *lpvInitData* parameter must be NULL if the device driver is to use the default initialization information (if any) specified by the user through Windows Control Panel.

Returns
The return value is the handle of an information context for the given device if the function is successful. Otherwise, it is NULL.

Comments
The PRINT.H header file is required if the **DEVMODE** structure is used.

MS-DOS device names follow MS-DOS conventions; an ending colon (:) is recommended, but optional. Windows strips the terminating colon so that a device name ending with a colon is mapped to the same port as would be the same name without a colon.

The driver and port names must not contain leading or trailing spaces.

GDI output functions cannot be used with information contexts.

When it has finished using an information context created by **CreateIC**, an application should remove the information context by using the **DeleteDC** function.

Example
The following example uses the **CreateIC** function to create an information context for the display and then uses the **GetDCOrg** function to retrieve the origin for the information context:

```
HDC   hdcIC;
DWORD dwOrigin;

hdcIC = CreateIC("DISPLAY", NULL, NULL, NULL);
dwOrigin = GetDCOrg(hdcIC);

DeleteDC(hdcIC);
```

See Also
CreateDC, **DeleteDC**, **ExtDeviceMode**, **DEVMODE**

CreateMetaFile (2.x)

HDC CreateMetaFile(*lpszFile***)**

LPCSTR *lpszFile;* /* address of metafile name */

The **CreateMetaFile** function creates a metafile device context.

Parameter	Description
lpszFile	Points to a null-terminated string that specifies the MS-DOS filename of the metafile to create. If this parameter is NULL, a device context for a memory metafile is returned.

Returns
The return value is the handle of the metafile device context if the function is successful. Otherwise, it is NULL.

Comments
When it has finished using a metafile device context created by **CreateMetaFile**, an application should close it by using the **CloseMetaFile** function.

Example
The following example uses the **CreateMetaFile** function to create the handle of a device context for a memory metafile, draws a line in that device context, retrieves a handle of the metafile by calling the **CloseMetaFile** function, plays the metafile by using the **PlayMetaFile** function, and finally deletes the metafile by using the **DeleteMetaFile** function:

```
HDC hdcMeta;
HMETAFILE hmf;

hdcMeta = CreateMetaFile(NULL);
MoveTo(hdcMeta, 10, 10);
LineTo(hdcMeta, 100, 100);
hmf = CloseMetaFile(hdcMeta);
PlayMetaFile(hdc, hmf);
DeleteMetaFile(hmf);
```

See Also
DeleteMetaFile

CreatePalette (3.0)

HPALETTE CreatePalette(*lplgpl***)**

const LOGPALETTE FAR* *lplgpl;* /* address of LOGPALETTE structure */

The **CreatePalette** function creates a logical color palette.

Parameter	Description
lplgpl	Points to a **LOGPALETTE** structure that contains information about the colors in the logical palette.

Returns

The return value is the handle of the logical palette if the function is successful. Otherwise, it is NULL.

Comments

When it has finished using a palette created by **CreatePalette**, an application should remove the palette by using the **DeleteObject** function.

Example

The following example initializes a **LOGPALETTE** structure and an array of **PALETTEENTRY** structures, and then uses the **CreatePalette** function to retrieve a handle of a logical palette:

```
#define NUMENTRIES 128
HPALETTE hpal;
PALETTEENTRY ape[NUMENTRIES];

plgpl = (LOGPALETTE*) LocalAlloc(LPTR,
    sizeof(LOGPALETTE) + cColors * sizeof(PALETTEENTRY));

plgpl->palNumEntries = cColors;
plgpl->palVersion = 0x300;

for (i = 0, red = 0, green = 127, blue = 127; i < NUMENTRIES;
        i++, red += 1, green += 1, blue += 1) {
    ape[i].peRed =
        plgpl->palPalEntry[i].peRed = LOBYTE(red);
    ape[i].peGreen =
        plgpl->palPalEntry[i].peGreen = LOBYTE(green);
    ape[i].peBlue =
        plgpl->palPalEntry[i].peBlue = LOBYTE(blue);
    ape[i].peFlags =
        plgpl->palPalEntry[i].peFlags = PC_RESERVED;
}
hpal = CreatePalette(plgpl);
LocalFree((HLOCAL) plgpl);
.
. /* Use the palette handle. */
.
DeleteObject(hpal);
```

See Also

DeleteObject

CreatePatternBrush (2.x)

HBRUSH CreatePatternBrush(*hbmp***)**

HBITMAP *hbmp;* /* handle of bitmap */

The **CreatePatternBrush** function creates a brush whose pattern is specified by a bitmap. The brush can subsequently be selected for any device that supports raster operations.

Parameter	Description
hbmp	Identifies the bitmap.

Returns
The return value is the handle of the brush if the function is successful. Otherwise, it is NULL.

Comments
The bitmap identified by the *hbmp* parameter is typically created by using the **CreateBitmap**, **CreateBitmapIndirect**, **CreateCompatibleBitmap**, or **LoadBitmap** function.

Bitmaps used as fill patterns should be 8 pixels by 8 pixels. If the bitmap is larger, Windows will use the bits corresponding to only the first 8 rows and 8 columns of pixels in the upper-left corner of the bitmap.

An application can use the **DeleteObject** function to remove a pattern brush. This does not affect the associated bitmap, which means the bitmap can be used to create any number of pattern brushes. In any case, when the brush is no longer needed, the application should remove it by using **DeleteObject**.

A brush created by using a monochrome bitmap (one color plane, one bit per pixel) is drawn using the current text and background colors. Pixels represented by a bit set to 0 are drawn with the current text color, and pixels represented by a bit set to 1 are drawn with the current background color.

Example
The following example loads a bitmap named Pattern, uses the bitmap to create a pattern brush in a call to the **CreatePatternBrush** function, selects the brush into a device context, and fills a rectangle by using the new brush:

```
HBITMAP hbmp;
HBRUSH hbr, hbrOld;

hbmp = LoadBitmap(hinst, "Pattern");
hbr = CreatePatternBrush(hbmp);
hbrOld = SelectObject(hdc, hbr);
Rectangle(hdc, 10, 10, 100, 100);
```

See Also
CreateBitmap, **CreateBitmapIndirect**, **CreateCompatibleBitmap**, **CreateDIBPatternBrush**, **DeleteObject**, **GetDeviceCaps**, **LoadBitmap**, **SelectObject**, **SetBkColor**, **SetTextColor**

CreatePen (2.x)

HPEN CreatePen(*fnPenStyle, nWidth, clrref***)**

```
int fnPenStyle;      /* style of pen  */
int nWidth;          /* width of pen */
COLORREF clrref;     /* color of pen */
```

The **CreatePen** function creates a pen having the specified style, width, and color. The pen can subsequently be selected as the current pen for any device.

Parameter	Description
fnPenStyle	Specifies the pen style. This parameter can be one of the following values:

Value	Meaning
PS_SOLID	Creates a solid pen.
PS_DASH	Creates a dashed pen. (Valid only when the pen width is 1.)
PS_DOT	Creates a dotted pen. (Valid only when the pen width is 1.)
PS_DASHDOT	Creates a pen with alternating dashes and dots. (Valid only when the pen width is 1.)
PS_DASHDOTDOT	Creates a pen with alternating dashes and double dots. (Valid only when the pen width is 1.)
PS_NULL	Creates a null pen.
PS_INSIDEFRAME	Creates a pen that draws a line inside the frame of closed shapes produced by graphics device interface (**GDI**) output functions that specify a bounding rectangle (for example, the **Ellipse**, **Rectangle**, **RoundRect**, **Pie**, and **Chord** functions). When this style is used with GDI output functions that do not specify a bounding rectangle (for example, the **LineTo** function), the drawing area of the pen is not limited by a frame.

nWidth	Specifies the width, in logical units, of the pen. If this value is zero, the width in device units is always one pixel, regardless of the mapping mode.
clrref	Specifies the color of the pen.

Returns

The return value is the handle of the pen if the function is successful. Otherwise, it is NULL.

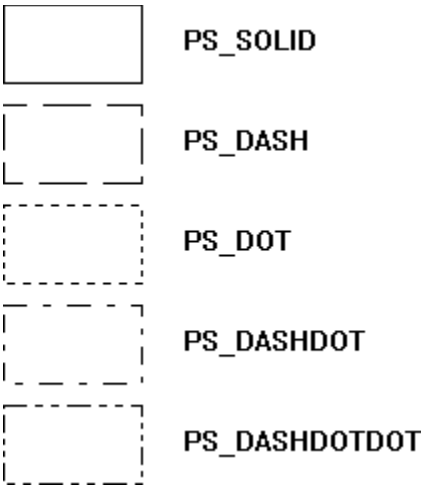
Comments

Pens whose width is greater than one pixel always have the **PS_NULL**, **PS_SOLID**, or **PS_INSIDEFRAME** style.

If a pen has the **PS_INSIDEFRAME** style and a color that does not match a color in the logical color table, the pen is drawn with a dithered color. The **PS_SOLID** pen style cannot be used to create a pen with a dithered color. The style PS_INSIDEFRAME is identical to PS_SOLID if the pen width is less than or equal to 1.

When it has finished using a pen created by **CreatePen**, an application should remove the pen by using the **DeleteObject** function.

The following illustration shows how the various system pens appear when used to draw a rectangle.



Example
The following example uses the **CreatePen** function to create a solid blue pen 6 units wide, selects the pen into a device context, and then uses the pen to draw a rectangle:

```
HPEN hpen, hpenOld;

hpen = CreatePen(PS_SOLID, 6, RGB(0, 0, 255));
hpenOld = SelectObject(hdc, hpen);

Rectangle(hdc, 10, 10, 100, 100);

SelectObject(hdc, hpenOld);
DeleteObject(hpen);
```

See Also
CreatePenIndirect, **DeleteObject**, **Ellipse**, **Rectangle**, **RoundRect**, **RGB**

PS_SOLID 0

Creates a solid pen.

PS_SOLID 0

PS_DASH 1

Creates a dashed pen. (Valid only when the pen width is 1.)

PS_DASH 1

PS_DOT 2

Creates a dotted pen. (Valid only when the pen width is 1.)

PS_DOT 2

PS_DASHDOT 3

Creates a pen with alternating dashes and dots. (Valid only when the pen width is 1.)

PS_DASHDOT 3

PS_DASHDOTDOT 4

Creates a pen with alternating dashes and double dots. (Valid only when the pen width is 1.)

PS_DASHDOTDOT 4

PS_NULL 5

Creates a null pen.

PS_NULL 5

PS_INSIDEFRAME 6

Creates a pen that draws a line inside the frame of closed shapes produced by graphics device interface (**GDI**) output functions that specify a bounding rectangle (for example, the **Ellipse**, **Rectangle**, **RoundRect**, **Pie**, and **Chord** functions). When this style is used with GDI output functions that do not specify a bounding rectangle (for example, the **LineTo** function), the drawing area of the pen is not limited by a frame.

PS_INSIDEFRAME 6

CreatePenIndirect (2.x)

HPEN CreatePenIndirect(*lplgpn***)**

LOGPEN FAR* *lplgpn;* /* address of structure with pen data */

The **CreatePenIndirect** function creates a pen that has the style, width, and color given in the specified structure.

Parameter	Description
lplgpn	Points to the **LOGPEN** structure that contains information about the pen.

Returns
The return value is the handle of the pen if the function is successful. Otherwise, it is NULL.

Comments
Pens whose width is greater than 1 pixel always have the **PS_NULL**, **PS_SOLID**, or **PS_INSIDEFRAME** style.

If a pen has the **PS_INSIDEFRAME** style and a color that does not match a color in the logical color table, the pen is drawn with a dithered color. The PS_INSIDEFRAME style is identical to **PS_SOLID** if the pen width is less than or equal to 1.

When it has finished using a pen created by **CreatePenIndirect**, an application should remove the pen by using the **DeleteObject** function.

Example
The following example fills a **LOGPEN** structure with values defining a solid red pen 10 logical units wide, uses the **CreatePenIndirect** function to create this pen, selects the pen into a device context, and then uses the pen to draw a rectangle:

```
LOGPEN lp;
HPEN hpen, hpenOld;

lp.lopnStyle = PS_SOLID;
lp.lopnWidth.x = 10;
lp.lopnWidth.y = 0;               /* y-dimension not used */
lp.lopnColor = RGB(255, 0, 0);

hpen = CreatePenIndirect(&lp);
hpenOld = SelectObject(hdc, hpen);
Rectangle(hdc, 10, 10, 100, 100);
```

See Also
CreatePen, **DeleteObject**, **LOGPEN**, **RGB**

CreatePolygonRgn (2.x)

HRGN CreatePolygonRgn(*lppt, cPoints, fnPolyFillMode***)**

const POINT FAR* *lppt;* /* address of array of points */
int *cPoints;* /* number of points in array */
int *fnPolyFillMode;* /* polygon-filling mode */

The **CreatePolygonRgn** function creates a polygonal region. The system closes the polygon automatically, if necessary, by drawing a line from the last vertex to the first.

Parameter	Description
lppt	Points to an array of **POINT** structures. Each structure specifies the x-coordinate and y-coordinate of one vertex of the polygon.
cPoints	Specifies the number of **POINT** structures in the array pointed to by the *lppt* parameter.
fnPolyFillMode	Specifies the polygon-filling mode. This value may be either ALTERNATE or WINDING.

Returns

The return value is the handle of the region if the function is successful. Otherwise, it is NULL.

Comments

The size of a region is limited to 32,767 by 32,767 logical units or 64K of memory, whichever is smaller.

When the polygon-filling mode is ALTERNATE, the system fills the area between odd-numbered and even-numbered polygon sides on each scan line. That is, the system fills the area between the first and second side, between the third and fourth side, and so on.

When the polygon-filling mode is WINDING, the system uses the direction in which a figure was drawn to determine whether to fill an area. Each line segment in a polygon is drawn in either a clockwise or a counterclockwise direction. Whenever an imaginary line drawn from an enclosed area to the outside of a figure passes through a clockwise line segment, the system increments a count (increases it by one); when the line passes through a counterclockwise line segment, the system decrements the count. The area is filled if the count is nonzero when the line reaches the outside of the figure.

When it has finished using a region created by **CreatePolygonRgn**, an application should remove the region by using the **DeleteObject** function.

Example

The following example fills an array of **POINT** structures with the coordinates of a five-pointed star, uses this array in a call to the **CreatePolygonRgn** function, selects the region into a device context, and then uses the **PaintRgn** function to display the region:

```
HDC hdc;
HRGN hrgn;
POINT apts[5] = {{ 200, 10  },
                 { 300, 200 },
                 { 100, 100 },
                 { 300, 100 },
                 { 100, 200 }};

hrgn = CreatePolygonRgn(apts,          /* array of points  */
    sizeof(apts) / sizeof(POINT),      /* number of points */
    ALTERNATE);                        /* alternate mode   */
SelectObject(hdc, hrgn);
PaintRgn(hdc, hrgn);
```

See Also

CreatePolyPolygonRgn, **DeleteObject**, **Polygon**, **SetPolyFillMode**, **POINT**

CreatePolyPolygonRgn (3.0)

HRGN CreatePolyPolygonRgn(*lppt, lpnPolyCount, cIntegers, fnPolyFillMode***)**

```
const POINT FAR* lppt;          /* address of structure of points   */
const int FAR* lpnPolyCount;    /* address of array of vertex data  */
int cIntegers;                  /* number of integers in array      */
int fnPolyFillMode;             /* polygon-filling mode             */
```

The **CreatePolyPolygonRgn** function creates a region consisting of a series of closed polygons. The polygons may be disjoint, or they may overlap.

Parameter	Description
lppt	Points to an array of **POINT** structures that define the vertices of the polygons. Each polygon must be explicitly closed, because the system does not close them automatically. The polygons are specified consecutively.
lpnPolyCount	Points to an array of integers. The first integer specifies the number of vertices in the first polygon in the array pointed to by the *lppt* parameter, the second integer specifies the number of vertices in the second polygon, and so on.
cIntegers	Specifies the total number of integers in the array pointed to by the *lpnPolyCount* parameter.
fnPolyFillMode	Specifies the polygon-filling mode. This value may be either ALTERNATE or WINDING.

Returns

The return value is the handle of the region if the function is successful. Otherwise, it is NULL.

Comments

The size of a region is limited to 32,767 by 32,767 logical units or 64K of memory, whichever is smaller.

When the polygon-filling mode is ALTERNATE, the system fills the area between odd-numbered and even-numbered polygon sides on each scan line. That is, the system fills the area between the first and second side, between the third and fourth side, and so on.

When the polygon-filling mode is WINDING, the system uses the direction in which a figure was drawn to determine whether to fill an area. Each line segment in a polygon is drawn in either a clockwise or a counterclockwise direction. Whenever an imaginary line drawn from an enclosed area to the outside of a figure passes through a clockwise line segment, the system increments a count (increases it by one); when the line passes through a counterclockwise line segment, the system decrements the count. The area is filled if the count is nonzero when the line reaches the outside of the figure.

When it has finished using a region created by **CreatePolyPolygonRgn**, an application should remove the region by using the **DeleteObject** function.

Example

The following example fills an array of **POINT** structures with the coordinates of a five-pointed star and a rectangle, uses this array in a call to the **CreatePolyPolygonRgn** function, selects the region into a device context, and then uses the **PaintRgn** function to display the region:

```
HDC hdc;
HRGN hrgn;
int aVertices[2] = { 6, 5 };
POINT apts[11] = {{ 200, 10  },
                  { 300, 200 },
                  { 100, 100 }, /* Star figure, manually closed */
                  { 300, 100 },
                  { 100, 200 },
                  { 200, 10  },
```

```
                    {  10, 150 },
                    { 350, 150 },
                    { 350, 170 }, /* Rectangle, manually closed */
                    {  10, 170 },
                    {  10, 150 }};

hrgn = CreatePolyPolygonRgn(apts,    /* array of points          */
    aVertices,                       /* array of vertices        */
    sizeof(aVertices) / sizeof(int), /* integers in vertex array */
    ALTERNATE);                      /* alternate mode           */
SelectObject(hdc, hrgn);
PaintRgn(hdc, hrgn);
```

See Also

CreatePolygonRgn, **DeleteObject**, **PolyPolygon**, **SetPolyFillMode**, **POINT**

CreateRectRgn (2.x)

HRGN CreateRectRgn(*nLeftRect, nTopRect, nRightRect, nBottomRect***)**

int *nLeftRect;* /* x-coordinate upper-left corner of region */
int *nTopRect;* /* y-coordinate upper-left corner of region */
int *nRightRect;* /* x-coordinate lower-right corner of region */
int *nBottomRect;* /* y-coordinate lower-right corner of region */

The **CreateRectRgn** function creates a rectangular region.

Parameter	Description
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the region.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the region.
nRightRect	Specifies the logical x-coordinate of the lower-right corner of the region.
nBottomRect	Specifies the logical y-coordinate of the lower-right corner of the region.

Returns
The return value is the handle of a rectangular region if the function is successful. Otherwise, it is NULL.

Comments
The size of a region is limited to 32,767 by 32,767 logical units or 64K of memory, whichever is smaller.

When it has finished using a region created by **CreateRectRgn**, an application should remove the region by using the **DeleteObject** function.

Example
The following example uses the **CreateRectRgn** function to create a rectangular region, selects the region into a device context, and then uses the **PaintRgn** function to display the region:

```
HDC hdc;
HRGN hrgn;

hrgn = CreateRectRgn(10, 10, 110, 110);
SelectObject(hdc, hrgn);
PaintRgn(hdc, hrgn);
```

See Also
CreateRectRgnIndirect, **CreateRoundRectRgn**, **DeleteObject**, **PaintRgn**

CreateRectRgnIndirect (2.x)

HRGN CreateRectRgnIndirect(*lprc***)**

const RECT FAR* *lprc;* /* address of structure with region */

The **CreateRectRgnIndirect** function creates a rectangular region by using a **RECT** structure.

Parameter	Description
lprc	Points to a **RECT** structure that contains the logical coordinates of the upper-left and lower-right corners of the region.

Returns

The return value is the handle of the rectangular region if the function is successful. Otherwise, it is NULL.

Comments

The size of a region is limited to 32,767 by 32,767 logical units or 64K of memory, whichever is smaller.

When it has finished using a region created by **CreateRectRgnIndirect**, an application should remove the region by using the **DeleteObject** function.

Example

The following example assigns values to the members of a **RECT** structure, uses the **CreateRectRgnIndirect** function to create a rectangular region, selects the region into a device context, and then uses the **PaintRgn** function to display the region:

```
RECT rc;
HRGN hrgn;

SetRect(&rc, 10, 10, 200, 50);

hrgn = CreateRectRgnIndirect(&rc);
SelectObject(hdc, hrgn);
PaintRgn(hdc, hrgn);
```

See Also

CreateRectRgn, **CreateRoundRectRgn**, **DeleteObject**, **PaintRgn**, **RECT**

CreateRoundRectRgn (3.0)

HRGN CreateRoundRectRgn(*nLeftRect, nTopRect, nRightRect, nBottomRect, nWidthEllipse, nHeightEllipse***)**

int *nLeftRect;* /* x-coordinate upper-left corner of region */
int *nTopRect;* /* y-coordinate upper-left corner of region */
int *nRightRect;* /* x-coordinate lower-right corner of region */
int *nBottomRect;* /* y-coordinate lower-right corner of region */
int *nWidthEllipse;* /* height of ellipse for rounded corners */
int *nHeightEllipse;* /* width of ellipse for rounded corners */

The **CreateRoundRectRgn** function creates a rectangular region with rounded corners.

Parameter	Description
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the region.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the region.
nRightRect	Specifies the logical x-coordinate of the lower-right corner of the region.
nBottomRect	Specifies the logical y-coordinate of the lower-right corner of the region.
nWidthEllipse	Specifies the width of the ellipse used to create the rounded corners.
nHeightEllipse	Specifies the height of the ellipse used to create the rounded corners.

Returns
The return value is the handle of the region if the function is successful. Otherwise, it is NULL.

Comments
The size of a region is limited to 32,767 by 32,767 logical units or 64K of memory, whichever is smaller.

When it has finished using a region created by **CreateRoundRectRgn**, an application should remove the region by using the **DeleteObject** function.

Example
The following example uses the **CreateRoundRectRgn** function to create a region, selects the region into a device context, and then uses the **PaintRgn** function to display the region:

```
HRGN hrgn;
int nEllipWidth = 10;
int nEllipHeight = 30;

hrgn = CreateRoundRectRgn(10, 10, 110, 110,
    nEllipWidth, nEllipHeight);
SelectObject(hdc, hrgn);
PaintRgn(hdc, hrgn);
```

See Also
CreateRectRgn, **CreateRectRgnIndirect**, **DeleteObject**, **PaintRgn**

CreateScalableFontResource (3.1)

BOOL CreateScalableFontResource(*fHidden, lpszResourceFile, lpszFontFile, lpszCurrentPath***)**

```
UINT fHidden;           /* flag for read-only embedded font      */
LPCSTR lpszResourceFile; /* address of filename of font resource */
LPCSTR lpszFontFile;    /* address of filename of scalable font  */
LPCSTR lpszCurrentPath; /* address of path to font file          */
```

The **CreateScalableFontResource** function creates a font resource file for the specified scalable font file.

Parameter	Description
fHidden	Specifies whether the font is a read-only embedded font. This parameter can be one of the following values:

Value	Meaning
0	The font has read-write permission.
1	The font has read-only permission and should be hidden from other applications in the system. When this flag is set, the font is not enumerated by the **EnumFonts** or **EnumFontFamilies** function.

lpszResourceFile	Points to a null-terminated string specifying the name of the font resource file that this function creates.
lpszFontFile	Points to a null-terminated string specifying the scalable font file this function uses to create the font resource file. This parameter must specify either the filename and extension or a full path and filename, including drive and filename extension.
lpszCurrentPath	Points to a null-terminated string specifying either the path to the scalable font file specified in the *lpszFontFile* parameter or NULL, if *lpszFontFile* specifies a full path.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

An application must use the **CreateScalableFontResource** function to create a font resource file before installing an embedded font. Font resource files for fonts with read-write permission should use the .FOT filename extension. Font resource files for read-only fonts should use a different extension (for example, .FOR) and should be hidden from other applications in the system by specifying 1 for the *fHidden* parameter. The font resource files can be installed by using the **AddFontResource** function.

When the *lpszFontFile* parameter specifies only a filename and extension, the *lpszCurrentPath* parameter must specify a path. When the *lpszFontFile* parameter specifies a full path, the *lpszCurrentPath* parameter must be NULL or a pointer to NULL.

When only a filename and extension is specified in the *lpszFontFile* parameter and a path is specified in the *lpszCurrentPath* parameter, the string in *lpszFontFile* is copied into the .FOT file as the .TTF file that belongs to this resource. When the **AddFontResource** function is called, the system assumes that the .TTF file has been copied into the SYSTEM directory (or into the main Windows directory in the case of a network installation). The .TTF file need not be in this directory when the **CreateScalableFontResource** function is called, because the *lpszCurrentPath* parameter contains the directory information. A resource created in this manner does not contain absolute path information and can be used in any Windows installation.

When a path is specified in the *lpszFontFile* parameter and NULL is specified in the *lpszCurrentPath* parameter, the string in *lpszFontFile* is copied into the .FOT file. In this case, when the **AddFontResource** function is called, the .TTF file must be at the location specified in the *lpszFontFile* parameter when the **CreateScalableFontResource** function was called; the *lpszCurrentPath* parameter is not needed. A resource created in this manner contains absolute references to paths and drives and

will not work if the .TTF file is moved to a different location.

The **CreateScalableFontResource** function supports only TrueType scalable fonts.

Example

The following example shows how to create a TrueType font file in the SYSTEM directory of the Windows startup directory:

```
CreateScalableFontResource(0, "c:\\windows\\system\\font.fot",
   "font.ttr", "c:\\windows\\system");

AddFontResource("c:\\windows\\system\\font.fot");
```

The following example shows how to create a TrueType font file in a specified directory:

```
CreateScalableFontResource(0, "c:\\windows\\system\\font.fot",
    "c:\\fontdir\\font.ttr", NULL);

AddFontResource("c:\\windows\\system\\font.fot");
```

The following example shows how to work with a standard embedded font:

```
HFONT hfont;

/* Extract .TTF file into C:\MYDIR\FONT.TTR. */

CreateScalableFontResource(0, "font.fot", "c:\\mydir\\font.ttr", NULL);

AddFontResource("font.fot");

hfont = CreateFont(..., CLIP_DEFAULT_PRECIS, ..., "FONT");
    .
    . /* Use the font. */
    .
DeleteObject(hfont);

RemoveFontResource("font.fot");
    .
    . /* Delete C:\MYDIR\FONT.FOT and C:\MYDIR\FONT.TTR. */
    .
```

The following example shows how to work with a read-only embedded font:

```
HFONT hfont;

/* Extract.TTF file into C:\MYDIR\FONT.TTR. */

CreateScalableFontResource(1, "font.for", "c:\\mydir\\font.ttr", NULL);

AddFontResource("font.for");

hfont = CreateFont(..., CLIP_EMBEDDED, ..., "FONT");
    .
    . /* Use the font. */
    .
DeleteObject(hfont);

RemoveFontResource("font.for");
    .
```

```
. /* Delete C:\MYDIR\FONT.FOR and C:\MYDIR\FONT.TTR. */
.
```

See Also

AddFontResource

CreateSolidBrush (2.x)

HBRUSH CreateSolidBrush(*clrref***)**

COLORREF *clrref;* /* brush color */

The **CreateSolidBrush** function creates a brush that has a specified solid color. The brush can subsequently be selected as the current brush for any device.

Parameter	Description
clrref	Specifies the color of the brush.

Returns
The return value is the handle of the brush if the function is successful. Otherwise, it is NULL.

Comments
When an application has finished using the brush created by **CreateSolidBrush**, it should select the brush out of the device context and then remove it by using the **DeleteObject** function.

Example
The following example uses the **CreateSolidBrush** function to create a green brush, selects the brush into a device context, and then uses the brush to fill a rectangle:

```
HBRUSH hbrOld;
HBRUSH hbr;

hbr = CreateSolidBrush(RGB(0, 255, 0));
hbrOld = SelectObject(hdc, hbr);
Rectangle(hdc, 10, 10, 100, 100);
```

See Also
CreateBrushIndirect, **CreateDIBPatternBrush**, **CreateHatchBrush**, **CreatePatternBrush**, **DeleteObject**, **RGB**

DeleteDC (2.x)

BOOL DeleteDC(*hdc***)**

HDC *hdc;* /* handle of device context */

The **DeleteDC** function deletes the given device context.

Parameter	Description
hdc	Identifies the device context.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
If the *hdc* parameter identifies the last device context for a given device, the device is notified and all storage and system resources used by the device are released.

An application must not delete a device context whose handle was retrieved by calling the **GetDC** function. Instead, the application must call the **ReleaseDC** function to free the device context.

An application should not call **DeleteDC** if the application has selected objects into the device context. Objects must be selected out of the device context before it is deleted.

Example
The following example uses the **CreateDC** function to create a device context for a printer and then calls the **DeleteDC** function when the device context is no longer needed:

```
/* Retrieves a device context for a printer. */

hdcPrinter = CreateDC(lpDriverName, lpDeviceName, lpOutput,
    lpInitData);
    .
    . /* Use the device context. */
    .

/* Delete the device context. */

DeleteDC(hdcPrinter);
```

See Also
CreateDC, **GetDC**, **ReleaseDC**

DeleteMetaFile (2.x)

BOOL DeleteMetaFile(*hmf*)

HMETAFILE *hmf;* /* handle of metafile */

The **DeleteMetaFile** function invalidates the given metafile handle.

Parameter	Description
hmf	Identifies the metafile to be deleted.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The **DeleteMetaFile** function does not destroy a metafile that is saved on disk. After calling **DeleteMetaFile**, an application can retrieve a new handle of a disk-based metafile by calling the **GetMetaFile** function.

Example
The following example uses the **CreateMetaFile** function to create the handle of a memory metafile device context, draws a line in that device context, retrieves a handle of the metafile by calling the **CloseMetaFile** function, plays the metafile by using the **PlayMetaFile** function, and finally deletes the metafile by using **DeleteMetaFile**:

```
HDC hdcMeta;
HMETAFILE hmf;

hdcMeta = CreateMetaFile(NULL);
MoveTo(hdcMeta, 10, 10);
LineTo(hdcMeta, 100, 100);
hmf = CloseMetaFile(hdcMeta);
PlayMetaFile(hdc, hmf);
DeleteMetaFile(hmf);
```

See Also
CreateMetaFile, **GetMetaFile**

DeleteObject (2.x)

BOOL DeleteObject(*hgdiobj***)**

HGDIOBJ *hgdiobj;* /* handle of object to delete */

The **DeleteObject** function deletes an object from memory by freeing all system storage associated with the object. (Objects include pens, brushes, fonts, bitmaps, regions, and palettes.)

Parameter	Description
hgdiobj	Identifies a pen, brush, font, bitmap, region, or palette.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
After the object is deleted, the handle given in the *hgdiobj* parameter is no longer valid.

An application should not delete an object that is currently selected into a device context.

When a pattern brush is deleted, the bitmap associated with the brush is not deleted. The bitmap must be deleted independently.

Example
The following example creates a pen, selects it into a device context, and uses the pen to draw a rectangle. To delete the pen, the original pen is selected back into the device context and the **DeleteObject** function is called.

```
HPEN hpen, hpenOld;

hpen = CreatePen(PS_SOLID, 6, RGB(0, 0, 255));
hpenOld = SelectObject(hdc, hpen);

Rectangle(hdc, 10, 10, 100, 100);

SelectObject(hdc, hpenOld);
DeleteObject(hpen);
```

See Also
SelectObject, **RGB**

Changes

DeviceCapabilities (3.0)

#include <print.h>

DWORD DeviceCapabilities(*lpszDevice, lpszPort, fwCapability, lpszOutput, lpdm***)**

```
LPSTR lpszDevice;     /* address of device-name string        */
LPSTR lpszPort;       /* address of port-name string          */
WORD fwCapability;    /* device capability to query           */
LPSTR lpszOutput;     /* address of the output                */
LPDEVMODE lpdm;       /* address of structure with device data */
```

The **DeviceCapabilities** function retrieves the capabilities of the printer device driver.

Parameter	Description
lpszDevice	Points to a null-terminated string that contains the name of the printer device, such as PCL/HP LaserJet.
lpszPort	Points to a null-terminated string that contains the name of the port to which the device is connected, such as LPT1.
fwCapability	Specifies the capabilities to query. This parameter can be one of the following values:

Value	Meaning
DC_BINNAMES	Copies an array containing a list of the names of the paper bins. This array is in the form **char** *PaperNames*[*cBinMax*][*cchBinName*] where *cchBinName* is 24. If the *lpszOutput* parameter is NULL, the return value is the number of bin entries required. Otherwise, the return value is the number of bins copied.
DC_BINS	Retrieves a list of available bins. The function copies the list to the *lpszOutput* parameter as a **WORD** array. If *lpszOutput* is NULL, the function returns the number of supported bins to allow the application the opportunity to allocate a buffer with the correct size. For more information about these bins, see the description of the **dmDefaultSource** member of the **DEVMODE** structure.
DC_COPIES	Returns the number of copies the device can print.
DC_DRIVER	Returns the version number of the printer driver.
DC_DUPLEX	Returns the level of duplex support. The function returns 1 if the printer is capable of duplex printing. Otherwise, the return value is zero.
DC_ENUMRESOLUTIONS	Returns a list of available resolutions. If *lpszOutput* is NULL, the function returns the number of available resolution configurations. Resolutions are represented by pairs of **LONG** integers representing the horizontal and vertical resolutions (specified in dots per inch).
DC_EXTRA	Returns the number of bytes required for the device-specific portion of the **DEVMODE** structure for the printer driver.
DC_FIELDS	Returns the **dmFields** member of the printer driver's **DEVMODE** structure. The **dmFields** member

indicates which fields in the device-independent portion of the structure are supported by the printer driver.

DC_FILEDEPENDENCIES — Returns a list of files that also need to be loaded when a driver is installed. If the *lpszOutput* parameter is NULL, the function returns the number of files. Otherwise, *lpszOutput* points to an array of filenames in the form **char[***chFileName***, 64]**. Each filename is a null-terminated string.

DC_MAXEXTENT — Returns a **POINT** structure containing the maximum paper size that the **dmPaperLength** and **dmPaperWidth** members of the printer driver's **DEVMODE** structure can specify.

DC_MINEXTENT — Returns a **POINT** structure containing the minimum paper size that the **dmPaperLength** and **dmPaperWidth** members of the printer driver's **DEVMODE** structure can specify.

DC_ORIENTATION — Returns the relationship between portrait and landscape orientations for a device, in terms of the number of degrees that portrait orientation is rotated counterclockwise to produce landscape orientation. The return value can be one of the following:

Value	Meaning
0	No landscape orientation.
90	Portrait is rotated 90 degrees to produce landscape. (For example, Hewlett-Packard PCL printers.)
270	Portrait is rotated 270 degrees to produce landscape. (For example, dot-matrix printers.)

DC_PAPERNAMES — Retrieves a list of supported paper names--for example, Letter or Legal. If the *lpszOutput* parameter is NULL, the function returns the number of paper sizes available. Otherwise, *lpszOutput* points to an array for the paper names in the form **char[***cPaperNames***, 64]**. Each paper name is a null-terminated string.

DC_PAPERS — Retrieves a list of supported paper sizes. The function copies the list to *lpszOutput* as a **WORD** array and returns the number of entries in the array. If *lpszOutput* is NULL, the function returns the number of supported paper sizes to allow the application the opportunity to allocate a buffer with the correct size. For more information on paper sizes, see the description of the **dmPaperSize** member of the **DEVMODE** structure.

DC_PAPERSIZE — Copies the dimensions of all supported paper sizes, in tenths of a millimeter, to an array of **POINT** structures pointed to by the *lpszOutput* parameter. The width (x-dimension) and length (y-dimension) of a paper size are returned as if the paper were in the DMORIENT_PORTRAIT orientation.

DC_SIZE — Returns the **dmSize** member of the printer driver's

DEVMODE structure.

DC_TRUETYPE — Retrieves the abilities of the driver to use TrueType fonts. The return value can be one or more of the following:

Value	Meaning
DCTT_BITMAP	Device is capable of printing TrueType fonts as graphics. (For example, dot-matrix and PCL printers.)
DCTT_DOWNLOAD	Device is capable of downloading TrueType fonts. (For example, PCL and PostScript printers.)
DCTT_SUBDEV	Device is capable of substituting device fonts for TrueType fonts. (For example, PostScript printers.)

For **DC_TRUETYPE**, the *lpszOutput* parameter should be NULL.

DC_VERSION — Returns the specification version to which the printer driver conforms.

lpszOutput — Points to an array of bytes. The format of the array depends on the setting of the *fwCapability* parameter. If *lpszOutput* is zero, **DeviceCapabilities** returns the number of bytes required for the output data.

lpdm — Points to a **DEVMODE** structure. If this parameter is NULL, **DeviceCapabilities** retrieves the current default initialization values for the specified printer driver. Otherwise, the function retrieves the values contained in the structure to which *lpdm* points.

Returns

The return value, if the function is successful, depends on the setting of the *fwCapability* parameter. The return value is -1 if the function fails.

Comments

This function is supplied by the printer driver. To use the **DeviceCapabilities** function, an application must retrieve the address of the function by calling the **LoadLibrary** and **GetProcAddress** functions, and it must include the PRINT.H file.

DeviceCapabilities is not supported by all printer drivers. If the **GetProcAddress** function returns NULL, **DeviceCapabilities** is not supported.

See Also

GetProcAddress, **LoadLibrary**

Changes

The following index values have been added for Windows version 3.1:

DC_COPIES
DC_ENUMRESOLUTIONS
DC_FILEDEPENDENCIES
DC_ORIENTATION
DC_PAPERNAMES
DC_TRUETYPE
DCTT_BITMAP
DCTT_DOWNLOAD
DCTT_SUBDEV

Corrections

Changed the type of the last argument *lpdm* from LPFNDEVMODE to LPDEVMODE.

DC_BINNAMES 12

Copies an array containing a list of the names of the paper bins. This array is in the form **char** *PaperNames*[*cBinMax*][*cchBinName*] where *cchBinName* is 24. If the *lpszOutput* parameter is NULL, the return value is the number of bin entries required. Otherwise, the return value is the number of bins copied.

DC_BINNAMES 12

DC_BINS 6

Retrieves a list of available bins. The function copies the list to the *lpszOutput* parameter as a **WORD** array. If *lpszOutput* is NULL, the function returns the number of supported bins to allow the application the opportunity to allocate a buffer with the correct size. For more information about these bins, see the description of the **dmDefaultSource** member of the **DEVMODE** structure.

DC_BINS 6

DC_COPIES 18

Returns the number of copies the device can print.

DC_COPIES 18

DC_DRIVER 11

Returns the version number of the printer driver.

DC_DUPLEX 7

Returns the level of duplex support. The function returns 1 if the printer is capable of duplex printing. Otherwise, the return value is zero.

DC_DUPLEX 7

DC_ENUMRESOLUTIONS 13

Returns a list of available resolutions. If *lpszOutput* is NULL, the function returns the number of available resolution configurations. Resolutions are represented by pairs of **LONG** integers representing the horizontal and vertical resolutions (specified in dots per inch).

DC_EXTRA 9

Returns the number of bytes required for the device-specific portion of the **DEVMODE** structure for the printer driver.

DC_EXTRA 9

DC_FIELDS 1

Returns the **dmFields** member of the printer driver's **DEVMODE** structure. The **dmFields** member indicates which fields in the device-independent portion of the structure are supported by the printer driver.

DC_FIELDS 1

DC_FILEDEPENDENCIES 14

Returns a list of files that also need to be loaded when a driver is installed. If the *lpszOutput* parameter is NULL, the function returns the number of files. Otherwise, *lpszOutput* points to an array of filenames in the form **char[***chFileName***, 64]**. Each filename is a null-terminated string.

DC_FILEDEPENDENCIES 14

DC_MAXEXTENT 5

Returns a **POINT** structure containing the maximum paper size that the **dmPaperLength** and **dmPaperWidth** members of the printer driver's **DEVMODE** structure can specify.

DC_MAXEXTENT 5

DC_MINEXTENT 4

Returns a **POINT** structure containing the minimum paper size that the **dmPaperLength** and **dmPaperWidth** members of the printer driver's **DEVMODE** structure can specify.

DC_MINEXTENT 4

DC_ORIENTATION 17

Returns the relationship between portrait and landscape orientations for a device, in terms of the number of degrees that portrait orientation is rotated counterclockwise to produce landscape orientation. The return value can be one of the following:

DC_PAPERNAMES 16

Retrieves a list of supported paper names--for example, Letter or Legal. If the *lpszOutput* parameter is NULL, the function returns the number of paper sizes available. Otherwise, *lpszOutput* points to an array for the paper names in the form **char[***cPaperNames***, 64]**. Each paper name is a null-terminated string.

DC_PAPERNAMES 16

DC_PAPERS 2

Retrieves a list of supported paper sizes. The function copies the list to *lpszOutput* as a **WORD** array and returns the number of entries in the array. If *lpszOutput* is NULL, the function returns the number of supported paper sizes to allow the application the opportunity to allocate a buffer with the correct size. For more information on paper sizes, see the description of the **dmPaperSize** member of the **DEVMODE** structure.

DC_PAPERSIZE 3

Copies the dimensions of all supported paper sizes, in tenths of a millimeter, to an array of **POINT** structures pointed to by the *lpszOutput* parameter. The width (x-dimension) and length (y-dimension) of a paper size are returned as if the paper were in the DMORIENT_PORTRAIT orientation.

DC_PAPERSIZE 3

DC_SIZE 8

Returns the **dmSize** member of the printer driver's **DEVMODE** structure.

DC_SIZE 8

DC_TRUETYPE 15

Retrieves the abilities of the driver to use TrueType fonts. The return value can be one or more of the following:

DC_TRUETYPE 15

For

DC_TRUETYPE, the *lpszOutput* parameter should be NULL.

DC_VERSION 10

Returns the specification version to which the printer driver conforms.

DC_VERSION 10

DeviceMode (2.x)

void DeviceMode(*hwnd, hModule, lpszDevice, lpszOutput***)**

```
HWND hwnd;          /* handle of window owning dialog box */
HANDLE hModule;     /* handle of printer-driver module    */
LPSTR lpszDevice;   /* address of string for device name  */
LPSTR lpszOutput;   /* address of string for output name  */
```

The **DeviceMode** function sets the current printing modes for a specified device by using a dialog box to prompt for those modes. An application calls **DeviceMode** to allow the user to change the printing modes of the corresponding device. **DeviceMode** copies the mode information to the environment block that is associated with the device and maintained by the graphics device interface (**GDI**).

The **ExtDeviceMode** function provides a superset of the functionality of the **DeviceMode** function; new applications should use **ExtDeviceMode** instead of **DeviceMode** whenever possible. (Applications can use the **DM_IN_PROMPT** constant with **ExtDeviceMode** to duplicate the functionality of **DeviceMode**.)

Parameter	Description
hwnd	Identifies the window that will own the dialog box.
hModule	Identifies the printer-driver module. The application should retrieve this handle by calling either the **GetModuleHandle** or **LoadLibrary** function.
lpszDevice	Points to a null-terminated string that specifies the name of the specific device to be supported (for example, Epson FX-80). The device name is the same as the name passed to the **CreateDC** function.
lpszOutput	Points to a null-terminated string that specifies the MS-DOS filename or device name for the physical output medium (file or output port). The output name is the same as the name passed to the **CreateDC** function.

Returns

This function does not return a value.

Comments

The **DeviceMode** function is part of the printer's device driver, not part of GDI. To call this function, an application must load the printer driver by calling the **LoadLibrary** function and retrieve the address of the function by using the **GetProcAddress** function. The application can then use the address to set up the printer.

DeviceMode is not supported by all printer drivers. If the **GetProcAddress** function returns NULL, **DeviceMode** is not supported.

See Also

CreateDC, **ExtDeviceMode**, **GetModuleHandle**, **LoadLibrary**

DPtoLP (2.x)

BOOL DPtoLP(*hdc, lppt, cPoints***)**

```
HDC hdc;            /* handle of device context      */
POINT FAR* lppt;    /* address of array with points */
int cPoints;        /* number of points in array     */
```

The **DPtoLP** function converts device coordinates (points) into logical coordinates.

Parameter	Description
hdc	Identifies the device context.
lppt	Points to an array of **POINT** structures. Each coordinate in each structure is mapped into the logical coordinate system for the current device context.
cPoints	Specifies the number of points in the array.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The conversion depends on the current mapping mode and the settings of the origins and extents for the device's window and viewport.

Example

The following example sets the mapping mode to MM_LOENGLISH, and then calls the **DPtoLP** function to convert the coordinates of a rectangle into logical coordinates:

```
RECT rc;

SetMapMode(hdc, MM_LOENGLISH);
SetRect(&rc, 100, 100, 200, 200);
DPtoLP(hdc, (LPPOINT) &rc, 2);
```

See Also

LPtoDP, **POINT**

Ellipse (2.x)

BOOL Ellipse(*hdc, nLeftRect, nTopRect, nRightRect, nBottomRect***)**

```
HDC hdc;          /* handle of device context                        */
int nLeftRect;    /* x-coordinate upper-left corner bounding rectangle  */
int nTopRect;     /* y-coordinate upper-left corner bounding rectangle  */
int nRightRect;   /* x-coordinate lower-right corner bounding rectangle */
int nBottomRect;  /* y-coordinate lower-right corner bounding rectangle */
```

The **Ellipse** function draws an ellipse. The center of the ellipse is the center of the specified bounding rectangle. The ellipse is drawn by using the current pen, and its interior is filled by using the current brush.

If either the width or the height of the bounding rectangle is zero, the function does not draw the ellipse.

Parameter	Description
hdc	Identifies the device context.
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the bounding rectangle.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the bounding rectangle.
nRightRect	Specifies the logical x-coordinate of the lower-right corner of the bounding rectangle.
nBottomRect	Specifies the logical y-coordinate of the lower-right corner of the bounding rectangle.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The figure drawn by this function extends up to but does not include the right and bottom coordinates. This means that the height of the figure is determined as follows:

nBottomRect - nTopRect

Similarly, the width of the figure is determined as follows:

nRightRect - nLeftRect

Both the width and the height of a rectangle must be greater than 2 units and less than 32,767 units.

See Also
Arc, **Chord**, **RECT**

EndDoc (3.1)

int EndDoc(*hdc***)**

HDC *hdc;* /* handle of device context */

The **EndDoc** function ends a print job. This function replaces the ENDDOC printer escape for Windows version 3.1.

Parameter	Description
hdc	Identifies the device context for the print job.

Returns
The return value is greater than or equal to zero if the function is successful. Otherwise, it is less than zero.

Comments
An application should call the **EndDoc** function immediately after finishing a successful print job. To terminate a print job because of an error or if the user chooses to cancel the job, an application should call the **AbortDoc** function.

Do not use the **EndDoc** function inside metafiles.

See Also
AbortDoc, **Escape**, **StartDoc**

EndPage (3.1)

int EndPage(*hdc***)**

HDC *hdc;* /* handle of device context */

The **EndPage** function signals the device that the application has finished writing to a page. This function is typically used to direct the driver to advance to a new page.

This function replaces the **NEWFRAME** printer escape for Windows 3.1. Unlike **NEWFRAME**, this function is always called after printing a page.

Parameter	Description
hdc	Identifies the device context for the print job.

Returns

The return value is greater than or equal to zero if the function is successful. Otherwise, it is an error value.

Errors

If the function fails, it returns one of the following error values:

Value	Meaning
SP_ERROR	General error.
SP_APPABORT	Job was terminated because the application's print-canceling function returned zero.
SP_USERABORT	User terminated the job by using Windows Print Manager (PRINTMAN.EXE).
SP_OUTOFDISK	Not enough disk space is currently available for spooling, and no more space will become available.
SP_OUTOFMEMORY	Not enough memory is available for spooling.

Comments

The **ResetDC** function can be used to change the device mode, if necessary, after calling the **EndPage** function.

See Also

Escape, **ResetDC**, **StartPage**

SP_ERROR (-1)

General error.

SP_ERROR (-1)

SP_APPABORT (-2)

Job was terminated because the application's print-canceling function returned zero.

SP_APPABORT (-2)

SP_USERABORT (-3)

User terminated the job by using Windows Print Manager (PRINTMAN.EXE).

SP_USERABORT (-3)

SP_OUTOFDISK (-4)

Not enough disk space is currently available for spooling, and no more space will become available.

SP_OUTOFDISK (-4)

SP_OUTOFMEMORY (-5)

Not enough memory is available for spooling.

SP_OUTOFMEMORY (-5)

EnumFontFamilies (3.1)

int EnumFontFamilies(*hdc, lpszFamily, fntenmprc, lParam***)**

HDC *hdc;* /* handle of device context */
LPCSTR *lpszFamily;* /* address of font-family name */
FONTENUMPROC *fntenmprc;* /* address of callback function */
LPARAM *lParam;* /* application-defined data */

The **EnumFontFamilies** function enumerates the fonts in a specified font family that are available on a given device. **EnumFontFamilies** continues until there are no more fonts or the callback function returns zero.

Parameter	Description
hdc	Identifies the device context.
lpszFamily	Points to a null-terminated string that specifies the family name of the desired fonts. If this parameter is NULL, the **EnumFontFamilies** function selects and enumerates one font from each available font family.
fntenmprc	Specifies the procedure-instance address of the application-defined callback function. The address must be created by the **MakeProcInstance** function. For more information about the callback function, see the description of the **EnumFontFamProc** callback function.
lParam	Specifies a 32-bit application-defined value that is passed to the callback function along with the font information.

Returns

The return value specifies the last value returned by the callback function, if the function is successful. This value depends on which font families are available for the given device.

Comments

The **EnumFontFamilies** function differs from the **EnumFonts** function in that it retrieves the style names associated with a TrueType font. Using **EnumFontFamilies**, an application can retrieve information about unusual font styles (for example, Outline) that cannot be enumerated by using the **EnumFonts** function. Applications should use **EnumFontFamilies** instead of **EnumFonts**.

For each font having the font name specified by the *lpszFamily* parameter, the **EnumFontFamilies** function retrieves information about that font and passes it to the function pointed to by the *fntenmprc* parameter. The application-supplied callback function can process the font information, as necessary.

Example

The following example uses the **MakeProcInstance** function to create a pointer to the callback function for the **EnumFontFamilies** function. The **FreeProcInstance** function is called when enumeration is complete. Because the second parameter is NULL, **EnumFontFamilies** enumerates one font from each family that is available in the given device context. The aFontCount variable points to an array that is used inside the callback function.

```
FONTENUMPROC lpEnumFamCallBack;
int aFontCount[] = { 0, 0, 0 };

lpEnumFamCallBack = (FONTENUMPROC) MakeProcInstance(
    (FARPROC) EnumFamCallBack, hAppInstance);
EnumFontFamilies(hdc, NULL, lpEnumFamCallBack, (LPARAM) aFontCount);
FreeProcInstance((FARPROC) lpEnumFamCallBack);
```

See Also

EnumFonts, **EnumFontFamProc**, **LOGFONT**, **TEXTMETRIC**

EnumFonts (2.x)

int EnumFonts(*hdc, lpszFace, fntenmprc, lParam***)**

```
HDC hdc;                    /* handle of device context      */
LPCSTR lpszFace;            /* address of font name          */
FONTENUMPROC fntenmprc;     /* address of callback function  */
LPARAM lParam;              /* application-defined data      */
```

The **EnumFonts** function enumerates the fonts available for a given device. This function is provided for backwards compatibility with earlier versions of Windows; current applications should use the **EnumFontFamilies** function.

EnumFonts continues until there are no more fonts or the callback function returns zero.

Parameter	Description
hdc	Identifies the device context.
lpszFace	Points to a null-terminated string that specifies the names of the requested fonts. If this parameter is NULL, the **EnumFonts** function randomly selects and enumerates one font from each available typeface.
fntenmprc	Specifies the procedure-instance address of the application-defined callback function. The address must be created by the **MakeProcInstance** function. For more information about the callback function, see the description of the **EnumFontsProc** callback function.
lParam	Specifies a 32-bit application-defined value that is passed to the callback function along with the font information.

Returns

The return value specifies the last value returned by the callback function and is defined by the user.

Comments

The **EnumFonts** function retrieves information about the specified font and passes it to the function pointed to by the *fntenmprc* parameter. The application-supplied callback function can process the font information, as necessary.

If the device is capable of text transformations (scaling, italicizing, and so on), only the base font will be enumerated. The user must know the device's text-transformation abilities to determine which additional fonts are available directly from the device. The graphics device interface (**GDI**) can simulate the bold, italic, underlined, and strikeout attributes for any GDI-based font.

The **EnumFonts** function enumerates fonts from the **GDI** internal table only. This does not include fonts that are generated by a device, such as fonts that are transformations of fonts from the internal table. The **GetDeviceCaps** function can be used to determine which transformations a device can perform. This information is available by using the TEXTCAPS index.

GDI can scale GDI-based raster fonts by one to five units horizontally and one to eight units vertically, unless PROOF_QUALITY is being used.

Example

The following example uses the **MakeProcInstance** function to create a pointer to the callback function for the **EnumFonts** function. The **FreeProcInstance** function is called when enumeration is complete. Because the second parameter is "Arial", **EnumFonts** enumerates the Arial fonts available in the given device context. The cArial variable is passed to the callback function.

```
FONTENUMPROC lpEnumFontsCallBack;
int cArial = 0;

lpEnumFontsCallBack = (FONTENUMPROC) MakeProcInstance(
    (FARPROC) EnumFontsCallBack, hAppInstance);
```

```
EnumFonts(hdc, "Arial", lpEnumFontsCallBack, (LPARAM) &cArial);
FreeProcInstance((FARPROC) lpEnumFontsCallBack);
```

See Also
EnumFontFamilies, **EnumFontsProc**

EnumMetaFile (2.x)

BOOL EnumMetaFile(*hdc, hmf, mfenmprc, lParam***)**

```
HDC hdc;                /* handle of device context      */
HLOCAL hmf;             /* handle of metafile            */
MFENUMPROC mfenmprc;    /* address of callback function  */
LPARAM lParam;          /* application-defined data      */
```

The **EnumMetaFile** function enumerates the metafile records in a given metafile. **EnumMetaFile** continues until there are no more graphics device interface (**GDI**) calls or the callback function returns zero.

Parameter	Description
hdc	Identifies the device context associated with the metafile.
hmf	Identifies the metafile. Note: The **HLOCAL** type for this parameter is incorrect in the WINDOWS.H file. The type of this parameter is actually **HMETAFILE**. Developers should cast this parameter to an **HLOCAL** type to avoid compiler warnings.
mfenmprc	Specifies the procedure-instance address of the application-supplied callback function. The address must be created by using the **MakeProcInstance** function. For more information about the callback function, see the description of the **EnumMetaFileProc** callback function.
lParam	Specifies a 32-bit application-defined value that is passed to the callback function along with the metafile information.

Returns

The return value is nonzero if the callback function enumerates all the **GDI** calls in a metafile. Otherwise, it is zero.

Comments

The **EnumMetaFile** function retrieves metafile records and passes them to a callback function. An application can modify the metafile record inside the callback function. The application can also use the **PlayMetaFileRecord** function inside the callback function; this is useful for very large metafiles, when using the **PlayMetaFile** function might be time-consuming.

Example

The following example creates a dashed green pen and passes it to the callback function for the **EnumMetaFile** function. If the first element in the array of object handles is a handle, that handle is replaced by the handle of the green pen before the **PlayMetaFileRecord** function is called. (For this example, it is assumed that the table of object handles contains only one handle and that it is the handle of a pen.)

```
MFENUMPROC lpEnumMetaProc;
HPEN hpenGreen;

lpEnumMetaProc = (MFENUMPROC) MakeProcInstance(
    (FARPROC) EnumMetaFileProc, hAppInstance);
hpenGreen = CreatePen(PS_DASH, 1, RGB(0, 255, 0));
EnumMetaFile(hdc, hmf, lpEnumMetaProc, (LPARAM) &hpenGreen);
FreeProcInstance((FARPROC) lpEnumMetaProc);
DeleteObject(hpenGreen);
    .
    .
    .
```

```
int FAR PASCAL EnumMetaFileProc(HDC hdc, HANDLETABLE FAR* lpHTable,
    METARECORD FAR* lpMFR, int cObj, BYTE FAR* lpClientData)
{
    if (lpHTable->objectHandle[0] != 0)
        lpHTable->objectHandle[0] = *(HPEN FAR *) lpClientData;
    PlayMetaFileRecord(hdc, lpHTable, lpMFR, cObj);

    return 1;
}
```

See Also

EnumMetaFileProc, **MakeProcInstance**, **PlayMetaFile**, **PlayMetaFileRecord**

EnumObjects (2.x)

int EnumObjects(*hdc, fnObjectType, goenmprc, lParam***)**

```
HDC hdc;                    /* handle of device context        */
int fnObjectType;           /* type of object                  */
GOBJENUMPROC goenmprc;      /* address of callback function    */
LPARAM lParam;              /* application-defined data        */
```

The **EnumObjects** function enumerates the pens and brushes available in the given device context. For each object of a given type, the callback function is called with the information for that object. **EnumObjects** continues until there are no more objects or the callback function returns zero.

Parameter	Description
hdc	Identifies the device context.
fnObjectType	Specifies the object type. This parameter can be one of the following values:

Value	Meaning
OBJ_BRUSH	Specifies a brush.
OBJ_PEN	Specifies a pen.

goenmprc	Specifies the procedure-instance address of the application-supplied callback function. The address must be created by the **MakeProcInstance** function. For more information about the callback function, see the description of the **EnumObjectsProc** callback function.
lParam	Specifies a 32-bit application-defined value that is passed to the callback function.

Returns

The return value specifies the last value returned by the callback function and is defined by the user.

Example

The following example retrieves the number of horizontally hatched brushes and fills **LOGBRUSH** structures with information about each of them:

```
#define MAXBRUSHES 50

GOBJENUMPROC lpProcCallback;
HGLOBAL hglbl;
LPBYTE lpbCountBrush;

lpProcCallback = (GOBJENUMPROC) MakeProcInstance(
    (FARPROC) Callback, hinst);

hglbl = GlobalAlloc(GMEM_FIXED, sizeof(LOGBRUSH)
    * MAXBRUSHES);
lpbCountBrush = (LPBYTE) GlobalLock(hglbl);
*lpbCountBrush = 0;
EnumObjects(hdc, OBJ_BRUSH, lpProcCallback,
    (LPARAM) lpbCountBrush);

FreeProcInstance((FARPROC) lpProcCallback);

int FAR PASCAL Callback(LPLOGBRUSH lpLogBrush, LPBYTE pbData)
{
    /*
     * The pbData parameter contains the number of horizontally
     * hatched brushes; the lpDest parameter is set to follow the
     * byte reserved for pbData and the LOGBRUSH structures that
```

```
     * have been filled with brush information.
     */

    LPLOGBRUSH lpDest =
        (LPLOGBRUSH) (pbData + 1 + (*pbData * sizeof(LOGBRUSH)));

    if (lpLogBrush->lbStyle ==
            BS_HATCHED && /* if horiz hatch */
            lpLogBrush->lbHatch == HS_HORIZONTAL) {
        *lpDest++ = *lpLogBrush; /* fills structure with brush info */
        (*pbData) ++;            /* increments brush count          */
        if (*pbData >= MAXBRUSHES)
            return 0;
    }

    return 1;
}
```

See Also

EnumObjectsProc, **FreeProcInstance**, **GlobalAlloc**, **GlobalLock**, **MakeProcInstance**, **LOGBRUSH**, **LOGPEN**

OBJ_BRUSH 2

Specifies a brush.

OBJ_BRUSH 2

OBJ_PEN 1

Specifies a pen.

OBJ_PEN 1

EqualRgn (2.x)

BOOL EqualRgn(*hrgnSrc1, hrgnSrc2***)**

HRGN *hrgnSrc1;* /* handle of first region to test for equality */
HRGN *hrgnSrc2;* /* handle of second region to test for equality */

The **EqualRgn** function determines whether two given regions are identical.

Parameter	Description
hrgnSrc1	Identifies the first region.
hrgnSrc2	Identifies the second region.

Returns
The return value is nonzero if the two regions are equal. Otherwise, it is zero.

Example
The following example uses the **EqualRgn** function to test the equality of a region against two other regions. In this case, hrgn2 is identical to hrgn1, but hrgn3 is not identical to hrgn1.

```
BOOL fEqual;
HRGN hrgn1, hrgn2, hrgn3;
LPSTR lpszEqual = "Regions are equal.";
LPSTR lpszNotEqual = "Regions are not equal.";

hrgn1 = CreateRectRgn(10, 10, 110, 110); /* 1 and 2 identical */
hrgn2 = CreateRectRgn(10, 10, 110, 110);
hrgn3 = CreateRectRgn(100, 100, 210, 210); /* same dimensions */

fEqual = EqualRgn(hrgn1, hrgn2);
if (fEqual)
    TextOut(hdc, 10, 10, lpszEqual, lstrlen(lpszEqual));
else
    TextOut(hdc, 10, 10, lpszNotEqual, lstrlen(lpszNotEqual));

fEqual = EqualRgn(hrgn1, hrgn3);
if (fEqual)
    TextOut(hdc, 10, 30, lpszEqual, lstrlen(lpszEqual));
else
    TextOut(hdc, 10, 30, lpszNotEqual, lstrlen(lpszNotEqual));

DeleteObject(hrgn1);
DeleteObject(hrgn2);
DeleteObject(hrgn3);
```

Changes

Escape (2.x)

int Escape(*hdc, nEscape, cbInput, lpszInData, lpvOutData***)**

```
HDC hdc;                /* handle of device context          */
int nEscape;            /* specifies escape function         */
int cbInput;            /* size of structure for input       */
LPCSTR lpszInData;      /* address of structure for input    */
void FAR* lpvOutData;   /* address of structure for output   */
```

The **Escape** function allows applications to access capabilities of a particular device that are not directly available through the graphics device interface (**GDI**). Escape calls made by an application are translated and sent to the driver.

Parameter	Description
hdc	Identifies the device context.
nEscape	Specifies the escape function to be performed.
cbInput	Specifies the number of bytes of data pointed to by the *lpszInData* parameter.
lpszInData	Points to the input structure required for the specified escape.
lpvOutData	Points to the structure that receives output from this escape. This parameter should be NULL if no data is returned.

Returns

The return value specifies the outcome of the function. It is greater than zero if the function is successful, except for the QUERYESCSUPPORT printer escape, which checks for implementation only. The return value is zero if the escape is not implemented. A return value less than zero indicates an error.

Errors

If the function fails, the return value is one of the following:

Value	Meaning
SP_ERROR	General error.
SP_OUTOFDISK	Not enough disk space is currently available for spooling, and no more space will become available.
SP_OUTOFMEMORY	Not enough memory is available for spooling.
SP_USERABORT	User terminated the job through Print Manager.

Changes

Windows version 3.1 introduces six new functions that supersede some printer escapes:

Function	Description
AbortDoc	Terminates a print job. Supersedes the **ABORTDOC** escape.
EndDoc	Ends a print job. Supersedes the **ENDDOC** escape.
EndPage	Ends a page. Supersedes the **NEWFRAME** escape. Unlike **NEWFRAME**, this function is always called after printing a page.
SetAbortProc	Sets the abort function for a print job. Supersedes the **SETABORTPROC** escape.
StartDoc	Starts a print job. Supersedes the **STARTDOC** escape.
StartPage	Prepares printer driver to receive data.

The **ResetDC** function is also new for Windows version 3.1. **ResetDC** updates a device context, allowing such new functionality as changing the paper orientation or paper bin within a single print job. This ability was not supported by an escape in previous versions of Windows.

For a complete list of the printer escapes under Windows version 3.0, and how support has changed for Windows 3.1, see the **Printer escapes** topic.

Printer escapes

Escape	Description
ABORTDOC	Superseded by the **AbortDoc** function in Windows version 3.1.
BANDINFO	Obsolete in Windows version 3.1. Because all printer drivers for Windows version 3.1 and later set the text flag in every band, this escape is useful only for older printer drivers.
BEGIN_PATH	No changes for Windows version 3.1. This escape is specific to PostScript printers.
CLIP_TO_PATH	No changes for Windows version 3.1. This escape is specific to PostScript printers.
DEVICEDATA	Superseded in Windows version 3.1. Applications should use the **PASSTHROUGH** escape to achieve the same functionality.
DRAFTMODE	Superseded in Windows version 3.1. Applications can achieve the same functionality by setting the *dmPrintQuality* member of the **DEVMODE** structure to DMRES_DRAFT and passing this structure to the **CreateDC** function.
DRAWPATTERNRECT	No changes for Windows version 3.1.
ENABLEDUPLEX	Superseded in Windows version 3.1. Applications can achieve the same functionality by setting the *dmDuplex* member of the **DEVMODE** structure and passing this structure to the **CreateDC** function.
ENABLEPAIRKERNING	No changes for Windows version 3.1.
ENABLERELATIVEWIDTHS	No changes for Windows version 3.1.
ENDDOC	Superseded by the **EndDoc** function in Windows version 3.1.
END_PATH	No changes for Windows version 3.1. This escape is specific to PostScript printers.
ENUMPAPERBINS	Superseded in Windows version 3.1. Applications can use the **DeviceCapabilities** function to achieve the same functionality.
ENUMPAPERMETRICS	Superseded in Windows version 3.1. Applications can use the **DeviceCapabilities** function to achieve the same functionality.
EPSPRINTING	No changes for Windows version 3.1. This escape is specific to PostScript printers.
EXT_DEVICE_CAPS	Superseded in Windows version 3.1. Applications can use the **GetDeviceCaps** function to achieve the same functionality. This escape is specific to PostScript printers.
EXTTEXTOUT	Superseded in Windows version 3.1. Applications can use the **ExtTextOut** function to achieve the same functionality. This escape is not supported by the version 3.1 PCL driver.
FLUSHOUTPUT	Removed for Windows version 3.1.
GETCOLORTABLE	Removed for Windows version 3.1.
GETEXTENDEDTEXTMETRICS	No changes for Windows version 3.1. Support for this escape may change in future versions of Windows.
GETEXTENTTABLE	Superseded in Windows version 3.1. Applications can use the **GetCharWidth** function to achieve the same

	functionality. This escape is not supported by the version 3.1 PCL or PSCRIPT drivers.
GETFACENAME	No changes for Windows version 3.1. This escape is specific to PostScript printers.
GETPAIRKERNTABLE	No changes for Windows version 3.1.
GETPHYSPAGESIZE	No changes for Windows version 3.1. Support for this escape may change in future versions of Windows.
GETPRINTINGOFFSET	No changes for Windows version 3.1. Support for this escape may change in future versions of Windows.
GETSCALINGFACTOR	No changes for Windows version 3.1. Support for this escape may change in future versions of Windows.
GETSETPAPERBINS	Superseded in Windows version 3.1. Applications can achieve the same functionality by calling the **DeviceCapabilities** function to find the number of paper bins, calling the **ExtDeviceMode** function to find the current bin, and then setting the *dmDefaultSource* member of the **DEVMODE** structure and passing this structure to the **CreateDC** function. **GETSETPAPERBINS** changes the paper bin only for the current device context. A new device context will use the system-default paper bin until the bin is explicitly changed for that device context.
GETSETPAPERMETRICS	Obsolete in Windows version 3.1. Applications can use the **DeviceCapabilities** and **ExtDeviceMode** functions to achieve the same functionality.
GETSETPAPERORIENT	Obsolete in Windows version 3.1. Applications can achieve the same functionality by setting the *dmOrientation* member of the **DEVMODE** structure and passing this structure to the **CreateDC** function. This escape is not supported by the Windows 3.1 PCL driver.
GETSETSCREENPARAMS	No changes for Windows version 3.1.
GETTECHNOLOGY	No changes for Windows version 3.1. Support for this escape may change in future versions of Windows. This escape is not supported by the Windows 3.1 PCL driver.
GETTRACKKERNTABLE	No changes for Windows version 3.1.
GETVECTORBRUSHSIZE	No changes for Windows version 3.1. Support for this escape may change in future versions of Windows.
GETVECTORPENSIZE	No changes for Windows version 3.1. Support for this escape may change in future versions of Windows.
MFCOMMENT	No changes for Windows version 3.1.
NEWFRAME	No changes for Windows version 3.1. Applications should use the **StartPage** and **EndPage** functions instead of this escape. Support for this escape may change in future versions of Windows.
NEXTBAND	No changes for Windows version 3.1. Support for this escape may change in future versions of Windows.
PASSTHROUGH	No changes for Windows version 3.1.
QUERYESCAPESUPPORT	No changes for Windows version 3.1.
RESTORE_CTM	No changes for Windows version 3.1. This escape is specific to PostScript printers.
SAVE_CTM	No changes for Windows version 3.1. This escape is

	specific to PostScript printers.
SELECTPAPERSOURCE	Obsolete in Windows version 3.1. Applications can achieve the same functionality by using the **DeviceCapabilities** function.
SETABORTPROC	Superseded in Windows version 3.1 by the **SetAbortProc** function.
SETALLJUSTVALUES	No changes for Windows version 3.1. Support for this escape may change in future versions of Windows. This escape is not supported by the Windows 3.1 PCL driver.
SET_ARC_DIRECTION	No changes for Windows version 3.1. This escape is specific to PostScript printers.
SET_BACKGROUND_COLOR	No changes for Windows version 3.1. Applications should use the **SetBkColor** function instead of this escape. Support for this escape may change in future versions of Windows.
SET_BOUNDS	No changes for Windows version 3.1. This escape is specific to PostScript printers.
SETCOLORTABLE	No changes for Windows version 3.1. Support for this escape may change in future versions of Windows.
SETCOPYCOUNT	Superseded in Windows version 3.1. An application should call the **DeviceCapabilities** function, specifying **DC_COPIES** for the *nIndex* parameter, to find the maximum number of copies the device can make. Then the application can set the number of copies by passing to the **CreateDC** function a pointer to the **DEVMODE** structure.
SETKERNTRACK	No changes for Windows version 3.1.
SETLINECAP	No changes for Windows version 3.1. This escape is specific to PostScript printers.
SETLINEJOIN	No changes for Windows version 3.1. This escape is specific to PostScript printers.
SETMITERLIMIT	No changes for Windows version 3.1. This escape is specific to PostScript printers.
SET_POLY_MODE	No changes for Windows version 3.1. This escape is specific to PostScript printers.
SET_SCREEN_ANGLE	No changes for Windows version 3.1.
SET_SPREAD	No changes for Windows version 3.1.
STARTDOC	Superseded in Windows version 3.1. An application should call the **StartDoc** function instead of this escape.
TRANSFORM_CTM	No changes for Windows version 3.1. This escape is specific to PostScript printers.

ExcludeClipRect (2.x)

int ExcludeClipRect(*hdc, nLeftRect, nTopRect, nRightRect, nBottomRect***)**

```
HDC hdc;          /* handle of device context                    */
int nLeftRect;    /* x-coordinate top-left corner of rectangle   */
int nTopRect;     /* y-coordinate top-left corner of rectangle   */
int nRightRect;   /* x-coordinate bottom-right corner of rectangle */
int nBottomRect;  /* y-coordinate bottom-right corner of rectangle */
```

The **ExcludeClipRect** function creates a new clipping region that consists of the existing clipping region minus the specified rectangle.

Parameter	Description
hdc	Identifies the device context.
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the rectangle.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the rectangle.
nRightRect	Specifies the logical x-coordinate of the lower-right corner of the rectangle.
nBottomRect	Specifies the logical y-coordinate of the lower-right corner of the rectangle.

Returns

The return value is SIMPLEREGION (region has no overlapping borders), COMPLEXREGION (region has overlapping borders), or NULLREGION (region is empty), if the function is successful. Otherwise, the return value is ERROR (no region is created).

Comments

The width of the rectangle, specified by the absolute value of *nRightRect* - *nLeftRect,* must not exceed 32,767 units. This limit applies to the height of the rectangle as well.

Example

The following example uses the **ExcludeClipRect** function to create a clipping region in the shape of a frame that is 20 units wide. The frame is painted red when the **FillRect** function is used to paint the client area.

```
RECT rc;
HRGN hrgn;
HBRUSH hbrRed;

GetClientRect(hwnd, &rc);
hrgn = CreateRectRgn(10, 10, 110, 110);
SelectClipRgn(hdc, hrgn);

ExcludeClipRect(hdc, 30, 30, 90, 90);

hbrRed = CreateSolidBrush(RGB(255, 0, 0));
FillRect(hdc, &rc, hbrRed);

DeleteObject(hbrRed);
DeleteObject(hrgn);
```

See Also

CombineRgn

ExtDeviceMode (3.0)

#include <print.h>

int ExtDeviceMode(*hwnd, hDriver, lpdmOutput, lpszDevice, lpszPort, lpdmInput, lpszProfile, fwMode***)**

```
HWND hwnd;              /* handle of window                      */
HANDLE hDriver;         /* handle of driver                      */
LPDEVMODE lpdmOutput;   /* address of structure for driver output*/
LPSTR lpszDevice;       /* string for name of device             */
LPSTR lpszPort;         /* string for name of port               */
LPDEVMODE lpdmInput;    /* address of structure for driver input */
LPSTR lpszProfile;      /* string for profile filename           */
WORD fwMode;            /* operations mask                       */
```

The **ExtDeviceMode** function retrieves or modifies device initialization information for a given printer driver or displays a driver-supplied dialog box for configuring the printer driver. Printer drivers that support device initialization by applications export **ExtDeviceMode** so that applications can call it.

Parameter	Description
hwnd	Identifies a window. If the application calls the **ExtDeviceMode** function to display a dialog box, the specified window is the parent window of the dialog box.
hDriver	Identifies the device-driver module. The **GetModuleHandle** function or **LoadLibrary** function returns a module handle.
lpdmOutput	Points to a **DEVMODE** structure. The driver writes the initialization information supplied in the *lpdmInput* parameter to this structure.
lpszDevice	Points to a null-terminated string that contains the name of the printer device--for example, PCL/HP LaserJet.
lpszPort	Points to a null-terminated string that contains the name of the port to which the device is connected--for example, LPT1.
lpdmInput	Points to a **DEVMODE** structure that supplies initialization information to the printer driver.
lpszProfile	Points to a null-terminated string that contains the name of the initialization file, where initialization information is recorded and read from. If this parameter is NULL, WIN.INI is the default initialization file.
fwMode	Specifies a mask of values that determines the operations the function performs. If this parameter is zero, the **ExtDeviceMode** function returns the number of bytes required by the printer driver's **DEVMODE** structure. Otherwise, the *fwMode* parameter can be one or more of the following values (to change the print settings, the application must specify at least one input value and one output value):

Value	Meaning
DM_IN_BUFFER	Input value. Before prompting, copying, or updating, this value merges the printer driver's current print settings with the settings in the **DEVMODE** structure identified by the *lpdmInput* parameter. The structure is updated only for those members indicated by the application in the **dmFields** member. This value is also defined as DM_MODIFY.
DM_IN_PROMPT	Input value. This value presents the printer driver's Print Setup dialog box and then changes the settings in the printer's **DEVMODE** structure to values specified by the user. This value is also defined as DM_PROMPT.
DM_OUT_BUFFER	Output value. This value writes the printer driver's current print settings (including private data) to the **DEVMODE** structure identified by the *lpdmOutput* parameter. The calling

	application must allocate a buffer sufficiently large to contain the information. If this bit is clear, *lpdmOutput* can be NULL. This value is also defined as DM_COPY.
DM_OUT_DEFAULT	Output value. This value updates graphics device interface (**GDI**)'s current printer environment and the WIN.INI file, using the contents of the printer driver's **DEVMODE** structure. Avoid using this value, because it permanently changes the print settings for all applications. This value is also defined as DM_UPDATE.

Returns

If the *fwMode* parameter is zero, the return value is the size of the buffer required to contain the printer driver initialization data. (Note that this buffer can be larger than a **DEVMODE** structure, if the printer driver appends private data to the structure.) If the function displays the initialization dialog box, the return value is either **IDOK** or **IDCANCEL**, depending on which button the user selects. If the function does not display the dialog box and is successful, the return value is IDOK. The return value is less than zero if the function fails.

Comments

The **ExtDeviceMode** function is part of the printer's device driver and not part of GDI. To use this function, an application must retrieve the address of the function by calling the **LoadLibrary** and **GetProcAddress** functions, and it must include the header file PRINT.H. The application can then use the address to set up the printer.

ExtDeviceMode is not supported by all printer drivers. If the **GetProcAddress** function returns NULL, **ExtDeviceMode** is not supported.

To make changes to print settings that are local to the application, an application should call the **ExtDeviceMode** function, specifying the **DM_OUT_BUFFER** value; modify the returned **DEVMODE** structure; and then pass the modified **DEVMODE** structure back to **ExtDeviceMode**, specifying **DM_IN_BUFFER** and DM_OUT_BUFFER (combined by using the OR operator). The **DEVMODE** structure returned by this second call to **ExtDeviceMode** can be used as an argument in a call to the **CreateDC** function.

Any call to **ExtDeviceMode** must set either **DM_OUT_BUFFER** or DM_OUT_DEFAULT.

An application can set the *fwMode* parameter to **DM_OUT_BUFFER** to obtain a **DEVMODE** structure filled with the printer driver's initialization data. The application can then pass this structure to the **CreateDC** function to set a private environment for the printer device context.

See Also

CreateDC, **DeviceMode**, **GetModuleHandle**, **GetProcAddress**, **LoadLibrary**, **DEVMODE**

DM_IN_BUFFER DM_MODIFY

Input value. Before prompting, copying, or updating, this value merges the printer driver's current print settings with the settings in the **DEVMODE** structure identified by the *lpdmInput* parameter. The structure is updated only for those members indicated by the application in the **dmFields** member. This value is also defined as DM_MODIFY.

DM_IN_BUFFER DM_MODIFY

DM_IN_PROMPT DM_PROMPT

Input value. This value presents the printer driver's Print Setup dialog box and then changes the settings in the printer's **DEVMODE** structure to values specified by the user. This value is also defined as DM_PROMPT.

DM_IN_PROMPT DM_PROMPT

DM_OUT_BUFFER DM_COPY

Output value. This value writes the printer driver's current print settings (including private data) to the **DEVMODE** structure identified by the *lpdmOutput* parameter. The calling application must allocate a buffer sufficiently large to contain the information. If this bit is clear, *lpdmOutput* can be NULL. This value is also defined as DM_COPY.

DM_OUT_BUFFER DM_COPY

DM_OUT_DEFAULT DM_UPDATE

Output value. This value updates graphics device interface (**GDI**)'s current printer environment and the WIN.INI file, using the contents of the printer driver's **DEVMODE** structure. Avoid using this value, because it permanently changes the print settings for all applications. This value is also defined as DM_UPDATE.

DM_OUT_DEFAULT DM_UPDATE

ExtFloodFill (3.0)

BOOL ExtFloodFill(*hdc, nXStart, nYStart, clrref, fuFillType***)**

```
HDC hdc;            /* handle of device context          */
int nXStart;        /* x-coordinate where filling begins */
int nYStart;        /* y-coordinate where filling begins */
COLORREF clrref;    /* color of fill                     */
UINT fuFillType;    /* fill type                         */
```

The **ExtFloodFill** function fills an area of the screen surface by using the current brush. The type of flood fill specified determines which part of the screen is filled.

Parameter	Description
hdc	Identifies the device context.
nXStart	Specifies the logical x-coordinate at which to begin filling.
nYStart	Specifies the logical y-coordinate at which to begin filling.
clrref	Specifies the color of the boundary or area to be filled. The interpretation of this parameter depends on the value of the *fuFillType* parameter.
fuFillType	Specifies the type of flood fill to be performed. It must be one of the following values:

Value	Meaning
FLOODFILLBORDER	Fill area is bounded by the color specified by the *clrref* parameter. This style is identical to the filling performed by the **FloodFill** function.
FLOODFILLSURFACE	Fill area is defined by the color specified by the *clrref* parameter. Filling continues outward in all directions as long as the color is encountered. This style is useful for filling areas that have multicolored boundaries.

Returns

The return value is nonzero if the function is successful. It is zero if the filling cannot be completed, if the given point has the boundary color specified by the *clrref* parameter (if **FLOODFILLBORDER** was requested), if the given point does not have the color specified by *clrref* (if **FLOODFILLSURFACE** was requested), or if the point is outside the clipping region.

Comments

Only memory device contexts and devices that support raster-display technology support the **ExtFloodFill** function.

If the *fuFillType* parameter is the **FLOODFILLBORDER** value, the area is assumed to be completely bounded by the color specified by the *clrref* parameter. The **ExtFloodFill** function begins at the coordinates specified by the *nXStart* and *nYStart* parameters and fills in all directions to the color boundary.

If *fuFillType* is **FLOODFILLSURFACE**, **ExtFloodFill** begins at the coordinates specified by *nXStart* and *nYStart* and continues in all directions, filling all adjacent areas containing the color specified by *clrref.*

See Also

FloodFill, **GetDeviceCaps**

FLOODFILLBORDER 0

Fill area is bounded by the color specified by the *clrref* parameter. This style is identical to the filling performed by the **FloodFill** function.

FLOODFILLBORDER 0

FLOODFILLSURFACE 1

Fill area is defined by the color specified by the *clrref* parameter. Filling continues outward in all directions as long as the color is encountered. This style is useful for filling areas that have multicolored boundaries.

ExtTextOut (2.x)

BOOL ExtTextOut(*hdc, nXStart, nYStart, fuOptions, lprc, lpszString, cbString, lpDx***)**

```
HDC hdc;                    /* handle of device context                */
int nXStart;                /* x-coordinate of starting position       */
int nYStart;                /* y-coordinate of starting position       */
UINT fuOptions;             /* rectangle type                          */
const RECT FAR* lprc;       /* address of structure with rectangle     */
LPCSTR lpszString;          /* address of string                       */
UINT cbString;              /* number of bytes in string               */
int FAR* lpDx;              /* spacing between character cells         */
```

The **ExtTextOut** function writes a character string within a rectangular region, using the currently selected font. The rectangular region can be opaque (filled by using the current background color as set by the **SetBkColor** function), and it can be a clipping region.

Parameter	Description
hdc	Identifies the device context.
nXStart	Specifies the logical x-coordinate at which the string begins.
nYStart	Specifies the logical y-coordinate at which the string begins.
fuOptions	Specifies the rectangle type. This parameter can be one, both, or neither of the following values:

Value	Meaning
ETO_CLIPPED	Text is clipped to the rectangle.
ETO_OPAQUE	Current background color fills the rectangle. (An application can set and query the current background color by using the **SetBkColor** and **GetBkColor** functions.)

lprc	Points to a **RECT** structure that determines the dimensions of the rectangle.
lpszString	Points to the specified character string.
cbString	Specifies the number of bytes in the string.
lpDx	Points to an array of values that indicate the distance, in logical units, between origins of adjacent character cells. The *n*th element in the array specifies the number of logical units that separate the origin of the *n*th item in the string from the origin of item *n* + 1. If this parameter is NULL, **ExtTextOut** uses the default spacing between characters. Otherwise, the array contains the number of elements specified in the *cbString* parameter.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

If the *fuOptions* parameter is zero and the *lprc* parameter is NULL, the **ExtTextOut** function writes text to the device context without using a rectangular region.

By default, the current position is not used or updated by **ExtTextOut**. If an application needs to update the current position when it calls **ExtTextOut**, the application can call the **SetTextAlign** function with the *wFlags* parameter set to TA_UPDATECP. When this flag is set, Windows ignores the *nXStart* and *nYStart* parameters on subsequent calls to **ExtTextOut**, using the current position instead. When an application uses **TA_UPDATECP** to update the current position, **ExtTextOut** sets the current position either to the end of the previous line of text or to the position specified by the last element of the array pointed to by the *lpDX* parameter, whichever is greater.

Example

The following example uses the **ExtTextOut** function to clip text to a rectangular region defined by a

RECT structure:

```
RECT rc;

SetRect(&rc, 90, 190, 250, 220);

ExtTextOut(hdc, 100, 200,    /* x and y coordinates       */
    ETO_CLIPPED,             /* clips text to rectangle   */
    &rc,                     /* address of RECT structure */
    "Test of ExtTextOut function.", /* string to write    */
    28,                      /* characters in string      */
    (LPINT) NULL);           /* default character spacing */
```

See Also

GetBkColor, **SetBkColor**, **SetTextAlign**, **SetTextColor**, **TabbedTextOut**, **TextOut**, **RECT**

ETO_CLIPPED 0x0004

Text is clipped to the rectangle.

ETO_CLIPPED 0x0004

ETO_OPAQUE 0x0002

Current background color fills the rectangle. (An application can set and query the current background color by using the **SetBkColor** and **GetBkColor** functions.)

ETO_OPAQUE 0x0002

FillRgn (2.x)

BOOL FillRgn(*hdc, hrgn, hbr***)**

HDC *hdc;* /* handle of device context */
HRGN *hrgn;* /* handle of region */
HBRUSH *hbr;* /* handle of brush */

The **FillRgn** function fills the given region by using the specified brush.

Parameter	Description
hdc	Identifies the device context.
hrgn	Identifies the region to be filled. The coordinates for the given region are specified in device units.
hbr	Identifies the brush to be used to fill the region.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Example
The following example uses a blue brush to fill a rectangular region. Note that it is not necessary to select the brush into the device context before using it to fill the region.

```
HRGN hrgn;
HBRUSH hBrush;

hrgn = CreateRectRgn(10, 10, 110, 110);
SelectObject(hdc, hrgn);

hBrush = CreateSolidBrush(RGB(0, 0, 255));

FillRgn(hdc, hrgn, hBrush);

DeleteObject(hrgn);
```

See Also
CreateBrushIndirect, **CreateDIBPatternBrush**, **CreateHatchBrush**, **CreatePatternBrush**, **CreateSolidBrush**, **PaintRgn**

FloodFill (2.x)

BOOL FloodFill(*hdc, nXStart, nYStart, clrref***)**

```
HDC hdc;          /* handle of device context          */
int nXStart;      /* x-coordinate of starting position */
int nYStart;      /* y-coordinate of starting position */
COLORREF clrref;  /* color of fill boundary            */
```

The **FloodFill** function fills an area of the screen surface by using the current brush. The area is assumed to be bounded as specified by the *clrref* parameter. The **FloodFill** function begins at the point specified by the *nXStart* and *nYStart* parameters and continues in all directions to the color boundary.

Parameter	Description
hdc	Identifies the device context.
nXStart	Specifies the logical x-coordinate at which to begin filling.
nYStart	Specifies the logical y-coordinate at which to begin filling.
clrref	Specifies the color of the boundary.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero, indicating that the filling cannot be completed, that the given point has the boundary color specified by *clrref,* or that the point is outside the clipping region.

Comments

Only memory device contexts and devices that support raster-display technology support the **FloodFill** function.

See Also

ExtFloodFill, **GetDeviceCaps**

FrameRgn (2.x)

BOOL FrameRgn(*hdc, hrgn, hbr, nWidth, nHeight***)**

HDC *hdc;* /* handle of device context */
HRGN *hrgn;* /* handle of region */
HBRUSH *hbr;* /* handle of brush */
int *nWidth;* /* width of region frame */
int *nHeight;* /* height of region frame */

The **FrameRgn** function draws a border around the given region, using the specified brush.

Parameter	Description
hdc	Identifies the device context.
hrgn	Identifies the region to be enclosed in a border.
hbr	Identifies the brush to be used to draw the border.
nWidth	Specifies the width, in device units, of vertical brush strokes.
nHeight	Specifies the height, in device units, of horizontal brush strokes.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Example
The following example uses a blue brush to frame a rectangular region. Note that it is not necessary to select the brush or the region into the device context.

```
HRGN hrgn;
HBRUSH hBrush;
int Width = 5, Height = 2;

hrgn = CreateRectRgn(10, 10, 110, 110);
hBrush = CreateSolidBrush(RGB(0, 0, 255));

FrameRgn(hdc, hrgn, hBrush, Width, Height);

DeleteObject(hrgn);
DeleteObject(hBrush);
```

See Also
FillRgn, **PaintRgn**

GetAspectRatioFilter (2.x)

DWORD GetAspectRatioFilter(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetAspectRatioFilter** function retrieves the setting for the current aspect-ratio filter. The aspect ratio is the ratio formed by a device's pixel width and height. Information about a device's aspect ratio is used in the creation, selection, and display of fonts. Windows provides a special filter, the aspect-ratio filter, to select fonts designed for a particular aspect ratio from all of the available fonts. The filter uses the aspect ratio specified by the **SetMapperFlags** function.

Parameter	Description
hdc	Identifies the device context that contains the specified aspect ratio.

Returns

The low-order word of the return value contains the x-coordinate of the aspect ratio if the function is successful; the high-order word contains the y-coordinate.

See Also

SetMapperFlags

GetAspectRatioFilterEx (3.1)

BOOL GetAspectRatioFilterEx(*hdc, lpAspectRatio***)**

HDC *hdc;*
SIZE FAR* *lpAspectRatio;*

The **GetAspectRatioFilterEx** function retrieves the setting for the current aspect-ratio filter. The aspect ratio is the ratio formed by a device's pixel width and height. Information about a device's aspect ratio is used in the creation, selection, and displaying of fonts. Windows provides a special filter, the aspect-ratio filter, to select fonts designed for a particular aspect ratio from all of the available fonts. The filter uses the aspect ratio specified by the **SetMapperFlags** function.

Parameter	Description
hdc	Identifies the device context that contains the specified aspect ratio.
lpAspectRatio	Pointer to a **SIZE** structure where the current aspect ratio filter will be returned.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also
SetMapperFlags

GetBitmapBits (2.x)

LONG GetBitmapBits(*hbm, cbBuffer, lpvBits***)**

```
HBITMAP hbm;        /* handle of bitmap                  */
LONG cbBuffer;      /* number of bytes to copy to buffer */
void FAR* lpvBits;  /* address of buffer for bitmap bits */
```

The **GetBitmapBits** function copies the bits of the specified bitmap into a buffer.

Parameter	Description
hbm	Identifies the bitmap.
cbBuffer	Specifies the number of bytes to be copied.
lpvBits	Points to the buffer that is to receive the bitmap. The bitmap is an array of bytes. This array conforms to a structure in which horizontal scan lines are multiples of 16 bits.

Returns

The return value specifies the number of bytes in the bitmap if the function is successful. It is zero if there is an error.

Comments

An application can use the **GetObject** function to determine the number of bytes to copy into the buffer pointed to by the *lpvBits* parameter.

See Also

GetObject, **SetBitmapBits**

GetBitmapDimension (2.x)

DWORD GetBitmapDimension(*hbm***)**

HBITMAP *hbm;* /* handle of bitmap */

The **GetBitmapDimension** function returns the width and height of the specified bitmap. The height and width is assumed to have been set by the **SetBitmapDimension** function.

Parameter	Description
hbm	Identifies the bitmap.

Returns

The low-order word of the return value contains the bitmap width, in tenths of a millimeter, if the function is successful; the high-order word contains the height. If the bitmap width and height have not been set by using the **SetBitmapDimension** function, the return value is zero.

See Also

SetBitmapDimension

GetBitmapDimensionEx (2.x)

BOOL GetBitmapDimensionEx(*hBitmap, lpDimension***)**

HBITMAP *hBitmap;* /* handle of bitmap */
SIZE FAR* *lpDimension;* /* address of dimension structure */

The **GetBitmapDimensionEx** function returns the dimensions of the bitmap previously set by the **SetBitmapDimensionEx** function. If no dimensions have been set, a default of 0,0 will be returned.

Parameter	Description
hBitmap	Identifies the bitmap.
lpDimension	Points to a **SIZE** structure to which the dimensions are returned.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also
SetBitmapDimensionEx, **SIZE**

GetBkColor (2.x)

COLORREF GetBkColor(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetBkColor** function returns the current background color.

Parameter	Description
hdc	Identifies the device context.

Returns

The return value is an **RGB** (red, green, blue) color value if the function is successful.

Comments

If the background mode is **OPAQUE**, the system uses the background color to fill the gaps in styled lines, the gaps between hatched lines in brushes, and the background in character cells. The system also uses the background color when converting bitmaps between color and monochrome device contexts.

Example

The following example uses the **GetBkColor** function to determine whether the current background color is white. If it is, the **SetBkColor** function sets it to red.

```
DWORD dwBackColor;

dwBackColor = GetBkColor(hdc);
if (dwBackColor == RGB(255, 255, 255)) { /* if color is white */
    SetBkColor(hdc, RGB(255, 0, 0));     /* sets color to red */
    TextOut(hdc, 100, 200, "SetBkColor test.", 16);
}
```

See Also

GetBkMode, **SetBkColor**, **SetBkMode**, **RGB**

GetBkMode (2.x)

int GetBkMode(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetBkMode** function returns the background mode. The background mode defines whether the system removes existing background colors on the drawing surface before drawing text, hatched brushes, or any pen style that is not a solid line.

Parameter	Description
hdc	Identifies the device context.

Returns

The return value specifies the current background mode if the function is successful. It can be **OPAQUE**, **TRANSPARENT**, or TRANSPARENT1.

Example

The following example determines the current background mode by calling the **GetBkMode** function. If the mode is **OPAQUE**, the **SetBkMode** function sets it to TRANSPARENT.

```
int nBackMode;

nBackMode = GetBkMode(hdc);
if (nBackMode == OPAQUE) {
    TextOut(hdc, 90, 100, "This background mode is OPAQUE.", 31);
    SetBkMode(hdc, TRANSPARENT);
}
```

See Also

GetBkColor, **SetBkColor**, **SetBkMode**

GetBoundsRect (3.1)

UINT GetBoundsRect(*hdc, lprcBounds, flags***)**

```
HDC hdc;                    /* handle of device context                    */
RECT FAR* lprcBounds;       /* address of structure for bounding rectangle */
UINT flags;                 /* specifies whether to clear rectangle        */
```

The **GetBoundsRect** function returns the current accumulated bounding rectangle for the specified device context.

Parameter	Description
hdc	Identifies the device context to return the bounding rectangle for.
lprcBounds	Points to a buffer that will receive the current bounding rectangle. The rectangle is returned in logical coordinates.
flags	Specifies whether the bounding rectangle to be cleared after it is returned. This parameter can be DCB_RESET, to clear the rectangle. Otherwise, it should be zero.

Returns

The return value is DBC_SET if the bounding rectangle is not empty. Otherwise it is DCB_RESET.

See Also

SetBoundsRect

GetBrushOrg (2.x)

DWORD GetBrushOrg(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetBrushOrg** function retrieves the origin, in device coordinates, of the brush currently selected for the given device context.

Parameter	Description
hdc	Identifies the device context.

Returns

The low-order word of the return value contains the current x-coordinate of the brush, in device coordinates, if the function is successful; the high-order word contains the y-coordinate.

Comments

The initial brush origin is at the coordinates (0,0) in the client area. The return value specifies these coordinates in device units relative to the origin of the desktop window.

Example

The following example uses the **LOWORD** and **HIWORD** macros to extract the x- and y-coordinate of the current brush from the return value of the **GetBrushOrg** function:

```
DWORD dwBrOrg;
WORD wXBrOrg, wYBrOrg;

dwBrOrg = GetBrushOrg(hdc);
wXBrOrg = LOWORD(dwBrOrg);
wYBrOrg = HIWORD(dwBrOrg);
```

See Also

GetBrushOrgEx, **SelectObject**, **SetBrushOrg**, **HIWORD**, **LOWORD**

GetBrushOrgEx (3.1)

BOOL GetBrushOrgEx(*hDC, lpPoint***)**

```
HDC hDC;                /* handle of device context              */
POINT FAR* lpPoint;     /* address of structure for brush origin */
```

The **GetBrushOrgEx** function retrieves the current brush origin for the given device context.

Parameter	Description
hDC	Identifies the device context.
lpPoint	Points to a **POINT** structure to which the device coordinates of the brush origin are to be returned.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The initial brush origin is at the coordinate (0,0).

See Also

GetBrushOrg, **SetBrushOrg**

GetCharABCWidths (3.1)

BOOL GetCharABCWidths(*hdc, uFirstChar, uLastChar, lpabc***)**

```
HDC hdc;          /* handle of device context          */
UINT uFirstChar;  /* first character in range to query */
UINT uLastChar;   /* last character in range to query  */
LPABC lpabc;      /* address of ABC width structures   */
```

The **GetCharABCWidths** function retrieves the widths of consecutive characters in a specified range from the current TrueType font. The widths are returned in logical units. This function succeeds only with TrueType fonts.

Parameter	Description
hdc	Identifies the device context.
uFirstChar	Specifies the first character in the range of characters from the current font for which character widths are returned.
uLastChar	Specifies the last character in the range of characters from the current font for which character widths are returned.
lpabc	Points to an array of **ABC** structures that receive the character widths when the function returns. This array must contain at least as many **ABC** structures as there are characters in the range specified by the *uFirstChar* and *uLastChar* parameters.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The TrueType rasterizer provides **ABC** character spacing after a specific point size has been selected. "A" spacing is the distance that is added to the current position before placing the glyph. "B" spacing is the width of the black part of the glyph. "C" spacing is added to the current position to account for the white space to the right of the glyph. The total advanced width is given by A + B + C.

When the **GetCharABCWidths** function retrieves negative "A" or "C" widths for a character, that character includes underhangs or overhangs.

To convert the **ABC** widths to font design units, an application should create a font whose height (as specified in the **lfHeight** member of the **LOGFONT** structure) is equal to the value stored in the **ntmSizeEM** member of the **NEWTEXTMETRIC** structure. (The value of the **ntmSizeEM** member can be retrieved by calling the **EnumFontFamilies** function.)

The **ABC** widths of the default character are used for characters that are outside the range of the currently selected font.

To retrieve the widths of characters in non-TrueType fonts, applications should use the **GetCharWidth** function.

See Also

EnumFontFamilies, **GetCharWidth**, **ABC**, **OUTLINETEXTMETRIC**

GetCharWidth (2.x)

BOOL GetCharWidth(*hdc, uFirstChar, uLastChar, lpnWidths***)**

HDC *hdc;* /* handle of device context */
UINT *uFirstChar;* /* first character in range to query */
UINT *uLastChar;* /* last character in range to query */
int FAR* *lpnWidths;* /* address of buffer for widths */

The **GetCharWidth** function retrieves the widths of individual characters in a range of consecutive characters in the current font.

Parameter	Description
hdc	Identifies the device context.
uFirstChar	Specifies the first character in a group of consecutive characters in the current font.
uLastChar	Specifies the last character in a group of consecutive characters in the current font.
lpnWidths	Points to a buffer that receives the width values for a group of consecutive characters in the current font.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

If a character in the group of consecutive characters does not exist in a particular font, it will be assigned the width value of the default character.

Example

The following example uses the **GetCharWidth** function to retrieve the widths of the characters from "I" through "S" and displays the total number of widths retrieved in a message box:

```
HDC hdc;
WORD wTotalValues;
WORD wFirstChar, wLastChar;
int InfoBuffer[256];
char szMessage[30];

wFirstChar = (WORD) 'I';
wLastChar  = (WORD) 'S';

hdc = GetDC(hwnd);
if (GetCharWidth(hdc, wFirstChar, wLastChar, (int FAR*) InfoBuffer)) {
    wTotalValues = wLastChar - wFirstChar + 1;
    wsprintf(szMessage, "Total values received: %d", wTotalValues);
    MessageBox(hwnd, szMessage, "GetCharWidth", MB_OK);
}
else
    MessageBox(hwnd, "GetCharWidth was unsuccessful", "ERROR!",
        MB_OK);

ReleaseDC(hwnd, hdc);
```

See Also

GetCharABCWidths

GetClipBox (2.x)

int GetClipBox(*hdc, lprc***)**

```
HDC hdc;          /* handle of device context          */
RECT FAR* lprc;   /* address of structure with rectangle */
```

The **GetClipBox** function retrieves the dimensions of the smallest rectangle that completely contains the current clipping region.

Parameter	Description
hdc	Identifies the device context.
lprc	Points to the **RECT** structure that receives the logical coordinates of the rectangle.

Returns

The return value is SIMPLEREGION (region has no overlapping borders), COMPLEXREGION (region has overlapping borders), or NULLREGION (region is empty), if the function is successful. Otherwise, the return value is ERROR.

See Also

GetBoundsRect, **GetRgnBox**, **GetTextExtent**, **SelectClipRgn**, **RECT**

GetCurrentPosition (2.x)

DWORD GetCurrentPosition(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetCurrentPosition** function retrieves the logical coordinates of the current position. The current position is set by using the **MoveTo** function.

Parameter	Description
hdc	Identifies the device context.

Returns

The low-order word of the return value contains the logical x-coordinate of the current position if the function is successful; the high-order word contains the logical y-coordinate.

See Also

GetCurrentPositionEx, **LineTo**, **MoveTo**

GetCurrentPositionEx (3.1)

BOOL GetCurrentPositionEx(*hdc, lpPoint***)**

HDC *hdc;*
POINT FAR* *lpPoint;*

The **GetCurrentPositionEx** function retrieves the current position in logical coordinates.

Parameter	Description
hdc	Identifies the device context to get the current position from.
lpPoint	Points to a **POINT** structure that gets filled with the current position.

Returns
The return value is nonzero if the function is successful, zero if there is an error.

See Also
GetCurrentPosition

GetDCOrg (2.x)

DWORD GetDCOrg(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetDCOrg** function retrieves the coordinates of the final translation origin for the device context. This origin specifies the offset used by Windows to translate device coordinates into client coordinates for points in an application's window. The final translation origin is relative to the physical origin of the screen.

Parameter	Description
hdc	Identifies the device context whose origin is to be retrieved.

Returns

The low-order word of the return value contains the x-coordinate of the final translation origin, in device coordinates, if the function is successful; the high-order word contains the y-coordinate.

Example

The following example uses the **CreateIC** function to create an information context for the screen and then retrieves the context's origin by using the **GetDCOrg** function:

```
HDC   hdcIC;
DWORD dwOrigin;

hdcIC = CreateIC("DISPLAY", NULL, NULL, NULL);
dwOrigin = GetDCOrg(hdcIC);

DeleteDC(hdcIC);
```

See Also

CreateIC

GetDeviceCaps (2.x)

int GetDeviceCaps(*hdc, iCapability***)**

HDC *hdc;* /* handle of device context */
int *iCapability;* /* index of capability to query */

The **GetDeviceCaps** function retrieves device-specific information about a given display device.

Parameter	Description
hdc	Identifies the device context.
iCapability	Specifies the type of information to be returned. It can be one of the following indices:

Index	Description
DRIVERVERSION	Version number of the device driver.
TECHNOLOGY	Device technology. It can be one of the following values:

Value	Meaning
DT_PLOTTER	Vector plotter
DT_RASDISPLAY	Raster display
DT_RASPRINTER	Raster printer
DT_RASCAMERA	Raster camera
DT_CHARSTREAM	Character stream
DT_METAFILE	Metafile
DT_DISPFILE	Display file

HORZSIZE	Width of the physical display, in millimeters.
VERTSIZE	Height of the physical display, in millimeters.
HORZRES	Width of the display, in pixels.
VERTRES	Height of the display, in raster lines.
LOGPIXELSX	Number of pixels per logical inch along the display width.
LOGPIXELSY	Number of pixels per logical inch along the display height.
BITSPIXEL	Number of adjacent color bits for each pixel.
PLANES	Number of color planes.
NUMBRUSHES	Number of device-specific brushes.
NUMPENS	Number of device-specific pens.
NUMMARKERS	Number of device-specific markers.
NUMFONTS	Number of device-specific fonts.
NUMCOLORS	Number of entries in the device's color table.
ASPECTX	Relative width of a device pixel used for line drawing.
ASPECTY	Relative height of a device pixel used for line drawing.
ASPECTXY	Diagonal width of a device pixel used for line drawing.
PDEVICESIZE	Size of the **PDEVICE** internal structure, in bytes.
CLIPCAPS	Clipping capabilities the device supports. It can be one of the following values:

Value	Meaning
CP_NONE	Output is not clipped.
CP_RECTANGLE	Output is clipped to rectangles.
CP_REGION	Output is clipped to regions.

SIZEPALETTE	Number of entries in the system palette. This index is valid only if the device driver sets the RC_PALETTE bit in the

RASTERCAPS index; it is available only if the driver is written for Windows 3.0 or later.

NUMRESERVED — Number of reserved entries in the system palette. This index is valid only if the device driver sets the RC_PALETTE bit in the RASTERCAPS index; it is available only if the driver is written for Windows 3.0 or later.

COLORRES — Color resolution of the device, in bits per pixel. This index is valid only if the device driver sets the RC_PALETTE bit in the RASTERCAPS index; it is available only if the driver is written for Windows 3.0 or later.

RASTERCAPS — Raster capabilities the device supports. It can be a combination of the following values:

Value	Meaning
RC_BANDING	Supports banding.
RC_BIGFONT	Supports fonts larger than 64K.
RC_BITBLT	Transfers bitmaps.
RC_BITMAP64	Supports bitmaps larger than 64K.
RC_DEVBITS	Supports device bitmaps.
RC_DI_BITMAP	Supports the **SetDIBits** and **GetDIBits** functions.
RC_DIBTODEV	Supports the **SetDIBitsToDevice** function.
RC_FLOODFILL	Performs flood fills.
RC_GDI20_OUTPUT	Supports Windows version 2.0 features.
RC_GDI20_STATE	Includes a state block in the device context.
RC_NONE	Supports no raster operations.
RC_OP_DX_OUTPUT	Supports dev opaque and DX array.
RC_PALETTE	Specifies a palette-based device.
RC_SAVEBITMAP	Saves bitmaps locally.
RC_SCALING	Supports scaling.
RC_STRETCHBLT	Supports the **StretchBlt** function.
RC_STRETCHDIB	Supports the **StretchDIBits** function.

CURVECAPS — Curve capabilities the device supports. It can be a combination of the following values:

Value	Meaning
CC_NONE	Supports curves.
CC_CIRCLES	Supports circles.
CC_PIE	Supports pie wedges.
CC_CHORD	Supports chords.
CC_ELLIPSES	Supports ellipses.
CC_WIDE	Supports wide borders.
CC_STYLED	Supports styled borders.
CC_WIDESTYLED	Supports wide, styled borders.
CC_INTERIORS	Supports interiors.

	CC_ROUNDRECT	Supports rectangles with rounded corners.
LINECAPS	Line capabilities the device supports. It can be a combination of the following values:	
	Value	**Meaning**
	LC_NONE	Supports no lines.
	LC_POLYLINE	Supports polylines.
	LC_MARKER	Supports markers.
	LC_POLYMARKER	Supports polymarkers.
	LC_WIDE	Supports wide lines.
	LC_STYLED	Supports styled lines.
	LC_WIDESTYLED	Supports wide, styled lines.
	LC_INTERIORS	Supports interiors.
POLYGONALCAPS	Polygonal capabilities the device supports. It can be a combination of the following values:	
	Value	**Meaning**
	PC_NONE	Supports no polygons.
	PC_POLYGON	Supports alternate fill polygons.
	PC_RECTANGLE	Supports rectangles.
	PC_WINDPOLYGON	Supports winding number fill polygons.
	PC_SCANLINE	Supports scan lines.
	PC_WIDE	Supports wide borders.
	PC_STYLED	Supports styled borders.
	PC_WIDESTYLED	Supports wide, styled borders.
	PC_INTERIORS	Supports interiors.
TEXTCAPS	Text capabilities the device supports. It can be a combination of the following values:	
	Value	**Meaning**
	TC_OP_CHARACTER	Supports character output precision, which indicates the device can place device fonts at any pixel location. This is required for any device with device fonts.
	TC_OP_STROKE	Supports stroke output precision, which indicates the device can omit any stroke of a device font.
	TC_CP_STROKE	Supports stroke clip precision, which indicates the device can clip device fonts to a pixel boundary.
	TC_CR_90	Supports 90-degree character rotation, which indicates the device can rotate characters only 90 degrees at a time.
	TC_CR_ANY	Supports character rotation at any degree, which indicates the device can rotate device fonts

	through any angle.
TC_SF_X_YINDEP	Supports scaling independent of x and y directions, which indicates the device can scale device fonts separately in x and y directions.
TC_SA_DOUBLE	Supports doubled characters for scaling, which indicates the device can double the size of device fonts.
TC_SA_INTEGER	Supports integer multiples for scaling, which indicates the device can scale the size of device fonts in any integer multiple.
TC_SA_CONTIN	Supports any multiples for exact scaling, which indicates the device can scale device fonts by any amount but still preserve the x and y ratios.
TC_EA_DOUBLE	Supports double-weight characters, which indicates the device can make device fonts bold. If this bit is not set for printer drivers, graphics device interface (**GDI**) attempts to create bold device fonts by printing them twice.
TC_IA_ABLE	Supports italics, which indicates the device can make device fonts italic. If this bit is not set, **GDI** assumes italics are not available.
TC_UA_ABLE	Supports underlining, which indicates the device can underline device fonts. If this bit is not set, **GDI** creates underlines for device fonts.
TC_SO_ABLE	Supports strikeouts, which indicates the device can strikeout device fonts. If this bit is not set, **GDI** creates strikeouts for device fonts.
TC_RA_ABLE	Supports raster fonts, which indicates that **GDI** should enumerate any raster or TrueType fonts available for this device in response to a call to the **EnumFonts** or **EnumFontFamilies** function. If this bit is not set, GDI-supplied raster or TrueType fonts are not enumerated when these functions are called.

TC_VA_ABLE	Supports vector fonts, which indicates that **GDI** should enumerate any vector fonts available for this device in response to a call to the **EnumFonts** or **EnumFontFamilies** function. This is significant for vector devices only (that is, for plotters). Display drivers (which must be able to use raster fonts) and raster printer drivers always enumerate vector fonts, because GDI rasterizes vector fonts before sending them to the driver.
TC_RESERVED	Reserved; must be zero.

Returns

The return value is the value of the requested capability if the function is successful.

Example

The following example uses the **GetDeviceCaps** function to determine whether a device supports raster capabilities and is palette-based. If so, the example calls the **GetSystemPaletteUse** function.

```
WORD nUse;

hdc = GetDC(hwnd);
if ((GetDeviceCaps(hdc, RASTERCAPS) & RC_PALETTE) == 0) {
    ReleaseDC(hwnd, hdc);
    break;
}
nUse = GetSystemPaletteUse(hdc);
ReleaseDC(hwnd, hdc);
```

See Also

LOGFONT

GetDIBits (3.0)

int GetDIBits(*hdc, hbmp, nStartScan, cScanLines, lpvBits, lpbmi, fuColorUse***)**

```
HDC hdc;                    /* handle of device context                    */
HBITMAP hbmp;               /* handle of bitmap                            */
UINT nStartScan;            /* first scan line to set in destination bitmap*/
UINT cScanLines;            /* number of scan lines to copy                */
void FAR* lpvBits;          /* address of array for bitmap bits            */
BITMAPINFO FAR* lpbmi;      /* address of structure with bitmap data       */
UINT fuColorUse;            /* type of color table                         */
```

The **GetDIBits** function retrieves the bits of the specified bitmap and copies them, in device-independent format, into the buffer pointed to by the *lpvBits* parameter. The *lpbmi* parameter retrieves the color format for the device-independent bits.

Parameter	Description
hdc	Identifies the device context.
hbmp	Identifies the bitmap.
nStartScan	Specifies the first scan line to be set in the bitmap received in the *lpvBits* parameter.
cScanLines	Specifies the number of lines to be copied.
lpvBits	Points to a buffer that will receive the bitmap bits in device-independent format.
lpbmi	Points to a **BITMAPINFO** structure that specifies the color format and dimension for the device-independent bitmap.
fuColorUse	Specifies whether the **bmiColors** members of the **BITMAPINFO** structure are to contain explicit **RGB** values or indices into the currently realized logical palette. The *fuColorUse* parameter must be one of the following values:

Value	Meaning
DIB_PAL_COLORS	Color table is to consist of an array of 16-bit indices into the currently realized logical palette.
DIB_RGB_COLORS	Color table is to contain literal **RGB** values.

Returns

The return value specifies the number of scan lines copied from the bitmap if the function is successful. Otherwise, it is zero.

Comments

If the *lpvBits* parameter is NULL, the **GetDIBits** function fills in the **BITMAPINFO** structure to which the *lpbmi* parameter points but does not retrieve bits from the bitmap.

The bitmap identified by the *hbmp* parameter must not be selected into a device context when the application calls this function.

The origin for device-independent bitmaps (DIBs) is the lower-left corner of the bitmap, not the upper-left corner, which is the origin when the mapping mode is MM_TEXT.

See Also

SetDIBits, **BITMAPINFO**

GetFontData (3.1)

DWORD GetFontData(*hdc, dwTable, dwOffset, lpvBuffer, cbData***)**

```
HDC hdc;            /* handle of device context        */
DWORD dwTable;      /* metric table to query           */
DWORD dwOffset;     /* offset into table being queried */
void FAR* lpvBuffer;/* address of buffer for font data */
DWORD cbData;       /* length of data to query         */
```

The **GetFontData** function retrieves font-metric information from a scalable font file. The information to retrieve is identified by specifying an offset into the font file and the length of the information to return.

Parameter	Description
hdc	Identifies the device context.
dwTable	Specifies the name of the metric table to be returned. This parameter can be one of the metric tables documented in the TrueType Font Files specification, published by Microsoft Corporation. If this parameter is zero, the information is retrieved starting at the beginning of the font file.
dwOffset	Specifies the offset from the beginning of the table at which to begin retrieving information. If this parameter is zero, the information is retrieved starting at the beginning of the table specified by the *dwTable* parameter. If this value is greater than or equal to the size of the table, **GetFontData** returns zero.
lpvBuffer	Points to a buffer that will receive the font information. If this value is NULL, the function returns the size of the buffer required for the font data specified in the *dwTable* parameter.
cbData	Specifies the length, in bytes, of the information to be retrieved. If this parameter is zero, **GetFontData** returns the size of the data specified in the *dwTable* parameter.

Returns

The return value specifies the number of bytes returned in the buffer pointed to by the *lpvBuffer* parameter, if the function is successful. Otherwise, it is -1.

Comments

An application can sometimes use the **GetFontData** function to save a TrueType font with a document. To do this, the application determines whether the font can be embedded and then retrieves the entire font file, specifying zero for the *dwTable, dwOffset,* and *cbData* parameters.

Applications can determine whether a font can be embedded by checking the **otmfsType** member of the **OUTLINETEXTMETRIC** structure. If bit 1 of **otmfsType** is set, embedding is not permitted for the font. If bit 1 is clear, the font can be embedded. If bit 2 is set, the embedding is read-only.

If an application attempts to use this function to retrieve information for a non-TrueType font, the **GetFontData** function returns -1.

Example

The following example retrieves an entire TrueType font file:

```
HGLOBAL hglb;
DWORD dwSize;
void FAR* lpvBuffer;

dwSize = GetFontData(hdc, NULL, 0L, NULL, 0L); /* get file size   */

hglb = GlobalAlloc(GPTR, dwSize);  /* allocate memory */
lpvBuffer = GlobalLock(hglb);
GetFontData(hdc, NULL, 0L, lpvBuffer, dwSize);  /* retrieve data   */
```

The following retrieves an entire TrueType font file 4K at a time:

```
#define BUFFER_SIZE  4096
BYTE Buffer[BUFFER_SIZE];
DWORD dwOffset;
DWORD dwSize;

dwOffset = 0L;
while(dwSize = GetFontData(hdc, NULL, dwOffset,
    Buffer, BUFFER_SIZE)) {
  .
  . /* process data in buffer */
  .
  dwOffset += dwSize;
}
```

The following example retrieves a TrueType font table:

```
HGLOBAL hglb;
DWORD dwSize;
void FAR* lpvBuffer;

LPSTR lpszTable;
DWORD dwTable;

lpszTable = "cmap";
dwTable   = *(LPDWORD) lpszTable;          /* construct DWORD type */

dwSize = GetFontData(hdc, dwTable, 0L, NULL, 0L); /* get table size */

hglb = GlobalAlloc(GPTR, dwSize);                /* allocate memory */
lpvBuffer = GlobalLock(hglb);
GetFontData(hdc, dwTable, 0L, lpvBuffer, dwSize);  /* retrieve data */
```

See Also
GetOutlineTextMetrics, **OUTLINETEXTMETRIC**

GetGlyphOutline (3.1)

DWORD GetGlyphOutline(*hdc, uChar, fuFormat, lpgm, cbBuffer, lpBuffer, lpmat2***)**

```
HDC hdc;                /* handle of device context                */
UINT uChar;             /* character to query                      */
UINT fuFormat;          /* format of data to return                */
LPGLYPHMETRICS lpgm;    /* address of structure with glyph metrics */
DWORD cbBuffer;         /* size of buffer for data                 */
void FAR* lpBuffer;     /* address of buffer for outline data      */
LPMAT2 lpmat2;          /* address of structure with transform matrix */
```

The **GetGlyphOutline** function retrieves the outline curve or bitmap for an outline character in the current font.

Parameter	Description
hdc	Identifies the device context.
uChar	Specifies the character for which information is to be returned.
fuFormat	Specifies the format in which the function is to return information. It can be one of the following values:

Value	Meaning
GGO_BITMAP	Returns the glyph bitmap. When the function returns, the buffer pointed to by the *lpBuffer* parameter contains a 1-bit-per-pixel bitmap whose rows start on doubleword boundaries.
GGO_NATIVE	Returns the curve data points in the rasterizer's native format, using device units. When this value is specified, any transformation specified in the *lpmat2* parameter is ignored.

When the value of this parameter is zero, the function fills in a **GLYPHMETRICS** structure but does not return glyph-outline data.

lpgm	Points to a **GLYPHMETRICS** structure that describes the placement of the glyph in the character cell.
cbBuffer	Specifies the size of the buffer into which the function copies information about the outline character. If this value is zero and the *fuFormat* parameter is either the **GGO_BITMAP** or **GGO_NATIVE** values, the function returns the required size of the buffer.
lpBuffer	Points to a buffer into which the function copies information about the outline character. If the *fuFormat* parameter specifies the **GGO_NATIVE** value, the information is copied in the form of **TTPOLYGONHEADER** and **TTPOLYCURVE** structures. If this value is NULL and the *fuFormat* parameter is either the **GGO_BITMAP** or GGO_NATIVE value, the function returns the required size of the buffer.
lpmat2	Points to a **MAT2** structure that contains a transformation matrix for the character. This parameter cannot be NULL, even when the **GGO_NATIVE** value is specified for the *fuFormat* parameter.

Returns

The return value is the size, in bytes, of the buffer required for the retrieved information if the *cbBuffer* parameter is zero or the *lpBuffer* parameter is NULL. Otherwise, it is a positive value if the function is successful, or -1 if there is an error.

Comments

An application can rotate characters retrieved in bitmap format by specifying a 2-by-2 transformation matrix in the structure pointed to by the *lpmat2* parameter.

A glyph outline is returned as a series of contours. Each contour is defined by a **TTPOLYGONHEADER** structure followed by as many **TTPOLYCURVE** structures as are required to describe it. All points are

returned as **POINTFX** structures and represent absolute positions, not relative moves. The starting point given by the **pfxStart** member of the **TTPOLYGONHEADER** structure is the point at which the outline for a contour begins. The **TTPOLYCURVE** structures that follow can be either polyline records or spline records. Polyline records are a series of points; lines drawn between the points describe the outline of the character. Spline records represent the quadratic curves used by TrueType (that is, quadratic b-splines).

For example, the **GetGlyphOutline** function retrieves the following information about the lowercase "i" in the Arial TrueType font:

```
dwrc = 88                       /* total size of native buffer     */

TTPOLYGONHEADER #1              /* contour for dot on i            */
  cb     = 44                   /* size for contour                */
  dwType = 24                   /* TT_POLYGON_TYPE                 */
  pfxStart = 1.000, 11.000

  TTPOLYCURVE #1
    wType  = TT_PRIM_LINE
    cpfx   = 3
    pfx[0] = 1.000, 12.000
    pfx[1] = 2.000, 12.000
    pfx[2] = 2.000, 11.000      /* automatically close to pfxStart */

TTPOLYGONHEADER #2              /* contour for body of i           */
  cb     = 44
  dwType = 24                   /* TT_POLYGON_TYPE                 */
  pfxStart = 1.000, 0.000

  TTPOLYCURVE #1
    wType  = TT_PRIM_LINE
    cpfx   = 3
    pfx[0] = 1.000, 9.000
    pfx[1] = 2.000, 9.000
    pfx[2] = 2.000, 0.000       /* automatically close to pfxStart */
```

See Also

GetOutlineTextMetrics, **GLYPHMETRICS**, **MAT2**, **OUTLINETEXTMETRIC**, **POINTFX**, **TTPOLYCURVE**, **TTPOLYGONHEADER**

GGO_BITMAP 1

Returns the glyph bitmap. When the function returns, the buffer pointed to by the *lpBuffer* parameter contains a 1-bit-per-pixel bitmap whose rows start on doubleword boundaries.

GGO_BITMAP 1

GGO_NATIVE 2

Returns the curve data points in the rasterizer's native format, using device units. When this value is specified, any transformation specified in the *lpmat2* parameter is ignored.

GetKerningPairs (3.1)

int GetKerningPairs(*hdc, cPairs, lpkrnpair***)**

```
HDC hdc;                          /* handle of device context              */
int cPairs;                       /* number of kerning pairs               */
KERNINGPAIR FAR* lpkrnpair;       /* pointer to structures for kerning pairs*/
```

The **GetKerningPairs** function retrieves the character kerning pairs for the font that is currently selected in the specified device context.

Parameter	Description
hdc	Identifies a device context. The **GetKerningPairs** function retrieves kerning pairs for the current font for this device context.
cPairs	Specifies the number of **KERNINGPAIR** structures pointed to by the *lpkrnpair* parameter. The function will not copy more kerning pairs than specified by *cPairs.*
lpkrnpair	Points to an array of **KERNINGPAIR** structures that receive the kerning pairs when the function returns. This array must contain at least as many structures as specified by the *cPairs* parameter. If this parameter is NULL, the function returns the total number of kerning pairs for the font.

Returns

The return value specifies the number of kerning pairs retrieved or the total number of kerning pairs in the font, if the function is successful. It is zero if the function fails or there are no kerning pairs for the font.

See Also

KERNINGPAIR

GetMapMode (2.x)

int GetMapMode(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetMapMode** function retrieves the current mapping mode.

Parameter	Description
hdc	Identifies the device context.

Returns
The return value specifies the mapping mode if the function is successful.

It can be one of the following values:

Value	Meaning
MM_ANISOTROPIC	Logical units are converted to arbitrary units with arbitrarily scaled axes. Setting the mapping mode to MM_ANISOTROPIC does not change the current window or viewport settings. To change the units, orientation, and scaling, an application should use the **SetWindowExt** and **SetViewportExt** functions.
MM_HIENGLISH	Each logical unit is converted to 0.001 inch. Positive x is to the right; positive y is up.
MM_HIMETRIC	Each logical unit is converted to 0.01 millimeter. Positive x is to the right; positive y is up.
MM_ISOTROPIC	Logical units are converted to arbitrary units with equally scaled axes; that is, one unit along the x-axis is equal to one unit along the y-axis. The **SetWindowExt** and **SetViewportExt** functions must be used to specify the desired units and the orientation of the axes. **GDI** makes adjustments as necessary to ensure that the x and y units remain the same size.
MM_LOENGLISH	Each logical unit is converted to 0.01 inch. Positive x is to the right; positive y is up.
MM_LOMETRIC	Each logical unit is converted to 0.1 millimeter. Positive x is to the right; positive y is up.
MM_TEXT	Each logical unit is converted to one device pixel. Positive x is to the right; positive y is down.
MM_TWIPS	Each logical unit is converted to 1/20 of a point. (Because a point is 1/72 inch, a twip is 1/1440 inch). Positive x is to the right; positive y is up.

Example
The following example uses the **GetMapMode** function to determine whether the current mapping mode is MM_TEXT:

```
if (GetMapMode(hdc) != MM_TEXT) {
    TextOut(hdc, 100, -200, "Mapping mode must be MM_TEXT", 28);
    return FALSE;
}
```

See Also
SetMapMode

GetMetaFile (2.x)

HMETAFILE GetMetaFile(*lpszFile***)**

LPCSTR *lpszFile;* /* address of metafile name */

The **GetMetaFile** function creates a handle of a specified metafile.

Parameter	Description
lpszFile	Points to the null-terminated string that specifies the MS-DOS filename of the metafile. The metafile is assumed to exist.

Returns
The return value is the handle of a metafile if the function is successful. Otherwise, it is NULL.

Example
The following example uses the **CopyMetaFile** function to copy a metafile to a specified file, plays the copied metafile, uses the **GetMetaFile** function to retrieve a handle to the copied metafile, uses the **SetWindowOrg** function to change the position at which the metafile is played 200 logical units to the right, and then plays the metafile at the new location:

```
HANDLE hmf, hmfSource, hmfOld;
LPSTR lpszFile1 = "MFTest";

hmf = CopyMetaFile(hmfSource, lpszFile1);
PlayMetaFile(hdc, hmf);
DeleteMetaFile(hmf);

hmfOld = GetMetaFile(lpszFile1);
SetWindowOrg(hdc, -200, 0);
PlayMetaFile(hdc, hmfOld);

DeleteMetaFile(hmfSource);
DeleteMetaFile(hmfOld);
```

See Also
CopyMetaFile, **PlayMetaFile**, **SetWindowOrg**

GetMetaFileBits (2.x)

HGLOBAL GetMetaFileBits(*hmf***)**

HMETAFILE *hmf;* /* handle of metafile */

The **GetMetaFileBits** function returns a handle of the global memory object that contains the specified metafile as a collection of bits. The memory object can be used to determine the size of the metafile or to save the metafile as a file. The memory object should not be modified.

Parameter	Description
hmf	Identifies the memory metafile.

Returns

The return value is the handle of the global memory object that contains the metafile, if the function is successful. Otherwise, it is NULL.

Comments

The handle contained in the *hmf* parameter becomes invalid when the **GetMetaFileBits** function returns, so the returned global memory handle must be used to refer to the metafile.

When it no longer requires a global memory object that is associated with a metafile, an application should remove the object by using the **GlobalFree** function.

See Also

GlobalFree

GetNearestColor (2.x)

COLORREF GetNearestColor(*hdc, clrref***)**

```
HDC hdc;            /* handle of device context */
COLORREF clrref;    /* color to match           */
```

The **GetNearestColor** function retrieves the solid color that best matches a specified logical color; the given device must be able to represent this solid color.

Parameter	Description
hdc	Identifies the device context.
clrref	Specifies the color to be matched.

Returns

The return value specifies an **RGB** (red, green, blue) color value that defines the solid color closest to the *clrref* value that the device can represent.

See Also

GetNearestPaletteIndex

GetNearestPaletteIndex (3.0)

UINT GetNearestPaletteIndex(*hpal, clrref***)**

HPALETTE *hpal;* /* handle of palette */
COLORREF *clrref;* /* color to match */

The **GetNearestPaletteIndex** function retrieves the index of the logical-palette entry that best matches the specified color value.

Parameter	Description
hpal	Identifies the logical palette.
clrref	Specifies the color to be matched.

Returns

The return value is the index of the logical-palette entry whose corresponding color best matches the specified color.

Example

The following example uses the **GetNearestPaletteIndex** function to retrieve a color index from a palette. It then creates a brush with that retrieved color by using the **PALETTEINDEX** macro in a call to the **CreateSolidBrush** function.

```
WORD nColor;
HPALETTE hpal;
DWORD dwBrushColors[8][8];
HBRUSH hbr;
int x, y;
    .
    . /* Initialize the array of brush colors. */
    .
nColor = GetNearestPaletteIndex(hpal, dwBrushColors[x][y]);
hbr = CreateSolidBrush(PALETTEINDEX(nColor));

    .
    . /* Use the brush handle. */
    .
DeleteObject(hbr);
```

See Also

CreateSolidBrush, **GetNearestColor**, **GetPaletteEntries**, **GetSystemPaletteEntries**, **PALETTEINDEX**

GetObject (2.x)

int GetObject(*hgdiobj, cbBuffer, lpvObject***)**

```
HGDIOBJ hgdiobj;        /* handle of object                      */
int cbBuffer;           /* size of buffer for object information */
void FAR* lpvObject;    /* address of buffer for object information */
```

The **GetObject** function fills a buffer with information that defines a given object. The function retrieves a **LOGPEN**, **LOGBRUSH**, **LOGFONT**, or **BITMAP** structure, or an integer, depending on the specified object.

Parameter	Description
hgdiobj	Identifies a logical pen, brush, font, bitmap, or palette.
cbBuffer	Specifies the number of bytes to be copied to the buffer.
lpvObject	Points to the buffer that is to receive the information.

Returns

The return value specifies the number of bytes retrieved if the function is successful. Otherwise, it is zero.

Comments

The buffer pointed to by the *lpvObject* parameter must be sufficiently large to receive the information.

If the *hgdiobj* parameter identifies a bitmap, the **GetObject** function returns only the width, height, and color format information of the bitmap. The bits can be retrieved by using the **GetBitmapBits** function.

If *hgdiobj* identifies a logical palette, **GetObject** retrieves an integer that specifies the number of entries in the palette; the function does not retrieve the **LOGPALETTE** structure that defines the palette. To retrieve information about palette entries, an application can call the **GetPaletteEntries** function.

Example

The following example uses the **GetObject** function to fill a **LOGBRUSH** structure with the attributes of the current brush and then tests whether the brush style is BS_SOLID:

```
LOGBRUSH lb;

HBRUSH hbr;

GetObject(hbr, sizeof(LOGBRUSH), (LPSTR) &lb);
if (lb.lbStyle == BS_SOLID) {
    .
    .
    .
}
```

See Also

GetBitmapBits, **GetPaletteEntries**, **GetStockObject**, **BITMAP**, **LOGBRUSH**, **LOGFONT**, **LOGPALETTE**, **LOGPEN**

GetOutlineTextMetrics (3.1)

WORD GetOutlineTextMetrics(*hdc, cbData, lpotm***)**

```
HDC hdc;                                /* handle of device context          */
UINT cbData;                            /* size of buffer for information    */
OUTLINETEXTMETRIC FAR* lpotm;           /* address of structure for metrics  */
```

The **GetOutlineTextMetrics** function retrieves metric information for TrueType fonts.

Parameter	Description
hdc	Identifies the device context.
cbData	Specifies the size, in bytes, of the buffer to which information is returned.
lpotm	Points to an **OUTLINETEXTMETRIC** structure. If this parameter is NULL, the function returns the size of the buffer required for the retrieved metric information.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **OUTLINETEXTMETRIC** structure contains most of the font metric information provided with the TrueType format, including a **TEXTMETRIC** structure. The last four members of the **OUTLINETEXTMETRIC** structure are pointers to strings. Applications should allocate space for these strings in addition to the space required for the other members. Because there is no system-imposed limit to the size of the strings, the simplest method for allocating memory is to retrieve the required size by specifying NULL for the *lpotm* parameter in the first call to the **GetOutlineTextMetrics** function.

See Also

GetTextMetrics, **OUTLINETEXTMETRIC**, **TEXTMETRIC**

GetPaletteEntries (3.0)

UINT GetPaletteEntries(*hpal, iStart, cEntries, lppe***)**

```
HPALETTE hpal;                  /* handle of palette                    */
UINT iStart;                    /* first palette entry to retrieve      */
UINT cEntries;                  /* number of entries to retrieve        */
PALETTEENTRY FAR* lppe;         /* address of structure for palette entries */
```

The **GetPaletteEntries** function retrieves a range of palette entries in a logical palette.

Parameter	Description
hpal	Identifies the logical palette.
iStart	Specifies the first logical-palette entry to be retrieved.
cEntries	Specifies the number of logical-palette entries to be retrieved.
lppe	Points to an array of **PALETTEENTRY** structures that will receive the palette entries. The array must contain at least as many structures as specified by the *cEntries* parameter.

Returns

The return value is the number of entries retrieved from the logical palette, if the function is successful. Otherwise, it is zero.

See Also

GetSystemPaletteEntries, **PALETTEENTRY**

GetPixel (2.x)

COLORREF GetPixel(*hdc, nXPos, nYPos***)**

```
HDC hdc;        /* handle of device context          */
int nXPos;      /* x-coordinate of pixel to retrieve */
int nYPos;      /* y-coordinate of pixel to retrieve */
```

The **GetPixel** function retrieves the **RGB** (red, green, blue) color value of the pixel at the specified coordinates. The point must be in the clipping region; if it is not, the function is ignored.

Parameter	Description
hdc	Identifies the device context.
nXPos	Specifies the logical x-coordinate of the point to be examined.
nYPos	Specifies the logical y-coordinate of the point to be examined.

Returns

The return value specifies an **RGB** color value for the color of the given point, if the function is successful. It is -1 if the coordinates do not specify a point in the clipping region.

Comments

Not all devices support the **GetPixel** function.

See Also

GetDeviceCaps, **SetPixel**

GetPolyFillMode (2.x)

int GetPolyFillMode(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetPolyFillMode** function retrieves the current polygon-filling mode.

Parameter	Description
hdc	Identifies the device context.

Returns

The return value specifies the polygon-filling mode, ALTERNATE or WINDING, if the function is successful.

Comments

When the polygon-filling mode is ALTERNATE, the system fills the area between odd-numbered and even-numbered polygon sides on each scan line. That is, the system fills the area between the first and second side, between the third and fourth side, and so on.

When the polygon-filling mode is WINDING, the system uses the direction in which a figure was drawn to determine whether to fill an area. Each line segment in a polygon is drawn in either a clockwise or a counterclockwise direction. Whenever an imaginary line drawn from an enclosed area to the outside of a figure passes through a clockwise line segment, a count is incremented. When the line passes through a counterclockwise line segment, the count is decremented. The area is filled if the count is nonzero when the line reaches the outside of the figure.

Example

The following example uses the **GetPolyFillMode** function to determine whether the current polygon-filling mode is ALTERNATE:

```
int nPolyFillMode;

nPolyFillMode = GetPolyFillMode(hdc);
if (nPolyFillMode == ALTERNATE) {
    .
    .
    .
}
```

See Also

SetPolyFillMode

GetRasterizerCaps (3.1)

BOOL GetRasterizerCaps(*lpraststat, cb***)**

```
RASTERIZER_STATUS FAR* lpraststat;      /* address of structure for status*/
int cb;                                 /* number of bytes in structure   */
```

The **GetRasterizerCaps** function returns flags indicating whether TrueType fonts are installed in the system.

Parameter	Description
lpraststat	Points to a **RASTERIZER_STATUS** structure that receives information about the rasterizer.
cb	Specifies the number of bytes that will be copied into the structure pointed to by the *lpraststat* parameter.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **GetRasterizerCaps** function enables applications and printer drivers to determine whether TrueType is installed.

If the TT_AVAILABLE flag is set in the **wFlags** member of the **RASTERIZER_STATUS** structure, at least one TrueType font is installed. If the TT_ENABLED flag is set, TrueType is enabled for the system.

See Also

GetOutlineTextMetrics, **RASTERIZER_STATUS**

GetRgnBox (3.0)

int GetRgnBox(*hrgn, lprc***)**

HRGN *hrgn;* /* handle of region */
RECT FAR* *lprc;* /* address of structure with rectangle */

The **GetRgnBox** function retrieves the coordinates of the bounding rectangle of the given region.

Parameter	Description
hrgn	Identifies the region.
lprc	Points to a **RECT** structure that receives the coordinates of the bounding rectangle.

Returns

The return value is SIMPLEREGION (region has no overlapping borders), COMPLEXREGION (region has overlapping borders), or NULLREGION (region is empty), if the function is successful. Otherwise, the return value is ERROR.

Example

The following example uses the **GetRgnBox** function to determine the type of a region:

```
RECT rc;
HRGN hrgn;
int RgnType;

RgnType = GetRgnBox(hrgn, &rc);

if (RgnType == COMPLEXREGION)
    TextOut(hdc, 10, 10, "COMPLEXREGION", 13);
else if (RgnType == SIMPLEREGION)
    TextOut(hdc, 10, 10, "SIMPLEREGION", 12);
else
    TextOut(hdc, 10, 10, "NULLREGION", 10);
```

See Also

RECT

GetROP2 (2.x)

int GetROP2(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetROP2** function retrieves the current drawing mode. The drawing mode specifies how the colors of the pen and the interior of filled objects are combined with the color already on the screen surface.

Parameter	Description
hdc	Identifies the device context.

Returns
The return value specifies the drawing mode if the function is successful.

Comments
The drawing mode is for raster devices only and does not apply to vector devices. It can be any of the following values:

Value	Meaning
R2_BLACK	Pixel is always black.
R2_WHITE	Pixel is always white.
R2_NOP	Pixel remains unchanged.
R2_NOT	Pixel is the inverse of the screen color.
R2_COPYPEN	Pixel is the pen color.
R2_NOTCOPYPEN	Pixel is the inverse of the pen color.
R2_MERGEPENNOT	Pixel is a combination of the pen color and the inverse of the screen color (final pixel = (~screen pixel) | pen).
R2_MASKPENNOT	Pixel is a combination of the colors common to both the pen and the inverse of the screen (final pixel = (~screen pixel) & pen).
R2_MERGENOTPEN	Pixel is a combination of the screen color and the inverse of the pen color (final pixel = (~pen) | screen pixel).
R2_MASKNOTPEN	Pixel is a combination of the colors common to both the screen and the inverse of the pen (final pixel = (~pen) & screen pixel).
R2_MERGEPEN	Pixel is a combination of the pen color and the screen color (final pixel = pen | screen pixel).
R2_NOTMERGEPEN	Pixel is the inverse of the R2_MERGEPEN color (final pixel = ~(pen | screen pixel)).
R2_MASKPEN	Pixel is a combination of the colors common to both the pen and the screen (final pixel = pen & screen pixel).
R2_NOTMASKPEN	Pixel is the inverse of the R2_MASKPEN color (final pixel = ~(pen & screen pixel)).
R2_XORPEN	Pixel is a combination of the colors that are in the pen and in the screen, but not in both (final pixel = pen ^ screen pixel).
R2_NOTXORPEN	Pixel is the inverse of the R2_XORPEN color (final pixel = ~(pen ^ screen pixel)).

Example
The following example uses the **GetROP2** function to test whether the current drawing mode is R2_COPYPEN:

```
int nROP;

nROP = GetROP2(hdc);
```

```
if (nROP == R2_COPYPEN)
    TextOut(hdc, 100, 100, "ROP is R2_COPYPEN.", 18);
```

See Also
GetDeviceCaps, **SetROP2**

GetStockObject (2.x)

HGDIOBJ GetStockObject(*fnObject***)**

int *fnObject;* /* type of stock object */

The **GetStockObject** function retrieves a handle of one of the predefined stock pens, brushes, or fonts.

Parameter	Description
fnObject	Specifies the type of stock object for which to retrieve a handle. This parameter can be one of the following values:

Value	Meaning
BLACK_BRUSH	Black brush.
DKGRAY_BRUSH	Dark-gray brush.
GRAY_BRUSH	Gray brush.
HOLLOW_BRUSH	Hollow brush.
LTGRAY_BRUSH	Light-gray brush.
NULL_BRUSH	Null brush.
WHITE_BRUSH	White brush.
BLACK_PEN	Black pen.
NULL_PEN	Null pen.
WHITE_PEN	White pen.
ANSI_FIXED_FONT	Windows fixed-pitch system font.
ANSI_VAR_FONT	Windows variable-pitch system font.
DEVICE_DEFAULT_FONT	Device-dependent font.
OEM_FIXED_FONT	OEM-dependent fixed font.
SYSTEM_FONT	System font. By default, Windows uses the system font to draw menus, dialog box controls, and other text. In Windows versions 3.0 and later, the system font is a variable-pitch font width; earlier versions of Windows use a fixed-pitch system font.
SYSTEM_FIXED_FONT	Fixed-pitch system font used in Windows versions earlier than 3.0. This object is available for compatibility with earlier versions of Windows.
DEFAULT_PALETTE	Default color palette. This palette consists of the static colors in the system palette.

Returns

The return value is the handle of the specified object if the function is successful. Otherwise, it is NULL.

Comments

The **DKGRAY_BRUSH**, **GRAY_BRUSH**, and **LTGRAY_BRUSH** objects should be used only in windows with the **CS_HREDRAW** and **CS_VREDRAW** class styles. Using a gray stock brush in any other style of window can lead to misalignment of brush patterns after a window is moved or sized. The origins of stock brushes cannot be adjusted.

Example

The following example retrieves the handle of a black brush by calling the **GetStockObject** function, selects the brush into the device context, and fills a rectangle by using the black brush:

```
HBRUSH hbr, hbrOld;

hbr = GetStockObject(BLACK_BRUSH);
```

```
hbrOld = SelectObject(hdc, hbr);
Rectangle(hdc, 10, 10, 100, 100);
```

See Also
GetObject, **SetBrushOrg**

BLACK_BRUSH 4

Black brush.

BLACK_BRUSH 4

DKGRAY_BRUSH 3

Dark-gray brush.

DKGRAY_BRUSH 3

GRAY_BRUSH 2

Gray brush.

GRAY_BRUSH 2

HOLLOW_BRUSH **NULL_BRUSH**

Hollow brush.

HOLLOW_BRUSH NULL_BRUSH

LTGRAY_BRUSH 1

Light-gray brush.

LTGRAY_BRUSH 1

NULL_BRUSH 5

Null brush.

NULL_BRUSH 5

WHITE_BRUSH 0

White brush.

WHITE_BRUSH 0

BLACK_PEN 7

Black pen.

BLACK_PEN 7

NULL_PEN 8

Null pen.

NULL_PEN 8

WHITE_PEN 6

White pen.

WHITE_PEN 6

ANSI_FIXED_FONT 11

Windows fixed-pitch system font.

ANSI_FIXED_FONT 11

ANSI_VAR_FONT 12

Windows variable-pitch system font.

ANSI_VAR_FONT 12

DEVICE_DEFAULT_FONT 14

Device-dependent font.

DEVICE_DEFAULT_FONT 14

OEM_FIXED_FONT 10

OEM-dependent fixed font.

OEM_FIXED_FONT 10

SYSTEM_FONT 13

System font. By default, Windows uses the system font to draw menus, dialog box controls, and other text. In Windows versions 3.0 and later, the system font is a variable-pitch font width; earlier versions of Windows use a fixed-pitch system font.

SYSTEM_FONT 13

SYSTEM_FIXED_FONT 16

Fixed-pitch system font used in Windows versions earlier than 3.0. This object is available for compatibility with earlier versions of Windows.

SYSTEM_FIXED_FONT 16

DEFAULT_PALETTE 15

Default color palette. This palette consists of the static colors in the system palette.

DEFAULT_PALETTE 15

GetStretchBltMode (2.x)

int GetStretchBltMode(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetStretchBltMode** function retrieves the current bitmap-stretching mode. The bitmap-stretching mode defines how information is removed from bitmaps that were compressed by using the **StretchBlt** function.

Parameter	Description
hdc	Identifies the device context.

Returns

The return value specifies the current bitmap-stretching mode--STRETCH_ANDSCANS, **STRETCH_DELETESCANS**, or STRETCH_ORSCANS--if the function is successful.

Comments

The **STRETCH_ANDSCANS** and **STRETCH_ORSCANS** modes are typically used to preserve foreground pixels in monochrome bitmaps. The **STRETCH_DELETESCANS** mode is typically used to preserve color in color bitmaps.

Example

The following example uses the **GetStretchBltMode** function to determine whether the current bitmap-stretching mode is **STRETCH_DELETESCANS**; if so, it uses the **StretchBlt** function to display a compressed bitmap.

```
HDC hdcMem;

int nStretchMode;

nStretchMode = GetStretchBltMode(hdc);
if (nStretchMode == STRETCH_DELETESCANS) {
    StretchBlt(hdc, 50, 175, 32, 32, hdcMem, 0, 0, 64, 64,
        SRCCOPY);
        .
        .
        .
}
```

See Also

SetStretchBltMode, **StretchBlt**

GetSystemPaletteEntries (3.0)

UINT GetSystemPaletteEntries(*hdc, iStart, cEntries, lppe***)**

HDC *hdc;*	/* handle of device context	*/
UINT *iStart;*	/* first palette entry to retrieve	*/
UINT *cEntries;*	/* number of entries to retrieve	*/
PALETTEENTRY FAR* *lppe;*	/* address of structure for palette entries	*/

The **GetSystemPaletteEntries** function retrieves a range of palette entries from the system palette.

Parameter	Description
hdc	Identifies the device context.
iStart	Specifies the first system-palette entry to be retrieved.
cEntries	Specifies the number of system-palette entries to be retrieved.
lppe	Points to an array of **PALETTEENTRY** structures that receives the palette entries. The array must contain at least as many structures as specified by the *cEntries* parameter.

Returns

The return value is the number of entries retrieved from the system palette, if the function is successful. Otherwise, it is zero.

Example

The following example uses the **GetDeviceCaps** function to determine whether the specified device is palette-based. If the device supports palettes, the **GetSystemPaletteEntries** function is called, using **GetDeviceCaps** again, this time to determine the number of entries in the system palette.

```
PALETTEENTRY pe[MAXNUMBER];

hdc = GetDC(hwnd);
if (!(GetDeviceCaps(hdc, RASTERCAPS) & RC_PALETTE)) {
    ReleaseDC(hwnd, hdc);
    break;
}
GetSystemPaletteEntries(hdc, 0, GetDeviceCaps(hdc, SIZEPALETTE),
    pe);
ReleaseDC(hwnd, hdc);
```

See Also

GetDeviceCaps, **GetPaletteEntries**, **PALETTEENTRY**

GetSystemPaletteUse (3.0)

UINT GetSystemPaletteUse(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetSystemPaletteUse** function determines whether an application has access to the entire system palette.

Parameter	Description
hdc	Identifies the device context. This device context must support color palettes.

Returns

The return value specifies the current use of the system palette, if the function is successful. This parameter can be one of the following values:

Value	Meaning
SYSPAL_NOSTATIC	System palette contains no static colors except black and white.
SYSPAL_STATIC	System palette contains static colors that do not change when an application realizes its logical palette.

Comments

The system palette contains 20 default static colors that are not changed when an application realizes its logical palette. An application can gain access to most of these colors by calling the **SetSystemPaletteUse** function.

Example

The following example uses the **GetDeviceCaps** function to determine whether the specified device is palette-based. If the device supports palettes, the **GetSystemPaletteUse** function is called.

```
WORD nUse;

hdc = GetDC(hwnd);
if ((GetDeviceCaps(hdc, RASTERCAPS) & RC_PALETTE) == 0) {
    ReleaseDC(hwnd, hdc);
    break;
}
nUse = GetSystemPaletteUse(hdc);
ReleaseDC(hwnd, hdc);
```

See Also

GetDeviceCaps, **SetSystemPaletteUse**

SYSPAL_NOSTATIC 2

System palette contains no static colors except black and white.

SYSPAL_NOSTATIC 2

SYSPAL_STATIC 1

System palette contains static colors that do not change when an application realizes its logical palette.

SYSPAL_STATIC 1

GetTextCharacterExtra (2.x)

int GetTextCharacterExtra(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetTextCharacterExtra** function retrieves the current setting for the amount of intercharacter spacing. Graphics device interface (**GDI**) adds this spacing to each character, including break characters, when it writes a line of text to the device context.

Parameter	Description
hdc	Identifies the device context.

Returns
The return value specifies the amount of intercharacter spacing if the function is successful.

Comments
The default value for the amount of intercharacter spacing is zero.

See Also
SetTextCharacterExtra

GetTextAlign (2.x)

UINT GetTextAlign(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetTextAlign** function retrieves the status of the text-alignment flags for the given device context.

Parameter	Description
hdc	Identifies the device context.

Returns

The return value specifies the status of the text-alignment flags. This parameter can be one or more of the following values:

Value	Meaning
TA_BASELINE	Specifies alignment of the x-axis and the base line of the chosen font within the bounding rectangle.
TA_BOTTOM	Specifies alignment of the x-axis and the bottom of the bounding rectangle.
TA_CENTER	Specifies alignment of the y-axis and the center of the bounding rectangle.
TA_LEFT	Specifies alignment of the y-axis and the left side of the bounding rectangle.
TA_NOUPDATECP	Specifies that the current position is not updated.
TA_RIGHT	Specifies alignment of the y-axis and the right side of the bounding rectangle.
TA_TOP	Specifies alignment of the x-axis and the top of the bounding rectangle.
TA_UPDATECP	Specifies that the current position is updated.

Comments

The text-alignment flags retrieved by the **GetTextAlign** function are used by the **TextOut** and **ExtTextOut** functions. These flags determine how **TextOut** and **ExtTextOut** align a string of text in relation to the string's starting point.

The text-alignment flags are not necessarily single-bit flags and may be equal to zero. To test whether a flag is set, an application should follow three steps:

1 Apply the bitwise OR operator to the flag and its related flags.

Following are the groups of related flags:

- **TA_LEFT**, **TA_CENTER**, and **TA_RIGHT**
- **TA_BASELINE**, **TA_BOTTOM**, and **TA_TOP**
- **TA_NOUPDATECP** and **TA_UPDATECP**

2 Apply the bitwise AND operator to the result and the return value of the **GetTextAlign** function.

3 Test for the equality of this result and the flag.

Example

The following example uses the method described in the preceding Comments section to determine whether text is aligned at the right, left, or center of the bounding rectangle. If the **TA_RIGHT** flag is set, the **SetTextAlign** function is used to set the text alignment to the left side of the rectangle.

```
switch ((TA_LEFT | TA_CENTER | TA_RIGHT) & GetTextAlign(hdc)) {
    case TA_RIGHT:
        TextOut(hdc, 200, 100, "This is TA_RIGHT.", 17);
        SetTextAlign(hdc, TA_LEFT);
        TextOut(hdc, 200, 120, "This is TA_LEFT.", 16);
        break;
    case TA_LEFT:
        .
        .
```

```
        .
    case TA_CENTER:
        .
        .
        .
}
```

See Also
ExtTextOut, **SetTextAlign**, **TextOut**

TA_BASELINE 0x0018

Specifies alignment of the x-axis and the base line of the chosen font within the bounding rectangle.

TA_BASELINE 0x0018

TA_BOTTOM 0x0008

Specifies alignment of the x-axis and the bottom of the bounding rectangle.

TA_BOTTOM 0x0008

TA_CENTER 0x0006

Specifies alignment of the y-axis and the center of the bounding rectangle.

TA_CENTER 0x0006

TA_LEFT 0x0000

Specifies alignment of the y-axis and the left side of the bounding rectangle.

TA_LEFT 0x0000

TA_NOUPDATECP 0x0000

Specifies that the current position is not updated.

TA_NOUPDATECP 0x0000

TA_RIGHT 0x0002

Specifies alignment of the y-axis and the right side of the bounding rectangle.

TA_RIGHT 0x0002

TA_TOP 0x0000

Specifies alignment of the x-axis and the top of the bounding rectangle.

TA_TOP 0x0000

TA_UPDATECP 0x0001

Specifies that the current position is updated.

TA_UPDATECP 0x0001

GetTextColor (2.x)

COLORREF GetTextColor(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetTextColor** function retrieves the current text color. The text color is the foreground color of characters drawn by using the graphics device interface (**GDI**) text-output functions.

Parameter	Description
hdc	Identifies the device context.

Returns

The return value specifies the current text color as a red, green, blue (**RGB**) color value, if the function is successful.

Example

The following example sets the text color to red if the **GetTextColor** function determines that the current text color is black:

```
DWORD dwColor;

dwColor = GetTextColor(hdc);
if (dwColor == RGB(0, 0, 0))     /* if current color is black */
    SetTextColor(hdc, RGB(255, 0, 0)); /* sets color to red  */
```

See Also

GetBkColor, **GetBkMode**, **SetBkMode**, **SetTextColor**, **RGB**

GetTextExtent (2.x)

DWORD GetTextExtent(*hdc, lpszString, cbString***)**

HDC *hdc;* /* handle of device context */
LPCSTR *lpszString;* /* address of string */
int *cbString;* /* number of bytes in string */

The **GetTextExtent** function computes the width and height of a line of text, using the current font to compute the dimensions.

Parameter	Description
hdc	Identifies the device context.
lpszString	Points to a character string.
cbString	Specifies the number of bytes in the string.

Returns
The low-order word of the return value contains the string width, in logical units, if the function is successful; the high-order word contains the string height.

Comments
The current clipping region does not affect the width and height returned by the **GetTextExtent** function.

Since some devices do not place characters in regular cell arrays (that is, they kern characters), the sum of the extents of the characters in a string may not be equal to the extent of the string.

Example
The following example retrieves the number of characters in a string by using the **lstrlen** function, calls the **GetTextExtent** function to retrieve the dimensions of the string, and then uses the **LOWORD** macro to determine the string width, in logical units:

```
DWORD dwExtent;
WORD wTextWidth;
LPSTR lpszJustified = "Text to be justified in this test.";

dwExtent = GetTextExtent(hdc, lpszJustified, lstrlen(lpszJustified));
wTextWidth = LOWORD(dwExtent);
```

See Also
GetTabbedTextExtent, **SetTextJustification**

GetTextExtentPoint (3.1)

BOOL GetTextExtentPoint(*hdc, lpszString, cbString, lpSize***)**

```
HDC hdc;              /* handle of device context          */
LPCSTR lpszString;    /* address of text string            */
int cbString;         /* number of bytes in string         */
SIZE FAR* lpSize;     /* address if structure for string size*/
```

The **GetTextExtentPoint** function computes the width and height of the specified text string. The **GetTextExtentPoint** function uses the currently selected font to compute the dimensions of the string. The width and height, in logical units, are computed without considering any clipping.

The **GetTextExtentPoint** function may be used as either a wide-character function (where text arguments must use Unicode) or an ANSI function (where text arguments must use characters from the Windows 3.*x* character set

Parameter	Description
hdc	Identifies the device context.
lpszString	Points to a text string.
cbString	Specifies the number of bytes in the text string.
lpSize	Points to a **SIZE** structure that will receive the dimensions of the string

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

Because some devices do not place characters in regular cell arrays--that is, because they carry out kerning--the sum of the extents of the characters in a string may not be equal to the extent of the string.

The calculated width takes into account the intercharacter spacing set by the **SetTextCharacterExtra** function.

See Also

SetTextCharacterExtra

GetTextFace (2.x)

int GetTextFace(*hdc, cbBuffer, lpszFace***)**

```
HDC hdc;          /* handle of device context       */
int cbBuffer;     /* size of buffer for face name   */
LPSTR lpszFace;   /* pointer to buffer for face name*/
```

The **GetTextFace** function copies the typeface name of the current font into a buffer. The typeface name is copied as a null-terminated string.

Parameter	Description
hdc	Identifies the device context.
cbBuffer	Specifies the buffer size, in bytes. If the typeface name is longer than the number of bytes specified by this parameter, the name is truncated.
lpszFace	Points to the buffer for the typeface name.

Returns

The return value specifies the number of bytes copied to the buffer, not including the terminating null character, if the function is successful. Otherwise, it is zero.

Example

The following example uses the **GetTextFace** function to retrieve the name of the current typeface, calls the **SetTextAlign** function so that the current position is updated when the **TextOut** function is called, and then writes some introductory text and the name of the typeface by calling **TextOut**:

```
int nFaceNameLen;
char aFaceName[80];

nFaceNameLen = GetTextFace(hdc, /* returns length of string */
    sizeof(aFaceName),       /* size of face-name buffer    */
    (LPSTR) aFaceName);      /* address of face-name buffer */

SetTextAlign(hdc,
    TA_UPDATECP);          /* updates current position       */
MoveTo(hdc, 100, 100);     /* sets current position          */
TextOut(hdc, 0, 0,         /* uses current position for text */
    "This is the current face name: ", 31);
TextOut(hdc, 0, 0, aFaceName, nFaceNameLen);
```

See Also

GetTextMetrics, **SetTextAlign**, **TextOut**

GetTextMetrics (2.x)

BOOL GetTextMetrics(*hdc, lptm***)**

HDC *hdc;* /* handle of device context */
TEXTMETRIC FAR* *lptm;* /* pointer to structure for font metrics */

The **GetTextMetrics** function retrieves the metrics for the current font.

Parameter	Description
hdc	Identifies the device context.
lptm	Points to the **TEXTMETRIC** structure that receives the metrics.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Example
The following example calls the **GetTextMetrics** function and then uses information in a **TEXTMETRIC** structure to determine how many break characters are in a string of text:

```
TEXTMETRIC tm;
int j, cBreakChars, cchString;
LPSTR lpszJustified = "Text to be justified in this test.";

GetTextMetrics(hdc, &tm);

cchString = lstrlen(lpszJustified);

for (cBreakChars = 0, j = 0; j < cchString; j++)
    if(*(lpszJustified + j) == (char) tm.tmBreakChar)
        cBreakChars++;
```

See Also
GetTextAlign, **GetTextExtent**, **GetTextFace**, **SetTextJustification**, **TEXTMETRIC**

GetViewportExt (2.x)

DWORD GetViewportExt(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetViewportExt** function retrieves the x- and y-extents of the device context's viewport.

Parameter	Description
hdc	Identifies the device context.

Returns

The low-order word of the return value contains the x-extent, in device units, if the function is successful; the high-order word contains the y-extent.

Example

The following example uses the **GetViewportExt** function and the **LOWORD** and **HIWORD** macros to retrieve the x- and y-extents for a device context:

```
HDC  hdc;
DWORD dw;
int xViewExt, yViewExt;

hdc = GetDC(hwnd);
dw  = GetViewportExt(hdc);
ReleaseDC(hwnd, hdc);
xViewExt = LOWORD(dw);
yViewExt = HIWORD(dw);
```

See Also

GetViewportExtEx, **SetViewportExt**

GetViewportExtEx (3.1)

BOOL GetViewportExtEx(*hdc, lpSize***)**

HDC *hdc;*
SIZE FAR* *lpSize;*

The **GetViewportExtEx** function retrieves the x- and y-extents of the device context's viewport.

Parameter	Description
hdc	Identifies the device context.
lpSize	Points to a **SIZE** structure. The x- and y-extents (in device units) are placed in this structure.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also
GetViewportExt, **SetViewportExt**, **SetViewportExtEx**

GetViewportOrg (2.x)

DWORD GetViewportOrg(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetViewportOrg** function retrieves the x- and y-coordinates of the origin of the viewport associated with the given device context.

Parameter	Description
hdc	Identifies the device context.

Returns

The low-order word of the return value contains the viewport origin's x-coordinate, in device coordinates, if the function is successful; the high-order word contains the y-coordinate of the viewport origin.

Example

The following example uses the **GetViewportOrg** function and the **LOWORD** and **HIWORD** macros to retrieve the x- and y-coordinates of the viewport origin:

```
HDC  hdc;
DWORD dw;
int xViewOrg, yViewOrg;

hdc = GetDC(hwnd);
dw  = GetViewportOrg(hdc);
ReleaseDC(hwnd, hdc);
xViewOrg = LOWORD(dw);
yViewOrg = HIWORD(dw);
```

See Also

GetViewportOrgEx, **GetWindowOrg**, **SetViewportOrg**

GetViewportOrgEx (3.1)

BOOL GetViewportOrgEx(*hdc, lpPoint***)**

HDC *hdc;*
POINT FAR* *lpPoint;*

The **GetViewportOrgEx** function retrieves the x- and y-coordinates of the origin of the viewport associated with the specified device context.

Parameter	Description
hdc	Identifies the device context.
lpPoint	Points to a **POINT** structure. The origin of the viewport (in device coordinates) is placed in this structure.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also
GetViewportOrg, **SetViewportOrg**, **SetViewportOrgEx**

GetWindowExt (2.x)

DWORD GetWindowExt(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetWindowExt** function retrieves the x- and y-extents of the window associated with the given device context.

Parameter	Description
hdc	Identifies the device context.

Returns

The return value specifies the x- and y-extents, in logical units, if the function is successful. The x-extent is in the low-order word; the y-extent is in the high-order word.

Example

The following example uses the **GetWindowExt** function and the **LOWORD** and **HIWORD** macros to retrieve the x- and y-extents of a window:

```
HDC  hdc;
DWORD dw;
int xWindExt, yWindExt;

hdc = GetDC(hwnd);
dw  = GetWindowExt(hdc);
ReleaseDC(hwnd, hdc);
xWindExt = LOWORD(dw);
yWindExt = HIWORD(dw);
```

See Also

GetWindowExtEx, **SetWindowExt**

GetWindowExtEx (3.1)

BOOL GetWindowExtEx(*hdc, lpSize***)**

HDC *hdc;*
SIZE FAR* *lpSize;*

This function retrieves the x- and y-extents of the window associated with the specified device context.

Parameter	Description
hdc	Identifies the device context.
lpSize	Points to a **SIZE** structure. The x- and y-extents (in logical units) are placed in this structure.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also
GetWindowExt, **SetWindowExt**, **SetWindowExtEx**

GetWindowOrg (2.x)

DWORD GetWindowOrg(*hdc***)**

HDC *hdc;* /* handle of device context */

The **GetWindowOrg** function retrieves the x- and y-coordinates of the origin of the window associated with the given device context.

Parameter	Description
hdc	Identifies the device context.

Returns

The low-order word of the return value contains the logical x-coordinate of the window's origin, if the function is successful; the high-order word contains the y-coordinate.

Example

The following example uses the **GetWindowOrg** function and the **LOWORD** and **HIWORD** macros to retrieve the x- and y-coordinates for the window origin:

```
HDC  hdc;
DWORD dw;
int xWindOrg, yWindOrg;

hdc = GetDC(hwnd);
dw  = GetWindowOrg(hdc);
ReleaseDC(hwnd, hdc);
xWindOrg = LOWORD(dw);
yWindOrg = HIWORD(dw);
```

See Also

GetViewportOrg, **GetWindowOrgEx**, **SetWindowOrg**

GetWindowOrgEx (3.1)

BOOL GetWindowOrgEx(*hdc, lpPoint***)**

HDC *hdc;*
POINT FAR* *lpPoint;*

The **GetWindowOrgEx** function retrieves the x- and y-coordinates of the origin of the window associated with the specified device context.

Parameter	Description
hdc	Identifies the device context.
lpPoint	Points to a **POINT** structure. The origin of the window (in logical coordinates) is placed in this structure.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also
GetWindowOrg, **SetWindowOrg**, **SetWindowOrgEx**

IntersectClipRect (2.x)

int IntersectClipRect(*hdc, nLeftRect, nTopRect, nRightRect, nBottomRect***)**

HDC *hdc;* /* handle of device context */
int *nLeftRect;* /* x-coordinate top-left corner of rectangle */
int *nTopRect;* /* y-coordinate top-left corner of rectangle */
int *nRightRect;* /* x-coordinate bottom-right corner of rectangle */
int *nBottomRect;* /* y-coordinate bottom-right corner of rectangle */

The **IntersectClipRect** function creates a new clipping region from the intersection of the current region and a specified rectangle.

Parameter	Description
hdc	Identifies the device context.
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the rectangle.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the rectangle.
nRightRect	Specifies the logical x-coordinate of the lower-right corner of the rectangle.
nBottomRect	Specifies the logical y-coordinate of the lower-right corner of the rectangle.

Returns

The return value specifies that the resulting region has overlapping borders (COMPLEXREGION), is empty (NULLREGION), or has no overlapping borders (SIMPLEREGION). Otherwise, the return value is ERROR.

Comments

An application uses the **IntersectClipRect** function to create a clipping region from the intersection of the current region and a specified rectangle. An application can also create a clipping region that is the intersection of two regions, by specifying **RGN_AND** in a call to the **CombineRgn** function and then making this combined region the clipping region by calling the **SelectClipRgn** function.

The width of the rectangle, specified by the absolute value of *nRightRect* - *nLeftRect,* must not exceed 32,767 units. This limit applies to the height of the rectangle as well.

Example

The following example creates a square clipping region and colors it red by using a red brush to fill the client area. The **IntersectClipRect** function is called with coordinates that overlap the region, and the client area is filled with a yellow brush. The only region colored yellow is the overlap between the region and the coordinates specified in the call to **IntersectClipRect**.

```
RECT rc;
HRGN hrgn;
HBRUSH hbrRed, hbrYellow;

GetClientRect(hwnd, &rc);
hrgn = CreateRectRgn(10, 10, 110, 110);
SelectClipRgn(hdc, hrgn);
hbrRed = CreateSolidBrush(RGB(255, 0, 0));
FillRect(hdc, &rc, hbrRed);

IntersectClipRect(hdc, 100, 100, 200, 200);

hbrYellow = CreateSolidBrush(RGB(255, 255, 0));
FillRect(hdc, &rc, hbrYellow);

DeleteObject(hbrRed);
DeleteObject(hbrYellow);
```

```
DeleteObject(hrgn);
```

See Also
CombineRgn, **SelectClipRgn**

InvertRgn (2.x)

BOOL InvertRgn(*hdc, hrgn***)**

HDC *hdc;* /* handle of device context */
HRGN *hrgn;* /* handle of region */

The **InvertRgn** function inverts the colors in a given region.

Parameter	Description
hdc	Identifies the device context.
hrgn	Identifies the region for which colors are to be inverted.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
On monochrome screens, the **InvertRgn** function makes white pixels black and black pixels white. On color screens, the inversion depends on how the colors are generated for the screen.

Example
The following example sets the device coordinates of and creates a rectangular region, selects the region into a device context, and then calls the **InvertRgn** function to display the region in inverted colors:

```
HRGN hrgn;

hrgn = CreateRectRgn(10, 10, 110, 110);
SelectObject(hdc, hrgn);
InvertRgn(hdc, hrgn);

DeleteObject(hrgn);
```

See Also
FillRgn, **PaintRgn**

IsGDIObject (3.1)

BOOL IsGDIObject(*hobj***)**

HGDIOBJ *hobj;* /* handle of a menu */

The **IsGDIObject** function determines whether the specified handle is not the handle of a graphics device interface (**GDI**) object.

Parameter	Description
hobj	Specifies a handle to test.

Returns

The return value is nonzero if the handle may be the handle of a **GDI** object. It is zero if the handle is not the handle of a GDI object.

Comments

An application cannot use **IsGDIObject** to guarantee that a given handle is to a **GDI** object. However, this function can be used to guarantee that a given handle is not to a GDI object.

See Also

GetObject

LineDDA (2.x)

void LineDDA(*nXStart, nYStart, nXEnd, nYEnd, lnddaprc, lParam***)**

```
int nXStart;                    /* x-coordinate of line beginning          */
int nYStart;                    /* y-coordinate of line beginning          */
int nXEnd;                      /* x-coordinate of line end                */
int nYEnd;                      /* y-coordinate of line end                */
LINEDDAPROC lnddaprc;           /* address of callback function            */
LPARAM lParam;                  /* address of application-defined data     */
```

The **LineDDA** function computes all successive points in a line specified by starting and ending coordinates. For each point on the line, the system calls an application-defined callback function, specifying the coordinates of that point.

Parameter	Description
nXStart	Specifies the logical x-coordinate of the first point.
nYStart	Specifies the logical y-coordinate of the first point.
nXEnd	Specifies the logical x-coordinate of the endpoint. This endpoint is not part of the line.
nYEnd	Specifies the logical y-coordinate of the endpoint. This endpoint is not part of the line.
lnddaprc	Specifies the procedure-instance address of the application-defined callback function. The address must have been created by using the **MakeProcInstance** function. For more information about the callback function, see the description of the **LineDDAProc** callback function.
lParam	Points to 32 bits of application-defined data that is passed to the callback function.

Returns

This function does not return a value.

Example

The following example uses the **LineDDA** function to draw a dot every two spaces between the beginning and ending points of a line:

```
/* Callback function */

void CALLBACK DrawDots(int xPos, int yPos, LPSTR lphdc)
{
    static short cSpaces = 1;

    if (cSpaces == 3) {

        /* Draw a black dot. */

        SetPixel(*(HDC FAR*) lphdc, xPos, yPos, 0);

        /* Initialize the space count. */

        cSpaces = 1;
    }
    else
        cSpaces++;
}
```

See Also

LineDDAProc, **MakeProcInstance**

LineTo (2.x)

BOOL LineTo(*hdc, xEnd, yEnd***)**

HDC *hdc;* /* handle of device context */
int *xEnd;* /* x-coordinate of line endpoint */
int *yEnd;* /* y-coordinate of line endpoint */

The **LineTo** function draws a line from the current position up to, but not including, the specified endpoint. The function uses the selected pen to draw the line and sets the current position to the coordinates (*xEnd,yEnd*).

Parameter	Description
hdc	Identifies the device context.
xEnd	Specifies the logical x-coordinate of the line's endpoint.
yEnd	Specifies the logical y-coordinate of the line's endpoint.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Example
The following example sets the current position by using the **MoveTo** function before calling the **LineTo** function. The example uses **POINT** structures to store the coordinates.

```
HDC hdc;

POINT ptStart = {  12,  12 };
POINT ptEnd = { 128, 135 };

MoveTo(hdc, ptStart.x, ptStart.y);
LineTo(hdc, ptEnd.x, ptEnd.y);
```

See Also
MoveTo, **POINT**

LPtoDP (2.x)

BOOL LPtoDP(*hdc, lppt, cPoints***)**

```
HDC hdc;                /* handle of device context      */
POINT FAR* lppt;        /* address of array with points */
int cPoints;            /* number of points in array     */
```

The **LPtoDP** function converts logical coordinates (points) into device coordinates.

Parameter	Description
hdc	Identifies the device context.
lppt	Points to an array of **POINT** structures. The coordinates in each structure are mapped to the device coordinates of the current device context.
cPoints	Specifies the number of points in the array.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The conversion depends on the current mapping mode and the settings of the origins and extents of the device's window and viewport.

The x- and y-coordinates of points are 2-byte signed integers in the range -32,768 through 32,767. In cases where the mapping mode would result in values larger than these limits, the system sets the values to -32,768 and 32,767, respectively.

Example

The following example sets the mapping mode to MM_LOENGLISH and then calls the **LPtoDP** function to convert the coordinates of a rectangle into device coordinates:

```
RECT rc;

SetMapMode(hdc, MM_LOENGLISH);
SetRect(&rc, 100, -100, 200, -200);
LPtoDP(hdc, (LPPOINT) &rc, 2);
```

See Also

DPtoLP, **POINT**

MoveTo (2.x)

DWORD MoveTo(*hdc, x, y***)**

HDC *hdc;* /* handle of device context */
int *x;* /* x-coordinate of new position */
int *y;* /* y-coordinate of new position */

The **MoveTo** function moves the current position to the specified coordinates.

Parameter	Description
hdc	Identifies the device context.
x	Specifies the logical x-coordinate of the new position.
y	Specifies the logical y-coordinate of the new position.

Returns

The low-order word of the return value contains the logical x-coordinate of the previous position, if the function is successful; the high-order word contains the logical y-coordinate.

Example

The following example uses the **MoveTo** function to set the current position and then calls the **LineTo** function. The example uses **POINT** structures to store the coordinates.

```
HDC hdc;

POINT ptStart = {  12,  12 };
POINT ptEnd = { 128, 135 };

MoveTo(hdc, ptStart.x, ptStart.y);
LineTo(hdc, ptEnd.x, ptEnd.y);
```

See Also

GetCurrentPosition, **LineTo**, **POINT**

MoveToEx (3.1)

BOOL MoveToEx(*hdc, x, y, lpPoint***)**

```
HDC hdc;                /* handle of device context                    */
int x;                  /* x-coordinate of new position                */
int y;                  /* y-coordinate of new position                */
POINT FAR* lpPoint;     /* pointer to structure for previous position  */
```

The **MoveToEx** function moves the current position to the point specified by the *x* and *y* parameters, optionally returning the previous position.

Parameter	Description
hdc	Identifies the device context.
x	Specifies the logical x-coordinate of the new position.
y	Specifies the logical y-coordinate of the new position.
lpPoint	Points to a **POINT** structure in which the previous current position will be stored. If this parameter is NULL, no previous position is returned.

Returns

The return value is nonzero if the call is successful. Otherwise, it is zero.

See Also

MoveTo, **POINT**

OffsetClipRgn (2.x)

int OffsetClipRgn(*hdc, nXOffset, nYOffset***)**

HDC *hdc;* /* device-context handle */
int *nXOffset;* /* offset along x-axis */
int *nYOffset;* /* offset along y-axis */

The **OffsetClipRgn** function moves the clipping region of the given device by the specified offsets.

Parameter	Description
hdc	Identifies the device context.
nXOffset	Specifies the number of logical units to move left or right.
nYOffset	Specifies the number of logical units to move up or down.

Returns

The return value is SIMPLEREGION (region has no overlapping borders), COMPLEXREGION (region has overlapping borders), or NULLREGION (region is empty), if the function is successful. Otherwise, the return value is ERROR.

Example

The following example creates an elliptical region and selects it as the clipping region for a device context. The **OffsetClipRgn** function is called repeatedly to move the clipping region from left to right across the screen. Because only the new clipping region is redrawn each time the **Rectangle** function is called, the left side of each ellipse remains on the screen when the clipping region moves. When the loop has finished, a wide blue line with rounded ends stretches from one side of the client area to the other.

```
RECT rc;
HRGN hrgn;
HBRUSH hbr, hbrPrevious;
int i;

GetClientRect(hwnd, &rc);
hrgn = CreateEllipticRgn(0, 100, 100, 200);
SelectClipRgn(hdc, hrgn);
hbr = CreateSolidBrush(RGB(0, 0, 255));
hbrPrevious = SelectObject(hdc, hbr);

for (i = 0; i < rc.right - 100; i++) {
    OffsetClipRgn(hdc, 1, 0);
    Rectangle(hdc, rc.left, rc.top, rc.right, rc.bottom);
}

SelectObject(hdc, hbrPrevious);
DeleteObject(hbr);
DeleteObject(hrgn);
```

See Also

CreateEllipticRgn, **SelectClipRgn**

OffsetRgn (2.x)

int OffsetRgn(*hrgn, nXOffset, nYOffset***)**

HRGN *hrgn;* /* handle of region */
int *nXOffset;* /* offset along x-axis */
int *nYOffset;* /* offset along y-axis */

The **OffsetRgn** function moves the given region by the specified offsets.

Parameter	Description
hrgn	Identifies the region to be moved.
nXOffset	Specifies the number of logical units to move left or right.
nYOffset	Specifies the number of logical units to move up or down.

Returns

The return value is SIMPLEREGION (region has no overlapping borders), COMPLEXREGION (region has overlapping borders), or NULLREGION (region is empty), if the function is successful. Otherwise, the return value is ERROR.

Comments

The coordinate values of a region must not be greater than 32,767 or less than -32,768. The *nXOffset* and *nYOffset* parameters must be carefully chosen to prevent invalid regions.

Example

The following example creates a rectangular region, uses the **OffsetRgn** function to move the region 50 positive units in the x- and y-directions, selects the offset region into the device context, and then fills it by using a blue brush:

```
HDC hdcLocal;
HRGN hrgn;
HBRUSH hbrBlue;
int RgnType;

hdcLocal = GetDC(hwnd);
hrgn = CreateRectRgn(100, 10, 210, 110);
SelectObject(hdc, hrgn);
PaintRgn(hdc, hrgn);

RgnType = OffsetRgn(hrgn, 50, 50);
SelectObject(hdc, hrgn);

if (RgnType == ERROR)
    TextOut(hdcLocal, 10, 135, "ERROR", 5);
else if (RgnType == SIMPLEREGION)
    TextOut(hdcLocal, 10, 135, "SIMPLEREGION", 12);
else if (RgnType == NULLREGION)
    TextOut(hdcLocal, 10, 135, "NULLREGION", 10);
else
    TextOut(hdcLocal, 10, 135, "Unrecognized value.", 19);

hbrBlue = CreateSolidBrush(RGB(0, 0, 255));
FillRgn(hdc, hrgn, hbrBlue);

DeleteObject(hrgn);
DeleteObject(hbrBlue);
ReleaseDC(hwnd, hdcLocal);
```

OffsetViewportOrg (2.x)

DWORD OffsetViewportOrg(*hdc, nXOffset, nYOffset***)**

```
HDC hdc;        /* handle of device context */
int nXOffset;   /* offset along x-axis      */
int nYOffset;   /* offset along y-axis      */
```

The **OffsetViewportOrg** function modifies the coordinates of the viewport origin relative to the coordinates of the current viewport origin.

Parameter	Description
hdc	Identifies the device context.
nXOffset	Specifies the value, in device units, to add to the x-coordinate of the current origin.
nYOffset	Specifies the value, in device units, to add to the y-coordinate of the current origin.

Returns

The low-order word of the return value contains the x-coordinate, in device units, of the previous viewport origin, if the function is successful; the high-order word contains the y-coordinate.

Comments

The viewport origin is the origin of the device coordinate system for a window. By changing the viewport origin, an application can change the way the graphics device interface (**GDI**) maps points from the logical coordinate system. GDI maps all points in the logical coordinate system to the viewport in the same way as it maps the origin.

To map points to the right, specify a negative value for the *nXOffset* parameter. Similarly, to map points down (in the MM_TEXT mapping mode), specify a negative value for the *nYOffset* parameter.

Example

The following example uses the **OffsetWindowOrg** and **OffsetViewportOrg** functions to reposition the output of the **PlayMetaFile** function on the screen:

```
HDC hdcMeta;
HANDLE hmf;

hdcMeta = CreateMetaFile((LPSTR) NULL);
    .
    . /* Record the metafile. */
    .

PlayMetaFile(hdc, hmf);

OffsetWindowOrg(hdc, -200, -200);
PlayMetaFile(hdc, hmf);   /* MM_TEXT screen output +200 x, +200 y */

OffsetViewportOrg(hdc, 0, -200);
PlayMetaFile(hdc, hmf);   /* outputs -200 y from last PlayMetaFile */

DeleteMetaFile(hmf);
```

See Also

GetViewportOrg, **OffsetWindowOrg**, **SetViewportOrg**

OffsetViewportOrgEx (3.1)

BOOL OffsetViewportOrgEx(*hdc, nX, nY, lpPoint***)**

```
HDC hdc;                /* handle of device context              */
int nX;                 /* device units to add to x-coordinate   */
int nY;                 /* device units to add to y-coordinate   */
POINT FAR* lpPoint;     /* address of POINT structure            */
```

The **OffsetViewportOrgEx** function modifies the viewport origin relative to the current values. The formulas are written as follows:

```
xNewVO = xOldVO + X
yNewVO = yOldVO + Y
```

The new origin is the sum of the current origin and the *nX* and *nY* values.

Parameter	Description
hdc	Identifies the device context.
nX	Specifies the number of device units to add to the current origin's x-coordinate.
nY	Specifies the number of device units to add to the current origin's y-coordinate.
lpPoint	Points to a **POINT** structure. The previous viewport origin (in device coordinates) is placed in this structure. If *lpPoint* is NULL, the previous viewport origin in not returned.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

OffsetWindowOrg (2.x)

DWORD OffsetWindowOrg(*hdc, nXOffset, nYOffset***)**

```
HDC hdc;        /* handle of device context */
int nXOffset;   /* offset along x-axis      */
int nYOffset;   /* offset along y-axis      */
```

The **OffsetWindowOrg** function modifies the window origin relative to the coordinates of the current window origin.

Parameter	Description
hdc	Identifies the device context.
nXOffset	Specifies the value, in logical units, to add to the x-coordinate of the current origin.
nYOffset	Specifies the value, in logical units, to add to y-coordinate of the current origin.

Returns

The low-order word of the return value contains the logical x-coordinate of the previous window origin, if the function is successful; the high-order word contains the logical y-coordinate.

Comments

The window origin is the origin of the logical coordinate system for a window. By changing the window origin, an application can change the way the graphics device interface (**GDI**) maps logical points to the physical coordinate system (the viewport). GDI maps all points in the logical coordinate system to the viewport in the same way as it maps the origin.

To map points to the right, specify a negative value for the *nXOffset* parameter. Similarly, to map points down (in the MM_TEXT mapping mode), specify a negative value for the *nYOffset* parameter.

Example

The following example uses the **OffsetWindowOrg** and **OffsetViewportOrg** functions to reposition the output of the **PlayMetaFile** function on the screen:

```
HDC hdcMeta;
HANDLE hmf;

hdcMeta = CreateMetaFile((LPSTR) NULL);
    .
    . /* Record the metafile. */
    .

PlayMetaFile(hdc, hmf);

OffsetWindowOrg(hdc, -200, -200);
PlayMetaFile(hdc, hmf);   /* MM_TEXT screen output +200 x, +200 y */

OffsetViewportOrg(hdc, 0, -200);
PlayMetaFile(hdc, hmf);   /* outputs -200 y from last PlayMetaFile */

DeleteMetaFile(hmf);
```

See Also

GetWindowOrg, **OffsetViewportOrg**, **SetWindowOrg**

OffsetWindowOrgEx (3.1)

BOOL OffsetWindowOrgEx(*hdc, nX, nY, lpPoint***)**

```
HDC hdc;                    /* handle of device context          */
int nX;                     /* logical units to add to x-coordinate */
int nY;                     /* logical units to add to y-coordinate */
POINT FAR* lpPoint;         /* address of POINT structure        */
```

The **OffsetWindowOrgEx** function modifies the viewport origin relative to the current values. The formulas are written as follows:

```
xNewWO = xOldWO + X
yNewWO = yOldWO + Y
```

The new origin is the sum of the current origin and the *nX* and *nY* values.

Parameter	Description
hdc	Identifies the device context.
nX	Specifies the number of logical units to add to the current origin's x-coordinate.
nY	Specifies the number of logical units to add to the current origin's y-coordinate.
lpPoint	Points to a **POINT** structure. The previous window origin (in logical coordinates) is placed in this structure. If *lpPoint* is NULL, the previous origin is not returned.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

PaintRgn (2.x)

BOOL PaintRgn(*hdc, hrgn***)**

HDC *hdc;* /* handle of device context */
HRGN *hrgn;* /* handle of region */

The **PaintRgn** function fills a region by using the current brush for the given device context.

Parameter	Description
hdc	Identifies the device context that contains the region to be filled.
hrgn	Identifies the region to be filled. The coordinates for the given region are specified in device units.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Example
The following example uses the current brush for a device context to fill an elliptical region:

```
HDC hdc;
HRGN hrgn;

hrgn = CreateEllipticRgn(10, 10, 110, 110);
SelectObject(hdc, hrgn);
PaintRgn(hdc, hrgn);

DeleteObject(hrgn);
```

See Also
CreateBrushIndirect, **CreateDIBPatternBrush**, **CreateHatchBrush**, **CreatePatternBrush**, **CreateSolidBrush**, **FillRgn**

Changes

PatBlt (2.x)

BOOL PatBlt(*hdc, nLeftRect, nTopRect, nwidth, nheight, fdwRop***)**

```
HDC hdc;          /* handle of device context                          */
int nLeftRect;    /* x-coordinate top-left corner destination rectangle */
int nTopRect;     /* y-coordinate top-left corner destination rectangle */
int nwidth;       /* width of destination rectangle                    */
int nheight;      /* height of destination rectangle                   */
DWORD fdwRop;     /* raster operation                                  */
```

The **PatBlt** function creates a bit pattern on the specified device. The pattern is a combination of the selected brush and the pattern already on the device. The specified raster-operation code defines how the patterns are combined.

Parameter	Description
hdc	Identifies the device context.
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the rectangle that receives the pattern.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the rectangle that receives the pattern.
nwidth	Specifies the width, in logical units, of the rectangle that will receive the pattern.
nheight	Specifies the height, in logical units, of the rectangle that will receive the pattern.
fdwRop	Specifies the raster-operation code that determines how the graphics device interface (**GDI**) combines the colors in the output operation. This parameter can be one of the following values:

Value	Meaning
PATCOPY	Copies the pattern to the destination bitmap.
PATINVERT	Combines the destination bitmap with the pattern by using the Boolean XOR operator.
PATPAINT	Paints the destination bitmap.
DSTINVERT	Inverts the destination bitmap.
BLACKNESS	Turns all output black.
WHITENESS	Turns all output white.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The raster operations listed for this function are a limited subset of the full 256 ternary raster-operation codes; in particular, a raster-operation code that refers to a source cannot be used.

Not all devices support the **PatBlt** function. To determine whether a device supports **PatBlt**, an application can call the **GetDeviceCaps** function with the RASTERCAPS index.

Example

The following example uses the **CreateBitmap** function to create a bitmap with a zig-zag pattern, and then uses the **PatBlt** function to fill the client area with that pattern:

```
HDC hdc;
HBITMAP hbmp;
HBRUSH hbr, hbrPrevious;
RECT rc;
```

```
int aZigzag[] = { 0xFF, 0xF7, 0xEB, 0xDD, 0xBE, 0x7F, 0xFF, 0xFF };

hbmp = CreateBitmap(8, 8, 1, 1, aZigzag);
hbr = CreatePatternBrush(hbmp);

hdc = GetDC(hwnd);
UnrealizeObject(hbr);
hbrPrevious = SelectObject(hdc, hbr);
GetClientRect(hwnd, &rc);

PatBlt(hdc, rc.left, rc.top,
    rc.right - rc.left, rc.bottom - rc.top, PATCOPY);
SelectObject(hdc, hbrPrevious);
ReleaseDC(hwnd, hdc);

DeleteObject(hbr);
DeleteObject(hbmp);
```

See Also

GetDeviceCaps

Windows 3.1 corrections

The following raster operation has been added:

Value	Meaning
PATPAINT	Paints the destination bitmap.

Pie (2.x)

BOOL Pie(*hdc, nLeftRect, nTopRect, nRightRect, nBottomRect, nxStartArc, nyStartArc, nxEndArc, nyEndArc***)**

```
HDC hdc;          /* handle of device context                          */
int nLeftRect;    /* x-coordinate upper-left corner bounding rectangle */
int nTopRect;     /* y-coordinate upper-left corner bounding rectangle */
int nRightRect;   /* x-coordinate lower-right corner bounding rectangle */
int nBottomRect;  /* y-coordinate lower-right corner bounding rectangle */
int nxStartArc;   /* x-coordinate arc starting point                   */
int nyStartArc;   /* y-coordinate arc starting point                   */
int nxEndArc;     /* x-coordinate arc ending point                     */
int nyEndArc;     /* y-coordinate arc ending point                     */
```

The **Pie** function draws a pie-shaped wedge by drawing an elliptical arc whose center and two endpoints are joined by lines.

Parameter	Description
hdc	Identifies the device context.
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the bounding rectangle.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the bounding rectangle.
nRightRect	Specifies the logical x-coordinate of the lower-right corner of the bounding rectangle.
nBottomRect	Specifies the logical y-coordinate of the lower-right corner of the bounding rectangle.
nxStartArc	Specifies the logical x-coordinate of the arc's starting point. This point does not have to lie exactly on the arc.
nyStartArc	Specifies the logical y-coordinate of the arc's starting point. This point does not have to lie exactly on the arc.
nxEndArc	Specifies the logical x-coordinate of the arc's endpoint. This point does not have to lie exactly on the arc.
nyEndArc	Specifies the logical y-coordinate of the arc's endpoint. This point does not have to lie exactly on the arc.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The center of the arc drawn by the **Pie** function is the center of the bounding rectangle specified by the *nLeftRect, nTopRect, nRightRect,* and *nBottomRect* parameters. The starting and ending points of the arc are specified by the *nxStartArc, nyStartArc, nxEndArc,* and *nyEndArc* parameters. The function draws the arc by using the selected pen, moving in a counterclockwise direction. It then draws two additional lines from each endpoint to the arc's center. Finally, it fills the pie-shaped area by using the current brush.

If *nxStartArc* equals *nxEndArc* and *nyStartArc* equals *nyEndArc,* the result is an ellipse with a single line from the center of the ellipse to the point (*nxStartArc,nyStartArc*) or (*nxEndArc,nyEndArc*).

The figure drawn by this function extends up to but does not include the right and bottom coordinates. This means that the height of the figure is *nBottomRect - nTopRect* and the width of the figure is *nRightRect - nLeftRect.*

Both the width and the height of a rectangle must be greater than 2 units and less than 32,767 units.

Example

The following example uses a **RECT** structure to store the points that define the bounding rectangle and uses **POINT** structures to store the coordinates that specify the beginning and end of the wedge:

```
HDC hdc;

RECT rc = { 10, 10, 180, 140 };
POINT ptStart = {  12,  12 };
POINT ptEnd = { 128, 135 };

Pie(hdc, rc.left, rc.top, rc.right, rc.bottom,
    ptStart.x, ptStart.y, ptEnd.x, ptEnd.y);
```

See Also
Chord, **POINT**, **RECT**

PlayMetaFile (2.x)

BOOL PlayMetaFile(*hdc, hmf***)**

HDC *hdc;* /* handle of device context */
HMETAFILE *hmf;* /* handle of metafile */

The **PlayMetaFile** function plays the contents of the specified metafile on the given device. The metafile can be played any number of times.

Parameter	Description
hdc	Identifies the device context of the output device.
hmf	Identifies the metafile to be played.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Example
The following example uses the **CreateMetaFile** function to create a device-context handle of a memory metafile, draws a line in the device context, retrieves a metafile handle by calling the **CloseMetaFile** function, plays the metafile by using the **PlayMetaFile** function, and finally deletes the metafile by using the **DeleteMetaFile** function:

```
HDC hdcMeta;
HMETAFILE hmf;

hdcMeta = CreateMetaFile(NULL);
MoveTo(hdcMeta, 10, 10);
LineTo(hdcMeta, 100, 100);
hmf = CloseMetaFile(hdcMeta);
PlayMetaFile(hdc, hmf);
DeleteMetaFile(hmf);
```

See Also
PlayMetaFileRecord

PlayMetaFileRecord (2.x)

void PlayMetaFileRecord(*hdc, lpht, lpmr, cHandles***)**

```
HDC hdc;                        /* handle of device context          */
HANDLETABLE FAR* lpht;          /* address of table of object handles */
METARECORD FAR* lpmr;           /* address of metafile record        */
UINT cHandles;                  /* number of handles in table        */
```

The **PlayMetaFileRecord** function plays a metafile record by executing the graphics device interface (**GDI**) function contained in the record.

Parameter	Description
hdc	Identifies the device context of the output device.
lpht	Points to a table of handles associated with the objects (pens, brushes, and so on) in the metafile.
lpmr	Points to the metafile record to be played.
cHandles	Specifies the number of handles in the handle table.

Returns

This function does not return a value.

Comments

An application typically uses this function in conjunction with the **EnumMetafile** function to modify and then play a metafile.

Example

The following example creates a dashed green pen and passes it to the callback function for the **EnumMetaFile** function. If the first element in the array of object handles contains a handle, that handle is replaced by the handle of the green pen before the **PlayMetaFileRecord** function is called. (For this example, it is assumed that the table of object handles contains only one handle and that it is a pen handle.)

```
MFENUMPROC lpEnumMetaProc;
HPEN hpenGreen;

lpEnumMetaProc = (MFENUMPROC) MakeProcInstance(
    (FARPROC) EnumMetaFileProc, hAppInstance);
hpenGreen = CreatePen(PS_DASH, 1, RGB(0, 255, 0));
EnumMetaFile(hdc, hmf, lpEnumMetaProc, (LPARAM) &hpenGreen);
FreeProcInstance((FARPROC) lpEnumMetaProc);
DeleteObject(hpenGreen);
    .
    .
    .

int FAR PASCAL EnumMetaFileProc(HDC hdc, HANDLETABLE FAR* lpHTable,
    METARECORD FAR* lpMFR, int cObj, BYTE FAR* lpClientData)
{
    if (lpHTable->objectHandle[0] != 0)
        lpHTable->objectHandle[0] = *(HPEN FAR *) lpClientData;
    PlayMetaFileRecord(hdc, lpHTable, lpMFR, cObj);

    return 1;
}
```

See Also

EnumMetafile, **PlayMetaFile**

Polygon (2.x)

BOOL Polygon(*hdc, lppt, cPoints***)**

HDC *hdc;*	/* handle of device context */
const POINT FAR* *lppt;*	/* address of array with points for vertices */
int *cPoints;*	/* number of points in array */

The **Polygon** function draws a polygon consisting of two or more points (vertices) connected by lines. The system closes the polygon automatically, if necessary, by drawing a line from the last vertex to the first. Polygons are surrounded by a frame drawn by using the current pen and filled by using the current brush.

Parameter	Description
hdc	Identifies the device context.
lppt	Points to an array of **POINT** structures that specify the vertices of the polygon. Each structure in the array specifies a vertex.
cPoints	Specifies the number of vertices in the array.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The current polygon-filling mode can be retrieved or set by using the **GetPolyFillMode** and **SetPolyFillMode** functions.

Example

The following example assigns values to an array of points and then calls the **Polygon** function:

```
HDC hdc;

POINT aPoints[3];

aPoints[0].x = 50;
aPoints[0].y = 10;
aPoints[1].x = 250;
aPoints[1].y = 50;
aPoints[2].x = 125;
aPoints[2].y = 130;

Polygon(hdc, aPoints, sizeof(aPoints) / sizeof(POINT));
```

See Also

GetPolyFillMode, **Polyline**, **PolyPolygon**, **SetPolyFillMode**, **POINT**

Polyline (2.x)

BOOL Polyline(*hdc, lppt, cPoints***)**

```
HDC hdc;                    /* handle of device context                 */
const POINT FAR* lppt;      /* address of array with points to connect */
int cPoints;                /* number of points in array                */
```

The **Polyline** function draws a set of line segments, connecting the specified points. The lines are drawn from the first point through subsequent points, using the current pen. Unlike the **LineTo** function, the **Polyline** function neither uses nor updates the current position.

Parameter	Description
hdc	Identifies the device context.
lppt	Points to an array of **POINT** structures. Each structure in the array specifies a point.
cPoints	Specifies the number of points in the array. This value must be at least 2.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Example
The following example assigns values to an array of points and then calls the **Polyline** function:

```
HDC hdc;

POINT aPoints[3];

aPoints[0].x = 50;
aPoints[0].y = 10;
aPoints[1].x = 250;
aPoints[1].y = 50;
aPoints[2].x = 125;
aPoints[2].y = 130;

Polyline(hdc, aPoints, sizeof(aPoints) / sizeof(POINT));
```

See Also
LineTo, **Polygon**, **POINT**

PolyPolygon (3.0)

BOOL PolyPolygon(*hdc, lppt, lpnPolyCounts, cPolygons***)**

HDC *hdc;*	/* handle of device context */
const POINT FAR* *lppt;*	/* address of array with vertices */
int FAR* *lpnPolyCounts;*	/* address of array with point counts */
int *cPolygons;*	/* number of polygons to draw */

The **PolyPolygon** function creates two or more polygons that are filled by using the current polygon-filling mode. The polygons may be disjoint or overlapping.

Parameter	Description
hdc	Identifies the device context.
lppt	Points to an array of **POINT** structures. Each structure in the array specifies a vertext of a polygon.
lpnPolyCounts	Points to an array of integers, each of which specifies the number of points in one of the polygons in the array pointed to by the *lppt* parameter.
cPolygons	Specifies the number of polygons to be drawn. This value must be at least 2.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

Each polygon specified in a call to the **PolyPolygon** function must be closed. Unlike polygons created by the **Polygon** function, the polygons created by **PolyPolygon** are not closed automatically.

The **PolyPolygon** function creates two or more polygons. To create a single polygon, an application should use the **Polygon** function.

The current polygon-filling mode can be retrieved or set by using the **GetPolyFillMode** and **SetPolyFillMode** functions.

Example

The following example draws two overlapping polygons by assigning values to an array of points and then calling the **PolyPolygon** function:

```
HDC hdc;

POINT aPolyPoints[8];
int aVertices[] = { 4, 4 };

aPolyPoints[0].x = 50;
aPolyPoints[0].y = 10;
aPolyPoints[1].x = 250;
aPolyPoints[1].y = 50;
aPolyPoints[2].x = 125;
aPolyPoints[2].y = 130;
aPolyPoints[3].x = 50;
aPolyPoints[3].y = 10;

aPolyPoints[4].x = 100;
aPolyPoints[4].y = 25;
aPolyPoints[5].x = 300;
aPolyPoints[5].y = 125;
aPolyPoints[6].x = 70;
aPolyPoints[6].y = 150;
aPolyPoints[7].x = 100;
```

```
aPolyPoints[7].y = 25;

PolyPolygon(hdc, aPolyPoints, aVertices,
    sizeof(aVertices) / sizeof(int));
```

See Also
GetPolyFillMode, **Polygon**, **Polyline**, **SetPolyFillMode**, **POINT**

PtInRegion (2.x)

BOOL PtInRegion(*hrgn, nXPos, nYPos***)**

HRGN *hrgn;* /* handle of region */
int *nXPos;* /* x-coordinate of point */
int *nYPos;* /* y-coordinate of point */

The **PtInRegion** function determines whether a specified point is in the given region.

Parameter	Description
hrgn	Identifies the region to be examined.
nXPos	Specifies the logical x-coordinate of the point.
nYPos	Specifies the logical y-coordinate of the point.

Returns
The return value is nonzero if the point is in the region. Otherwise, it is zero.

Example
The following example uses the **PtInRegion** function to determine whether the point (50, 50) is in the specified region and prints the result:

```
HRGN hrgn;
BOOL fPtIn;
LPSTR lpszInRegion = "Specified point is in region.";
LPSTR lpszNotInRegion = "Specified point is not in region.";

fPtIn = PtInRegion(hrgn, 50, 50);
if (!fPtIn)
    TextOut(hdc, 10, 10, lpszNotInRegion,
        lstrlen(lpszNotInRegion));
else
    TextOut(hdc, 10, 10, lpszInRegion, lstrlen(lpszInRegion));
```

See Also
RectInRegion

PtVisible (2.x)

BOOL PtVisible(*hdc, nXPos, nYPos***)**

HDC *hdc;* /* handle of device context */
int *nXPos;* /* x-coordinate of point to query */
int *nYPos;* /* y-coordinate of point to query */

The **PtVisible** function determines whether the specified point is within the clipping region of the given device context.

Parameter	Description
hdc	Identifies the device context.
nXPos	Specifies the logical x-coordinate of the point.
nYPos	Specifies the logical y-coordinate of the point.

Returns
The return is nonzero if the point is within the clipping region. Otherwise, it is zero.

Example
The following example creates a rectangular region, displays a message inside it, and selects the region as the clipping region. The **PtVisible** function is used to determine whether coordinates generated by a double-click are inside the region. If so, the message changes to "Thank you." If not, the **CombineRgn** function is used to create a clipping region that combines the first region with a new region that surrounds the specified coordinates, and the word "Missed!" is displayed at the coordinates.

```
HDC hdcLocal;
HRGN hrgnClick, hrgnMiss, hrgnCombine;
HBRUSH hbr;

hdcLocal = GetDC(hwnd);
hbr = GetStockObject(BLACK_BRUSH);

hrgnClick = CreateRectRgn(90, 95, 225, 120);
FrameRgn(hdcLocal, hrgnClick, hbr, 1, 1);
TextOut(hdcLocal, 100, 100, "Double-click here.", 18);
SelectClipRgn(hdcLocal, hrgnClick);

if (PtVisible(hdcLocal, XClick, YClick)) {
    PaintRgn(hdcLocal, hrgnClick);
    FrameRgn(hdcLocal, hrgnClick, hbr, 1, 1);
    TextOut(hdcLocal, 100, 100, "Thank you.", 10);
}
else if (XClick > 0) {
    hrgnMiss = CreateRectRgn(XClick - 5, YClick - 5, XClick + 60,
        YClick + 20);
    hrgnCombine = CreateRectRgn(0, 0, 0, 0);
    CombineRgn(hrgnCombine, hrgnClick, hrgnMiss, RGN_OR);
    SelectClipRgn(hdcLocal, hrgnCombine);
    FrameRgn(hdcLocal, hrgnCombine, hbr, 1, 1);
    TextOut(hdcLocal, XClick, YClick, "Missed!", 7);
}

InvalidateRect(hwnd, NULL, FALSE);

DeleteObject(hrgnClick);
DeleteObject(hrgnMiss);
```

```
DeleteObject(hrgnCombine);
ReleaseDC(hwnd, hdcLocal);
```

See Also
CombineRgn, **RectVisible**

QueryAbort (3.1)

BOOL QueryAbort(*hdc, reserved***)**

```
HDC hdc;        /* device-context handle   */
int reserved;   /* reserved; must be zero */
```

The **QueryAbort** function calls the **AbortProc** callback function for a printing application and queries whether the printing should be terminated.

Parameter	Description
hdc	Identifies the device context.
reserved	Reserved; must be zero.

Returns

The return value is TRUE if printing should continue or if there is no abort procedure. It is FALSE if the print job should be terminated. The return value is supplied by the **AbortProc** callback function.

See Also

AbortDoc, **AbortProc**, **SetAbortProc**

Rectangle (2.x)

BOOL Rectangle(*hdc, nLeftRect, nTopRect, nRightRect, nBottomRect***)**

HDC *hdc;* /* handle of device context */
int *nLeftRect;* /* x-coordinate upper-left corner */
int *nTopRect;* /* y-coordinate upper-left corner */
int *nRightRect;* /* x-coordinate lower-right corner */
int *nBottomRect;* /* y-coordinate lower-right corner */

The **Rectangle** function draws a rectangle, using the current pen. The interior of the rectangle is filled by using the current brush.

Parameter	Description
hdc	Identifies the device context.
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the rectangle.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the rectangle.
nRightRect	Specifies the logical x-coordinate of the lower-right corner of the rectangle.
nBottomRect	Specifies the logical y-coordinate of the lower-right corner of the rectangle.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The figure this function draws extends up to, but does not include, the right and bottom coordinates. This means that the height of the figure is *nBottomRect - nTopRect* and the width of the figure is *nRightRect - nLeftRect.*

Both the width and the height of a rectangle must be greater than 2 units and less than 32,767 units.

Example
The following example uses a **RECT** structure to store the coordinates used by the **Rectangle** function:

```
HDC hdc;

RECT rc = { 10, 10, 180, 140 };
Rectangle(hdc, rc.left, rc.top,
    rc.right, rc.bottom);
```

See Also
PolyLine, **RoundRect**, **RECT**

RectInRegion (3.0)

BOOL RectInRegion(*hrgn, lprc***)**

HRGN *hrgn;* /* handle of region */
const RECT FAR* *lprc;* /* address of structure with rectangle */

The **RectInRegion** function determines whether any part of the specified rectangle is within the boundaries of the given region.

Parameter	Description
hrgn	Identifies the region.
lprc	Points to a **RECT** structure containing the coordinates of the rectangle.

Returns

The return value is nonzero if any part of the specified rectangle lies within the boundaries of the region. Otherwise, it is zero.

Example

The following example uses the **RectInRegion** function to determine whether a specified rectangle is in a region and prints the result:

```
HRGN hrgn;
RECT rc = { 100, 10, 130, 50 };
BOOL fRectIn;
LPSTR lpszOverlap = "Some overlap between rc and region.";
LPSTR lpszNoOverlap = "No common points in rc and region.";

fRectIn = RectInRegion(hrgn, &rc);
if (!fRectIn)
    TextOut(hdc, 10, 10, lpszNoOverlap, lstrlen(lpszNoOverlap));
else
    TextOut(hdc, 10, 10, lpszOverlap, lstrlen(lpszOverlap));
```

See Also

PtInRegion, **RECT**

RectVisible (2.x)

BOOL RectVisible(*hdc, lprc***)**

HDC *hdc;* /* handle of device context */
const RECT FAR* *lprc;* /* address of structure with rectangle */

The **RectVisible** function determines whether any part of the specified rectangle lies within the clipping region of the given device context.

Parameter	Description
hdc	Identifies the device context.
lprc	Points to a **RECT** structure that contains the logical coordinates of the specified rectangle.

Returns

The return value is nonzero if some portion of the rectangle is within the clipping region. Otherwise, it is zero.

Example

The following example paints a clipping region yellow by painting the client area. The **RectVisible** function is called to determine whether a specified rectangle overlaps the clipping region. If there is some overlap, the rectangle is filled by using a red brush. If there is no overlap, text is displayed inside the clipping region. In this case, the rectangle and the region do not overlap, even though they both specify 110 as a boundary on the y-axis, because regions are defined as including the pixels up to but not including the specified right and bottom coordinates.

```
RECT rc, rcVis;
HRGN hrgn;
HBRUSH hbrRed, hbrYellow;

GetClientRect(hwnd, &rc);
hrgn = CreateRectRgn(10, 10, 310, 110);
SelectClipRgn(hdc, hrgn);

hbrYellow = CreateSolidBrush(RGB(255, 255, 0));
FillRect(hdc, &rc, hbrYellow);

SetRect(&rcVis, 10, 110, 310, 300);
if (RectVisible(hdc, &rcVis)) {
    hbrRed = CreateSolidBrush(RGB(255, 0, 0));
    FillRect(hdc, &rcVis, hbrRed);
    DeleteObject(hbrRed);
}
else {
    SetBkColor(hdc, RGB(255, 255, 0));
    TextOut(hdc, 20, 50, "Rectangle outside clipping region.", 34);
}

DeleteObject(hbrYellow);
DeleteObject(hrgn);
```

See Also

CreateRectRgn, **PtVisible**, **SelectClipRgn**, **RECT**

RemoveFontResource (2.x)

BOOL RemoveFontResource(*lpszFile***)**

LPCSTR *lpszFile;* /* address of string for filename */

The **RemoveFontResource** function removes an added font resource from the specified file or from the Windows font table.

Parameter	Description
lpszFile	Points to a string that names the font resource file or contains a handle of a loaded module. If this parameter points to the font resource file, the string must be null-terminated and have the MS-DOS filename format. If the parameter contains a handle, the handle must be in the low-order word and the high-order word must be zero.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

Any application that adds or removes fonts from the Windows font table should send a **WM_FONTCHANGE** message to all top-level windows in the system by using the **SendMessage** function with the *hwnd* parameter set to 0xFFFF.

In some cases, the **RemoveFontResource** function may not remove the font resource immediately. If there are outstanding references to the resource, it remains loaded until the last logical font using it has been removed (deleted) by using the **DeleteObject** function.

Example

The following example uses the **AddFontResource** function to add a font resource from a file, notifies other applications by using the **SendMessage** function, then removes the font resource by calling the **RemoveFontResource** function:

```
AddFontResource("fontres.fon");
SendMessage(HWND_BROADCAST, WM_FONTCHANGE, 0, 0);
    .
    . /* Work with the font. */
    .
if (RemoveFontResource("fontres.fon")) {
    SendMessage(HWND_BROADCAST, WM_FONTCHANGE, 0, 0);
    return TRUE;
}
else
    return FALSE;
```

See Also

AddFontResource, **DeleteObject**, **SendMessage**

ResetDC (3.1)

#include <print.h>

HDC ResetDC(*hdc, lpdm***)**

HDC *hdc;* /* handle of device context */
const DEVMODE FAR* *lpdm;* /* address of DEVMODE structure*/

The **ResetDC** function updates the given device context, based on the information in the specified **DEVMODE** structure.

Parameter	Description
hdc	Identifies the device context to be updated.
lpdm	Points to a **DEVMODE** structure containing information about the new device context.

Returns

The return value is the handle of the original device context if the function is successful. Otherwise, it is NULL.

Comments

An application will typically use the **ResetDC** function when a window receives a **WM_DEVMODECHANGE** message. **ResetDC** can also be used to change the paper orientation or paper bins while printing a document.

The **ResetDC** function cannot be used to change the driver name, device name or the output port. When the user changes the port connection or device name, the application must delete the original device context and create a new device context with the new information.

Before calling **ResetDC**, the application must ensure that all objects (other than stock objects) that had been selected into the device context have been selected out.

See Also

DeviceCapabilities, **Escape**, **ExtDeviceMode**, **DEVMODE**, **WM_DEVMODECHANGE**

ResizePalette (3.0)

BOOL ResizePalette(*hpal, cEntries***)**

```
HPALETTE hpal;      /* handle of palette                        */
UINT cEntries;      /* number of palette entries after resizing */
```

The **ResizePalette** function changes the size of the given logical palette.

Parameter	Description
hpal	Identifies the palette to be changed.
cEntries	Specifies the number of entries in the palette after it has been resized.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

If an application calls the **ResizePalette** function to reduce the size of the palette, the entries remaining in the resized palette are unchanged. If the application calls **ResizePalette** to enlarge the palette, the additional palette entries are set to black (the red, green, and blue values are all zero) and the flags for all additional entries are set to zero.

RestoreDC (2.x)

BOOL RestoreDC(*hdc, nSavedDC***)**

HDC *hdc;* /* handle of device context */
int *nSavedDC;* /* integer identifying device context to restore */

The **RestoreDC** function restores the given device context to a previous state. The device context is restored by popping state information off a stack created by earlier calls to the **SaveDC** function.

Parameter	Description
hdc	Identifies the device context.
nSavedDC	Specifies the device context to be restored. This parameter can be a value returned by a previous **SaveDC** function. If the parameter is -1, the most recently saved device context is restored.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The stack can contain the state information for several instances of the device context. If the context specified by the *nSavedDC* parameter is not at the top of the stack, **RestoreDC** deletes all state information between the instance specified by *nSavedDC* and the top of the stack.

Example
The following example uses the **GetMapMode** function to retrieve the mapping mode for the current device context, uses the **SaveDC** function to save the state of the device context, changes the mapping mode, restores the previous state of the device context by using the **RestoreDC** function, and retrieves the mapping mode again. The final mapping mode is the same as the mapping mode prior to the call to the **SaveDC** function.

```
HDC hdcLocal;
int MapMode;
char *aModes[] = {"ZERO", "MM_TEXT", "MM_LOMETRIC", "MM_HIMETRIC",
    "MM_LOENGLISH", "MM_HIENGLISH", "MM_TWIPS",
    "MM_ISOTROPIC", "MM_ANISOTROPIC" };

hdcLocal = GetDC(hwnd);
MapMode = GetMapMode(hdcLocal);
TextOut(hdc, 100, 100, (LPSTR) aModes[MapMode],
    lstrlen(aModes[MapMode]));

SaveDC(hdcLocal);

SetMapMode(hdcLocal, MM_LOENGLISH);
MapMode = GetMapMode(hdcLocal);
TextOut(hdc, 100, 120, (LPSTR) aModes[MapMode],
    lstrlen(aModes[MapMode]));

RestoreDC(hdcLocal, -1);

MapMode = GetMapMode(hdcLocal);
TextOut(hdc, 100, 140, (LPSTR) aModes[MapMode],
    lstrlen(aModes[MapMode]));

ReleaseDC(hwnd, hdcLocal);
```

See Also

SaveDC

RoundRect (2.x)

BOOL RoundRect(*hdc, nLeftRect, nTopRect, nRightRect, nBottomRect, nEllipseWidth, nEllipseHeight***)**

```
HDC hdc;            /* handle of device context            */
int nLeftRect;      /* x-coordinate upper-left corner      */
int nTopRect;       /* y-coordinate upper-left corner      */
int nRightRect;     /* x-coordinate lower-right corner     */
int nBottomRect;    /* y-coordinate lower-right corner     */
int nEllipseWidth;  /* width of ellipse for rounded corners */
int nEllipseHeight; /* height of ellipse for rounded corners */
```

The **RoundRect** function draws a rectangle with rounded corners, using the current pen. The interior of the rectangle is filled by using the current brush.

Parameter	Description
hdc	Identifies the device context.
nLeftRect	Specifies the logical x-coordinate of the upper-left corner of the rectangle.
nTopRect	Specifies the logical y-coordinate of the upper-left corner of the rectangle.
nRightRect	Specifies the logical x-coordinate of the lower-right corner of the rectangle.
nBottomRect	Specifies the logical y-coordinate of the lower-right corner of the rectangle.
nEllipseWidth	Specifies the width, in logical units, of the ellipse used to draw the rounded corners.
nEllipseHeight	Specifies the height, in logical units, of the ellipse used to draw the rounded corners.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The figure this function draws extends up to but does not include the right and bottom coordinates. This means that the height of the figure is *nBottomRect* - *nTopRect* and the width of the figure is *nRightRect* - *nLeftRect.*

Both the width and the height of a rectangle must be greater than 2 units and less than 32,767 units.

Example

The following example uses a **RECT** structure to store the coordinates used by the **RoundRect** function:

```
HDC hdc;

RECT rc = { 10, 10, 180, 140 };
int iEllipseWidth, iEllipseHeight;

iEllipseWidth = 20;
iEllipseHeight = 40;

RoundRect(hdc, rc.left, rc.top, rc.right, rc.bottom,
    iEllipseWidth, iEllipseHeight);
```

See Also

Rectangle, **RECT**

SaveDC (2.x)

int SaveDC(*hdc***)**

HDC *hdc;* /* handle of device context */

The **SaveDC** function saves the current state of the given device context by copying state information (such as clipping region, selected objects, and mapping mode) to a context stack. The saved device context can later be restored by using the **RestoreDC** function.

Parameter	Description
hdc	Identifies the device context to be saved.

Returns

The return value is an integer identifying the saved device context if the function is successful. This integer can be used to restore the device context by calling the **RestoreDC** function. The return value is zero if an error occurs.

Comments

The **SaveDC** function can be used any number of times to save any number of device-context states.

Example

The following example uses the **GetMapMode** function to retrieve the mapping mode for the current device context, uses the **SaveDC** function to save the state of the device context, changes the mapping mode, restores the previous state of the device context by using the **RestoreDC** function, and retrieves the mapping mode again. The final mapping mode is the same as the mapping mode prior to the call to the **SaveDC** function.

```
HDC hdcLocal;
int MapMode;
char *aModes[] = {"ZERO", "MM_TEXT", "MM_LOMETRIC", "MM_HIMETRIC",
    "MM_LOENGLISH", "MM_HIENGLISH", "MM_TWIPS",
    "MM_ISOTROPIC", "MM_ANISOTROPIC" };

hdcLocal = GetDC(hwnd);
MapMode = GetMapMode(hdcLocal);
TextOut(hdc, 100, 100, (LPSTR) aModes[MapMode],
    lstrlen(aModes[MapMode]));

SaveDC(hdcLocal);

SetMapMode(hdcLocal, MM_LOENGLISH);
MapMode = GetMapMode(hdcLocal);
TextOut(hdc, 100, 120, (LPSTR) aModes[MapMode],
    lstrlen(aModes[MapMode]));

RestoreDC(hdcLocal, -1);

MapMode = GetMapMode(hdcLocal);
TextOut(hdc, 100, 140, (LPSTR) aModes[MapMode],
    lstrlen(aModes[MapMode]));

ReleaseDC(hwnd, hdcLocal);
```

See Also

RestoreDC

ScaleViewportExt (2.x)

DWORD ScaleViewportExt(*hdc, nXNum, nXDenom, nYNum, nYDenom***)**

```
HDC hdc;        /* handle of device context                          */
int nXNum;      /* amount by which current x-extent is multiplied    */
int nXDenom;    /* amount by which current x-extent is divided       */
int nYNum;      /* amount by which current y-extent is multiplied    */
int nYDenom;    /* amount by which current y-extent is divided       */
```

The **ScaleViewportExt** function modifies the viewport extents relative to the current values.

Parameter	Description
hdc	Identifies the device context.
nXNum	Specifies the amount by which to multiply the current x-extent.
nXDenom	Specifies the amount by which to divide the result of multiplying the current x-extent by the value of the *nXNum* parameter.
nYNum	Specifies the amount by which to multiply the current y-extent.
nYDenom	Specifies the amount by which to divide the result of multiplying the current y-extent by the value of the *nYNum* parameter.

Returns

The low-order word of the return value contains the x-extent, in device units, of the previous viewport if the function is successful; the high-order word contains the y-extent.

Comments

The new viewport extents are calculated by multiplying the current extents by the given numerator and then dividing by the given denominator, as shown in the following formulas:

```
nXNewVE = (nXOldVE * nXNum) / nXDenom
nYNewVE = (nYOldVE * nYNum) / nYDenom
```

Example

The following example draws a rectangle that is 4 logical units high and 4 logical units wide. It then calls the **ScaleViewportExt** function and draws a rectangle that is 8 units by 8 units. Because of the viewport scaling, the second rectangle is the same size as the first.

```
HDC  hdc;
RECT rc;

GetClientRect(hwnd, &rc);
hdc = GetDC(hwnd);
SetMapMode(hdc, MM_ANISOTROPIC);

SetWindowExt(hdc, 10, 10);
SetViewportExt(hdc, rc.right, rc.bottom);
Rectangle(hdc, 3, 3, 7, 7);

ScaleViewportExt(hdc, 1, 2, 1, 2);
Rectangle(hdc, 6, 6, 14, 14);

ReleaseDC(hwnd, hdc);
```

See Also

GetViewportExt

ScaleViewportExtEx (3.1)

BOOL ScaleViewportExtEx(*hdc, nXnum, nXdenom, nYnum, nYdenom, lpSize***)**

```
HDC hdc;          /* handle of device context                    */
int nXnum;        /* amount by which current x-extent is multiplied */
int nXdenom;      /* amount by which current x-extent is divided */
int nYnum;        /* amount by which current y-extent is multiplied */
int nYdenom;      /* amount by which current y-extent is divided */
SIZE FAR* lpSize; /* address of SIZE structure                   */
```

The **ScaleViewportExtEx** function modifies the viewport extents relative to the current values. The formulas are written as follows:

```
xNewVE = (xOldVE * Xnum) / Xdenom
yNewVE = (yOldVE * Ynum) / Ydenom
```

The new extent is calculated by multiplying the current extents by the given numerator and then dividing by the given denominator.

Parameter	Description
hdc	Identifies the device context.
nXnum	Specifies the amount by which to multiply the current x-extent.
nXdenom	Specifies the amount by which to divide the current x-extent.
nYnum	Specifies the amount by which to multiply the current y-extent.
nYdenom	Specifies the amount by which to divide the current y-extent.
lpSize	Points to a **SIZE** structure. The previous viewport extents, in device units, are placed in this structure. If *lpSize* is NULL, nothing is returned.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

ScaleWindowExt (2.x)

DWORD ScaleWindowExt(*hdc, nXNum, nXDenom, nYNum, nYDenom***)**

HDC *hdc;* /* handle of device context */
int *nXNum;* /* amount by which current x-extent is multiplied */
int *nXDenom;* /* amount by which current x-extent is divided */
int *nYNum;* /* amount by which current y-extent is multiplied */
int *nYDenom;* /* amount by which current y-extent is divided */

The **ScaleWindowExt** function modifies the window extents relative to the current values.

Parameter	Description
hdc	Identifies the device context.
nXNum	Specifies the amount by which to multiply the current x-extent.
nXDenom	Specifies the amount by which to divide the result of multiplying the current x-extent by the value of the *nXNum* parameter.
nYNum	Specifies the amount by which to multiply the current y-extent.
nYDenom	Specifies the amount by which to divide the result of multiplying the current y-extent by the value of the *nYNum* parameter.

Returns

The low-order word of the return value contains the x-extent, in logical units, of the previous window, if the function is successful; the high-order word contains the y-extent.

Comments

The new window extents are calculated by multiplying the current extents by the given numerator and then dividing by the given denominator, as shown in the following formulas:

```
nXNewWE = (nXOldWE * nXNum) / nXDenom
nYNewWE = (nYOldWE * nYNum) / nYDenom
```

Example

The following example draws a rectangle that is 4 logical units high and 4 logical units wide. It then calls the **ScaleWindowExt** function and draws a rectangle that is 8 units by 8 units. Because of the window scaling, the second rectangle is the same size as the first.

```
HDC  hdc;
RECT rc;

GetClientRect(hwnd, &rc);
hdc = GetDC(hwnd);
SetMapMode(hdc, MM_ANISOTROPIC);

SetWindowExt(hdc, 10, 10);
SetViewportExt(hdc, rc.right, rc.bottom);
Rectangle(hdc, 3, 3, 7, 7);

ScaleWindowExt(hdc, 2, 1, 2, 1);
Rectangle(hdc, 6, 6, 14, 14);

ReleaseDC(hwnd, hdc);
```

See Also

GetWindowExt

ScaleWindowExtEx (3.1)

BOOL ScaleWindowExtEx(*hdc, nXnum, nXdenom, nYnum, nYdenom, lpSize***)**

```
HDC hdc;          /* handle of device context                    */
int nXnum;        /* amount by which current x-extent is multiplied */
int nXdenom;      /* amount by which current x-extent is divided */
int nYnum;        /* amount by which current y-extent is multiplied */
int nYdenom;      /* amount by which current y-extent is divided */
SIZE FAR* lpSize; /* address of SIZE structure                   */
```

The **ScaleWindowExtEx** function modifies the window extents relative to the current values. The formulas are written as follows:

```
xNewWE = (xOldWE * Xnum) / Xdenom
yNewWE = (yOldWE * Ynum) / Ydenom
```

The new extent is calculated by multiplying the current extents by the given numerator and then dividing by the given denominator.

Parameter	Description
hdc	Identifies the device context.
nXnum	Specifies the amount by which to multiply the current x-extent.
nXdenom	Specifies the amount by which to divide the current x-extent.
nYnum	Specifies the amount by which to multiply the current y-extent.
nYdenom	Specifies the amount by which to divide the current y-extent.
lpSize	Points to a **SIZE** structure. The previous window extents, in logical units, are placed in this structure. If *lpSize* is NULL, nothing is returned.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

SelectClipRgn (2.x)

int SelectClipRgn(*hdc, hrgn***)**

HDC *hdc;* /* handle of device context */
HRGN *hrgn;* /* handle of region */

The **SelectClipRgn** function selects the given region as the current clipping region for the given device context.

Parameter	Description
hdc	Identifies the device context.
hrgn	Identifies the region to be selected. If this value is NULL, the entire client area is selected and output is still clipped to the window.

Returns

The return value is SIMPLEREGION (region has no overlapping borders), COMPLEXREGION (region has overlapping borders), or NULLREGION (region is empty), if the function is successful. Otherwise, the return value is ERROR.

Comments

The **SelectClipRgn** function selects only a copy of the specified region. Because **SelectClipRgn** uses only a copy, the region can be selected for any number of other device contexts or it can be deleted.

The coordinates for the specified region should be specified in device units.

Some printer devices support text output at a higher resolution than graphics output in order to retain the precision needed to express text metrics. These devices report device units at the higher resolution--that is, text units. These devices then scale coordinates for graphics so that several reported device units map to only one graphics unit. Applications should always call the **SelectClipRgn** function using the text unit. Applications that must take the scaling of graphics objects in the graphics device interface (**GDI**) can use the **GETSCALINGFACTOR** printer escape to determine the scaling factor. This scaling factor affects clipping. If a region is used to clip graphics, GDI divides the coordinates by the scaling factor. (If the region is used to clip text, however, GDI makes no scaling adjustment.) A scaling factor of 1 causes the coordinates to be divided by 2; a scaling factor of 2 causes the coordinates to be divided by 4; and so on.

Example

The following example uses the **GetClipBox** function to determine the size of the current clipping region and the **GetTextExtent** function to determine the width of a line of text. If the text will not fit in the clipping region, the **SelectClipRgn** is used to make the region wide enough for the text. The output is clipped to the window regardless of the size of the region specified in the second parameter of **SelectClipRegion**.

```
HRGN hrgnClip;
RECT rcClip;
LPSTR lpszTest = "Test of clipping region.";
DWORD dwStringLen;
WORD wExtent;

GetClipBox(hdc, &rcClip);
dwStringLen = GetTextExtent(hdc, lpszTest, lstrlen(lpszTest));
wExtent = LOWORD(dwStringLen);
if (rcClip.right < 50 + wExtent) {
    hrgnClip = CreateRectRgn(50, 50, 50 + wExtent, 80);
    SelectClipRgn(hdc, hrgnClip);
}
```

```
TextOut(hdc, 50, 60, lpszTest, lstrlen(lpszTest));

DeleteObject(hrgnClip);
```

See Also
GetClipBox, **GetTextExtent**, **GETSCALINGFACTOR**

Changes

SelectObject (2.x)

HGDIOBJ SelectObject(*hdc, hgdiobj***)**

```
HDC hdc;            /* handle of device context */
HGDIOBJ hgdiobj;    /* handle of object         */
```

The **SelectObject** function selects an object into the given device context. The new object replaces the previous object of the same type.

Parameter	Description
hdc	Identifies the device context.
hgdiobj	Identifies the object to be selected. The object can be one of the following and must have been created by using one of the listed functions:

Object	Functions
Bitmap	**CreateBitmap**, **CreateBitmapIndirect**, **CreateCompatibleBitmap**, **CreateDIBitmap**
Brush	**CreateBrushIndirect**, **CreateDIBPatternBrush**, **CreateHatchBrush**, **CreatePatternBrush**, **CreateSolidBrush**
Font	**CreateFont**, **CreateFontIndirect**
Pen	**CreatePen**, **CreatePenIndirect**
Region	**CreateEllipticRgn**, **CreateEllipticRgnIndirect**, **CreatePolygonRgn**, **CreateRoundRectRgn**, **CreateRectRgn**, **CreateRectRgnIndirect**

Returns

The return value is the handle of the object being replaced, if the function is successful. Otherwise, it is NULL.

If the *hgdiobj* parameter identifies a region, this function performs the same task as the **SelectClipRgn** function and the return value is SIMPLEREGION (region has no overlapping borders), COMPLEXREGION (region has overlapping borders), or NULLREGION (region is empty). If an error occurs, the return value is ERROR and the previously selected object of the specified type remains selected in the device context.

Comments

When an application uses the **SelectObject** function to select a font, pen, or brush, the system allocates space for that object in its data segment. Because data-segment space is limited, an application should use the **DeleteObject** function to remove each drawing object that it no longer requires. Before removing the object, the application should select it out of the device context. To do this, the application can select a different object of the same type back into the device context; typically, this different object is the original object for the device context.

When the *hdc* parameter identifies a metafile device context, the **SelectObject** function does not return the handle of the previously selected object. When the device context is a metafile, calling **SelectObject** with the *hgdiobj* parameter set to a value returned by a previous call to **SelectObject** can cause unpredictable results. Because metafiles perform their own object cleanup, an application need not reselect default objects when recording a metafile.

Memory device contexts are the only device contexts into which an application can select a bitmap. A bitmap can be selected into only one memory device context at a time. The format of the bitmap must either be monochrome or be compatible with the given device; if it is not, **SelectObject** returns an error.

Example

The following example creates a pen, uses the **SelectObject** function to select it into a device context, uses the pen to draw a rectangle, selects the previous pen back into the device context, and uses the

DeleteObject function to remove the pen that was just created:

```
HPEN hpen, hpenOld;

hpen = CreatePen(PS_SOLID, 6, RGB(0, 0, 255));
hpenOld = SelectObject(hdc, hpen);

Rectangle(hdc, 10, 10, 100, 100);

SelectObject(hdc, hpenOld);
DeleteObject(hpen);
```

See Also
DeleteObject, **SelectClipRgn**, **SelectPalette**

Changes

For Windows 3.1, the **SelectObject** function returns the same value whether or not it is used in a metafile. Under previous versions of Windows, the **SelectObject** function returned a nonzero value for success and zero for failure when it was used in a metafile.

SetAbortProc (3.1)

int SetAbortProc(*hdc, abrtprc***)**

HDC *hdc;* /* handle of device context */
ABORTPROC *abrtprc;* /* instance address of abort function */

The **SetAbortProc** function sets the application-defined procedure that allows a print job to be canceled during spooling. This function replaces the SETABORTPROC printer escape for Windows version 3.1.

Parameter	Description
hdc	Identifies the device context for the print job.
abrtprc	Specifies the procedure-instance address of the callback function. The address must have been created by using the **MakeProcInstance** function. For more information about the callback function, see the description of the **AbortProc** callback function.

Returns

The return value is greater than zero if the function is successful. Otherwise, it is less than zero.

See Also

AbortDoc, **AbortProc**, **Escape**

SetBitmapBits (2.x)

LONG SetBitmapBits(*hbmp, cBits, lpvBits***)**

```
HBITMAP hbmp;          /* handle of bitmap                  */
DWORD cBits;           /* number of bytes in bitmap array   */
const void FAR* lpvBits;  /* address of array with bitmap bits */
```

The **SetBitmapBits** function sets the bits of the given bitmap, to the specified bit values.

Parameter	Description
hbmp	Identifies the bitmap to be set.
cBits	Specifies the number of bytes pointed to by the *lpvBits* parameter.
lpvBits	Points to an array of bytes for the bitmap bits.

Returns

The return value is the number of bytes used in setting the bitmap bits, if the function is successful. Otherwise, the return value is zero.

See Also

GetBitmapBits

SetBitmapDimension (2.x)

DWORD SetBitmapDimension(*hbmp, nWidth, nHeight***)**

```
HBITMAP hbmp;       /* handle of bitmap */
int nWidth;         /* bitmap width     */
int nHeight;        /* bitmap height    */
```

The **SetBitmapDimension** function assigns a width and height to a bitmap, in 0.1-millimeter units. The graphics device interface (**GDI**) does not use these values except to return them when an application calls the **GetBitmapDimension** function.

Parameter	Description
hbmp	Identifies the bitmap.
nWidth	Specifies the bitmap width, in 0.1-millimeter units.
nHeight	Specifies the bitmap height, in 0.1-millimeter units.

Returns

The return value is the dimensions of the previous bitmap, in 0.1-millimeter units, if the function is successful. The low-order word contains the previous width; the high-order word contains the previous height.

See Also

GetBitmapDimension

SetBitmapDimensionEx (3.1)

BOOL SetBitmapDimensionEx(*hbm, nX, nY, lpSize***)**

```
HBITMAP hbm;        /* handle of bitmap                        */
int nX;             /* bitmap width                            */
int nY;             /* bitmap height                           */
SIZE FAR* lpSize;   /* address of structure for prev. dimensions */
```

The **SetBitmapDimensionEx** function assigns the preferred size to a bitmap, in 0.1-millimeter units. The graphics device interface (**GDI**) does not use these values, except to return them when an application calls the **GetBitmapDimensionEx** function.

Parameter	Description
hbm	Identifies the bitmap.
nX	Specifies the width of the bitmap, in 0.1-millimeter units.
nY	Specifies the height of the bitmap, in 0.1-millimeter units.
lpSize	Points to a **SIZE** structure. The previous bitmap dimensions are placed in this structure. If *lpSize* is NULL, nothing is returned.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also

GetBitmapDimensionEx, **SIZE**

SetBkColor (2.x)

COLORREF SetBkColor(*hdc, clrref***)**

HDC *hdc;* /* handle of device context */
COLORREF *clrref;* /* color specification */

The **SetBkColor** function sets the current background color to the specified color.

Parameter	Description
hdc	Identifies the device context.
clrref	Specifies the new background color.

Returns

The return value is the **RGB** value of the previous background color, if the function is successful. The return value is 0x80000000 if an error occurs.

Comments

If the background mode is **OPAQUE**, the system uses the background color to fill the gaps in styled lines, the gaps between hatched lines in brushes, and the background in character cells. The system also uses the background color when converting bitmaps between color and monochrome device contexts.

If the device cannot display the specified color, the system sets the background color to the nearest physical color.

Example

The following example uses the **GetBkColor** function to determine whether the current background color is white. If it is, the **SetBkColor** function sets it to red.

```
DWORD dwBackColor;

dwBackColor = GetBkColor(hdc);
if (dwBackColor == RGB(255, 255, 255)) { /* if color is white */
    SetBkColor(hdc, RGB(255, 0, 0));     /* sets color to red */
    TextOut(hdc, 100, 200, "SetBkColor test.", 16);
}
```

See Also

BitBlt, **GetBkColor**, **GetBkMode**, **SetBkMode**, **StretchBlt**, **RGB**

SetBkMode (2.x)

int SetBkMode(*hdc, fnBkMode***)**

HDC *hdc;* /* handle of device context */
int *fnBkMode;* /* background mode */

The **SetBkMode** function sets the specified background mode. The background mode defines whether the system removes existing background colors on the drawing surface before drawing text, hatched brushes, or any pen style that is not a solid line.

Parameter	Description
hdc	Identifies the device context.
fnBkMode	Specifies the background mode to be set. This parameter can be one of the following values:

Value	Meaning
OPAQUE	Background is filled with the current background color before the text, hatched brush, or pen is drawn. This is the default background mode.
TRANSPARENT	Background is not changed before drawing.

Returns
The return value is the previous background mode, if the function is successful.

Example
The following example determines the current background mode by calling the **GetBkMode** function. If the mode is **OPAQUE**, the **SetBkMode** function sets it to TRANSPARENT.

```
int nBackMode;

nBackMode = GetBkMode(hdc);
if (nBackMode == OPAQUE) {
    TextOut(hdc, 90, 100, "This background mode is OPAQUE.", 31);
    SetBkMode(hdc, TRANSPARENT);
}
```

See Also
GetBkColor, **GetBkMode**, **SetBkColor**

OPAQUE 2

Background is filled with the current background color before the text, hatched brush, or pen is drawn. This is the default background mode.

OPAQUE 2

TRANSPARENT 1

Background is not changed before drawing.

TRANSPARENT 1

SetBoundsRect (3.1)

UINT SetBoundsRect(*hdc, lprcBounds, flags***)**

```
HDC hdc;                        /* handle of device context          */
const RECT FAR* lprcBounds;     /* address of structure for rectangle */
UINT flags;                     /* specifies information to return   */
```

The **SetBoundsRect** function controls the accumulation of bounding-rectangle information for the specified device context.

Parameter	Description
hdc	Identifies the device context to accumulate bounding rectangles for.
lprcBounds	Points to a **RECT** structure that is used to set the bounding rectangle. Rectangle dimensions are given in logical coordinates. This parameter can be NULL.
flags	Specifies how the new rectangle will be combined with the accumulated rectangle. This parameter may be a combination of the following values:

Value	Meaning
DCB_ACCUMULATE	Add the rectangle specified by the *lprcBounds* parameter to the bounding rectangle (using a rectangle union operation).
DCB_DISABLE	Turn off bounds accumulation.
DCB_ENABLE	Turn on bounds accumulation. (The default setting for bounds accumulation is disabled.)

Returns

The return value is the current state of the bounding rectangle, if the function is successful. Like the *flags* parameter, the return value can be a combination of DCB_ values, as shown in the following list:

Value	Meaning
DCB_ACCUMULATE	The bounding rectangle is not empty. (This value will always be set.)
DCB_DISABLE	Bounds accumulation is off.
DCB_ENABLE	Bounds accumulation is on.

Comments

Windows can maintain a bounding rectangle for all drawing operations. This rectangle can be queried and reset by the application. The drawing bounds are useful for invalidating bitmap caches.

See Also

GetBoundsRect

Changes

SetBrushOrg (2.x)

DWORD SetBrushOrg(*hdc, nXOrg, nYOrg***)**

HDC *hdc;* /* handle of device context */
int *nXOrg;* /* x-coordinate of new origin */
int *nYOrg;* /* y-coordinate of new origin */

The **SetBrushOrg** function specifies the origin that **GDI** will assign to the next brush an application selects into the specified device context.

Parameter	Description
hdc	Identifies the device context.
nXOrg	Specifies the x-coordinate, in device units, of the new origin. This value must be in the range 0 through 7.
nYOrg	Specifies the y-coordinate, in device units, of the new origin. This value must be in the range 0 through 7.

Returns
The return value is the coordinates, in device units, of the previous origin, if the function is successful. The low-order word contains the x-coordinate; the high-order word contains the y-coordinate.

Comments
The default coordinates for the brush origin are (0, 0).

To alter the origin of a brush, an application should call the **UnrealizeObject** function, specifying the handle of the brush for which the origin will be set; call **SetBrushOrg**; and then call the **SelectObject** function to select the brush into the device context.

The **SetBrushOrg** function should not be used with stock objects.

Example
The following example uses the **SetBrushOrg** function to shift the brush origin vertically by 5 pixels:

```
HBRUSH hbr, hbrOld;
SetBkMode(hdc, TRANSPARENT);
hbr = CreateHatchBrush(HS_CROSS, RGB(0, 0, 0));

UnrealizeObject(hbr);
SetBrushOrg(hdc, 0, 0);
hbrOld = SelectObject(hdc, hbr);

Rectangle(hdc, 0, 0, 200, 200);

hbr = SelectObject(hdc, hbrOld);              /* deselects hbr */
UnrealizeObject(hbr);  /* resets origin next time hbr selected */
SetBrushOrg(hdc, 3, 5);
hbrOld = SelectObject(hdc, hbr);          /* selects hbr again */

Rectangle(hdc, 0, 0, 200, 200);

SelectObject(hdc, hbrOld);
DeleteObject(hbr);
```

See Also
GetBrushOrg, **SelectObject**, **UnrealizeObject**, **HIWORD**, **LOWORD**

Corrections

The function purpose statement was incorrect. **SetBrushOrg** does not alter the origin of the current brush in a device context; instead, it sets the origin for the next brush to be selected into the device context. The original purpose statement read as follows: "The SetBrushOrg function sets the origin of the current brush for the specified device context."

SetDIBits (3.0)

int SetDIBits(*hdc, hbmp, uStartScan, cScanLines, lpvBits, lpbmi, fuColorUse***)**

```
HDC hdc;                        /* handle of device context              */
HBITMAP hbmp;                   /* handle of bitmap                      */
UINT uStartScan;                /* starting scan line                    */
UINT cScanLines;                /* number of scan lines                  */
const void FAR* lpvBits;        /* address of array with bitmap bits     */
BITMAPINFO FAR* lpbmi;          /* address of structure with bitmap data */
UINT fuColorUse;                /* type of color indices to use          */
```

The **SetDIBits** function sets the bits of a bitmap to the values given in a device-independent bitmap (DIB) specification.

Parameter	Description
hdc	Identifies the device context.
hbmp	Identifies the bitmap to set the data in.
uStartScan	Specifies the zero-based scan number of the first scan line in the buffer pointed to by the *lpvBits* parameter.
cScanLines	Specifies the number of scan lines in the *lpvBits* buffer to copy into the bitmap identified by the *hbmp* parameter.
lpvBits	Points to the device-independent bitmap bits that are stored as an array of bytes. The format of the bitmap values depends on the **biBitCount** member of the **BITMAPINFOHEADER** structure, which is the first member of the **BITMAPINFO** structure pointed to by the *lpbmi* parameter.
lpbmi	Points to a **BITMAPINFO** structure that contains information about the device-independent bitmap.
fuColorUse	Specifies whether the **bmiColors** member of the **BITMAPINFO** structure contains explicit **RGB** values or indices into the currently realized logical palette. This parameter must be one of the following values:

Value	Meaning
DIB_PAL_COLORS	The color table consists of an array of 16-bit indices into the palette of the device context identified by the *hdc* parameter.
DIB_RGB_COLORS	The color table contains literal **RGB** values.

Returns

The return value is the number of scan lines copied, if the function is successful. Otherwise, it is zero.

Comments

The bitmap identified by the *hbmp* parameter must not be selected into a device context when the application calls this function.

To reduce the amount of memory required to set bits from a large device-independent bitmap on a device surface, an application can band the output by repeatedly calling the **SetDIBitsToDevice** function, placing a different portion of the entire bitmap into the *lpvBits* buffer each time. The values of the *uStartScan* and *cScanLines* parameters identify the portion of the entire bitmap that is contained in the *lpvBits* buffer.

The origin of a device-independent bitmap is the bottom-left corner of the bitmap, not the top-left corner, which is the origin when the mapping mode is MM_TEXT. **GDI** performs the necessary transformation to display the image correctly.

See Also

SetDIBitsToDevice, **BITMAPCOREINFO**, **BITMAPINFO**, **BITMAPINFOHEADER**

SetDIBitsToDevice (3.0)

int SetDIBitsToDevice(*hdc, XDest, YDest, cx, cy, XSrc, YSrc, uStartScan, cScanLines, lpvBits, lpbmi, fuColorUse***)**

```
HDC hdc;                    /* handle of device context                */
int XDest;                  /* x-coordinate origin of destination rect */
int YDest;                  /* y-coordinate origin of destination rect */
int cx;                     /* rectangle width                         */
int cy;                     /* rectangle height                        */
int XSrc;                   /* x-coordinate origin of source rect      */
int YSrc;                   /* y-coordinate origin of source rect      */
UINT uStartScan;            /* number of first scan line in array      */
UINT cScanLines;            /* number of scan lines                    */
void FAR* lpvBits;          /* address of array with DIB bits          */
BITMAPINFO FAR* lpbmi;      /* address of structure with bitmap info   */
UINT fuColorUse;            /* RGB or palette indices                  */
```

The **SetDIBitsToDevice** function sets bits from a device-independent bitmap (DIB) directly on a device surface. The device coordinates specified define a rectangle within the total bitmap. **SetDIBitsToDevice** sets the bits in this rectangle directly on the display surface of the output device associated with the given device context, at the specified logical coordinates.

Parameter	Description
hdc	Identifies the device context.
XDest	Specifies the logical x-coordinate of the origin of the destination rectangle.
YDest	Specifies the logical y-coordinate of the origin of the destination rectangle.
cx	Specifies the x-extent, in device units, of the rectangle in the bitmap.
cy	Specifies the y-extent, in device units, of the rectangle in the bitmap.
XSrc	Specifies the x-coordinate, in device units, of the source rectangle in the bitmap.
YSrc	Specifies the y-coordinate, in device units, of the source rectangle in the bitmap.
uStartScan	Specifies the scan-line number of the device-independent bitmap that is contained in the first scan line of the buffer pointed to by the *lpvBits* parameter.
cScanLines	Specifies the number of scan lines in the *lpvBits* buffer to copy to the device.
lpvBits	Points to the DIB bits that are stored as an array of bytes.
lpbmi	Points to a **BITMAPINFO** structure that contains information about the bitmap.
fuColorUse	Specifies whether the **bmiColors** member of the *lpbmi* parameter contains explicit **RGB** values or indices into the currently realized logical palette. This parameter must be one of the following values:

Value	Meaning
DIB_PAL_COLORS	The color table consists of an array of 16-bit indices into the currently realized logical palette.
DIB_RGB_COLORS	The color table contains literal **RGB** values.

Returns

The return value is the number of scan lines set, if the function is successful.

Comments

The origin of a device-independent bitmap is the bottom-left corner of the bitmap, not the top-left corner, which is the origin when the mapping mode is MM_TEXT. **GDI** performs the necessary transformation to display the image correctly.

To reduce the amount of memory required to set bits from a large device-independent bitmap on a device surface, an application can band the output by repeatedly calling **SetDIBitsToDevice**, placing a

different portion of the entire bitmap into the *lpvBits* buffer each time. The values of the *uStartScan* and *cScanLines* parameters identify the portion of the entire bitmap that is contained in the *lpvBits* buffer.

See Also
SetDIBits, **BITMAPCOREINFO**, **BITMAPINFO**

SetMapMode (2.x)

int SetMapMode(*hdc, fnMapMode***)**

HDC *hdc;* /* handle of device context */
int *fnMapMode;* /* mapping mode to set */

The **SetMapMode** function sets the mapping mode of the given device context. The mapping mode defines the unit of measure used to convert logical units to device units; it also defines the orientation of the device's x- and y-axes. **GDI** uses the mapping mode to convert logical coordinates into the appropriate device coordinates.

Parameter	Description
hdc	Identifies the device context.
fnMapMode	Specifies the new mapping mode. This parameter can be any one of the following values:

Value	Meaning
MM_ANISOTROPIC	Logical units are converted to arbitrary units with arbitrarily scaled axes. Setting the mapping mode to MM_ANISOTROPIC does not change the current window or viewport settings. To change the units, orientation, and scaling, an application should use the **SetWindowExt** and **SetViewportExt** functions.
MM_HIENGLISH	Each logical unit is converted to 0.001 inch. Positive x is to the right; positive y is up.
MM_HIMETRIC	Each logical unit is converted to 0.01 millimeter. Positive x is to the right; positive y is up.
MM_ISOTROPIC	Logical units are converted to arbitrary units with equally scaled axes; that is, one unit along the x-axis is equal to one unit along the y-axis. The **SetWindowExt** and **SetViewportExt** functions must be used to specify the desired units and the orientation of the axes. **GDI** makes adjustments as necessary to ensure that the x and y units remain the same size.
MM_LOENGLISH	Each logical unit is converted to 0.01 inch. Positive x is to the right; positive y is up.
MM_LOMETRIC	Each logical unit is converted to 0.1 millimeter. Positive x is to the right; positive y is up.
MM_TEXT	Each logical unit is converted to one device pixel. Positive x is to the right; positive y is down.
MM_TWIPS	Each logical unit is converted to 1/20 of a point. (Because a point is 1/72 inch, a twip is 1/1440 inch). Positive x is to the right; positive y is up.

Returns

The return value is the previous mapping mode, if the function is successful.

Comments

The MM_TEXT mode allows applications to work in device pixels, where one unit is equal to one pixel. The physical size of a pixel varies from device to device.

The MM_HIENGLISH, MM_HIMETRIC, MM_LOENGLISH, MM_LOMETRIC, and MM_TWIPS modes are useful for applications that must draw in physically meaningful units (such as inches or millimeters).

The MM_ISOTROPIC mode ensures a 1:1 aspect ratio, which is useful when it is important to preserve

the exact shape of an image.

The MM_ANISOTROPIC mode allows the x- and y-coordinates to be adjusted independently.

Example

The following example uses the **SetMapMode** function to set the mapping mode to MM_TWIPS and then uses the **CreateFont** function to create an 18-point logical font:

```
HFONT hfont, hfontOld;
int MapModePrevious, iPtSize = 18;
PSTR pszFace = "MS Serif";

MapModePrevious = SetMapMode(hdc, MM_TWIPS);
hfont = CreateFont(-iPtSize * 20, 0, 0, 0, 0, /* specify pt size    */
    0, 0, 0, 0, 0, 0, 0, pszFace);          /* and face name only */

hfontOld = SelectObject(hdc, hfont);

TextOut(hdc, 100, -500, pszFace, strlen(pszFace));
SetMapMode(hdc, MapModePrevious);
SelectObject(hdc, hfontOld);
DeleteObject(hfont);
```

See Also

GetMapMode, **SetViewportExt**, **SetWindowExt**

SetMapperFlags (2.x)

DWORD SetMapperFlags(*hdc, fdwMatch***)**

```
HDC hdc;          /* handle of device context */
DWORD fdwMatch;   /* mapper flag              */
```

The **SetMapperFlags** function changes the method used by the font mapper when it converts a logical font to a physical font. An application can use **SetMapperFlags** to cause the font mapper to attempt to choose only a physical font that exactly matches the aspect ratio of the specified device.

Parameter	Description
hdc	Identifies a device context.
fdwMatch	Specifies whether the font mapper attempts to match a font's aspect height and width to the device. When this value is ASPECT_FILTERING, the mapper selects only fonts whose x-aspect and y-aspect exactly match those of the specified device, and the remaining bits are ignored.

Returns

The return value is the previous value of the font-mapper flag, if the function is successful.

Comments

An application that uses only raster fonts can use the **SetMapperFlags** function to ensure that the font selected by the font mapper is attractive and readable on the specified device. Applications that use scalable (TrueType) fonts typically do not use **SetMapperFlags**.

If no physical font has an aspect ratio that matches the specifications in the logical font, **GDI** chooses a new aspect ratio and selects a font that matches this new aspect ratio.

SetMetaFileBits (2.x)

HGLOBAL SetMetaFileBits(*hmf***)**

HMETAFILE *hmf;* /* handle of metafile */

The **SetMetaFileBits** function creates a memory metafile from the data in the given global memory object.

Parameter	Description
hmf	Identifies the global memory object that contains the metafile data. The object must have been created by a previous call to the **GetMetaFileBits** function. Note that this global handle must be cast to an HMETAFILE type to avoid compiler warnings.

Returns

The return value is the handle of a memory metafile, if the function is successful. Otherwise, it is NULL.

Comments

After the **SetMetaFileBits** function returns, the metafile handle it returns must be used instead of the *hmf* handle to refer to the metafile. If **SetMetaFileBits** is successful, the application should not use or free the memory handle specified by the *hmf* parameter, because that handle is reused by Windows.

When the application no longer needs the metafile handle, it should free the handle by calling the **DeleteMetaFile** function.

See Also

GetMetaFileBits, **GlobalFree**, **SetMetaFileBitsBetter**

SetMetaFileBitsBetter (3.1)

HGLOBAL SetMetaFileBitsBetter(*hmf***)**

HMETAFILE *hmf;* /* handle of the metafile */

The **SetMetaFileBitsBetter** function creates a memory metafile from the data in the specified global-memory object.

Parameter	Description
hmf	Identifies the global-memory object that contains the metafile data. The object must have been created by a previous call to the **GetMetaFileBits** function. Note that this global handle must be cast to an HMETAFILE type to avoid compiler warnings.

Returns

The return value is the handle of a memory metafile, if the function is successful. Otherwise, the return value is NULL.

Comments

The global-memory handle returned by **SetMetaFileBitsBetter** is owned by **GDI**, not by the application. This enables applications that use metafiles to support object linking and embedding (OLE) to use metafiles that persist beyond the termination of the application. An OLE application should always use **SetMetaFileBitsBetter** instead of the **SetMetaFileBits** function.

After the **SetMetaFileBitsBetter** function returns, the metafile handle returned by the function should be used to refer to the metafile, instead of the handle identified by the *hmf* parameter.

See Also

GetMetaFileBits, **SetMetaFileBits**

SetPaletteEntries (3.0)

UINT SetPaletteEntries(*hpal, iStart, cEntries, lppe***)**

```
HPALETTE hpal;                          /* handle of palette          */
UINT iStart;                            /* index of first entry to set */
UINT cEntries;                          /* number of entries to set   */
const PALETTEENTRY FAR* lppe;           /* address of array of structures */
```

The **SetPaletteEntries** function sets **RGB** color values and flags in a range of entries in the given logical palette.

Parameter	Description
hpal	Identifies the logical palette.
iStart	Specifies the first logical-palette entry to be set.
cEntries	Specifies the number of logical-palette entries to be set.
lppe	Points to the first member of an array of **PALETTEENTRY** structures containing the **RGB** values and flags.

Returns

The return value is the number of entries set in the logical palette, if the function is successful. Otherwise, it is zero.

Comments

If the logical palette is selected into a device context when the application calls the **SetPaletteEntries** function, the changes will not take effect until the application calls the **RealizePalette** function.

See Also

RealizePalette, **PALETTEENTRY**

SetPixel (2.x)

COLORREF SetPixel(*hdc, nXPos, nYPos, clrref***)**

```
HDC hdc;          /* handle of device context    */
int nXPos;        /* x-coordinate of pixel to set */
int nYPos;        /* y-coordinate of pixel to set */
COLORREF clrref;  /* color of set pixel          */
```

The **SetPixel** function sets the pixel at the specified coordinates to the closest approximation of the given color. The point must be in the clipping region; if it is not, the function does nothing.

Parameter	Description
hdc	Identifies the device context.
nXPos	Specifies the logical x-coordinate of the point to be set.
nYPos	Specifies the logical y-coordinate of the point to be set.
clrref	Specifies the color to be used to paint the point.

Returns

The return value is the **RGB** value for the color the point is painted, if the function is successful. This value can be different from the specified value if an approximation of that color is used. The return value is -1 if the function fails (if the point is outside the clipping region).

Comments

Not all devices support the **SetPixel** function. To discover whether a device supports raster operations, an application can call the **GetDeviceCaps** function using the RC_BITBLT index.

See Also

GetDeviceCaps, **GetPixel**

SetPolyFillMode (2.x)

int SetPolyFillMode(*hdc, fnMode***)**

HDC *hdc;* /* handle of device context */
int *fnMode;* /* polygon-filling mode */

The **SetPolyFillMode** function sets the specified polygon-filling mode.

Parameter	Description
hdc	Identifies the device context.
fnMode	Specifies the new filling mode. This value may be either ALTERNATE or WINDING. The default mode is ALTERNATE.

Returns

The return value specifies the previous filling mode, if the function is successful. Otherwise, it is zero.

Comments

When the polygon-filling mode is ALTERNATE, the system fills the area between odd-numbered and even-numbered polygon sides on each scan line. That is, the system fills the area between the first and second side, between the third and fourth side, and so on.

When the polygon-filling mode is WINDING, the system uses the direction in which a figure was drawn to determine whether to fill an area. Each line segment in a polygon is drawn in either a clockwise or a counterclockwise direction. Whenever an imaginary line drawn from an enclosed area to the outside of a figure passes through a clockwise line segment, a count is incremented (increased by one); when the line passes through a counterclockwise line segment, the count is decremented (decreased by one). The area is filled if the count is nonzero when the line reaches the outside of the figure.

Example

The following example uses winding mode to draw the same figure twice. The figure is a rectangle that completely encloses a triangle. The first time the figure is drawn, both the rectangle and the triangle are drawn clockwise, and both the rectangle and the triangle are filled. The second time, the rectangle is drawn clockwise, but the triangle is drawn counterclockwise; the rectangle is filled, but the triangle is not. (If the figures had been drawn using alternate mode, the rectangle would have been filled and the triangle would not have been filled, in both cases.)

```
HBRUSH hbrGray, hbrPrevious;

/*
 * Define the points for a clockwise triangle in a clockwise
 * rectangle.
 */

POINT aPolyPoints[9] = {{  50,  60 }, { 250,  60 }, { 250, 260 },
    {  50, 260 }, {  50,  60 }, { 150,  80 },
    { 230, 240 }, {  70, 240 }, { 150,  80 }};

int aPolyCount[] = { 5, 4 };
int cValues, i;

hbrGray = GetStockObject(GRAY_BRUSH);
hbrPrevious = SelectObject(hdc, hbrGray);

cValues = sizeof(aPolyCount) / sizeof(int);

SetPolyFillMode(hdc, WINDING);     /* sets winding mode */
PolyPolygon(hdc, aPolyPoints, aPolyCount, cValues);
```

```
/* Define the triangle counter-clockwise */

aPolyPoints[6].x = 70;  aPolyPoints[6].y = 240;
aPolyPoints[7].x = 230; aPolyPoints[7].y = 240;

for (i = 0; i < sizeof(aPolyPoints) / sizeof(POINT); i++)
    aPolyPoints[i].x += 300;   /* moves figure 300 units right */

PolyPolygon(hdc, aPolyPoints, aPolyCount, cValues);

SelectObject(hdc, hbrPrevious);
```

See Also
GetPolyFillMode, **PolyPolygon**

SetRectRgn (2.x)

void SetRectRgn(*hrgn, nLeftRect, nTopRect, nRightRect, nBottomRect***)**

```
HRGN hrgn;          /* handle of region                          */
int nLeftRect;      /* x-coordinate top-left corner of rectangle */
int nTopRect;       /* y-coordinate top-left corner of rectangle */
int nRightRect;     /* x-coordinate bottom-right corner of rectangle */
int nBottomRect;    /* y-coordinate bottom-right corner of rectangle */
```

The **SetRectRgn** function changes the given region into a rectangular region with the specified coordinates.

Parameter	Description
hrgn	Identifies the region.
nLeftRect	Specifies the x-coordinate of the upper-left corner of the rectangular region.
nTopRect	Specifies the y-coordinate of the upper-left corner of the rectangular region.
nRightRect	Specifies the x-coordinate of the lower-right corner of the rectangular region.
nBottomRect	Specifies the y-coordinate of the lower-right corner of the rectangular region.

Returns
This function does not return a value.

Comments
Applications can use this function instead of the **CreateRectRgn** function to avoid allocating more memory from the **GDI** heap. Because the memory allocated for the *hrgn* parameter is reused, no new allocation is performed.

Example
The following example uses the **CreateRectRgn** function to create a rectangular region and then calls the **SetRectRgn** function to change the region coordinates:

```
HRGN hrgn;

hrgn = CreateRectRgn(10, 10, 30, 30);
PaintRgn(hdc, hrgn);

SetRectRgn(hrgn, 50, 50, 150, 200);
PaintRgn(hdc, hrgn);

DeleteObject(hrgn);
```

See Also
CreateRectRgn

SetROP2 (2.x)

int SetROP2(*hdc, fnDrawMode***)**

HDC *hdc;* /* handle of device context */
int *fnDrawMode;* /* new drawing mode */

The **SetROP2** function sets the current drawing mode. The drawing mode specifies how the colors of the pen and the interior of filled objects are combined with the color already on the screen surface.

Parameter	Description
hdc	Identifies the device context.
fnDrawMode	Specifies the new drawing mode. This parameter can be one of the following values:

Value	Meaning
R2_BLACK	Pixel is always black.
R2_WHITE	Pixel is always white.
R2_NOP	Pixel remains unchanged.
R2_NOT	Pixel is the inverse of the screen color.
R2_COPYPEN	Pixel is the pen color.
R2_NOTCOPYPEN	Pixel is the inverse of the pen color.
R2_MERGEPENNOT	Pixel is a combination of the pen color and the inverse of the screen color (final pixel = (~screen pixel) | pen).
R2_MASKPENNOT	Pixel is a combination of the colors common to both the pen and the inverse of the screen (final pixel = (~screen pixel) & pen).
R2_MERGENOTPEN	Pixel is a combination of the screen color and the inverse of the pen color (final pixel = (~pen) | screen pixel).
R2_MASKNOTPEN	Pixel is a combination of the colors common to both the screen and the inverse of the pen (final pixel = (~pen) & screen pixel).
R2_MERGEPEN	Pixel is a combination of the pen color and the screen color (final pixel = pen | screen pixel).
R2_NOTMERGEPEN	Pixel is the inverse of the R2_MERGEPEN color (final pixel = ~(pen | screen pixel)).
R2_MASKPEN	Pixel is a combination of the colors common to both the pen and the screen (final pixel = pen & screen pixel).
R2_NOTMASKPEN	Pixel is the inverse of the R2_MASKPEN color (final pixel = ~(pen & screen pixel)).
R2_XORPEN	Pixel is a combination of the colors that are in the pen and in the screen, but not in both (final pixel = pen ^ screen pixel).
R2_NOTXORPEN	Pixel is the inverse of the R2_XORPEN color (final pixel = ~(pen ^ screen pixel)).

Returns

The return value specifies the previous drawing mode, if the function is successful.

Comments

The drawing mode is for raster devices only; it does not apply to vector devices.

Drawing modes are binary raster-operation codes representing all possible Boolean combinations of two variables. These values are created by using the binary operations AND, OR, and XOR (exclusive OR) and the unary operation NOT.

See Also
GetDeviceCaps, **GetROP2**

SetStretchBltMode (2.x)

int SetStretchBltMode(*hdc, fnStretchMode***)**

HDC *hdc;* /* handle of device context */
int *fnStretchMode;* /* bitmap-stretching mode */

The **SetStretchBltMode** function sets the bitmap-stretching mode. The bitmap-stretching mode defines how information is removed from bitmaps that are compressed by using the **StretchBlt** function.

Parameter	Description
hdc	Identifies the device context.
fnStretchMode	Specifies the new bitmap-stretching mode. This parameter can be one of the following values:

Value	Meaning
STRETCH_ANDSCANS	Uses the AND operator to combine eliminated lines with the remaining lines. This mode preserves black pixels at the expense of colored or white pixels. It is the default mode.
STRETCH_DELETESCANS	Deletes the eliminated lines. Information in the eliminated lines is not preserved.
STRETCH_ORSCANS	Uses the OR operator to combine eliminated lines with the remaining lines. This mode preserves colored or white pixels at the expense of black pixels.

Returns
The return value is the previous stretching mode, if the function is successful. It can be **STRETCH_ANDSCANS**, **STRETCH_DELETESCANS**, or STRETCH_ORSCANS.

Comments
The **STRETCH_ANDSCANS** and **STRETCH_ORSCANS** modes are typically used to preserve foreground pixels in monochrome bitmaps. The **STRETCH_DELETESCANS** mode is typically used to preserve color in color bitmaps.

See Also
GetStretchBltMode, **StretchBlt**, **StretchDIBits**

STRETCH_ANDSCANS 1

Uses the AND operator to combine eliminated lines with the remaining lines. This mode preserves black pixels at the expense of colored or white pixels. It is the default mode.

STRETCH_DELETESCANS 3

Deletes the eliminated lines. Information in the eliminated lines is not preserved.

STRETCH_ORSCANS 2

Uses the OR operator to combine eliminated lines with the remaining lines. This mode preserves colored or white pixels at the expense of black pixels.

STRETCH_ORSCANS 2

SetSystemPaletteUse (3.0)

UINT SetSystemPaletteUse(*hdc, fuStatic***)**

HDC *hdc;* /* handle of device context */
UINT *fuStatic;* /* system-palette contents */

The **SetSystemPaletteUse** function sets the use of static colors in the system palette. The default system palette contains 20 static colors, which are not changed when an application realizes its logical palette. An application can use **SetSystemPaletteUse** to change this to two static colors (black and white).

Parameter	Description
hdc	Identifies the device context. This device context must support color palettes.
fuStatic	Specifies the new use of the system palette. This parameter can be either of the following values:

Value	Meaning
SYSPAL_NOSTATIC	System palette contains no static colors except black and white.
SYSPAL_STATIC	System palette contains static colors that will not change when an application realizes its logical palette.

Returns

The return value is the previous setting for the static colors in the system palette, if the function is successful. This setting is either **SYSPAL_NOSTATIC** or SYSPAL_STATIC.

Comments

An application must call this function only when its window is maximized and has the input focus.

If an application calls **SetSystemPaletteUse** with *fuStatic* set to **SYSPAL_NOSTATIC**, Windows continues to set aside two entries in the system palette for pure white and pure black, respectively.

After calling this function with *fuStatic* set to **SYSPAL_NOSTATIC**, an application must follow these steps:

1 Call the **UnrealizeObject** function to force the graphics device interface (**GDI**) to remap the logical palette completely when it is realized.

2 Realize the logical palette.

3 Call the **GetSysColor** function to save the current system-color settings.

4 Call the **SetSysColors** function to set the system colors to reasonable values using black and white. For example, adjacent or overlapping items (such as window frames and borders) should be set to black and white, respectively.

5 Send the **WM_SYSCOLORCHANGE** message to other top-level windows to allow them to be redrawn with the new system colors.

When the application's window loses focus or closes, the application must perform the following steps:

1 Call **SetSystemPaletteUse** with the *fuStatic* parameter set to SYSPAL_STATIC.

2 Call **UnrealizeObject** to force **GDI** to remap the logical palette completely when it is realized.

3 Realize the logical palette.

4 Restore the system colors to their previous values.

5 Send the **WM_SYSCOLORCHANGE** message.

See Also

GetSysColor, **SetSysColors**, **SetSystemPaletteUse**, **UnrealizeObject**

SetTextAlign (2.x)

UINT SetTextAlign(*hdc, fuAlign***)**

```
HDC hdc;        /* handle of device context */
UINT fuAlign;   /* text-alignment flags     */
```

The **SetTextAlign** function sets the text-alignment flags for the given device context.

Parameter	Description
hdc	Identifies the device context.
fuAlign	Specifies text-alignment flags. The flags specify the relationship between a point and a rectangle that bounds the text. The point can be either the current position or coordinates specified by a text-output function (such as the **ExtTextOut** function). The rectangle that bounds the text is defined by the adjacent character cells in the text string. The *fuAlign* parameter can be one or more flags from the following three categories. Choose only one flag from each category. The first category affects text alignment in the x-direction:

Value	Meaning
TA_CENTER	Aligns the point with the horizontal center of the bounding rectangle.
TA_LEFT	Aligns the point with the left side of the bounding rectangle. This is the default setting.
TA_RIGHT	Aligns the point with the right side of the bounding rectangle.

The second category affects text alignment in the y-direction:

Value	Meaning
TA_BASELINE	Aligns the point with the base line of the chosen font.
TA_BOTTOM	Aligns the point with the bottom of the bounding rectangle.
TA_TOP	Aligns the point with the top of the bounding rectangle. This is the default setting.

The third category determines whether the current position is updated when text is written:

Value	Meaning
TA_NOUPDATECP	Does not update the current position after each call to a text-output function. This is the default setting.
TA_UPDATECP	Updates the current x-position after each call to a text-output function. The new position is at the right side of the bounding rectangle for the text. When this flag is set, the coordinates specified in calls to the **TextOut** function are ignored.

Returns

The return value is the previous text-alignment settings, if the function is successful. The low-order byte contains the horizontal setting; the high-order byte contains the vertical setting. Otherwise, the return value is zero.

Comments

The text-alignment flags set by **SetTextAlign** are used by the **TextOut** and **ExtTextOut** functions.

Example

The following example uses the **GetTextFace** function to retrieve the name of the current typeface, calls **SetTextAlign** so that the current position is updated when the **TextOut** function is called, and then writes some introductory text and the name of the typeface by calling **TextOut**:

```
int nFaceNameLen;
char aFaceName[80];

nFaceNameLen = GetTextFace(hdc, /* returns length of string */
    sizeof(aFaceName),       /* size of face-name buffer    */
    (LPSTR) aFaceName);      /* address of face-name buffer */

SetTextAlign(hdc,
    TA_UPDATECP);          /* updates current position       */
MoveTo(hdc, 100, 100);     /* sets current position          */
TextOut(hdc, 0, 0,         /* uses current position for text */
    "This is the current face name: ", 31);
TextOut(hdc, 0, 0, aFaceName, nFaceNameLen);
```

See Also

ExtTextOut, **GetTextAlign**, **TextOut**

SetTextCharacterExtra (2.x)

int SetTextCharacterExtra(*hdc, nExtraSpace***)**

HDC *hdc;* /* handle of device context */
int *nExtraSpace;* /* extra character spacing */

The **SetTextCharacterExtra** function sets the amount of intercharacter spacing. The graphics device interface (**GDI**) adds this spacing to each character, including break characters, when it writes a line of text to the device context.

Parameter	Description
hdc	Identifies the device context.
nExtraSpace	Specifies the amount of extra space, in logical units, to be added to each character. If the current mapping mode is not MM_TEXT, this parameter is transformed and rounded to the nearest pixel.

Returns
The return value is the previous intercharacter spacing, if the function is successful.

Comments
The default value for the amount of intercharacter spacing is zero.

See Also
GetTextCharacterExtra

SetTextColor (2.x)

COLORREF SetTextColor(*hdc, clrref***)**

HDC *hdc;* /* handle of device context */
COLORREF *clrref;* /* new color for text */

The **SetTextColor** function sets the text color to the specified color. The system uses the text color when writing text to a device context and also when converting bitmaps between color and monochrome device contexts.

Parameter	Description
hdc	Identifies the device context.
clrref	Specifies the color of the text.

Returns
The return value is the **RGB** (red-green-blue) value for the previous text color, if the function is successful.

Comments
If the device cannot represent the specified color, the system sets the text color to the nearest physical color.

The background color for a character is specified by the **SetBkColor** and **SetBkMode** functions.

Example
The following example sets the text color to red if the **GetTextColor** function determines that the current text color is black. The text color is specified by using the **RGB** macro.

```
DWORD dwColor;

dwColor = GetTextColor(hdc);
if (dwColor == RGB(0, 0, 0))     /* if current color is black */
    SetTextColor(hdc, RGB(255, 0, 0)); /* sets color to red  */
```

See Also
GetTextColor, **BitBlt**, **SetBkColor**, **SetBkMode**, **RGB**

SetTextJustification (2.x)

int SetTextJustification(*hdc, nExtraSpace, cBreakChars***)**

```
HDC hdc;          /* handle of device context                  */
int nExtraSpace;  /* space to add to string                    */
int cBreakChars;  /* number of break characters in the string  */
```

The **SetTextJustification** function adds space to the break characters in a string. An application can use the **GetTextMetrics** function to retrieve a font's break character.

Parameter	Description
hdc	Identifies the device context.
nExtraSpace	Specifies the total extra space, in logical units, to be added to the line of text. If the current mapping mode is not MM_TEXT, the value given by this parameter is converted to the current mapping mode and rounded to the nearest device unit.
cBreakChars	Specifies the number of break characters in the line.

Returns

The return value is 1 if the function is successful. Otherwise, it is zero.

Comments

After the **SetTextJustification** function is called, a call to a text-output function (for example, **TextOut**) distributes the specified extra space evenly among the specified number of break characters. The break character is usually the space character (ASCII 32), but it may be defined by a font as some other character.

The **GetTextExtent** function is typically used with **SetTextJustification**. The **GetTextExtent** function computes the width of a given line before alignment. An application can determine how much space to specify in the *nExtraSpace* parameter by subtracting the value returned by **GetTextExtent** from the width of the string after alignment.

The **SetTextJustification** function can be used to align a line that contains multiple runs in different fonts. In this case, the line must be created piecemeal by aligning and writing each run separately.

Because rounding errors can occur during alignment, the system keeps a running error term that defines the current error. When aligning a line that contains multiple runs, **GetTextExtent** automatically uses this error term when it computes the extent of the next run, allowing the text-output function to blend the error into the new run. After each line has been aligned, this error term must be cleared to prevent it from being incorporated into the next line. The term can be cleared by calling **SetTextJustification** with the *nExtraSpace* parameter set to zero.

Example

The following example writes two lines of text inside a box; one of the lines is aligned, and the other is not. The **GetTextExtent** function determines the width of the unaligned string. The **GetTextMetrics** function determines the break character that is used by the current font; this information is then used to determine how many break characters the string contains. The **SetTextJustification** function specifies the total amount of extra space and the number of break characters to distribute it among. After writing a line of aligned text, **SetTextJustification** is called again, to set the error term to zero.

```
POINT aPoints[5];
int iLMargin = 10, iRMargin = 10, iBoxWidth;
int cchString;
LPSTR lpszJustified = "Text to be justified in this test.";
DWORD dwExtent;
WORD wTextWidth;
TEXTMETRIC tm;
int j, cBreakChars;
```

```
aPoints[0].x = 100; aPoints[0].y =  50;
aPoints[1].x = 600; aPoints[1].y =  50;
aPoints[2].x = 600; aPoints[2].y = 200;
aPoints[3].x = 100; aPoints[3].y = 200;
aPoints[4].x = 100; aPoints[4].y =  50;

Polyline(hdc, aPoints, sizeof(aPoints) / sizeof(POINT));

TextOut(hdc, 100 + iLMargin, 100, "Unjustified text.", 17);
cchString = lstrlen(lpszJustified);
dwExtent = GetTextExtent(hdc, lpszJustified, cchString);
wTextWidth = LOWORD(dwExtent);

iBoxWidth = aPoints[1].x - aPoints[0].x;
GetTextMetrics(hdc, &tm);

for (cBreakChars = 0, j = 0; j < cchString; j++)
    if (*(lpszJustified + j) == (char) tm.tmBreakChar)
        cBreakChars++;

SetTextJustification(hdc,
    iBoxWidth - wTextWidth - (iLMargin + iRMargin),
    cBreakChars);

TextOut(hdc, 100 + iLMargin, 150, lpszJustified, cchString);

SetTextJustification(hdc, 0, 0);     /* clears error term */
```

See Also

GetMapMode, **GetTextExtent**, **GetTextMetrics**, **SetMapMode**, **TextOut**

SetViewportExt (2.x)

DWORD SetViewportExt(*hdc, nXExtent, nYExtent***)**

```
HDC hdc;        /* handle of device context */
int nXExtent;   /* x-extent of viewport     */
int nYExtent;   /* y-extent of viewport     */
```

The **SetViewportExt** function sets the x- and y-extents of the viewport of the given device context. The viewport, along with the window, defines how points are converted from logical coordinates to device coordinates.

Parameter	Description
hdc	Identifies the device context.
nXExtent	Specifies the x-extent, in device units, of the viewport.
nYExtent	Specifies the y-extent, in device units, of the viewport.

Returns

The return value is the previous viewport extents, in device units, if the function is successful. The low-order word contains the previous x-extent; the high-order word contains the previous y-extent. Otherwise, the return value is zero.

Comments

When the following mapping modes are set, calls to the **SetWindowExt** and **SetViewportExt** functions are ignored:

MM_HIENGLISH
MM_HIMETRIC
MM_LOENGLISH
MM_LOMETRIC
MM_TEXT
MM_TWIPS

When the mapping mode is MM_ISOTROPIC, an application must call the **SetWindowExt** function before calling **SetViewportExt**.

The x- and y-extents of the viewport define how much the graphics device interface (**GDI**) must stretch or compress units in the logical coordinate system to fit units in the device coordinate system. For example, if the x-extent of the window is 2 and the x-extent of the viewport is 4, GDI converts two logical units (measured from the x-axis) into four device units. Similarly, if the y-extent of the window is 2 and the y-extent of the viewport is -1, GDI converts two logical units (measured from the y-axis) into one device unit.

The extents also define the relative orientation of the x- and y-axes in both coordinate systems. If the signs of matching window and viewport extents are the same, the axes have the same orientation. If the signs are different, the orientation is reversed. For example, if the y-extent of the window is 2 and the y-extent of the viewport is -1, **GDI** converts the positive y-axis in the logical coordinate system to the negative y-axis in the device coordinate system. If the x-extents are 2 and 4, GDI converts the positive x-axis in the logical coordinate system to the positive x-axis in the device coordinate system.

Example

The following example uses the **SetMapMode**, **SetWindowExt**, and **SetViewportExt** functions to create a client area that is 10 logical units wide and 10 logical units high, and then draws a rectangle that is 4 logical units wide and 4 logical units high:

```
HDC  hdc;
RECT rc;

GetClientRect(hwnd, &rc);
```

```
hdc = GetDC(hwnd);
SetMapMode(hdc, MM_ANISOTROPIC);
SetWindowExt(hdc, 10, 10);
SetViewportExt(hdc, rc.right, rc.bottom);
Rectangle(hdc, 3, 3, 7, 7);
ReleaseDC(hwnd, hdc);
```

See Also

GetViewportExt, SetViewportExtEx, SetWindowExt

SetViewportExtEx (3.1)

BOOL SetViewportExtEx(*hdc, nX, nY, lpSize***)**

```
HDC hdc;                /* handle of device context              */
int nX;                 /* x-extent of viewport                  */
int nY;                 /* y-extent of viewport                  */
SIZE FAR* lpSize;       /* address of struct. with prev. extents */
```

The **SetViewportExtEx** function sets the x- and y-extents of the viewport of the specified device context. The viewport, along with the window, defines how points are mapped from logical coordinates to device coordinates.

Parameter	Description
hdc	Identifies the device context.
nX	Specifies the x-extent of the viewport, in device units.
nY	Specifies the y-extent of the viewport, in device units.
lpSize	Points to a **SIZE** structure. The previous extents of the viewport, in device units, are placed in this structure. If *lpSize* is NULL, nothing is returned.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

When the following mapping modes are set, calls to the **SetWindowExtEx** and **SetViewportExtEx** functions are ignored:

MM_HIENGLISH
MM_HIMETRIC
MM_LOENGLISH
MM_LOMETRIC
MM_TEXT
MM_TWIPS

When MM_ISOTROPIC mode is set, an application must call the **SetWindowExtEx** function before it calls **SetViewportExtEx**.

See Also

SetViewportExt, **SetWindowExtEx**

SetViewportOrg (2.x)

DWORD SetViewportOrg(*hdc, nXOrigin, nYOrigin***)**

HDC *hdc;* /* handle of device context */
int *nXOrigin;* /* x-coordinate of new origin */
int *nYOrigin;* /* y-coordinate of new origin */

The **SetViewportOrg** function sets the viewport origin of the specified device context. The viewport, along with the window, defines how points are converted from logical coordinates to device coordinates.

Parameter	Description
hdc	Identifies the device context.
nXOrigin	Specifies the x-coordinate, in device coordinates, of the origin of the viewport. This value must be within the range of the device coordinate system.
nYOrigin	Specifies the y-coordinate, in device coordinates, of the origin of the viewport. This value must be within the range of the device coordinate system.

Returns
The return value is the coordinates of the previous viewport origin, in device units, if the function is successful. The low-order word contains the previous x-coordinate; the high-order word contains the previous y-coordinate. Otherwise, the return value is zero.

Comments
The viewport origin is the origin of the device coordinate system. The graphics device interface (**GDI**) converts points from the logical coordinate system to device coordinates. (An application can specify the origin of the logical coordinate system by using the **SetWindowOrg** function.) GDI converts all points in the logical coordinate system to device coordinates in the same way as it converts the origin.

Example
The following example uses the **SetViewportOrg** function to set the viewport origin to the center of the client area and then draws a rectangle centered over the origin:

```
HDC  hdc;
RECT rc;

GetClientRect(hwnd, &rc);
hdc = GetDC(hwnd);
SetViewportOrg(hdc, rc.right/2, rc.bottom/2);
Rectangle(hdc, -100, -100, 100, 100);
ReleaseDC(hwnd, hdc);
```

See Also
SetViewportOrgEx, **SetWindowOrg**

SetViewportOrgEx (3.1)

BOOL SetViewportOrgEx(*hdc, nX, nY, lpPoint***)**

```
HDC hdc;                /* handle of device context          */
int nX;                 /* x-coordinate of new origin        */
int nY;                 /* y-coordinate of new origin        */
POINT FAR* lpPoint;     /* address of struct. with prev. origin */
```

The **SetViewportOrgEx** function sets the viewport origin of the specified device context. The viewport, along with the window, defines how points are mapped from logical coordinates to device coordinates.

Parameter	Description
hdc	Identifies the device context.
nX	Specifies the x-coordinate, in device units, of the origin of the viewport.
nY	Specifies the y-coordinate, in device units, of the origin of the viewport.
lpPoint	Points to a **POINT** structure. The previous origin of the viewport, in device coordinates, is placed in this structure. If *lpPoint* is NULL, nothing is returned.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also

SetViewportOrg, **SetWindowOrgEx**

SetWindowExt (2.x)

DWORD SetWindowExt(*hdc, nXExtent, nYExtent***)**

```
HDC hdc;        /* handle of device context */
int nXExtent;   /* x-extent of window       */
int nYExtent;   /* y-extent of window       */
```

The **SetWindowExt** function sets the x- and y-extents of the window associated with the given device context. The window, along with the viewport, defines how logical coordinates are converted to device coordinates.

Parameter	Description
hdc	Identifies the device context.
nXExtent	Specifies the x-extent, in logical units, of the window.
nYExtent	Specifies the y-extent, in logical units, of the window.

Returns

The return value is the window's previous extents, in logical units, if the function is successful. The low-order word contains the previous x-extent; the high-order word contains the previous y-extent. Otherwise, the return value is zero.

Comments

When the following mapping modes are set, calls to the **SetWindowExt** and **SetViewportExt** functions are ignored:

MM_HIENGLISH
MM_HIMETRIC
MM_LOENGLISH
MM_LOMETRIC
MM_TEXT
MM_TWIPS

When MM_ISOTROPIC mode is set, an application must call the **SetWindowExt** function before calling **SetViewportExt**.

The x- and y-extents of the window define how much the graphics device interface (**GDI**) must stretch or compress units in the logical coordinate system to fit units in the device coordinate system. For example, if the x-extent of the window is 2 and the x-extent of the viewport is 4, GDI converts two logical units (measured from the x-axis) into four device units. Similarly, if the y-extent of the window is 2 and the y-extent of the viewport is -1, GDI converts two logical units (measured from the y-axis) into one device unit.

The extents also define the relative orientation of the x- and y-axes in both coordinate systems. If the signs of matching window and viewport extents are the same, the axes have the same orientation. If the signs are different, the orientation is reversed. For example, if the y-extent of the window is 2 and the y-extent of the viewport is -1, **GDI** converts the positive y-axis in the logical coordinate system to the negative y-axis in the device coordinate system. If the x-extents are 2 and 4, GDI converts the positive x-axis in the logical coordinate system to the positive x-axis in the device coordinate system.

Example

The following example uses the **SetMapMode**, **SetWindowExt**, and **SetViewportExt** functions to create a client area that is 10 logical units wide and 10 logical units high and then draws a rectangle that is 4 units wide and 4 units high:

```
HDC  hdc;
RECT rc;

GetClientRect(hwnd, &rc);
```

```
hdc = GetDC(hwnd);
SetMapMode(hdc, MM_ANISOTROPIC);
SetWindowExt(hdc, 10, 10);
SetViewportExt(hdc, rc.right, rc.bottom);
Rectangle(hdc, 3, 3, 7, 7);
ReleaseDC(hwnd, hdc);
```

See Also

GetWindowExt, **SetViewportExt**, **SetWindowExtEx**

SetWindowExtEx (3.1)

BOOL SetWindowExtEx(*hdc, nX, nY, lpSize***)**

```
HDC hdc;          /* handle of device context          */
int nX;           /* x-extent of window                */
int nY;           /* y-extent of window                */
SIZE FAR* lpSize; /* address of struct. for prev. extents */
```

The **SetWindowExtEx** function sets the x- and y-extents of the window associated with the specified device context. The window, along with the viewport, defines how points are mapped from logical coordinates to device coordinates.

Parameter	Description
hdc	Identifies the device context.
nX	Specifies the x-extent, in logical units, of the window.
nY	Specifies the y-extent, in logical units, of the window.
lpSize	Points to a **SIZE** structure. The previous extents of the window (in logical units) are placed in this structure. If *lpSize* is NULL nothing is returned.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

When the following mapping modes are set, calls to the **SetWindowExtEx** and **SetViewportExt** functions are ignored:

MM_HIENGLISH
MM_HIMETRIC
MM_LOENGLISH
MM_LOMETRIC
MM_TEXT
MM_TWIPS

When MM_ISOTROPIC mode is set, an application must call the **SetWindowExtEx** function before calling **SetViewportExt**.

See Also

SetViewportExtEx, **SetWindowExt**

SetWindowOrg (2.x)

DWORD SetWindowOrg(*hdc, nXOrigin, nYOrigin***)**

```
HDC hdc;        /* handle of device context                          */
int nXOrigin;   /* x-coordinate to map to upper-left window corner   */
int nYOrigin;   /* y-coordinate to map to upper-left window corner   */
```

The **SetWindowOrg** function sets the window origin for the given device context.

Parameter	Description
hdc	Identifies the device context.
nXOrigin	Specifies the logical x-coordinate to map to the upper-left corner of the window.
nYOrigin	Specifies the logical y-coordinate to map to the upper-left corner of the window.

Returns

The return value is the coordinates of the previous window origin, in logical units, if the function is successful. The low-order word contains the x-coordinate of the previous window origin; the high-order word contains the y-coordinate. Otherwise, the return value is zero.

Comments

The window origin is the origin of the logical coordinate system for a window. By changing the window origin, an application can change the way the graphics device interface (**GDI**) converts logical coordinates to device coordinates (the viewport). GDI converts logical coordinates to the device coordinates of the viewport in the same way as it converts the origin.

To convert points to the right, an application can specify a negative value for the *nXOrigin* parameter. Similarly, to convert points down (in the MM_TEXT mapping mode), the *nYOrigin* parameter can be negative.

Example

The following example uses the **CopyMetaFile** function to copy a metafile to a specified file, plays the copied metafile, uses the **GetMetaFile** function to retrieve a handle of the copied metafile, uses the **SetWindowOrg** function to change the position at which the metafile is played 200 logical units to the right, and then plays the metafile at the new location:

```
HANDLE hmf, hmfSource, hmfOld;
LPSTR lpszFile1 = "MFTest";

hmf = CopyMetaFile(hmfSource, lpszFile1);
PlayMetaFile(hdc, hmf);
DeleteMetaFile(hmf);

hmfOld = GetMetaFile(lpszFile1);
SetWindowOrg(hdc, -200, 0);
PlayMetaFile(hdc, hmfOld);

DeleteMetaFile(hmfSource);
DeleteMetaFile(hmfOld);
```

See Also

CopyMetaFile, **GetMetaFile**, **GetWindowOrg**, **PlayMetaFile**, **SetViewportOrg**, **SetWindowOrgEx**

SetWindowOrgEx (3.1)

BOOL SetWindowOrgEx(*hdc, nX, nY, lpPoint***)**

```
HDC hdc;                    /* handle of device context          */
int nX;                     /* x-coordinate of window            */
int nY;                     /* y-coordinate of window            */
POINT FAR* lpPoint;         /* address of struct. for prev. origin */
```

The **SetWindowOrgEx** function sets the window origin of the specified device context. The window, along with the viewport, defines how points are mapped from logical coordinates to device coordinates.

Parameter	Description
hdc	Identifies the device context.
nX	Specifies the logical x-coordinate of the new origin of the window.
nY	Specifies the logical y-coordinate of the new origin of the window.
lpPoint	Points to a **POINT** structure. The previous origin of the window is placed in this structure. If *lpPoint* is NULL nothing is returned.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also

GetWindowOrg, **GetWindowOrgEx**, **SetViewportOrgEx**, **SetWindowOrg**

SpoolFile (3.1)

HANDLE SpoolFile(*lpszPrinter, lpszPort, lpszJob, lpszFile***)**

LPSTR *lpszPrinter;* /* printer name */
LPSTR *lpszPort;* /* port name */
LPSTR *lpszJob;* /* job name */
LPSTR *lpszFile;* /* file name */

The **SpoolFile** function puts a file into the spooler queue. This function is typically used by device drivers.

Parameter	Description
lpszPrinter	Points to a null-terminated string specifying the printer name--for example, "HP LasterJet IIP".
lpszPort	Points to a null-terminated string specifying the local name--for example, "LPT1:". This must be a local port.
lpszJob	Points to a null-terminated string specifying the name of the print job for the spooler. This string cannot be longer than 32 characters, including the null-terminating character.
lpszFile	Points to a null-terminated string specifying the path and filename of the file to put in the spooler queue. This file contains raw printer data.

Returns

The return value is the global handle that is passed to the spooler, if the function is successful. Otherwise, it is an error value, which can be one of the following:

SP_APPABORT
SP_ERROR
SP_NOTREPORTED
SP_OUTOFDISK
SP_OUTOFMEMORY
SP_USERABORT

Comments

Applications should ensure that the spooler is enabled before calling the **SpoolFile** function.

StartDoc (3.1)

int StartDoc(*hdc, lpdi***)**

```
HDC hdc;                    /* handle of device context        */
DOCINFO FAR* lpdi;          /* pointer to DOCINFO structure  */
```

The **StartDoc** function starts a print job. For Windows version 3.1, this function replaces the STARTDOC printer escape.

Parameter	Description
hdc	Identifies the device context for the print job.
lpdi	Points to a **DOCINFO** structure containing the name of the document file and the name of the output file.

Returns

The return value is positive if the function is successful. Otherwise, it is SP_ERROR.

Comments

Applications should call the **StartDoc** function immediately before beginning a print job. Using this function ensures that documents containing more than one page are not interspersed with other print jobs.

The **StartDoc** function should not be used inside metafiles.

See Also

EndDoc, **Escape**, **DOCINFO**

StartPage (3.1)

int StartPage(*hdc***)**

HDC *hdc;* /* handle of device context */

The **StartPage** function prepares the printer driver to accept data.

Parameter	Description
hdc	Identifies the device context for the print job.

Returns
The return value is greater than zero if the function is successful. It is less than or equal to zero if an error occurs.

Comments
The system disables the **ResetDC** function between calls to the **StartPage** and **EndPage** functions. This means that applications cannot change the device mode except at page boundaries.

See Also
EndPage, **Escape**, **ResetDC**

StretchBlt (2.x)

BOOL StretchBlt(*hdcDest, nXOriginDest, nYOriginDest, nWidthDest, nHeightDest, hdcSrc, nXOriginSrc, nYOriginSrc, nWidthSrc, nHeightSrc, fdwRop***)**

```
HDC hdcDest;        /* destination device-context handle                */
int nXOriginDest;   /* x-coordinate of origin of destination rectangle */
int nYOriginDest;   /* y-coordinate of origin of destination rectangle */
int nWidthDest;     /* width of destination rectangle                   */
int nHeightDest;    /* height of destination rectangle                  */
HDC hdcSrc;         /* source device-context handle                     */
int nXOriginSrc;    /* x-coordinate of origin of source rectangle       */
int nYOriginSrc;    /* y-coordinate of origin of source rectangle       */
int nWidthSrc;      /* width of source rectangle                        */
int nHeightSrc;     /* height of source rectangle                       */
DWORD fdwRop;       /* raster operation                                 */
```

The **StretchBlt** function copies a bitmap from a source rectangle into a destination rectangle, stretching or compressing the bitmap if necessary to fit the dimensions of the destination rectangle. The **StretchBlt** function uses the stretching mode of the destination device context (set by the **SetStretchBltMode** function) to determine how to stretch or compress the bitmap.

Parameter	Description
hdcDest	Identifies the device context to receive the bitmap.
nXOriginDest	Specifies the logical x-coordinate of the upper-left corner of the destination rectangle.
nYOriginDest	Specifies the logical y-coordinate of the upper-left corner of the destination rectangle.
nWidthDest	Specifies the width, in logical units, of the destination rectangle.
nHeightDest	Specifies the height, in logical units, of the destination rectangle.
hdcSrc	Identifies the device context that contains the source bitmap.
nXOriginSrc	Specifies the logical x-coordinate of the upper-left corner of the source rectangle.
nYOriginSrc	Specifies the logical y-coordinate of the upper-left corner of the source rectangle.
nWidthSrc	Specifies the width, in logical units, of the source rectangle.
nHeightSrc	Specifies the height, in logical units, of the source rectangle.
fdwRop	Specifies the raster operation to be performed. Raster-operation codes define how the graphics device interface (**GDI**) combines colors in output operations that involve a current brush, a possible source bitmap, and a destination bitmap. This parameter can be one of the following values:

Code	Description
BLACKNESS	Turns all output black.
DSTINVERT	Inverts the destination bitmap.
MERGECOPY	Combines the pattern and the source bitmap by using the Boolean AND operator.
MERGEPAINT	Combines the inverted source bitmap with the destination bitmap by using the Boolean OR operator.
NOTSRCCOPY	Copies the inverted source bitmap to the destination.
NOTSRCERASE	Inverts the result of combining the destination and source bitmaps by using the Boolean OR operator.
PATCOPY	Copies the pattern to the destination bitmap.
PATINVERT	Combines the destination bitmap with the pattern by using the Boolean XOR operator.
PATPAINT	Combines the inverted source bitmap with the pattern by using

	the Boolean OR operator. Combines the result of this operation with the destination bitmap by using the Boolean OR operator.
SRCAND	Combines pixels of the destination and source bitmaps by using the Boolean AND operator.
SRCCOPY	Copies the source bitmap to the destination bitmap.
SRCERASE	Inverts the destination bitmap and combines the result with the source bitmap by using the Boolean AND operator.
SRCINVERT	Combines pixels of the destination and source bitmaps by using the Boolean XOR operator.
SRCPAINT	Combines pixels of the destination and source bitmaps by using the Boolean OR operator.
WHITENESS	Turns all output white.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **StretchBlt** function stretches or compresses the source bitmap in memory and then copies the result to the destination. If a pattern is to be merged with the result, it is not merged until the stretched source bitmap is copied to the destination.

If a brush is used, it is the selected brush in the destination device context.

The destination coordinates are transformed according to the destination device context; the source coordinates are transformed according to the source device context.

If the destination, source, and pattern bitmaps do not have the same color format, **StretchBlt** converts the source and pattern bitmaps to match the destination bitmaps. The foreground and background colors of the destination device context are used in the conversion.

If **StretchBlt** must convert a monochrome bitmap to color, it sets white bits (1) to the background color and black bits (0) to the foreground color. To convert color to monochrome, it sets pixels that match the background color to white (1) and sets all other pixels to black (0). The foreground and background colors of the device context with color are used.

StretchBlt creates a mirror image of a bitmap if the signs of the *nWidthSrc* and *nWidthDest* or *nHeightSrc* and *nHeightDest* parameters differ. If *nWidthSrc* and *nWidthDest* have different signs, the function creates a mirror image of the bitmap along the x-axis. If *nHeightSrc* and *nHeightDest* have different signs, the function creates a mirror image of the bitmap along the y-axis.

Not all devices support the **StretchBlt** function. Applications can discover whether a device supports **StretchBlt** by calling the **GetDeviceCaps** function and specifying the RASTERCAPS index.

Example

The following example retrieves the handle of the desktop window and uses it to create a device context. After retrieving the dimensions of the desktop window, the example calls the **StretchBlt** function to copy the desktop bitmap into a smaller rectangle in the destination device context.

```
HWND hwndDesktop;
HDC hdcLocal;
RECT rc;

hwndDesktop = GetDesktopWindow();
hdcLocal = GetDC(hwndDesktop);
GetWindowRect(GetDesktopWindow(), &rc);

StretchBlt(hdc, 10, 10, 138, 106,
    hdcLocal, 0, 0, rc.right, rc.bottom, SRCCOPY);
```

```
ReleaseDC(hwndDesktop, hdcLocal);
```

See Also
BitBlt, **GetDeviceCaps**, **SetStretchBltMode**, **StretchDIBits**

StretchDIBits (3.0)

int StretchDIBits(*hdc, XDest, YDest, cxDest, cyDest, XSrc, YSrc, cxSrc, cySrc, lpvBits, lpbmi, fuColorUse, fdwRop***)**

```
HDC hdc;                        /* handle of device context                */
int XDest;                      /* x-coordinate of destination rectangle   */
int YDest;                      /* y-coordinate of destination rectangle   */
int cxDest;                     /* width of destination rectangle          */
int cyDest;                     /* height of destination rectangle         */
int XSrc;                       /* x-coordinate of source rectangle        */
int YSrc;                       /* y-coordinate of source rectangle        */
int cxSrc;                      /* width of source rectangle               */
int cySrc;                      /* height of source rectangle              */
const void FAR* lpvBits;        /* address of buffer with DIB bits         */
LPBITMAPINFO lpbmi;             /* address of structure with bitmap data   */
UINT fuColorUse;                /* RGB or palette indices                  */
DWORD fdwRop;                   /* raster operation                        */
```

The **StretchDIBits** function moves a device-independent bitmap (DIB) from a source rectangle into a destination rectangle, stretching or compressing the bitmap if necessary to fit the dimensions of the destination rectangle.

Parameter	Description
hdc	Identifies the destination device context for a screen surface or memory bitmap.
XDest	Specifies the logical x-coordinate of the destination rectangle.
YDest	Specifies the logical y-coordinate of the destination rectangle.
cxDest	Specifies the logical x-extent of the destination rectangle.
cyDest	Specifies the logical y-extent of the destination rectangle.
XSrc	Specifies the x-coordinate, in pixels, of the source rectangle in the DIB.
YSrc	Specifies the y-coordinate, in pixels, of the source rectangle in the DIB.
cxSrc	Specifies the width, in pixels, of the source rectangle in the DIB.
cySrc	Specifies the height, in pixels, of the source rectangle in the DIB.
lpvBits	Points to the DIB bits that are stored as an array of bytes.
lpbmi	Points to a **BITMAPINFO** structure that contains information about the DIB.
fuColorUse	Specifies whether the **bmiColors** member of the *lpbmi* parameter contains explicit **RGB** (red-green-blue) values or indices into the currently realized logical palette. The *fuColorUse* parameter can be one of the following values:

Value	Meaning
DIB_PAL_COLORS	The color table consists of an array of 16-bit indices into the currently realized logical palette.
DIB_RGB_COLORS	The color table contains literal **RGB** values.

fdwRop	Specifies the raster operation to be performed. Raster-operation codes define how the graphics device interface (**GDI**) combines colors in output operations that involve a current brush, a possible source bitmap, and a destination bitmap. For a list of raster-operation codes, see the description of the **BitBlt** function.

Returns

The return value is the number of scan lines copied, if the function is successful.

Comments

The **StretchDIBits** function uses the stretching mode of the destination device context (set by the **SetStretchBltMode** function) to determine how to stretch or compress the bitmap.

The origin of the coordinate system for a device-independent bitmap is the lower-left corner. The origin of the coordinates of the destination rectangle depends on the current mapping mode of the device context.

StretchDIBits creates a mirror image of a bitmap if the signs of the *cxSrc* and *cxDest* parameters or the *cySrc* and *cyDest* parameters differ. If *cxSrc* and *cxDest* have different signs, the function creates a mirror image of the bitmap along the x-axis. If *cySrc* and *cyDest* have different signs, the function creates a mirror image of the bitmap along the y-axis.

See Also
SetMapMode, **SetStretchBltMode**, **BITMAPINFO**

TextOut (2.x)

BOOL TextOut(*hdc, nXStart, nYStart, lpszString, cbString***)**

```
HDC hdc;            /* handle of device context          */
int nXStart;        /* x-coordinate of starting position */
int nYStart;        /* y-coordinate of starting position */
LPCSTR lpszString;  /* address of string                 */
int cbString;       /* number of bytes in string         */
```

The **TextOut** function writes a character string at the specified location, using the currently selected font.

Parameter	Description
hdc	Identifies the device context.
nXStart	Specifies the logical x-coordinate of the starting point of the string.
nYStart	Specifies the logical y-coordinate of the starting point of the string.
lpszString	Points to the character string to be drawn.
cbString	Specifies the number of bytes in the string.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

Character origins are at the upper-left corner of the character cell.

By default, the **TextOut** function does not use or update the current position. If an application must update the current position when calling **TextOut**, it can call the **SetTextAlign** function with the *wFlags* parameter set to TA_UPDATECP. When this flag is set, Windows ignores the *nXStart* and *nYStart* parameters on subsequent calls to the **TextOut** function, using the current position instead.

Example

The following example uses the **GetTextFace** function to retrieve the face name of the current font, calls **SetTextAlign** so that the current position is updated when the **TextOut** function is called, and then writes some introductory text and the face name by calling **TextOut**:

```
int nFaceNameLen;
char aFaceName[80];

nFaceNameLen = GetTextFace(hdc, /* returns length of string */
    sizeof(aFaceName),       /* size of face-name buffer    */
    (LPSTR) aFaceName);      /* address of face-name buffer */

SetTextAlign(hdc,
    TA_UPDATECP);          /* updates current position       */
MoveTo(hdc, 100, 100);     /* sets current position          */
TextOut(hdc, 0, 0,         /* uses current position for text */
    "This is the current face name: ", 31);
TextOut(hdc, 0, 0, aFaceName, nFaceNameLen);
```

See Also

ExtTextOut, **GetTextExtent**, **SetTextAlign**, **SetTextColor**, **TabbedTextOut**

UnrealizeObject (2.x)

BOOL UnrealizeObject(*hgdiobj***)**

HGDIOBJ *hgdiobj;* /* handle of brush or palette */

The **UnrealizeObject** function resets the origin of a brush or resets a logical palette. If the *hgdiobj* parameter identifies a brush, **UnrealizeObject** directs the system to reset the origin of the brush the next time it is selected. If the *hgdiobj* parameter identifies a logical palette, **UnrealizeObject** directs the system to realize the palette as though it had not previously been realized. The next time the application calls the **RealizePalette** function for the specified palette, the system completely remaps the logical palette to the system palette.

Parameter	Description
hgdiobj	Identifies the object to be reset.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The **UnrealizeObject** function should not be used with stock objects.

The **UnrealizeObject** function must be called whenever a new brush origin is set (by using the **SetBrushOrg** function).

A brush identified by the *hgdiobj* parameter must not be the currently selected brush of any device context.

A palette identified by *hgdiobj* can be the currently selected palette of a device context.

Example
The following example uses the **SetBrushOrg** function to set the origin coordinates of the current brush to (3,5), uses the **SelectObject** function to remove that brush from the device context, uses the **UnrealizeObject** function to force the system to reset the origin of the specified brush, and then calls **SelectObject** again to select the brush into the device context with the new brush origin:

```
HBRUSH hbr, hbrOld;
SetBkMode(hdc, TRANSPARENT);
hbr = CreateHatchBrush(HS_CROSS, RGB(0, 0, 0));

UnrealizeObject(hbr);
SetBrushOrg(hdc, 0, 0);
hbrOld = SelectObject(hdc, hbr);

Rectangle(hdc, 0, 0, 200, 200);

hbr = SelectObject(hdc, hbrOld);              /* deselects hbr */
UnrealizeObject(hbr);  /* resets origin next time hbr selected */
SetBrushOrg(hdc, 3, 5);
hbrOld = SelectObject(hdc, hbr);          /* selects hbr again */

Rectangle(hdc, 0, 0, 200, 200);

SelectObject(hdc, hbrOld);
DeleteObject(hbr);
```

See Also
RealizePalette, **SelectObject**, **SetBrushOrg**

UpdateColors (3.0)

int UpdateColors(*hdc***)**

HDC *hdc;* /* handle of device context */

The **UpdateColors** function updates the client area of the given device context by matching the current colors in the client area, pixel by pixel, to the system palette. An inactive window with a realized logical palette may call **UpdateColors** as an alternative to redrawing its client area when the system palette changes.

Parameter	Description
hdc	Identifies the device context.

Returns

The return value is not used.

Comments

Using **UpdateColors** to update a client area is typically faster than redrawing the area. However, because **UpdateColors** performs the color translation based on the color of each pixel before the system palette changed, each call to this function results in the loss of some color accuracy.

GDI functions (3.1)

AbortDoc	Terminates a print job
AddFontResource	Adds a font to the font table
AnimatePalette	Replaces entries in a logical palette
Arc	Draws an arc
BitBlt	Copies a bitmap between device contexts
Chord	Draws a chord
CloseMetaFile	Closes a metafile DC and gets the handle
CombineRgn	Creates a region by combining two regions
CopyMetaFile	Copies a metafile
CreateBitmap	Creates a device-dependent memory bitmap
CreateBitmapIndirect	Creates a bitmap using **BITMAP** structure
CreateBrushIndirect	Creates a brush with the specified attributes
CreateCompatibleBitmap	Creates a bitmap compatible with the DC
CreateCompatibleDC	Creates a DC compatible with the specified DC
CreateDC	Creates a device context
CreateDIBitmap	Creates bitmap handle from DIB specification
CreateDIBPatternBrush	Creates a pattern brush from a DIB
CreateDiscardableBitmap	Creates discardable bitmap
CreateEllipticRgn	Creates an elliptical region
CreateEllipticRgnIndirect	Creates an elliptical region
CreateFont	Creates a logical font
CreateFontIndirect	Creates a font using a **LOGFONT** structure
CreateHatchBrush	Creates a hatched brush
CreateIC	Creates an information context
CreateMetaFile	Creates a metafile device context
CreatePalette	Creates a logical color palette
CreatePatternBrush	Creates a pattern brush from a bitmap
CreatePen	Creates a pen
CreatePenIndirect	Creates a pen using a **LOGPEN** structure
CreatePolygonRgn	Creates a polygonal region
CreatePolyPolygonRgn	Creates a region consisting of polygons
CreateRectRgn	Creates a rectangular region
CreateRectRgnIndirect	Creates a region using a **RECT** structure
CreateRoundRectRgn	Creates a rectangular region with round corners
CreateScalableFontResource	Creates a resource file with font info
CreateSolidBrush	Creates a solid brush with a specified color
DeleteDC	Deletes a device context
DeleteMetaFile	Invalidates a metafile handle
DeleteObject	Deletes an object from memory
DeviceCapabilities	Retrieves the capabilities of a device
DeviceMode	Displays a dialog box for printing modes
DPtoLP	Converts device points to logical points
Ellipse	Draws an ellipse
EndDoc	Ends a print job
EndPage	Ends a page
EnumFontFamilies	Retrieves fonts in a specified family
EnumFonts	Enumerates fonts on the specified device
EnumMetaFile	Enumerates metafile records
EnumObjects	Enumerates pens and brushes in a device context
EqualRgn	Compares two regions for equality
Escape	Allows access to capabilities device
Printer escapes	
ExcludeClipRect	Changes clipping region, excluding rectangle
ExtDeviceMode	Displays a dialog box for printing modes

ExtFloodFill	Fills an area with the current brush
ExtTextOut	Writes character string in rectangular region
FillRgn	Fills a region with the specified brush
FloodFill	Fills an area with the current brush
FrameRgn	Draws a border around a region
GetAspectRatioFilter	Retrieves setting of aspect-ratio filter
GetAspectRatioFilterEx	Retrieves setting of aspect-ratio filter
GetBitmapBits	Copies bitmap bits to a buffer
GetBitmapDimension	Retrieves the width and height of a bitmap
GetBitmapDimensionEx	Retrieves the width and height of a bitmap
GetBkColor	Retrieves the current background color
GetBkMode	Retrieves the background mode
GetBoundsRect	Returns current accumulated bounding rectangle
GetBrushOrg	Retrieves the origin of the current brush
GetBrushOrgEx	Retrieves the origin of the current brush
GetCharABCWidths	Retrieves the widths of TrueType characters
GetCharWidth	Retrieves the character widths
GetClipBox	Retrieves a rectangle for the clipping region
GetCurrentPosition	Retrieves the current position, in logical units
GetCurrentPositionEx	Retrieves the current position, in logical units
GetDCOrg	Retrieves translation origin for device context
GetDeviceCaps	Retrieves the device capabilities
GetDIBits	Copies the DIB bits into a buffer
GetFontData	Retrieves font metric data
GetGlyphOutline	Retrieves data for individual outline character
GetKerningPairs	Retrieves kerning pairs for the current font
GetMapMode	Retrieves the mapping mode
GetMetaFile	Creates a handle to a specified metafile
GetMetaFileBits	Creates a global memory object from a metafile
GetNearestColor	Retrieves the closest available color
GetNearestPaletteIndex	Retrieves the nearest match for a color
GetObject	Retrieves information about an object
GetOutlineTextMetrics	Retrieves metrics for TrueType fonts
GetPaletteEntries	Retrieves a range of palette entries
GetPixel	Retrieves **RGB** color value of specified pixel
GetPolyFillMode	Retrieves the current polygon-filling mode
GetRasterizerCaps	Retrieves status of TrueType fonts on system
GetRgnBox	Retrieves the bounding rectangle for a region
GetROP2	Retrieves the current drawing mode
GetStockObject	Retrieves handle of stock pen, brush, or font
GetStretchBltMode	Retrieves the current bitmap-stretching mode
GetSystemPaletteEntries	Retrieves entries from the system palette
GetSystemPaletteUse	Determines the use of an entire system palette
GetTextCharacterExtra	Retrieves the intercharacter spacing
GetTextAlign	Retrieves the text-alignment flags
GetTextColor	Retrieves the current text color
GetTextExtent	Determines dimensions of specified text string
GetTextExtentPoint	Retrieves dimensions of specified text string
GetTextFace	Retrieves the typeface name of the current font
GetTextMetrics	Retrieves the metrics for the current font
GetViewportExt	Retrieves the viewport extent
GetViewportExtEx	Retrieves the viewport extent
GetViewportOrg	Retrieves the viewport origin
GetViewportOrgEx	Retrieves the viewport origin
GetWindowExt	Retrieves the window extents
GetWindowExtEx	Retrieves the window extents

GetWindowOrg	Retrieves the window origin
GetWindowOrgEx	Retrieves the window origin
IntersectClipRect	Creates a clipping region from an intersection
InvertRgn	Inverts the colors in a region
IsGDIObject	Determines if a handle is not a **GDI** object
LineDDA	Computes successive points in a line
LineTo	Draws a line from the current position
LPtoDP	Converts logical points to device points
MoveTo	Moves the current position
MoveToEx	Moves the current position
OffsetClipRgn	Moves a clipping region
OffsetRgn	Moves a region by a specified offset
OffsetViewportOrg	Moves the viewport origin
OffsetViewportOrgEx	Moves the viewport origin
OffsetWindowOrg	Moves the window origin
OffsetWindowOrgEx	Moves the window origin
PaintRgn	Fills region with brush in given device context
PatBlt	Creates a bitmap pattern
Pie	Draws a pie-shaped wedge
PlayMetaFile	Plays a metafile
PlayMetaFileRecord	Plays a metafile record
Polygon	Draws a polygon
Polyline	Draws line segments to connect specified points
PolyPolygon	Draws a series of polygons
PtInRegion	Determines whether a point is in a region
PtVisible	Determines whether point is in clipping region
QueryAbort	Determines whether to terminate a print job
Rectangle	Draws a rectangle
RectInRegion	Determines whether rectangle overlaps region
RectVisible	Determines whether rectangle is in clip region
RemoveFontResource	Removes an added font resource
ResetDC	Updates a device context
ResizePalette	Changes the size of a logical palette
RestoreDC	Restores the device context
RoundRect	Draws a rectangle with rounded corners
SaveDC	Saves the current state of a device context
ScaleViewportExt	Scales the viewport extents
ScaleViewportExtEx	Scales the viewport extents
ScaleWindowExt	Scales the window extents
ScaleWindowExtEx	Scales the window extents
SelectClipRgn	Selects clipping region for device context
SelectObject	Selects an object into a device context
SetAbortProc	Sets the abort function for a print job
SetBitmapBits	Sets the bitmap bits from an array of bytes
SetBitmapDimension	Sets the width and height of a bitmap
SetBitmapDimensionEx	Sets the width and height of a bitmap
SetBkColor	Sets the current background color
SetBkMode	Sets the background mode
SetBoundsRect	Controls the bounding-rectangle accumulation
SetBrushOrg	Sets the origin of the current brush
SetDIBits	Sets the bits of a bitmap
SetDIBitsToDevice	Sets DIB bits to a device
SetMapMode	Sets the mapping mode
SetMapperFlags	Sets the font-mapper flag
SetMetaFileBits	Creates a memory object from the metafile
SetMetaFileBitsBetter	Creates a memory object from the metafile

SetPaletteEntries	Sets the colors and flags for a color palette
SetPixel	Sets a pixel to the specified color
SetPolyFillMode	Sets the polygon-filling mode
SetRectRgn	Changes a region into a specified rectangle
SetROP2	Sets the current drawing mode
SetStretchBltMode	Sets the bitmap-stretching mode
SetSystemPaletteUse	Sets the use of system-palette static colors
SetTextAlign	Sets the text-alignment flags
SetTextCharacterExtra	Sets the intercharacter spacing
SetTextColor	Sets the foreground color for text
SetTextJustification	Sets the alignment for text output
SetViewportExt	Sets the viewport extents
SetViewportExtEx	Sets the viewport extents
SetViewportOrg	Sets the viewport origin
SetViewportOrgEx	Sets the viewport origin
SetWindowExt	Sets the window extents
SetWindowExtEx	Sets the window extents
SetWindowOrg	Sets the window origin
SetWindowOrgEx	Sets the window origin
SpoolFile	Puts a file in the spooler queue
StartDoc	Starts a print job
StartPage	Prepares a printer driver to receive data
StretchBlt	Copies a bitmap, transforming it if required
StretchDIBits	Moves DIB from source to destination rectangle
TextOut	Writes character string at specified location
UnrealizeObject	Resets brush origins and realizes palettes
UpdateColors	Updates colors in the client area

DRV_CLOSE (3.1)

DRV_CLOSE

The DRV_CLOSE message is the first message sent by Windows to an installable driver after an application calls the **CloseDriver** function.

Parameter	Description
dwDriverIdentifier	Specifies the unique 32-bit identifier returned by the **OpenDriver** function.
hDriver	Identifies the instance of the installable driver that should be closed.
lParam1	Specifies driver-specific data.
lParam2	Specifies driver-specific data.

Returns

An installable driver returns nonzero if its **DriverProc** function successfully closes the driver. Otherwise, it returns zero.

Comments

The *lParam1* and *lParam2* parameters specify the same values as the *lParam1* and *lParam2* parameters for the **CloseDriver** function.

Each time a driver processes this message, it must decrement a private use-count variable. When the value of this variable is zero, Windows closes the driver.

See Also

DRV_OPEN

DRV_CONFIGURE (3.1)

DRV_CONFIGURE

The DRV_CONFIGURE message is sent to inform an installable driver that it should display its private configuration dialog box.

Parameter	Description
dwDriverIdentifier	Specifies a unique 32-bit value that identifies the installable driver.
hDriver	Identifies an instance of the installable driver.
lParam1	Specifies the handle of the parent window for the configuration dialog box. This handle is in the parameter's low-order word.
lParam2	Points to an optional **DRVCONFIGINFO** structure. An installable driver should verify that this pointer is valid before using it.

Returns

An installable driver returns nonzero if it processes this message. Otherwise, it returns zero.

Comments

An installable driver that supports the DRV_CONFIGURE message must provide its own dialog box template and dialog box procedure. It must also record the user's configuration requests in an appropriate file. (This may be the SYSTEM.INI file or some other file used by the driver for this purpose.)

See Also

DRV_QUERYCONFIGURE

DRV_DISABLE (3.1)

DRV_DISABLE

The DRV_DISABLE message is the second message sent by Windows to an installable driver after an application calls the **CloseDriver** function.

Parameter	Description
dwDriverIdentifier	Not used.
hDriver	Identifies an instance of the installable driver.
lParam1	Not used.
lParam2	Not used.

Returns

An installable driver returns zero if it processes this message.

See Also

DRV_CLOSE

DRV_ENABLE (3.1)

DRV_ENABLE

The DRV_ENABLE message is sent to an installable driver when it is loaded or reloaded or whenever Windows is reinstalled after switching to an MS-DOS application.

Parameter	Description
dwDriverIdentifier	Not used.
hDriver	Identifies an instance of the installable driver.
lParam1	Not used.
lParam2	Not used.

Returns

An installable driver returns zero if it processes this message.

Comments

When the **DriverProc** function receives this message, it should initialize all of the driver-specific structures with default values.

See Also

DRV_OPEN

DRV_EXITAPPLICATION (3.1)

DRV_EXITAPPLICATION

The DRV_EXITAPPLICATION message is sent to all installable drivers when an application exits.

Parameter	Description
dwDriverIdentifier	Specifies a unique 32-bit value that identifies the installable driver.
lParam1	Specifies the type of application exit. This parameter can be one of the following values:

Value	Meaning
DRVEA_NORMALEXIT	Set if the application terminated normally.
DRVEA_ABNORMALEXIT	Set if the application terminated abnormally (because of an application or system error).

lParam2	Not used.

Returns

The value returned by the application is ignored for this message.

See Also

DRV_EXITSESSION

DRV_EXITSESSION (3.1)

DRV_EXITSESSION

The DRV_EXITSESSION message is sent to all installable drivers when Windows prepares to exit.

Parameter	Description
dwDriverIdentifier	Specifies a unique 32-bit value that identifies the installable driver.
lParam1	Reserved.
lParam2	Reserved.

Returns

The value returned by the application is ignored for this message.

Comments

The user interface and all other drivers are still enabled when this message is sent.

See Also

DRV_EXITAPPLICATION

DRV_FREE (3.1)

DRV_FREE

The DRV_FREE message is the third message sent by Windows to an installable driver after an application calls the **CloseDriver** function.

Parameter	Description
dwDriverIdentifier	Not used.
hDriver	Identifies an instance of the installable driver.
lParam1	Not used.
lParam2	Not used.

Returns

An installable driver returns zero if it processes this message.

Comments

When an installable driver's **DriverProc** function receives this message, it should free the memory that was allocated for all driver-specific structures.

DRV_INSTALL (3.1)

DRV_INSTALL

The DRV_INSTALL message is sent to an installable driver during the driver initialization process.

Parameter	Description
dwDriverIdentifier	Specifies a unique 32-bit value that identifies the installable driver.
hDriver	Identifies an instance of the installable driver.
lParam1	Not used.
lParam2	Points to an optional **DRVCONFIGINFO** structure. An installable driver should verify that this pointer is valid before using it.

Returns

An installable driver returns nonzero if it processes this message. Otherwise, it returns zero.

Comments

When the driver receives this message, it creates an entry for the driver in the SYSTEM.INI file and performs other necessary configuration operations.

DRV_LOAD (3.1)

DRV_LOAD

The DRV_LOAD message is sent to an installable driver to notify the driver that it has been loaded.

Parameter	Description
dwDriverIdentifier	Not used.
hDriver	Identifies an instance of the installable driver.
lParam1	Not used.
lParam2	Not used.

Returns

An installable driver returns nonzero if its **DriverProc** function successfully loads the driver. Otherwise, it returns zero.

DRV_OPEN (3.1)

DRV_OPEN

The DRV_OPEN message is sent to an installable driver each time it is opened.

Parameter	Description
dwDriverIdentifier	Specifies a unique 32-bit value that identifies the installable driver.
hDriver	Identifies an instance of the installable driver.
lParam1	Points to a null-terminated string containing any ASCII characters that followed the driver name in the SYSTEM.INI file.
lParam2	Contains the data specified by the *lParam* parameter, the third argument in the **OpenDriver** function.

Returns

An installable driver returns nonzero if it processes this message. Otherwise, it returns zero.

Comments

If no characters follow the driver name in SYSTEM.INI, the *lParam1* parameter is a NULL pointer.

See Also

DRV_CLOSE

DRV_QUERYCONFIGURE (3.1)

DRV_QUERYCONFIGURE

The DRV_QUERYCONFIGURE message is sent to an installable driver to determine whether it can be configured by the user.

Parameter	Description
dwDriverIdentifier	Specifies a unique 32-bit value that identifies the installable driver.
hDriver	Identifies an instance of the installable driver.
lParam1	Not used.
lParam2	Not used.

Returns

An installable driver returns nonzero if it supports custom configuration and is capable of displaying a configuration dialog box. Otherwise, it returns zero.

See Also

DRV_CONFIGURE

DRV_POWER (3.1)

DRV_POWER

The DRV_POWER message is sent to an installable driver each time the power supply to the associated device is about to be turned on or off.

Parameter	Description
dwDriverIdentifier	Specifies a unique 32-bit value that identifies the installable driver.
hDriver	Identifies an instance of the installable driver.
lParam1	Not used.
lParam2	Not used.

Returns

An installable driver returns nonzero if it processes this message. Otherwise, it returns zero.

DRV_REMOVE (3.1)

DRV_REMOVE

The DRV_REMOVE message is sent by an application to an installable driver to notify the driver that it is about to be removed from the system.

Parameter	Description
dwDriverIdentifier	Specifies a unique 32-bit value that identifies the installable driver.
lParam1	Not used.
lParam2	Not used.

Returns

An installable driver returns nonzero if it processes this message. Otherwise, it returns zero.

Comments

When an installable driver receives this message, it should remove necessary entries from the SYSTEM.INI file.

DRV_USER (3.1)

DRV_USER

The DRV_USER message is a user-defined or driver-dependent message.

Parameter	Description
dwDriverIdentifier	This parameter is not predefined; the value is driver dependent.
hDriver	This parameter is not predefined; the value is driver dependent.
lParam1	This parameter is not predefined; the value is driver dependent.
lParam2	This parameter is not predefined; the value is driver dependent.

Returns

The return value is driver dependent.

Installable-driver messages (3.1)

DRV_CLOSE	Indicates that driver should free resources
DRV_CONFIGURE	Indicates that driver should display dialog
DRV_DISABLE	Indicates that driver should unhook interrupts
DRV_ENABLE	Indicates that driver has been loaded or reloaded
DRV_EXITAPPLICATION	Indicates an application is exiting
DRV_EXITSESSION	Informs drivers that Windows is exiting
DRV_FREE	Indicates that driver must free all resources
DRV_INSTALL	Indicates that driver has been installed
DRV_LOAD	Indicates that driver has been loaded.
DRV_OPEN	Indicates that driver will be opened
DRV_QUERYCONFIGURE	Queries driver configuration capabilities
DRV_POWER	Indicates that device power-source was en/disabled
DRV_REMOVE	Indicates that driver will be removed
DRV_USER	Indicates that a user-defined action occurred

_hread (3.1)

long _hread(*hf, hpvBuffer, cbBuffer***)**

```
HFILE hf;                   /* file handle                        */
void _huge* hpvBuffer;      /* address of buffer for read data */
long cbBuffer;              /* length of data buffer              */
```

The **_hread** function reads data from the specified file. This function supports huge memory objects (that is, objects larger than 64K, allocated using the **GlobalAlloc** function).

Parameter	Description
hf	Identifies the file to be read.
hpvBuffer	Points to a buffer that is to receive the data read from the file.
cbBuffer	Specifies the number of bytes to be read from the file.

Returns

The return value indicates the number of bytes that the function read from the file, if the function is successful. If the number of bytes read is less than the number specified in *cbBuffer,* the function reached the end of the file (EOF) before reading the specified number of bytes. The return value is -1L if the function fails.

Comments

MS-DOS error return values are not available when an application calls this function.

See Also

_lread, **hmemcpy**, **_hwrite**

_hwrite (3.1)

long _hwrite(*hf, hpvBuffer, cbBuffer***)**

```
HFILE hf;                       /* file handle                      */
const void _huge* hpvBuffer;    /* address of buffer for write data */
long cbBuffer;                  /* size of data                     */
```

The **_hwrite** function writes data to the specified file. This function supports huge memory objects (that is, objects larger than 64K, allocated using the **GlobalAlloc** function).

Parameter	Description
hf	Identifies the file to be written to.
hpvBuffer	Points to a buffer that contains the data to be written to the file.
cbBuffer	Specifies the number of bytes to be written to the file.

Returns

The return value indicates the number of bytes written to the file, if the function is successful. Otherwise, the return value is -1L.

Comments

MS-DOS error return values are not available when an application calls this function.

See Also

hmemcpy, **_hread**, **_lwrite**

_lclose (2.x)

HFILE _lclose(*hf*)

HFILE *hf;* /* handle of file to close */

The **_lclose** function closes the given file. As a result, the file is no longer available for reading or writing.

Parameter	Description
hf	Identifies the file to be closed. This handle is returned by the function that created or last opened the file.

Returns
The return value is zero if the function is successful. Otherwise, it is HFILE_ERROR.

Example
The following example copies a file to a temporary file, then closes both files:

```
int cbRead;
PBYTE pbBuf;

/* Allocate a buffer for file I/O. */

pbBuf = (PBYTE) LocalAlloc(LMEM_FIXED, 2048);

/* Copy the input file to the temporary file. */

do {
    cbRead = _lread(hfReadFile, pbBuf, 2048);
    _lwrite(hfTempFile, pbBuf, cbRead);
} while (cbRead != 0);

/* Free the buffer and close the files. */

LocalFree((HLOCAL) pbBuf);

_lclose(hfReadFile);
_lclose(hfTempFile);
```

See Also
_lopen, **OpenFile**

_lcreat (2.x)

HFILE _lcreat(*lpszFilename, fnAttribute***)**

```
LPCSTR lpszFilename;      /* address of file to open */
int fnAttribute;          /* file attributes         */
```

The **_lcreat** function creates or opens a specified file. If the file does not exist, the function creates a new file and opens it for writing. If the file does exist, the function truncates the file size to zero and opens it for reading and writing. When the function opens the file, the pointer is set to the beginning of the file.

Parameter	Description
lpszFilename	Points to a null-terminated string that names the file to be opened. The string must consist of characters from the Windows character set.
fnAttribute	Specifies the file attributes. This parameter must be one of the following values:

Value	Meaning
0	Normal; can be read or written without restriction.
1	Read-only; cannot be opened for writing.
2	Hidden; not found by directory search.
3	System; not found by directory search.

Returns

The return value is a file handle if the function is successful. Otherwise, it is HFILE_ERROR.

Comments

Use this function carefully. It is possible to open any file, even one that has already been opened by another function.

Example

The following example uses the **_lcreat** function to open a temporary file:

```
HFILE hfTempFile;
char szBuf[144];

/* Create a temporary file. */

GetTempFileName(0, "tst", 0, szBuf);

hfTempFile = _lcreat(szBuf, 0);

if (hfTempFile == HFILE_ERROR) {
    ErrorHandler();
}
```

_llseek (2.x)

LONG _llseek(*hf, lOffset, nOrigin***)**

```
HFILE hf;       /* file handle                */
LONG lOffset;   /* number of bytes to move */
int nOrigin;    /* position to move from      */
```

The **_llseek** function repositions the pointer in a previously opened file.

Parameter	Description
hf	Identifies the file.
lOffset	Specifies the number of bytes the pointer is to be moved.
nOrigin	Specifies the starting position and direction of the pointer. This parameter must be one of the following values:

Value	Meaning
0	Move the file pointer *lOffset* bytes from the beginning of the file.
1	Move the file pointer *lOffset* bytes from its current position.
2	Move the file pointer *lOffset* bytes from the end of the file.

Returns

The return value specifies the new offset, in bytes, of the pointer from the beginning of the file, if the function is successful. Otherwise, the return value is HFILE_ERROR.

Comments

When a file is initially opened, the file pointer is positioned at the beginning of the file. The **_llseek** function permits random access to a file's contents by moving the pointer an arbitrary amount without reading data.

Example

The following example uses the **_llseek** function to move the file pointer to the end of an existing file:

```
HFILE hfAppendFile;

/* Open the write file. */

hfAppendFile = _lopen("append.txt", WRITE);

/* Move to the end of the file. */

if (_llseek(hfAppendFile, 0L, 2) == -1) {
    ErrorHandler();
}
```

See Also

_lopen

_lopen (2.x)

HFILE _lopen(*lpszFilename, fnOpenMode***)**

LPCSTR *lpszFilename;* /* address of file to open */
int *fnOpenMode;* /* file access */

The _**lopen** function opens an existing file and sets the file pointer to the beginning of the file.

Parameter	Description
lpszFilename	Points to a null-terminated string that names the file to be opened. The string must consist of characters from the Windows character set.
fnOpenMode	Specifies the modes in which to open the file. This parameter consists of one access mode and an optional share mode.

Value	Access mode
READ	Opens the file for reading only.
READ_WRITE	Opens the file for reading and writing.
WRITE	Opens the file for writing only.

Value	Share mode (optional)
OF_SHARE_COMPAT	Opens the file in compatibility mode, allowing any process on a given machine to open the file any number of times. If the file has been opened by using any of the other sharing modes, _**lopen** fails.
OF_SHARE_DENY_NONE	Opens the file without denying other programs read or write access to the file. If the file has been opened in compatibility mode by any other program, _**lopen** fails.
OF_SHARE_DENY_READ	Opens the file and denies other programs read access to the file. If the file has been opened in compatibility mode or for read access by any other program, _**lopen** fails.
OF_SHARE_DENY_WRITE	Opens the file and denies other programs write access to the file. If the file has been opened in compatibility mode or for write access by any other program, _**lopen** fails.
OF_SHARE_EXCLUSIVE	Opens the file in exclusive mode, denying other programs both read and write access to the file. If the file has been opened in any other mode for read or write access, even by the current program, _**lopen** fails.

Returns
The return value is a file handle if the function is successful. Otherwise, it is HFILE_ERROR.

Example
The following example uses the _**lopen** function to open an input file:

```
HFILE hfReadFile;
/* Open the input file (read only). */

hfReadFile = _lopen("testfile", READ);

if (hfReadFile == HFILE_ERROR) {
    ErrorHandler();
```

```
}
```

See Also
OpenFile

_lread (2.x)

UINT _lread(*hf, hpvBuffer, cbBuffer***)**

HFILE *hf;* /* file handle */
void _huge* *hpvBuffer;* /* address of buffer for read data */
UINT *cbBuffer;* /* length of data buffer */

The **_lread** function reads data from the specified file.

Parameter	Description
hf	Identifies the file to be read.
hpvBuffer	Points to a buffer that is to receive the data read from the file.
cbBuffer	Specifies the number of bytes to be read from the file. This value cannot be greater than 0xFFFE (65,534).

Returns

The return value indicates the number of bytes that the function read from the file, if the function is successful. If the number of bytes read is less than the number specified in *cbBuffer,* the function reached the end of the file (EOF) before reading the specified number of bytes. The return value is HFILE_ERROR if the function fails.

Comments

MS-DOS error return values are not available when an application calls this function.

Example

The following example uses the **_lread** and **_lwrite** functions to copy data from one file to another:

```
HFILE hfReadFile;
int cbRead;
PBYTE pbBuf;

/* Allocate a buffer for file I/O. */

pbBuf = (PBYTE) LocalAlloc(LMEM_FIXED, 2048);

/* Copy the input file to the temporary file. */

do {
    cbRead = _lread(hfReadFile, pbBuf, 2048);
    _lwrite(hfTempFile, pbBuf, cbRead);
} while (cbRead != 0);

/* Free the buffer and close the files. */

LocalFree((HLOCAL) pbBuf);

_lclose(hfReadFile);
_lclose(hfTempFile);
```

See Also

_hread, **_lwrite**

_lwrite (2.x)

UINT _lwrite(*hf, hpvBuffer, cbBuffer***)**

```
HFILE hf;                          /* file handle                      */
const void _huge* hpvBuffer;       /* address of buffer for write data */
UINT cbBuffer;                     /* size of data                     */
```

The **_lwrite** function writes data to the specified file.

Parameter	Description
hf	Identifies the file to be written to.
hpvBuffer	Points to a buffer that contains the data to be written to the file.
cbBuffer	Specifies the number of bytes to be written to the file. If this parameter is zero, the file is expanded or truncated to the current file-pointer position. This value cannot be greater than 0xFFFE (65,534).

Returns

The return value indicates the number of bytes written to the file, if the function is successful. Otherwise, the return value is HFILE_ERROR.

Comments

The buffer specified by *hpvBuffer* cannot extend past the end of a segment.

MS-DOS error return values are not available when an application calls this function.

Example

The following example uses the **_lread** and **_lwrite** functions to copy data from one file to another:

```
int cbRead;
PBYTE pbBuf;

/* Allocate a buffer for file I/O. */

pbBuf = (PBYTE) LocalAlloc(LMEM_FIXED, 2048);

/* Copy the input file to the temporary file. */

do {
    cbRead = _lread(hfReadFile, pbBuf, 2048);
    _lwrite(hfTempFile, pbBuf, cbRead);
} while (cbRead != 0);

/* Free the buffer and close the files. */

LocalFree((HLOCAL) pbBuf);

_lclose(hfReadFile);
_lclose(hfTempFile);
```

See Also

_hwrite, **_lread**

AccessResource (2.x)

int AccessResource(*hinst, hrsrc***)**

```
HINSTANCE hinst;        /* handle of module with resource */
HRSRC hrsrc;            /* handle of resource             */
```

The **AccessResource** function opens the given executable file and moves the file pointer to the beginning of the given resource.

Parameter	Description
hinst	Identifies the instance of the module whose executable file contains the resource.
hrsrc	Identifies the desired resource. This handle should be created by using the **FindResource** function.

Returns

The return value is the handle of the resource file if the function is successful. Otherwise, it is -1.

Comments

The **AccessResource** function supplies an MS-DOS file handle that can be used in subsequent file-read calls to load the resource. The file is opened for reading only.

Applications that use this function must close the resource file by calling the **_lclose** function after reading the resource. **AccessResource** can exhaust available MS-DOS file handles and cause errors if the opened file is not closed after the resource is accessed.

In general, the **LoadResource** and **LockResource** functions are preferred. These functions will access the resource more quickly if several resources are being read, because Windows maintains a file-handle cache for accessing executable files. However, each call to **AccessResource** requires that a new handle be opened to the executable file.

You should not use **AccessResource** to access executable files that are installed in ROM on a ROM-based system, since there are no disk files associated with the executable file; in such a case, a file handle cannot be returned.

See Also

FindResource, **_lclose**, **LoadResource**, **LockResource**

AddAtom (2.x)

ATOM AddAtom(*lpszName***)**

LPCSTR *lpszName;* /* address of string to add */

The **AddAtom** function adds a character string to the local atom table and returns a unique value identifying the string.

Parameter	Description
lpszName	Points to the null-terminated character string to be added to the table.

Returns
The return value specifies the newly created atom if the function is successful. Otherwise, it is zero.

Comments
The **AddAtom** function stores no more than one copy of a given string in the atom table. If the string is already in the table, the function returns the existing atom value and increments (increases by one) the string's reference count.

The **MAKEINTATOM** macro can be used to convert a word value into a string that can be added to the atom table by using the **AddAtom** function.

The atom values returned by **AddAtom** are in the range 0xC000 through 0xFFFF.

Atoms are case-insensitive.

Example
The following example uses the **AddAtom** function to add the string "This is an atom" to the local atom table:

```
ATOM at;
char szMsg[80];

at = AddAtom("This is an atom");

if (at == 0)
    MessageBox(hwnd, "AddAtom failed", "", MB_ICONSTOP);
else {
    wsprintf(szMsg, "AddAtom returned %u", at);
    MessageBox(hwnd, szMsg, "", MB_OK);
}
```

See Also
DeleteAtom, **FindAtom**, **GetAtomName**, **MAKEINTATOM**

Changes

AllocDStoCSAlias (3.0)

UINT AllocDStoCSAlias(*uSelector***)**

UINT *uSelector;* /* data-segment selector */

The **AllocDStoCSAlias** function accepts a data-segment selector and returns a code-segment selector that can be used to execute code in the data segment.

Parameter	Description
uSelector	Specifies the data-segment selector.

Returns

The return value is the code-segment selector corresponding to the data-segment selector if the function is successful. Otherwise, it is zero.

Comments

The application must free the new selector by calling the **FreeSelector** function.

In protected mode, attempting to execute code directly in a data segment will cause a general-protection violation. **AllocDStoCSAlias** allows an application to execute code that the application had created in its own stack segment.

Windows does not track segment movements. Consequently, the data segment must be fixed and nondiscardable; otherwise, the data segment might move, invalidating the code-segment selector.

The **PrestoChangoSelector** function provides another method of obtaining a code selector corresponding to a data selector.

An application should not use this function unless it is absolutely necessary, since its use violates preferred Windows programming practices.

See Also

FreeSelector, **PrestoChangoSelector**

Correction

The previous description of this function indicated that the application should free the selector with the **FreeSelector** function. Applications should *not* free the selector.

AllocResource (2.x)

HGLOBAL AllocResource(*hinst, hrsrc, cbResource***)**

```
HINSTANCE hinst;        /* handle of module containing resource */
HRSRC hrsrc;            /* handle of resource                   */
DWORD cbResource;       /* size to allocate, or zero            */
```

The **AllocResource** function allocates uninitialized memory for the given resource.

Parameter	Description
hinst	Identifies the instance of the module whose executable file contains the resource.
hrsrc	Identifies the desired resource. This handle should have been created by using the **FindResource** function.
cbResource	Specifies the size, in bytes, of the memory object to allocate for the resource. If this parameter is zero, Windows allocates enough memory for the specified resource.

Returns

The return value is the handle of the global memory object if the function is successful.

See Also

FindResource, **LoadResource**

AllocSelector (3.0)

UINT AllocSelector(*uSelector***)**

UINT *uSelector;* /* selector to copy or zero */

The **AllocSelector** function allocates a new selector.

Do not use this function in an application unless it is absolutely necessary, since its use violates preferred Windows programming practices.

Parameter	Description
uSelector	Specifies the selector to return. If this parameter specifies a valid selector, the function returns a new selector that is an exact copy of the one specified here. If this parameter is zero, the function returns a new, uninitialized sector.

Returns

The return value is a selector that is either a copy of an existing selector, or a new, uninitialized selector. Otherwise, the return value is zero.

Comments

The application must free the new selector by calling the **FreeSelector** function.

An application can call **AllocSelector** to allocate a selector that it can pass to the **PrestoChangoSelector** function.

See Also

PrestoChangoSelector

AnsiToOem (2.x)

void AnsiToOem(*hpszWindows, hpszOem***)**

const char _huge* *hpszWindows;* /* address of string to translate */
char _huge* *hpszOem;* /* address of buffer for string */

The **AnsiToOem** function translates a string from the Windows character set into the specified OEM character set.

Parameter	Description
hpszWindows	Points to a null-terminated string of characters from the Windows character set.
hpszOem	Points to the location where the translated string is to be copied. To translate the string in place, this parameter can be the same as *hpszWindows.*

Returns
This function does not return a value.

Comments
The string to be translated can be greater than 64K in length.

Windows-to-OEM mappings are defined by the keyboard driver, where this function is implemented. Some keyboard drivers may have different mappings than others, depending on the machine environment, and some keyboard driver support loading different OEM character sets; for example, the standard U.S. keyboard driver for an IBM keyboard supports loadable code pages, with the default being code page 437 and the most common alternative being code page 850. (The Windows character set is sometimes referred to as code page 1007.)

The OEM character set must always be used when accessing string data created by MS-DOS or MS-DOS applications. For example, a word processor should convert OEM characters to Windows characters when importing documents from an MS-DOS word processor. When an application makes an MS-DOS call, including a C run-time function call, filenames must be in the OEM character set, whereas they must be presented to the user in Windows characters (because the Windows fonts use Windows characters).

Example
The following example is part of a dialog box in which a user would create a directory by typing a name in an edit control:

```
case IDOK:
    GetWindowText(GetDlgItem(hwndDlg, ID_EDITDIRNAME), szDirName,
        sizeof(szDirName));
    AnsiToOem(szDirName, szDirName);
    mkdir(szDirName);
    EndDialog(hwndDlg, 1);
    return TRUE;
```

See Also
AnsiToOemBuff, **OemToAnsi**

AnsiToOemBuff (3.0)

void AnsiToOemBuff(*lpszWindowsStr, lpszOemStr, cbWindowsStr***)**

```
LPCSTR lpszWindowsStr;      /* address of string to translate          */
LPSTR lpszOemStr;           /* address of buffer for translated string */
UINT cbWindowsStr;          /* length of string to translate           */
```

The **AnsiToOemBuff** function translates a string from the Windows character set into the specified OEM character set.

Parameter	Description
lpszWindowsStr	Points to a buffer containing one or more characters from the Windows character set.
lpszOemStr	Points to the location where the translated string is to be copied. To translate the string in place, this parameter can be the same as *lpszWindowsStr.*
cbWindowsStr	Specifies the number of bytes in the buffer identified by the *lpszWindowsStr* parameter. If *cbWindowsStr* is zero, the length is 64K (65,536).

Returns

This function does not return a value.

See Also

AnsiToOem, **OemToAnsi**

Catch (2.x)

int Catch(*lpCatchBuf***)**

int FAR* *lpCatchBuf;* /* address of buffer for array */

The **Catch** function captures the current execution environment and copies it to a buffer. The **Throw** function can use this buffer later to restore the execution environment. The execution environment includes the state of all system registers and the instruction counter.

Parameter	Description
lpCatchBuf	Points to a memory buffer large enough to contain a **CATCHBUF** array.

Returns

The **Catch** function returns immediately with a return value of zero. When the **Throw** function is called, it returns again, this time with the return value specified in the *nErrorReturn* parameter of the **Throw** function.

Comments

The **Catch** function is similar to the C run-time function **setjmp**.

Example

The following example calls the **Catch** function to save the current execution environment before calling a recursive sort function. The first return value from **Catch** is zero. If the doSort function calls the **Throw** function, execution will again return to the **Catch** function. This time, **Catch** will return the STACKOVERFLOW error passed by the doSort function. The doSort function is recursive--that is, it calls itself. It maintains a variable, wStackCheck, that is used to check to see how much stack space has been used. If more then 3K of the stack has been used, doSort calls **Throw** to drop out of all the nested function calls back into the function that called **Catch**.

```
#define STACKOVERFLOW 1

UINT uStackCheck;
CATCHBUF catchbuf;

{
    int iReturn;
    char szBuf[80];

    if ((iReturn = Catch((int FAR*) catchbuf)) != 0) {
        .
        . /* Error processing goes here. */
        .
    }
    else {
        uStackCheck = 0;       /* initializes stack-usage count */
        doSort(1, 100);        /* calls sorting function        */
    }
    break;
}

void doSort(int sLeft, int sRight)
{
    int sLast;

    /*
     * Determine whether more than 3K of the stack has been
     * used, and if so, call Throw to drop back into the
```

```
     * original calling application.
     *
     * The stack is incremented by the size of the two parameters,
     * the two local variables, and the return value (2 for a near
     * function call).
     */

    uStackCheck += (sizeof(int) * 4) + 2;

    if (uStackCheck > (3 * 1024))
        Throw((int FAR*) catchbuf, STACKOVERFLOW);
    .
    . /* A sorting algorithm goes here. */
    .

    doSort(sLeft, sLast - 1);   /* note recursive call          */
    uStackCheck -= 10;          /* updates stack-check variable */
}
```

See Also

Throw

CloseSound (2.x)

void CloseSound(void)

This function is obsolete. Use the multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

CountVoiceNotes (2.x)

int CountVoiceNotes(*nvoice***)**

int *nvoice;* /* sound queue to be counted */

This function is obsolete. Use the multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

DebugBreak (3.0)

void DebugBreak(void)

The **DebugBreak** function causes a breakpoint exception to occur in the caller. This allows the calling process to signal the debugger, forcing it to take some action. If the process is not being debugged, the system invokes the default breakpoint exception handler. This may cause the calling process to terminate.

Returns

This function does not return a value.

Comments

This function is the only way to break into a **WEP** (Windows exit procedure) in a dynamic-link library.

For more information about using the debugging functions with Microsoft debugging tools, see Tools

Example

The following example uses the **DebugBreak** function to signal the debugger immediately before the application handles the **WM_DESTROY** message:

```
case WM_DESTROY:

    DebugBreak();
    PostQuitMessage(0);
    break;
```

See Also

WEP

DebugOutput (3.1)

void FAR _cdecl DebugOutput(*flags, lpszFmt, ...***)**

UINT *flags;* /* type of message */
LPCSTR *lpszFmt;* /* address of formatting string */

The **DebugOutput** function sends a message to the debugging terminal. Applications can apply the formatting codes to the message string and use filters and options to control the message category.

Parameter	Description
flags	Specifies the type of message to be sent to the debugging terminal. This parameter can be one of the following values:

Value	Meaning
DBF_TRACE	The message reports that no error has occurred and supplies information that may be useful during debugging. Example: "t Kernel: LoadResource(14AE of GDI)"
DBF_WARNING	The message reports a situation that may or may not be an error, depending on the circumstances. Example: "wn Kernel: GlobalWire(17BE of GDI) (try GlobalLock)"
DBF_ERROR	The message reports an error resulting from a failed call to a Windows function. The application continues to run. Example: "err Kernel: LocalShrink(15EA of GDI) (invalid local heap)"
DBF_FATAL	The message reports an error that will terminate the application. Example: "fatl User: SetDeskWallpaper(16CA of USER)"

lpszFmt	Points to a formatting string identical to the formatting strings used by the Windows function **wsprintf**. This string must be less than 160 characters long. Any additional formatting can be done by supplying additional parameters following *lpszFmt.*
. . .	Specifies zero or more optional arguments. The number and type of arguments depends on the corresponding format-control character sequences specified in the *lpszFmt* parameter.

Returns
This function does not return a value.

Comments
The messages sent by the **DebugOutput** function are affected by the system debugging options and trace-filter flags that are set and retrieved by using the **GetWinDebugInfo** and **SetWinDebugInfo** functions. These options and flags are stored in a **WINDEBUGINFO** structure.

Unlike most other Windows functions, **DebugOutput** uses the C calling convention (**_cdecl**), rather than the Pascal calling convention. As a result, the caller must pop arguments off the stack. Also, arguments must be pushed on the stack from right to left. In C-language modules, the C compiler performs this task.

See Also
GetWinDebugInfo, **OutputDebugString**, **SetWinDebugInfo**, **wsprintf**, **WINDEBUGINFO**

DBF_TRACE 0x0000

The message reports that no error has occurred and supplies information that may be useful during debugging. Example: "t Kernel: LoadResource(14AE of GDI)"

DBF_TRACE 0x0000

DBF_WARNING 0x4000

The message reports a situation that may or may not be an error, depending on the circumstances. Example: "wn Kernel: GlobalWire(17BE of GDI) (try GlobalLock)"

DBF_WARNING 0x4000

DBF_ERROR 0x8000

The message reports an error resulting from a failed call to a Windows function. The application continues to run. Example: "err Kernel: LocalShrink(15EA of GDI) (invalid local heap)"

DBF_ERROR 0x8000

DBF_FATAL 0xc000

The message reports an error that will terminate the application. Example: "fatl User: SetDeskWallpaper(16CA of USER)"

DBF_FATAL 0xc000

DeleteAtom (2.x)

ATOM DeleteAtom(*atm***)**

ATOM *atm;* /* atom to delete */

The **DeleteAtom** function decrements (decreases by one) the reference count of a local atom by one. If the atom's reference count is reduced to zero, the string associated with the atom is removed from the local atom table.

An atom's reference count specifies the number of times the atom has been added to the atom table. The **AddAtom** function increments (increases by one) the count on each call. **DeleteAtom** decrements the count on each call and removes the string only if the atom's reference count is reduced to zero.

Parameter	Description
atm	Identifies the atom and character string to be deleted.

Returns
The return value is zero if the function is successful. Otherwise, it is equal to the *atm* parameter.

Comments
The only way to ensure that an atom has been deleted from the atom table is to call this function repeatedly until it fails. When the count is decremented to zero, the next call to the **FindAtom** or **DeleteAtom** function will fail.

DeleteAtom has no effect on integer atoms (atoms created by using the **MAKEINTATOM** macro). The function always returns zero for integer atoms.

Example
The following example uses the **DeleteAtom** function to decrement the reference count for the specified atom:

```
ATOM at;

at = DeleteAtom(atTest);

if (at == NULL)
    MessageBox(hwnd, "atom count decremented",
        "DeleteAtom", MB_OK);
else
    MessageBox(hwnd, "atom count could not be decremented",
        "DeleteAtom", MB_ICONEXCLAMATION);
```

See Also
AddAtom, **FindAtom**, **GlobalDeleteAtom**

DirectedYield (3.1)

void DirectedYield(*htask***)**

HTASK *htask;*

The **DirectedYield** function puts the current task to sleep and awakens the given task.

Parameter	Description
htask	Specifies the task to be executed.

Returns
This function does not return a value.

Comments
When relinquishing control to other applications (that is, when exiting hard mode), a Windows-based debugger should call **DirectedYield**, identifying the handle of the task being debugged. This ensures that the debugged application runs next and that messages received during debugging are processed by the appropriate windows.

The Windows scheduler executes a task only when there is an event waiting for it, such as a paint message, or a message posted in the message queue.

If an application uses **DirectedYield** for a task with no events scheduled, the task will not be executed. Instead, Windows searches the task queue. In some cases, however, you may want the application to force a specific task to be scheduled. The application can do this by calling the **PostAppMessage** function, specifying a WM_NULL message identifier. Then, when the application calls **DirectedYield**, the scheduler will run the task regardless of the task's event status.

DirectedYield starts the task identified by *htask* at the location where it left off. Typically, debuggers should use **TaskSwitch** instead of **DirectedYield**, because **TaskSwitch** can start a task at any address.

DirectedYield returns when the current task is reawakened. This occurs when the task identified by *htask* waits for messages or uses the **Yield** or **DirectedYield** function. Execution will continue as before the task switch.

DirectedYield is located in KRNL286.EXE and KRNL386.EXE and is available in Windows versions 3.0 and 3.1.

See Also
PostAppMessage, **TaskSwitch**, **TaskGetCSIP**, **TaskSetCSIP**, **Yield**

DOS3Call (3.0)

DOS3Call

The **DOS3Call** function allows an application to call an MS-DOS Interrupt 21h function. **DOS3Call** can be called only from assembly-language routines. It is exported from KRNL286.EXE and KRNL386.EXE and is not defined in any Windows header or include files.

Parameters

Registers must be set up as required by the desired Interrupt 21h function before the application calls the **DOS3Call** function.

Returns

The register contents are preserved as they are returned by the Interrupt 21h function.

Comments

Applications should use this function instead of a directly coded MS-DOS Interrupt 21h function. The **DOS3Call** function runs somewhat faster than the equivalent MS-DOS Interrupt 21h function running in Windows.

Example

The following example shows how to prototype the **DOS3Call** function in C:

```
extern void FAR PASCAL DOS3Call(void);
```

To declare the **DOS3Call** function in an assembly-language routine, an application could use the following line:

```
extrn DOS3CALL: far
```

If the application includes CMACROS.INC, the function is declared as follows:

```
extrnFP DOS3Call
```

The following example is a typical use of the **DOS3Call** function:

```
extrn DOS3CALL: far
                .
                .
                .
        ; set registers

        mov     ah, DOSFUNC    ;DOSFUNC = Int 21h function number
        cCall   DOS3Call
```

FatalAppExit (3.0)

void FatalAppExit(*fuAction, lpszMessageText***)**

```
UINT fuAction;                  /* must be zero                    */
LPCSTR lpszMessageText;         /* string to display in message box */
```

The **FatalAppExit** function displays a message box and terminates the application when the message box is closed. If the user is running the debugging version of the Windows operating system, the message box gives the user the opportunity to terminate the application or to cancel the message box and return to the caller.

Parameter	Description
fuAction	Reserved; must be zero.
lpszMessageText	Points to a null-terminated string that is displayed in the message box. The message is displayed on a single line. To accommodate low-resolution screens, the string should contain no more than 35 characters.

Returns

This function does not return a value.

Comments

An application should call the **FatalAppExit** function only when it is incapable of terminating any other way. **FatalAppExit** may not always free an application's memory or close its files, and it may cause a general failure of Windows. An application that encounters an unexpected error should terminate by freeing all its memory and returning from its main message loop.

See Also

FatalExit, **TerminateApp**

FatalExit (2.x)

void FatalExit(*nErrCode***)**

int *nErrCode;* /* error value to display */

The **FatalExit** function sends the current state of Windows to the debugger and prompts for instructions on how to proceed.

An application should call this function for debugging purposes only; it should not call the function in a retail version of the application. Calling this function in the retail version will terminate the application.

Parameter	Description
nErrCode	Specifies the error value to be displayed.

Returns
This function does not return a value.

Comments
The displayed information includes an error value followed by a symbolic stack trace, showing the flow of execution up to the point of the call.

The **FatalExit** function prompts the user to respond to an Abort, Break, or Ignore message. Windows processes the response as follows:

Response	Description
A (Abort)	Terminate immediately.
B (Break)	Enter the debugger.
I (Ignore)	Return to the caller.

You can specify any combination of error values for the *nErrCode* parameter, since the meaning of the values is unique to your application. However, the error value -1 must always be reserved for the stack-overflow message. When this value is specified, Windows automatically displays a stack-overflow message.

See Also
FatalAppExit

FindAtom (2.x)

ATOM FindAtom(*lpszString***)**

LPCSTR *lpszString;* /* address of string to find */

The **FindAtom** function searches the local atom table for the specified character string and retrieves the atom associated with that string.

Parameter	Description
lpszString	Points to the null-terminated character string to search for.

Returns

The return value identifies the atom associated with the given string if the function is successful. Otherwise (if the string is not in the table), the return value is zero.

Example

The following example uses the **FindAtom** function to retrieve the atom for the string "This is an atom":

```
ATOM at;
char szMsg[80];

if ((at = FindAtom("This is an atom")) == 0)
    MessageBox(hwnd, "could not find atom",
        "FindAtom", MB_ICONEXCLAMATION);
else {
    wsprintf(szMsg, "atom = %u", at);
    MessageBox(hwnd, szMsg, "FindAtom", MB_OK);
}
```

See Also

AddAtom, **DeleteAtom**

FindResource (2.x)

HRSRC FindResource(*hinst, lpszName, lpszType***)**

```
HINSTANCE hinst;        /* handle of module containing resource */
LPCSTR lpszName;        /* address of resource name             */
LPCSTR lpszType;        /* address of resource type             */
```

The **FindResource** function determines the location of a resource in the specified resource file.

Parameter	Description
hinst	Identifies the instance of the module whose executable file contains the resource.
lpszName	Specifies the name of the resource. For details, see the following Comments section.
lpszType	Specifies the resource type. For details, see the following Comments section. For predefined resource types, this parameter should be one of the following values:

Value	Meaning
RT_ACCELERATOR	Accelerator table
RT_BITMAP	Bitmap resource
RT_CURSOR	Cursor resource
RT_DIALOG	Dialog box
RT_FONT	Font resource
RT_FONTDIR	Font directory resource
RT_ICON	Icon resource
RT_MENU	Menu resource
RT_RCDATA	User-defined resource (raw data)
RT_STRING	String resource

Returns

The return value is the handle of the named resource if the function is successful. Otherwise, it is NULL.

Comments

If the high-order word of the *lpszName* or *lpszType* parameter is zero, the low-order word specifies the integer identifier of the name or type of the given resource. Otherwise, the parameters are long pointers to null-terminated strings. If the first character of the string is a pound sign (#), the remaining characters represent a decimal number that specifies the integer identifier of the resource's name or type. For example, the string #258 represents the integer ID 258.

To reduce the amount of memory required for the resources used by an application, the application should refer to the resources by integer identifier instead of by name.

An application must not call the **FindResource** and **LoadResource** functions to load cursor, icon, and string resources. Instead, it must load these resources by calling the **LoadCursor**, **LoadIcon**, and **LoadString** functions, respectively.

Although the application can call the **FindResource** and **LoadResource** functions to load other predefined resource types, it should load the corresponding resources by calling the **LoadAccelerators**, **LoadBitmap**, and **LoadMenu** functions.

See Also

LoadAccelerators, **LoadBitmap**, **LoadCursor**, **LoadIcon**, **LoadMenu**, **LoadResource**, **LoadString**

RT_ACCELERATOR **MAKEINTRESOURCE**(9)

Accelerator table

RT_BITMAP **MAKEINTRESOURCE**(2)

Bitmap resource

Cursor resource

RT_DIALOG **MAKEINTRESOURCE**(5)

Dialog box

RT_FONT **MAKEINTRESOURCE**(8)

Font resource

Font directory resource

RT_ICON **MAKEINTRESOURCE**(3)

Icon resource

RT_MENU **MAKEINTRESOURCE**(4)

Menu resource

RT_RCDATA **MAKEINTRESOURCE**(10)

User-defined resource (raw data)

RT_RCDATA MAKEINTRESOURCE(10)

RT_STRING **MAKEINTRESOURCE**(6)

String resource

RT_STRING MAKEINTRESOURCE(6)

FreeLibrary (2.x)

void FreeLibrary(*hinst***)**

HINSTANCE *hinst;* /* handle of loaded library module */

The **FreeLibrary** function decrements (decreases by one) the reference count of the loaded library module. When the reference count reaches zero, the memory occupied by the module is freed.

Parameter	Description
hinst	Identifies the loaded library module.

Returns
This function does not return a value.

Comments
A dynamic-link library (DLL) must not call the **FreeLibrary** function within its **WEP** function (Windows exit procedure).

The reference count for a library module is incremented (increased by one) each time an application calls the **LoadLibrary** function for the library module.

Example
The following example uses the **LoadLibrary** function to load TOOLHELP.DLL and the **FreeLibrary** function to free it:

```
HINSTANCE hinstToolHelp = LoadLibrary("TOOLHELP.DLL");

if ((UINT) hinstToolHelp > 32) {
        .
        . /* use GetProcAddress to use TOOLHELP functions */
        .
}
else {
    ErrorHandler();
}

if ((UINT) hinstToolHelp > 32)
   FreeLibrary(hinstToolHelp); /* free TOOLHELP.DLL      */
```

See Also
GetProcAddress, **LoadLibrary**, **WEP**

FreeModule (3.0)

BOOL FreeModule(*hinst***)**

HINSTANCE *hinst;* /* handle of loaded module */

The **FreeModule** function decrements (decreases by one) the reference count of the loaded module. When the reference count reaches zero, the memory occupied by the module is freed.

Parameter	Description
hinst	Identifies the loaded module.

Returns

The return value is zero if the reference count is decremented to zero and the module's memory is freed. Otherwise, the return value is nonzero.

Comments

The reference count for a module is incremented (increased by one) each time an application calls the **LoadModule** function for the module.

See Also

LoadModule

FreeProcInstance (2.x)

void FreeProcInstance(*lpProc***)**

FARPROC *lpProc;* /* instance address of function to free */

The **FreeProcInstance** function frees the specified function from the data segment bound to it by the **MakeProcInstance** function.

Parameter	Description
lpProc	Points to the procedure-instance address of the function to be freed. It must be created by using the **MakeProcInstance** function.

Returns

This function does not return a value.

Comments

After a procedure instance has been freed, attempts to call the function using the freed procedure-instance address will result in an unrecoverable error.

See Also

MakeProcInstance

FreeResource (2.x)

BOOL FreeResource(*hglbResource***)**

HGLOBAL *hglbResource;* /* handle of loaded resource */

The **FreeResource** function decrements (decreases by one) the reference count of a loaded resource. When the reference count reaches zero, the memory occupied by the resource is freed.

Parameter	Description
hglbResource	Identifies the data associated with the resource. The handle is assumed to have been created by using the **LoadResource** function.

Returns

The return value is zero if the function is successful. Otherwise, it is nonzero, indicating that the function has failed and the resource has not been freed.

Comments

The reference count for a resource is incremented (increased by one) each time an application calls the **LoadResource** function for the resource.

See Also

LoadResource

FreeSelector (3.0)

UINT FreeSelector(*uSelector***)**

UINT *uSelector;* /* selector to be freed */

The **FreeSelector** function frees a selector originally allocated by the **AllocSelector** or **AllocDStoCSAlias** function. After the application calls this function, the selector is invalid and must not be used.

An application should not use this function unless it is absolutely necessary, since its use violates preferred Windows programming practices.

Parameter	Description
uSelector	Specifies the selector to be freed.

Returns

The return value is zero if the function is successful. Otherwise, it is the selector specified by the *uSelector* parameter.

Comments

The limit for the selector specified by the *uSelector* parameter must not be larger than 64K. If the limit of the selector exceeds 64K, the **FreeSelector** function may free selectors that are still required by the program.

See Also

AllocDStoCSAlias, **AllocSelector**

GetAtomHandle (2.x)

HLOCAL GetAtomHandle(*atm***)**

ATOM *atm;* /* atom to retrieve handle of */

The **GetAtomHandle** function retrieves a handle of the specified atom.

This function is only provided for compatibility with Windows, versions 1.*x* and 2.*x.* It should not be used with Windows 3.0 and later.

Parameter	Description
atm	Specifies an atom whose handle is to be retrieved.

Returns
The return value is a handle of the specified atom if the function is successful.

See Also
GetAtomName, **GlobalGetAtomName**

GetAtomName (2.x)

UINT GetAtomName(*atm, lpszBuffer, cbBuffer***)**

```
ATOM atm;          /* atom identifying character string */
LPSTR lpszBuffer;  /* address of buffer for atom string */
int cbBuffer;      /* size of buffer                    */
```

The **GetAtomName** function retrieves a copy of the character string associated with the specified local atom.

Parameter	Description
atm	Specifies the local atom that identifies the character string to be retrieved.
lpszBuffer	Points to the buffer for the character string.
cbBuffer	Specifies the maximum size, in bytes, of the buffer.

Returns
The return value specifies the number of bytes copied to the buffer, if the function is successful.

Comments
The string returned for an integer atom (an atom created by the **MAKEINTATOM** macro) will be a null-terminated string, where the first character is a pound sign (#) and the remaining characters make up the **UINT** used in **MAKEINTATOM**.

Example
The following example uses the **GetAtomName** function to retrieve the character string associated with a local atom:

```
char szBuf[80];

GetAtomName(atTest, szBuf, sizeof(szBuf));

MessageBox(hwnd, szBuf, "GetAtomName", MB_OK);
```

See Also
AddAtom, **DeleteAtom**, **FindAtom**, **MAKEINTATOM**

GetCodeHandle (2.x)

HGLOBAL GetCodeHandle(*lpProc***)**

FARPROC *lpProc;* /* instance address of function */

The **GetCodeHandle** function determines which code segment contains the specified function.

Parameter	Description
lpProc	Points to the procedure-instance address of the function for which to return the code segment. Typically, this address is returned by the **MakeProcInstance** function.

Returns

The return value identifies the code segment that contains the function if the **GetCodeHandle** function is successful. Otherwise, it is NULL.

Comments

If the code segment that contains the function is already loaded, the **GetCodeHandle** function marks the segment as recently used. If the code segment is not loaded, **GetCodeHandle** attempts to load it. Thus, an application can use this function to attempt to preload one or more segments necessary to perform a particular task.

See Also

MakeProcInstance

GetCodeInfo (3.0)

void GetCodeInfo(*lpProc, lpSegInfo***)**

```
FARPROC lpProc;          /* function address or module handle          */
SEGINFO FAR* lpSegInfo;  /* address of structure for segment information */
```

The **GetCodeInfo** function retrieves a pointer to a structure containing information about a code segment.

Parameter	Description
lpProc	Specifies the procedure-instance address of the function (typically, returned by the **MakeProcInstance** function) in the segment for which information is to be retrieved, or it specifies a module handle (typically, returned by the **GetModuleHandle** function) and segment number.
lpSegInfo	Points to a **SEGINFO** structure that will be filled with information about the code segment.

Returns

This function does not return a value.

See Also

GetModuleHandle, **MakeProcInstance**

GetCurrentPDB (3.0)

UINT GetCurrentPDB(void)

The **GetCurrentPDB** function returns the selector address of the current MS-DOS program database (PDB), also known as the program segment prefix (PSP).

Returns

The return value is the selector address of the current PDB if the function is successful.

Example

The following example uses the **GetCurrentPDB** function to list the current command tail:

```
typedef struct {
    WORD pspInt20;            /* Int 20h instruction             */
    WORD pspNextParagraph;    /* segment addr. of next paragraph */
    BYTE res1;                /* reserved                        */
    BYTE pspDispatcher[5];    /* long call to MS-DOS             */
    DWORD pspTerminateVector; /* termination address (Int 22h)   */
    DWORD pspControlCVector;  /* addr of CTRL+C (Int 23h)        */
    DWORD pspCritErrorVector; /* addr of Crit-Error (Int 24h)    */
    WORD res2[11];            /* reserved                        */
    WORD pspEnvironment;      /* segment address of environment  */
    WORD res3[23];            /* reserved                        */
    BYTE pspFCB_1[16];        /* default FCB #1                  */
    BYTE pspFCB_2[16];        /* default FCB #2                  */
    DWORD res4;               /* reserved                        */
    BYTE pspCommandTail[128]; /* command tail (also default DTA) */
} PSP, FAR* LPSP;

    LPSP lpsp = (LPSP) MAKELP(GetCurrentPDB(), 0);

    MessageBox(NULL, lpsp->pspCommandTail, "PDB Command Tail", MB_OK);
```

GetCurrentTask (2.x)

HTASK GetCurrentTask(void)

The **GetCurrentTask** function retrieves the handle of the current (running) task.

Returns
The return value is a handle of the current task if the function is successful. Otherwise, it is NULL.

GetDOSEnvironment (3.0)

LPSTR GetDOSEnvironment(void)

The **GetDOSEnvironment** function returns a far pointer to the environment string of the current (running) task.

Returns

The return value is a far pointer to the current environment string.

Comments

Unlike an application, a dynamic-link library (DLL) does not have a copy of the environment string. As a result, the library must call this function to retrieve the environment string.

Example

The following example uses the **GetDOSEnvironment** function to return a pointer to the environment, and then lists the environment settings:

```
LPSTR lpszEnv;

lpszEnv = GetDOSEnvironment();
while (*lpszEnv != '\0') {
    .
    . /* process the environment string */
    .

    /* Move to the next environment string */

    lpszEnv += lstrlen(lpszEnv) + 1;
}
```

GetDriveType (3.0)

UINT GetDriveType(*DriveNumber***)**

int *DriveNumber;* /* 0 = A, 1 = B, and so on */

The **GetDriveType** function determines whether a disk drive is removable, fixed, or remote.

Parameter	Description
DriveNumber	Specifies the drive for which the type is to be determined (0 = drive A, 1 = drive B, 2 = drive C, and so on).

Returns

The return value is DRIVE_REMOVABLE (disk can be removed from the drive), DRIVE_FIXED (disk cannot be removed from the drive), or DRIVE_REMOTE (drive is a remote, or network, drive), if the function is successful. Otherwise, the return value is zero.

Example

The following example uses the **GetDriveType** function to determine the drive type for all possible disk drives (letters A through Z):

```
int  iDrive;
WORD wReturn;
char szMsg[80];

for (iDrive = 0, wReturn = 0;
        (iDrive < 26) && (wReturn != 1); iDrive++) {

    wReturn = GetDriveType(iDrive);

    sprintf(szMsg, "drive %c: ", iDrive + 'A');

    switch (wReturn) {
        case 0:
            strcat(szMsg, "undetermined");
            break;

        case DRIVE_REMOVABLE:
            strcat(szMsg, "removable");
            break;

        case DRIVE_FIXED:
            strcat(szMsg, "fixed");
            break;

        case DRIVE_REMOTE:
            strcat(szMsg, "remote (network)");
            break;
    }
    TextOut(hdc, 10, 15 * iDrive, szMsg, strlen(szMsg));
}
```

GetFreeSpace (3.0)

DWORD GetFreeSpace(*fuFlags***)**

UINT *fuFlags;* /* ignored in Windows 3.1*/

The **GetFreeSpace** function scans the global heap and returns the number of bytes of memory currently available.

Parameter	Description
fuFlags	This parameter is ignored in Windows 3.1.

Returns
The return value is the amount of available memory, in bytes.

Comments
The amount of memory specified by the return value is not necessarily contiguous; the **GlobalCompact** function returns the number of bytes in the largest block of free global memory.

In standard mode, the value returned represents the number of bytes in the global heap that are not used and that are not reserved for code.

In 386-enhanced mode, the return value is an estimate of the amount of memory available to an application. It does not account for memory held in reserve for non-Windows applications.

See Also
GlobalCompact

GetInstanceData (2.x)

int GetInstanceData(*hinst, npbData, cbData***)**

```
HINSTANCE hinst;        /* handle of previous instance          */
BYTE* npbData;          /* address of current instance data buffer */
int cbData;             /* number of bytes to transfer          */
```

The **GetInstanceData** function copies data from a previous instance of an application into the data area of the current instance.

Parameter	Description
hinst	Identifies a previous instance of the application.
npbData	Points to a buffer in the current instance.
cbData	Specifies the number of bytes to be copied.

Returns

The return value specifies the number of bytes copied if the function is successful. Otherwise, it is zero.

GetKBCodePage (3.0)

int GetKBCodePage(void)

The **GetKBCodePage** function returns the current Windows code page.

Returns

The return value specifies the code page currently loaded by Windows, if the function is successful. It can be one of the following values:

Value	Meaning
437	Default (United States, used by most countries: indicates that there is no OEMANSI.BIN in the Windows directory)
850	International (OEMANSI.BIN = XLAT850.BIN)
860	Portugal (OEMANSI.BIN = XLAT860.BIN)
861	Iceland (OEMANSI.BIN = XLAT861.BIN)
863	French Canadian (OEMANSI.BIN = XLAT863.BIN)
865	Norway/Denmark (OEMANSI.BIN = XLAT865.BIN)

Comments

The keyboard driver provides the **GetKBCodePage** function. An application using this function must include the following information in its module-definition (.DEF) file:

```
IMPORTS
    KEYBOARD.GETKBCODEPAGE
```

If the OEMANSI.BIN file is in the Windows directory, Windows reads it and overwrites the OEM/ANSI translation tables in the keyboard driver.

When the user selects a language from the Setup program and the language does not use the default code page (437), Setup copies the appropriate file (such as XLAT850.BIN) to OEMANSI.BIN in the Windows system directory. If the language uses the default code page, Setup deletes OEMANSI.BIN, if it exists, from the Windows system directory.

Example

The following example uses the **GetKBCodePage** function to display the current code page:

```
char szBuf[80];
int i, cp, subtype, f_keys, len;

char *apszKeyboards[] = {
    "IBM PX/XT",
    "Olivetti ICO",
    "IBM AT",
    "IBM Enhanced",
    "Nokia 1050",
    "Nokia 9140",
    "Standard Japanese",
    };

cp = GetKBCodePage();

if ((i = GetKeyboardType(0)) == 0 || i > 7) {
    MessageBox(NULL, "invalid keyboard type",
        "GetKeyboardType", MB_ICONSTOP);
    break;
```

```
}

subtype = GetKeyboardType(1);
f_keys = GetKeyboardType(2);

len = wsprintf(szBuf, "%s keyboard, subtype %d\n",
    apszKeyboards[i - 1], subtype);
len = wsprintf(szBuf + len, " %d function keys, code page %d",
    f_keys, cp);

MessageBox(NULL, szBuf, "Keyboard Information", MB_OK);
```

See Also

GetKeyboardType

GetKeyboardType (3.0)

int GetKeyboardType(*fnKeybInfo***)**

int *fnKeybInfo;* /* specifies type of information to retrieve */

The **GetKeyboardType** function retrieves information about the current keyboard.

Parameter	Description
fnKeybInfo	Determines the type of keyboard information to be retrieved. This parameter can be one of the following values:

Value	Meaning
0	Retrieves the keyboard type.
1	Retrieves the keyboard subtype.
2	Retrieves the number of function keys on the keyboard.

Returns

The return value specifies the requested information if the function is successful. Otherwise, it is zero.

Comments

The subtype is an OEM-dependent value. The subtype may be one of the following values:

Value	Meaning
1	IBM PC/XT, or compatible (83-key) keyboard
2	Olivetti "ICO" (102-key) keyboard
3	IBM AT (84-key) or similar keyboard
4	IBM Enhanced (101- or 102-key) keyboard
5	Nokia 1050 and similar keyboards
6	Nokia 9140 and similar keyboards
7	Japanese keyboard

The keyboard driver provides the **GetKeyboardType** function. An application using this function must include the following information in its module-definition (.DEF) file:

```
IMPORTS
    KEYBOARD.GETKEYBOARDTYPE
```

The application can also determine the number of function keys on a keyboard from the keyboard type. The number of function keys for each keyboard type follows:

Type	Number of function keys
1	10
2	12 (sometimes 18)
3	10
4	12
5	10
6	24
7	This value is hardware-dependent and must be specified by the OEM.

Example

The following example uses the **GetKeyboardType** function to display information about the current keyboard:

```
char szBuf[80];
int i, cp, subtype, f_keys, len;
```

```
char *apszKeyboards[] = {
    "IBM PX/XT",
    "Olivetti ICO",
    "IBM AT",
    "IBM Enhanced",
    "Nokia 1050",
    "Nokia 9140",
    "Standard Japanese",
    };

cp = GetKBCodePage();

if ((i = GetKeyboardType(0)) == 0 || i > 7) {
    MessageBox(NULL, "invalid keyboard type",
        "GetKeyboardType", MB_ICONSTOP);
    break;
}

subtype = GetKeyboardType(1);
f_keys = GetKeyboardType(2);

len = wsprintf(szBuf, "%s keyboard, subtype %d\n",
    apszKeyboards[i - 1], subtype);
len = wsprintf(szBuf + len, " %d function keys, code page %d",
    f_keys, cp);

MessageBox(NULL, szBuf, "Keyboard Information", MB_OK);
```

GetKeyNameText (3.0)

int GetKeyNameText(*lParam, lpszBuffer, cbMaxKey***)**

```
LONG lParam;        /* 32-bit parameter of keyboard message  */
LPSTR lpszBuffer;   /* address of a buffer for key name      */
int cbMaxKey;       /* specifies maximum key string length   */
```

The **GetKeyNameText** function retrieves a string that represents the name of a key.

Parameter	Description
lParam	Specifies the 32-bit parameter of the keyboard message (such as **WM_KEYDOWN**) to be processed. The **GetKeyNameText** function interprets the following portions of *lParam:*

Bits	Meaning
16-23	Character scan code.
24	Extended bit. Distinguishes some keys on an enhanced keyboard.
25	"Don't care" bit. The application calling this function sets this bit to indicate that the function should not distinguish between left and right CTRL and SHIFT keys, for example.

lpszBuffer	Points to a buffer that will receive the key name.
cbMaxKey	Specifies the maximum length, in bytes, of the key name, not including the terminating null character (this parameter should one less than the size of the buffer pointed to by the *lpszBuffer* parameter).

Returns

The return value is the length, in bytes, of the string copied to the specified buffer, if the function is successful. Otherwise, it is zero.

Comments

The format of the key-name string depends on the current keyboard driver. This driver maintains a list of names in the form of character strings for keys with names longer than a single character. The key name is translated, according to the layout of the currently installed keyboard, into the principal language supported by the keyboard driver.

Correction

The previous documentation incorrectly listed bit 21 of *lparam* as the extended bit and bit 22 as the "don't care" bit.

GetModuleFileName (2.x)

int GetModuleFileName(*hinst, lpszFilename, cbFileName***)**

HINSTANCE *hinst;* /* handle of module */
LPSTR *lpszFilename;* /* address of buffer for filename */
int *cbFileName;* /* maximum number of bytes to copy */

The **GetModuleFileName** function retrieves the full path and filename of the executable file from which the specified module was loaded.

Parameter	Description
hinst	Identifies the module or the instance of the module.
lpszFilename	Points to the buffer that is to receive the null-terminated filename.
cbFileName	Specifies the maximum number of bytes to copy, including the terminating null character. The filename is truncated if it is longer than *cbFileName.* This parameter should be set to the length of the filename buffer.

Returns
The return value specifies the length, in bytes, of the string copied to the specified buffer, if the function is successful. Otherwise, it is zero.

Example
The following example retrieves an application's filename by using the instance handle passed to the application in the **WinMain** function:

```
int PASCAL WinMain(HINSTANCE hinst, HINSTANCE hPrevInst,
    LPSTR lpCmdLine, int nCmdShow)
{
    char szModuleName[260];

    GetModuleFileName(hinst, szModuleName, sizeof(szModuleName));
```

See Also
GetModuleHandle

GetModuleHandle (2.x)

HMODULE GetModuleHandle(*lpszModuleName***)**

LPCSTR *lpszModuleName;* /* address of name of module */

The **GetModuleHandle** function retrieves the handle of the specified module.

Parameter	Description
lpszModuleName	Points to a null-terminated string that specifies the name of the module.

Returns

The return value is the handle of the module if the function is successful. Otherwise, it is NULL.

See Also

GetModuleFileName

GetModuleUsage (2.x)

int GetModuleUsage(*hinst***)**

HINSTANCE *hinst;* /* handle of module */

The **GetModuleUsage** function retrieves the reference count of a specified module.

Parameter	Description
hinst	Identifies the module or an instance of the module.

Returns
The return value specifies the reference count of the module if the function is successful.

Comments
Windows increments (increases by one) a module's reference count each time an application calls the **LoadModule** function. The count is decremented (decreased by one) when an application calls the **FreeModule** function.

See Also
FreeModule, **LoadModule**

GetNumTasks (2.x)

UINT GetNumTasks(void)

The **GetNumTasks** function retrieves the number of currently running tasks.

Returns
The return value specifies the number of current tasks.

GetPrivateProfileInt (3.0)

UINT GetPrivateProfileInt(*lpszSection, lpszEntry, default, lpszFilename***)**

```
LPCSTR lpszSection;     /* address of section                */
LPCSTR lpszEntry;       /* address of entry                  */
int default;            /* return value if entry not found   */
LPCSTR lpszFilename;    /* address of initialization filename */
```

The **GetPrivateProfileInt** function retrieves the value of an integer from an entry within a specified section of a specified initialization file.

Parameter	Description
lpszSection	Points to a null-terminated string containing the section heading in the initialization file.
lpszEntry	Points to the null-terminated string containing the entry whose value is to be retrieved.
default	Specifies the default value to return if the entry cannot be found in the initialization file. This value must be a positive integer in the range 0 through 32,767 (0x0000 through 0x7FFF).
lpszFilename	Points to a null-terminated string that names the initialization file. If this parameter does not contain a full path, Windows searches for the file in the Windows directory.

Returns

The return value is the integer value of the specified entry if the function is successful. It is the value of the *default* parameter if the function does not find the entry. The return value is zero if the value that corresponds to the specified entry is not an integer.

Comments

The function searches the file for an entry that matches the name specified by the *lpszEntry* parameter under the section heading specified by the *lpszSection* parameter. An integer entry in the initialization file must have the following form:

[*section*]
entry=value
.
.
.

If the value that corresponds to the entry consists of digits followed by nonnumeric characters, the function returns the value of the digits. For example, the function would return 102 for the line "Entry=102abc".

The **GetPrivateProfileInt** function is not case-dependent, so the strings in the *lpszSection* and *lpszEntry* parameters may contain a combination of uppercase and lowercase letters.

GetPrivateProfileInt supports hexadecimal notation. When **GetPrivateProfileInt** is used to retrieve a negative integer, the value should be cast to an **int**.

An application can use the **GetProfileInt** function to retrieve an integer value from the WIN.INI file.

Example

The following example uses the **GetPrivateProfileInt** function to retrieve the last line number by reading the LastLine entry from the [MyApp] section of TESTCODE.INI:

```
WORD wInt;
char szMsg[144];

wInt = GetPrivateProfileInt("MyApp", "LastLine",
    0, "testcode.ini");
```

```
sprintf(szMsg, "last line was %d", wInt);
MessageBox(hwnd, szMsg, "GetPrivateProfileInt", MB_OK);
```

See Also
GetPrivateProfileString, **GetProfileInt**

Windows 3.1 changes

The **GetPrivateProfileInt** function supports hexadecimal notation. When the **GetPrivateProfileInt** function is used to retrieve a negative integer, the value should be cast to an **int**.

GetPrivateProfileString (3.0)

int GetPrivateProfileString(*lpszSection, lpszEntry, lpszDefault, lpszReturnBuffer, cbReturnBuffer, lpszFilename***)**

```
LPCSTR lpszSection;      /* address of section                */
LPCSTR lpszEntry;        /* address of entry                  */
LPCSTR lpszDefault;      /* address of default string         */
LPSTR lpszReturnBuffer;  /* address of destination buffer     */
int cbReturnBuffer;      /* size of destination buffer        */
LPCSTR lpszFilename;     /* address of initialization filename */
```

The **GetPrivateProfileString** function retrieves a character string from the specified section in the specified initialization file.

Parameter	Description
lpszSection	Points to a null-terminated string that specifies the section containing the entry.
lpszEntry	Points to the null-terminated string containing the entry whose associated string is to be retrieved. If this value is NULL, all entries in the section specified by the *lpszSection* parameter are copied to the buffer specified by the *lpszReturnBuffer* parameter. For more information, see the following Comments section.
lpszDefault	Points to a null-terminated string that specifies the default value for the given entry if the entry cannot be found in the initialization file. This parameter must never be NULL.
lpszReturnBuffer	Points to the buffer that receives the character string.
cbReturnBuffer	Specifies the size, in bytes, of the buffer pointed to by the *lpszReturnBuffer* parameter.
lpszFilename	Points to a null-terminated string that names the initialization file. If this parameter does not contain a full path, Windows searches for the file in the Windows directory.

Returns

The return value specifies the number of bytes copied to the specified buffer, not including the terminating null character.

Comments

The function searches the file for an entry that matches the name specified by the *lpszEntry* parameter under the section heading specified by the *lpszSection* parameter. If the entry is found, its corresponding string is copied to the buffer. If the entry does not exist, the default character string specified by the *lpszDefault* parameter is copied. A string entry in the initialization file must have the following form:

```
[section]
entry=string
    .
    .
    .
```

If *lpszEntry* is NULL, the **GetPrivateProfileString** function copies all entries in the specified section to the supplied buffer. Each string will be null-terminated, with the final string ending with two zero-termination characters. If the supplied destination buffer is too small to hold all the strings, the last string will be truncated and followed with two zero-termination characters.

If the string associated with *lpszEntry* is enclosed in single or double quotation marks, the marks are discarded when **GetPrivateProfileString** returns the string.

GetPrivateProfileString is not case-dependent, so the strings in *lpszSection* and *lpszEntry* may contain a combination of uppercase and lowercase letters.

An application can use the **GetProfileString** function to retrieve a string from the WIN.INI file.

The *lpszDefault* parameter must point to a valid string, even if the string is empty (its first character is zero).

Example

The following example uses the **GetPrivateProfileString** function to determine the last file saved by the [MyApp] application by reading the LastFile entry in TESTCODE.INI:

```
char szMsg[144], szBuf[80];

GetPrivateProfileString("MyApp", "LastFile",
    "", szBuf, sizeof(szBuf), "testcode.ini");

sprintf(szMsg, "last file was %s", szBuf);
MessageBox(hwnd, szMsg, "GetPrivateProfileString", MB_OK);
```

See Also

GetProfileString, **WritePrivateProfileString**

GetProcAddress (2.x)

FARPROC GetProcAddress(*hinst, lpszProcName***)**

HINSTANCE *hinst;* /* handle of module */
LPCSTR *lpszProcName;* /* address of function */

The **GetProcAddress** function retrieves the address of the given module function.

Parameter	Description
hinst	Identifies the module that contains the function.
lpszProcName	Points to a null-terminated string containing the function name, or specifies the ordinal value of the function. If it is an ordinal value, the value must be in the low-order word and the high-order word must be zero.

Returns

The return value is the address of the module function's entry point if the **GetProcAddress** function is successful. Otherwise, it is NULL.

If the *lpszProcName* parameter is an ordinal value and a function with the specified ordinal does not exist in the module, **GetProcAddress** can still return a non-NULL value. In cases where the function may not exist, specify the function by name rather than ordinal value.

Comments

Use the **GetProcAddress** function to retrieve addresses of exported functions in dynamic-link libraries (DLLs). The **MakeProcInstance** function can be used to access functions within different instances of the current module.

The spelling of the function name (pointed to by the *lpszProcName* parameter) must be identical to the spelling as it appears in the **EXPORTS** section of the source DLL's module-definition (.DEF) file.

Example

The following example uses the **GetProcAddress** function to retrieve the address of the **TimerCount** function in TOOLHELP.DLL:

```
char szBuf[80];
TIMERINFO timerinfo;
HINSTANCE hinstToolHelp;
BOOL (FAR *lpfnTimerCount) (TIMERINFO FAR*);

/* Turn off the "File not found" error box. */

SetErrorMode(SEM_NOOPENFILEERRORBOX);

/* Load the TOOLHELP.DLL library module. */

hinstToolHelp = LoadLibrary("TOOLHELP.DLL");

if (hinstToolHelp > HINSTANCE_ERROR) {    /* loaded successfully */

    /* Retrieve the address of the TimerCount function. */

    (FARPROC) lpfnTimerCount =
        GetProcAddress(hinstToolHelp, "TimerCount");

    if (lpfnTimerCount != NULL) {

        /* Call the TimerCount function. */
```

```
        timerinfo.dwSize = sizeof(TIMERINFO);

        if ((*lpfnTimerCount) ((TIMERINFO FAR *) &timerinfo)) {
            sprintf(szBuf, "task: %lu seconds\nVM: %lu seconds",
                timerinfo.dwmsSinceStart / 1000,
                timerinfo.dwmsThisVM / 1000);
        }
        else {
            strcpy(szBuf, "TimerCount failed");
        }
    }
    else {
        strcpy(szBuf, "GetProcAddress failed");
    }

    /* Free the TOOLHELP.DLL library module. */

    FreeLibrary(hinstToolHelp);
}
else {
    strcpy(szBuf, "LoadLibrary failed");
}

MessageBox(NULL, szBuf, "Library Functions", MB_ICONHAND);
```

See Also

MakeProcInstance

GetProfileInt (2.x)

UINT GetProfileInt(*lpszSection, lpszEntry, default***)**

```
LPCSTR lpszSection;     /* address of section                */
LPCSTR lpszEntry;       /* address of entry                  */
int default;            /* return value if entry is not found */
```

The **GetProfileInt** function retrieves the value of an integer from an entry within a specified section of the WIN.INI initialization file.

Parameter	Description
lpszSection	Points to a null-terminated string that specifies the section containing the entry.
lpszEntry	Points to the null-terminated string containing the entry whose value is to be retrieved.
default	Specifies the default value to return if the entry cannot be found. This value can be an unsigned value in the range 0 through 65,536 or a signed value in the range -32,768 through 32,768. Hexadecimal notation is accepted for both positive and negative values.

Returns

The return value is the integer value of the string following the specified entry, if the function is successful. The return value is the value of the *default* parameter if the function does not find the entry. The return value is zero if the value that corresponds to the specified entry is not an integer.

Comments

The **GetProfileInt** function is not case-dependent, so the strings in the *lpszSection* and *lpszEntry* parameters may contain a combination of uppercase and lowercase letters.

GetProfileInt supports hexadecimal notation. When the function is used to retrieve a negative integer, the value should be cast to an **int**.

An integer entry in the WIN.INI file must have the following form:

[*section*]
entry=value
.
.
.

If the value that corresponds to the entry consists of digits followed by nonnumeric characters, the function returns the value of the digits. For example, the function would return 102 for the line "Entry=102abc".

An application can use the **GetPrivateProfileInt** function to retrieve an integer from a specified file.

Example

The following example uses the **GetProfileInt** function to retrieve the screen-save timeout time from the WIN.INI file:

```
WORD wTimeOut;
char szMsg[80];

wTimeOut = GetProfileInt("windows",
    "ScreenSaveTimeOut", 0);

sprintf(szMsg, "timeout time is %d", wTimeOut);
MessageBox(hwnd, szMsg, "GetProfileInt", MB_OK);
```

See Also

GetPrivateProfileInt, **GetProfileString**

Windows 3.1 changes

The **GetProfileInt** function supports hexadecimal notation. When the **GetProfileInt** function is used to retrieve a negative integer, the value should be cast to an **int**.

GetProfileString (2.x)

int GetProfileString(*lpszSection, lpszEntry, lpszDefault, lpszReturnBuffer, cbReturnBuffer***)**

LPCSTR *lpszSection;* /* address of section */
LPCSTR *lpszEntry;* /* address of entry */
LPCSTR *lpszDefault;* /* address of default string */
LPSTR *lpszReturnBuffer;* /* address of destination buffer */
int *cbReturnBuffer;* /* size of destination buffer */

The **GetProfileString** function retrieves the string associated with an entry within the specified section in the WIN.INI initialization file.

Parameter	Description
lpszSection	Points to a null-terminated string that specifies the section containing the entry.
lpszEntry	Points to the null-terminated string containing the entry whose associated string is to be retrieved. If this value is NULL, all entries in the section specified by the *lpszSection* parameter are copied to the buffer specified by the *lpszReturnBuffer* parameter. For more information, see the following Comments section.
lpszDefault	Points to the default value for the given entry if the entry cannot be found in the initialization file. This parameter must never be NULL.
lpszReturnBuffer	Points to the buffer that will receive the character string.
cbReturnBuffer	Specifies the size, in bytes, of the buffer pointed to by the *lpszReturnBuffer* parameter.

Returns
The return value is the number of bytes copied to the buffer, not including the terminating zero, if the function is successful.

Comments
If the *lpszEntry* parameter is NULL, the **GetProfileString** function copies all entries in the specified section to the supplied buffer. Each string will be null-terminated, with the final string terminating with two null characters. If the supplied destination buffer is too small to hold all the strings, the last string will be truncated and followed by two terminating null characters.

If the string associated with *lpszEntry* is enclosed in single or double quotation marks, the marks are discarded when **GetProfileString** returns the string.

GetProfileString is not case-dependent, so the strings in the *lpszSection* and *lpszEntry* parameters may contain a combination of uppercase and lowercase letters.

A string entry in the WIN.INI file must have the following form:

[*section*]
entry=string
.
.
.

An application can use the **GetPrivateProfileString** function to retrieve a string from a specified file.

The *lpszDefault* parameter must point to a valid string, even if the string is empty (its first character is zero).

Example
The following example uses the **GetProfileString** function to list all the entries and strings in the [windows] section of the WIN.INI file:

```
int c, cc;
```

```
PSTR pszBuf, pszKey;
char szMsg[80], szVal[80];

/* Allocate a buffer for the entries. */

pszBuf = (PSTR) LocalAlloc(LMEM_FIXED, 1024);

/* Retrieve all the entries in the [windows] section. */

GetProfileString("windows", NULL, "", pszBuf, 1024);

 /*
  *  Retrieve the string for each entry, until
  *  reaching the double null character.
  */

for (pszKey = pszBuf, c = 0;
        *pszKey != '\0'; pszKey += strlen(pszKey) + 1) {

    /* Retrieve the value for each entry in the buffer. */

    GetProfileString("windows", pszKey, "not found",
        szVal, sizeof(szVal));

    cc = sprintf(szMsg, "%s = %s", pszKey, szVal);
    TextOut(hdc, 10, 15 * c++, szMsg, cc);
}

LocalFree((HANDLE) pszBuf);
```

See Also

GetPrivateProfileString, WriteProfileString

GetSelectorBase (3.1)

DWORD GetSelectorBase(*uSelector***)**

UINT *uSelector;*

The **GetSelectorBase** function retrieves the base address of a selector.

Parameter	Description
uSelector	Specifies the selector whose base address is retrieved.

Returns
This function returns the base address of the specified selector.

See Also
GetSelectorLimit, **SetSelectorBase**, **SetSelectorLimit**

GetSelectorLimit (3.1)

DWORD GetSelectorLimit(*uSelector***)**

UINT *uSelector;*

The **GetSelectorLimit** function retrieves the limit of a selector.

Parameter	Description
uSelector	Specifies the selector whose limit is being retrieved.

Returns
This function returns the limit of the specified selector.

See Also
GetSelectorBase, **SetSelectorBase**, **SetSelectorLimit**

GetSystemDirectory (3.0)

UINT GetSystemDirectory(*lpszSysPath, cbSysPath***)**

LPSTR *lpszSysPath;* /* address of buffer for system directory */
UINT *cbSysPath;* /* size of directory buffer */

The **GetSystemDirectory** function retrieves the path of the Windows system directory. The system directory contains such files as Windows libraries, drivers, and font files.

Parameter	Description
lpszSysPath	Points to the buffer that is to receive the null-terminated string containing the path of the system directory.
cbSysPath	Specifies the maximum size, in bytes, of the buffer. This value should be set to at least 144 to allow sufficient room in the buffer for the path.

Returns

The return value is the length, in bytes, of the string copied to the *lpszSysPath* parameter, not including the terminating null character. If the return value is greater than the size specified in the *cbSysPath* parameter, the return value is the size of the buffer required to hold the path. The return value is zero if the function fails.

Comments

Applications should *not* create files in the system directory. If the user is running a shared version of Windows, the application will not have write access to the system directory. Applications should create files only in the directory returned by the **GetWindowsDirectory** function.

The path that this function retrieves does not end with a backslash unless the system directory is the root directory. For example, if the system directory is named WINDOWS\SYSTEM on drive C, the path of the system directory retrieved by this function is C:\WINDOWS\SYSTEM.

A similar function, **GetSystemDir**, is intended for use by MS-DOS applications that set up Windows applications. Windows applications should use **GetSystemDirectory**, not **GetSystemDir**.

Example

The following example uses the **GetSystemDirectory** function to determine the path of the Windows system directory:

```
WORD wReturn;
char szBuf[144];

wReturn = GetSystemDirectory((LPSTR) szBuf, sizeof(szBuf));

if (wReturn == 0)
    MessageBox(hwnd, "function failed",
        "GetSystemDirectory", MB_ICONEXCLAMATION);

else if (wReturn > sizeof(szBuf))
    MessageBox(hwnd, "buffer is too small",
        "GetSystemDirectory", MB_ICONEXCLAMATION);

else
    MessageBox(hwnd, szBuf, "GetSystemDirectory", MB_OK);
```

See Also

GetWindowsDirectory

GetTempDrive (2.x)

BYTE GetTempDrive(*chDriveLetter***)**

char *chDriveLetter;* /* ignored */

The **GetTempDrive** function returns a letter that specifies a disk drive the application can use for temporary files.

Parameter	Description
chDriveLetter	This parameter is ignored.

Returns

The return value specifies a disk drive for temporary files if the function is successful. If at least one hard disk drive is available, the function returns the letter of the first hard disk drive (usually C). If no hard disk drives are available, the function returns the letter of the current drive.

Example

The following example uses the **GetTempDrive** function to determine a suitable disk drive for temporary files:

```
char szMsg[80];
BYTE bTempDrive;

bTempDrive = GetTempDrive(0);

sprintf(szMsg, "temporary drive: %c", bTempDrive);

MessageBox(hwnd, szMsg, "GetTempDrive", MB_OK);
```

See Also

GetTempFileName

GetTempFileName (2.x)

int GetTempFileName(*bDriveLetter, lpszPrefixString, uUnique, lpszTempFileName***)**

```
BYTE bDriveLetter;      /* suggested drive                    */
LPCSTR lpszPrefixString; /* address of filename prefix         */
UINT uUnique;           /* number to use as prefix            */
LPSTR lpszTempFileName; /* address of buffer for created filename */
```

The **GetTempFileName** function creates a temporary filename of the following form:

*drive:******path******prefixuuuu.***TMP**

The following list describes the filename syntax:

Element	Description
drive	Drive letter specified by the *bDriveLetter* parameter
path	Path of the temporary file (either the Windows directory or the directory specified in the TEMP environment variable)
prefix	All the letters (up to the first three) of the string pointed to by the *lpszPrefixString* parameter
uuuu	Hexadecimal value of the number specified by the *uUnique* parameter

Parameter	Description
bDriveLetter	Specifies the suggested drive for the temporary filename. If this parameter is zero, Windows uses the current default drive.
lpszPrefixString	Points to a null-terminated string to be used as the temporary filename prefix. This string must consist of characters in the OEM-defined character set.
uUnique	Specifies an unsigned short integer. If this parameter is nonzero, it will be appended to the temporary filename. If the parameter is zero, Windows uses the current system time to create a number to append to the filename.
lpszTempFileName	Points to the buffer that will receive the temporary filename. This string consists of characters in the OEM-defined character set. This buffer should be at least 144 bytes in length to allow sufficient room for the path.

Returns

The return value specifies a unique numeric value used in the temporary filename. If the *uUnique* parameter is nonzero, the return value specifies this same number.

Comments

Temporary files created with this function are *not* automatically deleted when Windows shuts down.

To avoid problems resulting from converting an OEM character string to a Windows string, an application should call the **_lopen** function to create the temporary file.

The **GetTempFileName** function uses the suggested drive letter for creating the temporary filename, except in the following cases:

- If a hard disk is present, **GetTempFileName** always uses the drive letter of the first hard disk.
- If, however, a TEMP environment variable is defined and its value begins with a drive letter, that drive letter is used.

If the TF_FORCEDRIVE bit of the *bDriveLetter* parameter is set, the preceding exceptions do not apply. The temporary filename will always be created in the current directory of the drive specified by *bDriveLetter,* regardless of the presence of a hard disk or the TEMP environment variable.

If the *uUnique* parameter is zero, **GetTempFileName** attempts to form a unique number based on the current system time. If a file with the resulting filename exists, the number is increased by one and the test for existence is repeated. This continues until a unique filename is found; **GetTempFileName** then

creates a file by that name and closes it. No attempt is made to create and open the file when *uUnique* is nonzero.

Example

The following example uses the **GetTempFileName** function to create a unique temporary filename on the first available hard disk:

```
HFILE hfTempFile;
char szBuf[144];

/* Create a temporary file. */

GetTempFileName(0, "tst", 0, szBuf);

hfTempFile = _lcreat(szBuf, 0);

if (hfTempFile == HFILE_ERROR) {
    ErrorHandler();
}
```

See Also

GetTempDrive, **_lopen**

GetThresholdEvent (2.x)

int FAR* GetThresholdEvent(void)

This function is obsolete. Use the Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

GetThresholdStatus (2.x)

int GetThresholdStatus(void)

This function is obsolete. Use the Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

GetVersion (2.x)

DWORD GetVersion(void)

The **GetVersion** function retrieves the current version numbers of the Windows and MS-DOS operation systems.

Returns
The return value specifies the major and minor version numbers of Windows and of MS-DOS.

Comments
The low-order word of the return value contains the version of Windows, if the function is successful. The high-order byte contains the minor version (revision) number as a two-digit decimal number. For example, in Windows 3.1, the minor version number is 10. The low-order byte contains the major version number.

The high-order word contains the version of MS-DOS, if the function is successful. The high-order byte contains the major version; the low-order byte contains the minor version (revision) number.

Example
The following example uses the **GetVersion** function to display the Windows and MS-DOS version numbers:

```
int len;
char szBuf[80];
DWORD dwVersion;

dwVersion = GetVersion();

len = sprintf(szBuf, "Windows version %d.%d\n",
    LOBYTE(LOWORD(dwVersion)),
    HIBYTE(LOWORD(dwVersion)));

sprintf(szBuf + len, "MS-DOS version %d.%d",
    HIBYTE(HIWORD(dwVersion)),
    LOBYTE(HIWORD(dwVersion)));

MessageBox(NULL, szBuf, "GetVersion", MB_ICONINFORMATION);
```

Note that the major and minor version information is reversed between the Windows version and MS-DOS version.

Win 3.1 correction

The return value is a **DWORD**, not a WORD. The high-order word contains the DOS version.

GetWinDebugInfo (3.1)

BOOL GetWinDebugInfo(*lpwdi, flags***)**

```
WINDEBUGINFO FAR* lpwdi;        /* address of WINDEBUGINFO structure   */
UINT flags;                     /* flags for returned information      */
```

The **GetWinDebugInfo** function retrieves current system-debugging information for the debugging version of the Windows 3.1 operating system.

Parameter	Description
lpwdi	Points to a **WINDEBUGINFO** structure that is filled with debugging information.
flags	Specifies which members of the **WINDEBUGINFO** structure should be filled in. This parameter can be one or more of the following values:

Value	Meaning
WDI_OPTIONS	Fill in the **dwOptions** member of **WINDEBUGINFO**.
WDI_FILTER	Fill in the **dwFilter** member of **WINDEBUGINFO**.
WDI_ALLOCBREAK	Fill in the **achAllocModule**, **dwAllocBreak**, and **dwAllocCount** members of **WINDEBUGINFO**.

Returns

The return value is nonzero if the function is successful. It is zero if the pointer specified in the *lpwdi* parameter is invalid or if the function is not called in the debugging version of Windows 3.1.

Comments

The **flags** member of the returned **WINDEBUGINFO** structure is set to the values supplied in the *flags* parameter of this function.

See Also

SetWinDebugInfo, **WINDEBUGINFO**

WDI_OPTIONS 0x0001

Fill in the **dwOptions** member of **WINDEBUGINFO**.

WDI_OPTIONS 0x0001

WDI_FILTER 0x0002

Fill in the **dwFilter** member of **WINDEBUGINFO**.

WDI_FILTER 0x0002

WDI_ALLOCBREAK 0x0004

Fill in the **achAllocModule**, **dwAllocBreak**, and **dwAllocCount** members of **WINDEBUGINFO**.

WDI_ALLOCBREAK 0x0004

GetWindowsDirectory (3.0)

UINT GetWindowsDirectory(*lpszSysPath, cbSysPath***)**

LPSTR *lpszSysPath;* /* address of buffer for Windows directory*/
UINT *cbSysPath;* /* size of directory buffer */

The **GetWindowsDirectory** function retrieves the path of the Windows directory. The Windows directory contains such files as Windows applications, initialization files, and help files.

Parameter	Description
lpszSysPath	Points to the buffer that will receive the null-terminated string containing the path.
cbSysPath	Specifies the maximum size, in bytes, of the buffer. This value should be set to at least 144 to allow sufficient room in the buffer for the path.

Returns

The return value is the length, in bytes, of the string copied to the *lpszSysPath* parameter, not including the terminating null character. If the return value is greater than the number specified in the *cbSysPath* parameter, it is the size of the buffer required to hold the path. The return value is zero if the function fails.

Comments

The Windows directory is the *only* directory where an application should create files. If the user is running a shared version of Windows, the Windows directory is the only directory guaranteed private to the user.

The path this function retrieves does not end with a backslash unless the Windows directory is the root directory. For example, if the Windows directory is named WINDOWS on drive C, the path retrieved by this function is C:\WINDOWS. If Windows is installed in the root directory of drive C, the path retrieved is C:\.

A similar function, **GetWindowsDir**, is intended for use by MS-DOS applications that set up Windows applications. Windows applications should use **GetWindowsDirectory**, not **GetWindowsDir**.

Example

The following example uses the **GetWindowsDirectory** function to determine the path of the Windows directory:

```
WORD wReturn;
char szBuf[144];

wReturn = GetWindowsDirectory((LPSTR)szBuf, sizeof(szBuf));

if (wReturn == 0)
    MessageBox(hwnd, "function failed",
        "GetWindowsDirectory", MB_ICONEXCLAMATION);

else if (wReturn > sizeof(szBuf))
    MessageBox(hwnd, "buffer is too small",
        "GetWindowsDirectory", MB_ICONEXCLAMATION);

else
    MessageBox(hwnd, szBuf, "GetWindowsDirectory", MB_OK);
```

See Also

GetSystemDirectory

GetWinFlags (3.0)

DWORD GetWinFlags(void)

The **GetWinFlags** function retrieves the current Windows system and memory configuration.

Returns
The return value specifies the current system and memory configuration.

Comments
The configuration returned by **GetWinFlags** can be a combination of the following values:

Value	Meaning
WF_80x87	System contains an Intel math coprocessor.
WF_CPU286	System CPU is an 80286.
WF_CPU386	System CPU is an 80386.
WF_CPU486	System CPU is an i486.
WF_ENHANCED	Windows is running in 386-enhanced mode. The **WF_PMODE** flag is always set when **WF_ENHANCED** is set.
WF_PAGING	Windows is running on a system with paged memory.
WF_PMODE	Windows is running in protected mode. In Windows 3.1, this flag is always set.
WF_STANDARD	Windows is running in standard mode. The **WF_PMODE** flag is always set when **WF_STANDARD** is set.
WF_WIN286	Same as WF_STANDARD.
WF_WIN386	Same as WF_ENHANCED.

Example
The following example uses the **GetWinFlags** function to display information about the current Windows system configuration:

```
int len;
char szBuf[80];
DWORD dwFlags;

dwFlags = GetWinFlags();

len = sprintf(szBuf, "system %s a coprocessor",
    (dwFlags & WF_80x87) ? "contains" : "does not contain");
TextOut(hdc, 10, 15, szBuf, len);

len = sprintf(szBuf, "processor is an %s",
    (dwFlags & WF_CPU286) ? "80286" :
    (dwFlags & WF_CPU386) ? "80386" :
    (dwFlags & WF_CPU486) ? "i486" : "unknown");
TextOut(hdc, 10, 30, szBuf, len);

len = sprintf(szBuf, "running in %s mode",
    (dwFlags & WF_ENHANCED) ? "enhanced" : "standard");
TextOut(hdc, 10, 45, szBuf, len);

len = sprintf(szBuf, "%s WLO",
    (dwFlags & WF_WLO) ? "using" : "not using");
TextOut(hdc, 10, 60, szBuf, len);
```

WF_80x87 0x0400

System contains an Intel math coprocessor.

WF_80x87 0x0400

WF_CPU286 0x0002

System CPU is an 80286.

WF_CPU286 0x0002

WF_CPU386 0x0004

System CPU is an 80386.

WF_CPU386 0x0004

WF_CPU486 0x0008

System CPU is an i486.

WF_CPU486 0x0008

WF_ENHANCED 0x0020

Windows is running in 386-enhanced mode. The **WF_PMODE** flag is always set when WF_ENHANCED is set.

WF_ENHANCED 0x0020

WF_PAGING 0x0800

Windows is running on a system with paged memory.

WF_PAGING 0x0800

WF_PMODE 0x0001

Windows is running in protected mode. In Windows 3.1, this flag is always set.

WF_PMODE 0x0001

WF_STANDARD 0x0010

Windows is running in standard mode. The **WF_PMODE** flag is always set when WF_STANDARD is set.

WF_STANDARD 0x0010

WF_WIN286 0x0010

Same as WF_STANDARD.

WF_WIN286 0x0010

WF_WIN386 0x0020

Same as WF_ENHANCED.

WF_WIN386 0x0020

GlobalAlloc (2.x)

HGLOBAL GlobalAlloc(*fuAlloc, cbAlloc***)**

UINT *fuAlloc;* /* how to allocate object */
DWORD *cbAlloc;* /* size of object */

The **GlobalAlloc** function allocates the specified number of bytes from the global heap.

Parameter	Description
fuAlloc	Specifies how to allocate memory. This parameter can be a combination of the following values:

Value	Meaning
GHND	Combines the **GMEM_MOVEABLE** and **GMEM_ZEROINIT** flags.
GMEM_DDESHARE	Allocates sharable memory. This flag is used for dynamic data exchange (DDE) only. This flag is equivalent to GMEM_SHARE.
GMEM_DISCARDABLE	Allocates discardable memory. This flag can only be used with the **GMEM_MOVEABLE** flag.
GMEM_FIXED	Allocates fixed memory. The **GMEM_FIXED** and **GMEM_MOVEABLE** flags cannot be combined.
GMEM_LOWER	Same as GMEM_NOT_BANKED. This flag is ignored in Windows 3.1.
GMEM_MOVEABLE	Allocates movable memory. The **GMEM_FIXED** and **GMEM_MOVEABLE** flags cannot be combined.
GMEM_NOCOMPACT	Does not compact or discard memory to satisfy the allocation request.
GMEM_NODISCARD	Does not discard memory to satisfy the allocation request.
GMEM_NOT_BANKED	Allocates non-banked memory (memory is not within the memory provided by expanded memory). This flag cannot be used with the **GMEM_NOTIFY** flag. This flag is ignored in Windows 3.1.
GMEM_NOTIFY	Calls the notification routine if the memory object is discarded.
GMEM_SHARE	Allocates memory that can be shared with other applications. This flag is equivalent to GMEM_DDESHARE.
GMEM_ZEROINIT	Initializes memory contents to zero.
GPTR	Combines the **GMEM_FIXED** and **GMEM_ZEROINIT** flags.

cbAlloc	Specifies the number of bytes to be allocated.

Returns

The return value is the handle of the newly allocated global memory object, if the function is successful. Otherwise, it is NULL.

Comments

To convert the handle returned by the **GlobalAlloc** function into a pointer, an application should use the **GlobalLock** function.

If this function is successful, it allocates at least the amount requested. If the amount allocated is greater than the amount requested, the application can use the entire amount. To determine the size of a global

memory object, an application can use the **GlobalSize** function.

To free a global memory object, an application should use the **GlobalFree** function. To change the size or attributes of an allocated memory object, an application can use the **GlobalReAlloc** function.

The largest memory object that an application can allocate on an 80286 processor is 1 megabyte less 80 bytes. The largest block on an 80386 processor is 16 megabytes less 64K.

If the *cbAlloc* parameter is zero, the **GlobalAlloc** function returns a handle of a memory object that is marked as discarded.

Example

The following example uses the **GlobalAlloc** and **GlobalLock** functions to allocate memory, and then calls the **GlobalUnlock** and **GlobalFree** functions to free it.

```
HGLOBAL hglb;
void FAR* lpvBuffer;

hglb = GlobalAlloc(GPTR, 1024);
lpvBuffer = GlobalLock(hglb);
    .
    .
    .
GlobalUnlock(hglb);
GlobalFree(hglb);
```

See Also

GlobalFree, **GlobalLock**, **GlobalNotify**, **GlobalReAlloc**, **GlobalSize**, **GlobalUnlock**, **LocalAlloc**

GHND (**GMEM_MOVEABLE** | **GMEM_ZEROINIT**)

Combines the **GMEM_MOVEABLE** and **GMEM_ZEROINIT** flags.

GHND (GMEM_MOVEABLE | GMEM_ZEROINIT)

GMEM_DDESHARE 0x2000

Allocates sharable memory. This flag is used for dynamic data exchange (DDE) only. This flag is equivalent to GMEM_SHARE.

GMEM_DDESHARE 0x2000

GMEM_DISCARDABLE 0x0100

Allocates discardable memory. This flag can only be used with the **GMEM_MOVEABLE** flag.

GMEM_DISCARDABLE 0x0100

GMEM_FIXED 0x0000

Allocates fixed memory. The GMEM_FIXED and **GMEM_MOVEABLE** flags cannot be combined.

GMEM_FIXED 0x0000

GMEM_LOWER **GMEM_NOT_BANKED**

Same as GMEM_NOT_BANKED. This flag is ignored in Windows 3.1.

GMEM_LOWER GMEM_NOT_BANKED

GMEM_MOVEABLE 0x0002

Allocates movable memory. The **GMEM_FIXED** and GMEM_MOVEABLE flags cannot be combined.

GMEM_MOVEABLE 0x0002

GMEM_NOCOMPACT 0x0010

Does not compact or discard memory to satisfy the allocation request.

GMEM_NOCOMPACT 0x0010

GMEM_NODISCARD 0x0020

Does not discard memory to satisfy the allocation request.

GMEM_NODISCARD 0x0020

GMEM_NOT_BANKED 0x1000

Allocates non-banked memory (memory is not within the memory provided by expanded memory). This flag cannot be used with the **GMEM_NOTIFY** flag. This flag is ignored in Windows 3.1.

GMEM_NOT_BANKED 0x1000

GMEM_NOTIFY 0x4000

Calls the notification routine if the memory object is discarded.

GMEM_NOTIFY 0x4000

GMEM_SHARE 0x2000

Allocates memory that can be shared with other applications. This flag is equivalent to GMEM_DDESHARE.

GMEM_SHARE 0x2000

GMEM_ZEROINIT 0x0040

Initializes memory contents to zero.

GMEM_ZEROINIT 0x0040

GPTR (**GMEM_FIXED** | **GMEM_ZEROINIT**)

Combines the **GMEM_FIXED** and **GMEM_ZEROINIT** flags.

```
GPTR    (GMEM_FIXED | GMEM_ZEROINIT)
```

GlobalCompact (2.x)

DWORD GlobalCompact(*dwMinFree***)**

DWORD *dwMinFree;* /* amount of memory requested */

The **GlobalCompact** function rearranges memory currently allocated to the global heap so that the specified amount of memory is free. If the function cannot free the requested amount of memory, it frees as much as possible.

Parameter	Description
dwMinFree	Specifies the number of contiguous free bytes desired. If this parameter is zero, the function does not discard memory, but the return value is valid.

Returns

The return value specifies the number of bytes in the largest free global memory object in the global heap. If the *dwMinFree* parameter is zero, the return value specifies the number of bytes in the largest free object that Windows can generate if it removes all discardable objects.

Comments

If an application passes the return value to the **GlobalAlloc** function, the **GMEM_NOCOMPACT** or **GMEM_NODISCARD** flag should not be used.

This function always rearranges movable memory objects before checking for free memory. Then it checks the memory currently allocated to the global heap for the number of contiguous free bytes specified by the *dwMinFree* parameter. If the specified amount of memory is not available, the function discards unlocked discardable objects, until the requested space is generated (if possible).

This function is not very useful in most enhanced-mode configurations, which rely on virtual memory. In such an environment, an application can discover how much memory is available by requesting the memory and checking the error value.

See Also

GlobalAlloc

GlobalDosAlloc (3.0)

DWORD GlobalDosAlloc(*cbAlloc***)**

DWORD *cbAlloc;* /* number of bytes to allocate */

The **GlobalDosAlloc** function allocates global memory that can be accessed by MS-DOS running in real mode. The memory is guaranteed to exist in the first megabyte of linear address space.

An application should not use this function unless it is absolutely necessary, because the memory pool from which the object is allocated is a scarce system resource.

Parameter	Description
cbAlloc	Specifies the number of bytes to be allocated.

Returns

The return value contains a paragraph-segment value in its high-order word and a selector in its low-order word. An application can use the paragraph-segment value to access memory in real mode and the selector to access memory in protected mode. If Windows cannot allocate a block of memory of the requested size, the return value is zero.

Comments

Memory allocated by using the **GlobalDosAlloc** function does not need to be locked by using the **GlobalLock** function.

See Also

GlobalDosFree

GlobalDosFree (3.0)

UINT GlobalDosFree(*uSelector***)**

UINT *uSelector;* /* memory to free */

The **GlobalDosFree** function frees a global memory object previously allocated by the **GlobalDosAlloc** function.

Parameter	Description
uSelector	Identifies the memory object to be freed.

Returns
The return value is zero if the function is successful. Otherwise, it is equal to the *uSelector* parameter.

See Also
GlobalDosAlloc

GlobalFix (3.0)

void GlobalFix(*hglb***)**

HGLOBAL *hglb;* /* handle of object to fix */

The **GlobalFix** function prevents the given global memory object from moving in linear memory.

This function interferes with effective Windows memory management and can result in linear-address fragmentation. Few applications need to fix memory in linear address space.

Parameter	Description
hglb	Identifies the global memory object to be fixed in linear memory.

Returns

This function does not return a value.

Comments

The object is locked into linear memory at its current address, and its lock count is incremented (increased by one). Locked memory is not subject to moving or discarding except when the memory object is being reallocated by the **GlobalReAlloc** function. The object remains locked in memory until its lock count is decreased to zero.

Each time an application calls the **GlobalFix** function for a memory object, it must eventually call the **GlobalUnfix** function, which decrements (decreases by one) the lock count for the object. Other functions also can affect the lock count of a memory object. For a list of these functions, see the description of the **GlobalFlags** function.

See Also

GlobalFlags, **GlobalReAlloc**, **GlobalUnfix**

GlobalFlags (2.x)

UINT GlobalFlags(*hglb***)**

HGLOBAL *hglb;* /* handle of global memory object */

The **GlobalFlags** function returns information about the given global memory object.

Parameter	Description
hglb	Identifies the global memory object.

Returns
The return value specifies the memory-allocation flag and the lock count for the memory object, if the function is successful.

Comments
When an application masks out the lock count in the low-order byte of the return value, the return value contains one of the following allocation flags:

Value	Meaning
GMEM_DISCARDABLE	Object can be discarded.
GMEM_DISCARDED	Object has been discarded.

The low-order byte of the return value contains the lock count of the object. Use the GMEM_LOCKCOUNT mask to retrieve the lock count from the return value.

The following functions can affect the lock count of a global memory object:

Increments lock count	Decrements lock count
GlobalFix	**GlobalUnfix**
GlobalLock	**GlobalUnlock**

See Also
GlobalFix, **GlobalLock**, **GlobalUnfix**, **GlobalUnlock**

GlobalFree (2.x)

HGLOBAL GlobalFree(*hglb***)**

HGLOBAL *hglb;* /* handle of object to free */

The **GlobalFree** function frees the given global memory object (if the object is not locked) and invalidates its handle.

Parameter	Description
hglb	Identifies the global memory object to be freed.

Returns

The return value is NULL if the function is successful. Otherwise, it is equal to the *hglb* parameter.

Comments

The **GlobalFree** function cannot be used to free a locked memory object--that is, a memory object with a lock count greater than zero. For a list of the functions that affect the lock count, see the description of the **GlobalFlags** function.

Once freed, the handle of the memory object must not be used again. Attempting to free the same memory object more than once can cause Windows to terminate abnormally.

Example

The following code fragment uses the **GlobalAlloc** and **GlobalLock** functions to allocate memory, and then calls the **GlobalUnlock** and **GlobalFree** functions to free it.

```
HGLOBAL hglb;
void FAR* lpvBuffer;

hglb = GlobalAlloc(GPTR, 1024);
lpvBuffer = GlobalLock(hglb);
    .
    .
    .
GlobalUnlock(hglb);
GlobalFree(hglb);
```

See Also

GlobalDiscard, **GlobalFlags**, **GlobalLock**, **GlobalUnlock**

GlobalHandle (2.x)

DWORD GlobalHandle(*uGlobalSel***)**

UINT *uGlobalSel;* /* selector of global memory object */

The **GlobalHandle** function retrieves the handle of the specified global memory object.

Parameter	Description
uGlobalSel	Specifies the selector of a global memory object.

Returns

The low-order word of the return value contains the handle of the global memory object, and the high-order word contains the selector of the memory object, if the function is successful. The return value is NULL if no handle exists for the memory object.

GlobalLock (2.x)

void FAR* GlobalLock(*hglb***)**

HGLOBAL *hglb;* /* handle of memory object to lock */

The **GlobalLock** function returns a pointer to the given global memory object. **GlobalLock** increments (increases by one) the lock count of movable objects and locks the memory. Locked memory will not be moved or discarded unless the memory object is reallocated by the **GlobalReAlloc** function. The object remains locked in memory until its lock count is decreased to zero.

Parameter	Description
hglb	Identifies the global memory object to be locked.

Returns

The return value points to the first byte of memory in the global object, if the function is successful. It is NULL if the object has been discarded or an error occurs.

Comments

Each time an application calls the **GlobalLock** function for an object, it must eventually call the **GlobalUnlock** function for the object.

This function will return NULL if an application attempts to lock a memory object with a zero-byte size.

If **GlobalLock** incremented the lock count for the object, **GlobalUnlock** decrements the lock count for the object. Other functions can also affect the lock count of a memory object. For a list of these functions, see the description of the **GetGlobalFlags** function.

Discarded objects always have a lock count of zero.

Example

The following example uses the **GlobalAlloc** and **GlobalLock** functions to allocate memory, and then calls the **GlobalUnlock** and **GlobalFree** functions to free it.

```
HGLOBAL hglb;
void FAR* lpvBuffer;

hglb = GlobalAlloc(GPTR, 1024);
lpvBuffer = GlobalLock(hglb);
    .
    .
    .
GlobalUnlock(hglb);
GlobalFree(hglb);
```

See Also

GlobalAlloc, **GlobalFlags**, **GlobalFree**, **GlobalLock**, **GlobalReAlloc**, **GlobalUnlock**

GlobalLRUNewest (2.x)

HGLOBAL GlobalLRUNewest(*hglb***)**

HGLOBAL *hglb;* /* handle of memory object to move */

The **GlobalLRUNewest** function moves a global memory object to the newest least-recently-used (LRU) position in memory. This greatly reduces the likelihood that the object will be discarded soon, but does not prevent the object from eventually being discarded.

Parameter	Description
hglb	Identifies the global memory object to be moved.

Returns
The return value is NULL if the *hglb* parameter is not a valid handle.

Comments
The **GlobalLRUNewest** function is useful only if the given object is discardable.

See Also
GlobalLRUOldest

GlobalLRUOldest (2.x)

HGLOBAL GlobalLRUOldest(*hglb***)**

HGLOBAL *hglb;* /* handle of memory object to move */

The **GlobalLRUOldest** function moves a global memory object to the oldest least-recently-used (LRU) position in memory. This makes the memory object the next candidate for discarding.

Parameter	Description
hglb	Identifies the global memory object to be moved.

Returns
The return value is NULL if the *hglb* parameter does not identify a valid handle.

Comments
The **GlobalLRUOldest** function is useful only if the *hglb* parameter is discardable.

See Also
GlobalLRUNewest

GlobalNotify (2.x)

void GlobalNotify(*lpNotifyProc***)**

GNOTIFYPROC *lpNotifyProc;* /* instance address of callback function */

The **GlobalNotify** function installs a notification procedure for the current task. A notification procedure is a library-defined callback function that the system calls whenever a global memory object allocated with the **GMEM_NOTIFY** flag is about to be discarded.

Parameter	Description
lpNotifyProc	Specifies the address of the current task's notification procedure. For more information, see the description of the **NotifyProc** callback function.

Returns

This function does not return a value.

Comments

An application must not call the **GlobalNotify** function more than once per instance.

The system does not call the notification procedure when discarding memory that belongs to a dynamic-link library (DLL).

If the object is discarded, the application must use the **GMEM_NOTIFY** flag when it calls the **GlobalRealloc** function to recreate the object. Otherwise, the application will not be notified when the object is discarded again.

If the notification procedure returns a nonzero value, Windows discards the global memory object. If the procedure returns zero, the block is not discarded.

The address of the **NotifyProc** callback function (specified in the *lpNotifyProc* parameter) must be in a fixed code segment of a dynamic-link library.

See Also

GlobalReAlloc, **NotifyProc**

GlobalPageLock (3.0)

UINT GlobalPageLock(*hglb***)**

HGLOBAL *hglb;* /* selector of global memory to lock */

The **GlobalPageLock** function increments (increases by one) the page-lock count for the memory associated with the given global selector. As long as its page-lock count is nonzero, the data that the selector references is guaranteed to remain in memory at the same physical address.

Parameter	Description
hglb	Specifies the selector of the memory to be page-locked.

Returns

The return value specifies the page-lock count after the function has incremented it. If the function fails, the return value is zero.

Comments

Because using this function violates preferred Windows programming practices, an application should not use it unless absolutely necessary. The function is intended to be used for dynamically allocated data that must be accessed at interrupt time. For this reason, it must be called only from a dynamic-link library (DLL).

The **GlobalPageLock** function increments the page-lock count for the block of memory, and the **GlobalPageUnlock** function decrements (decreases by one) the page-lock count. Page-locking operations can be nested, but each page-locking must be balanced by a corresponding unlocking.

See Also

GlobalPageUnlock

GlobalPageUnlock (3.0)

UINT GlobalPageUnlock(*hglb***)**

HGLOBAL *hglb;* /* selector of global memory to unlock */

The **GlobalPageLock** function decrements (decreases by one) the page-lock count for the memory associated with the specified global selector. When the page-lock count reaches zero, the data that the selector references is no longer guaranteed to remain in memory at the same physical address.

Parameter	Description
hglb	Specifies the selector of the memory to be page-unlocked.

Returns

The return value specifies the page-lock count after the function has decremented it. If the function fails, the return value is zero.

Comments

Because using this function violates preferred Windows programming practices, an application should not use it unless absolutely necessary. The function is intended to be used for dynamically allocated data that must be accessed at interrupt time. For this reason, it must only be called from a dynamic-link library (DLL).

The **GlobalPageLock** function increments the page-lock count for the block of memory, and the **GlobalPageUnlock** function decrements the page-lock count. Page-locking operations can be nested, but each page-locking must be balanced by a corresponding unlocking.

See Also

GlobalPageLock

GlobalReAlloc (2.x)

HGLOBAL GlobalReAlloc(*hglb, cbNewSize, fuAlloc***)**

```
HGLOBAL hglb;       /* handle of memory object to reallocate  */
DWORD cbNewSize;    /* new size of object                     */
UINT fuAlloc;       /* how object is reallocated              */
```

The **GlobalReAlloc** function changes the size or attributes of the given global memory object.

Parameter	Description
hglb	Identifies the global memory object to be reallocated.
cbNewSize	Specifies the new size of the memory object.
fuAlloc	Specifies how to reallocate the global object. If this parameter includes GMEM_MODIFY, the **GlobalReAlloc** function ignores the *cbNewSize* parameter.

Value	Meaning
GMEM_DISCARDABLE	Causes a previously movable object to become discardable. This flag can be used only with GMEM_MODIFY.
GMEM_MODIFY	Modifies the object's memory flags. This flag can be used with **GMEM_DISCARDABLE** and GMEM_MOVEABLE.
GMEM_MOVEABLE	Causes a previously movable and discardable object to be discarded, if the *cbNewSize* parameter is zero and the object's lock count is zero. If *cbNewSize* is zero and the object is not movable and discardable, this flag causes the **GlobalReAlloc** function to fail. If the *cbNewSize* parameter is nonzero and the object identified by the *hglb* parameter is fixed, this flag allows the reallocated object to be moved to a new fixed location. If a movable object is locked, this flag allows the object to be moved to a new locked location without invalidating the handle. This may occur even if the object is currently locked by a previous call to the **GlobalLock** function. If this flag is used with GMEM_MODIFY, the **GlobalReAlloc** function changes a fixed memory object to a movable memory object.
GMEM_NODISCARD	Prevents memory from being discarded to satisfy the allocation request. This flag cannot be used with GMEM_MODIFY.
GMEM_ZEROINIT	Causes the additional memory to be initialized to zero if the object is growing. This flag cannot be used with GMEM_MODIFY.

Returns

The return value is the handle of the reallocated global memory if the function is successful. It is NULL if the object cannot be reallocated as specified.

Comments

If **GlobalReAlloc** reallocates a movable object, the return value is a handle to the memory. To access the memory, an application must use the **GlobalLock** function to convert the handle to a pointer.

To free a global memory object, an application should use the **GlobalFree** function.

The **GMEM_ZEROINIT** flag will cause applications to fail if it is used as shown in the following sequence:

```
hMem = GlobalAlloc(GMEM_ZEROINIT | (other flags), dwSize1);
            .
            .
            .
hMem = GlobalReAlloc(hMem, dwSize2, GMEM_ZEROINIT | (other flags));

/* where dwSize2 > dwSize1. */
            .
            .
            .
hMem = GlobalReAlloc(hMem, dwSize3, GMEM_ZEROINIT | (other flags));

/* where dwSize3 < dwSize2. */
            .
            .
            .
hMem = GlobalReAlloc(hMem, dwSize4, GMEM_ZEROINIT | (other flags));

/* GMEM_ZEROINIT fails when dwSize4 > dwSize3. */
```

In the last step of the preceding example, the memory between dwSize3 and the internal allocation boundary is not set to zero. After the last step, the contents of the buffer equal its contents prior to the call to **GlobalReAlloc** that specified dwSize3.

See Also
GlobalAlloc, **GlobalDiscard**, **GlobalFree**, **GlobalLock**

GlobalSize (2.x)

DWORD GlobalSize(*hglb***)**

HGLOBAL *hglb;* /* handle of memory object to return size of */

The **GlobalSize** function retrieves the current size, in bytes, of the given global memory object.

Parameter	Description
hglb	Identifies the global memory object.

Returns

The return value specifies the size, in bytes, of the memory object. It is zero if the specified handle is not valid or if the object has been discarded.

Comments

The size of a memory object is sometimes larger than the size requested at the time the memory was allocated.

An application should call the **GlobalFlags** function prior to calling the **GlobalSize** function, to verify that the specified memory object was not discarded. If the memory object has been discarded, the return value for **GlobalSize** is meaningless.

See Also

GlobalAlloc, **GlobalFlags**

GlobalUnfix (3.0)

void GlobalUnfix(*hglb***)**

HGLOBAL *hglb;* /* handle of global memory to unlock */

The **GlobalUnfix** function cancels the effects of the **GlobalFix** function and allows a global memory object to be moved in linear memory.

Parameter	Description
hglb	Identifies the global memory object to be unlocked.

Returns
This function does not return a value.

Comments
This function interferes with effective Windows memory management and can result in linear-address fragmentation. Few applications need to fix memory in linear address space.

Each time an application calls the **GlobalFix** function for an object, it must eventually call the **GlobalUnfix** function for the object.

GlobalUnfix decrements (decreases by one) the object's lock count and returns the new lock count in the CX register. The object is completely unlocked and subject to moving or discarding if the lock count is decremented to zero. Other functions also can affect the lock count of a memory object. For a list of these functions, see the description of the **GlobalFlags** function.

See Also
GlobalFix, **GlobalFlags**

GlobalUnlock (2.x)

BOOL GlobalUnlock(*hglb***)**

HGLOBAL *hglb;* /* handle of global memory to unlock */

The **GlobalUnlock** function unlocks the given global memory object. This function has no effect on fixed memory.

Parameter	Description
hglb	Identifies the global memory object to be unlocked.

Returns
The return value is zero if the object's lock count was decremented (decreased by one) to zero. Otherwise, the return value is nonzero.

Comments
With movable or discardable memory, this function decrements the object's lock count. The object is completely unlocked and subject to moving or discarding if the lock count is decreased to zero.

This function returns nonzero if the given memory object is not movable. An application should not rely on the return value to determine the number of times it must subsequently call the **GlobalUnlock** function for the memory object.

Other functions can also affect the lock count of a memory object. For a list of the functions that affect the lock count, see the description of the **GlobalFlags** function.

Each time an application calls **GlobalLock** for an object, it must eventually call the **GlobalUnlock** function for the object.

Example
The following example uses the **GlobalAlloc** and **GlobalLock** functions to allocate memory, and then calls the **GlobalUnlock** and **GlobalFree** functions to free it.

```
HGLOBAL hglb;
void FAR* lpvBuffer;

hglb = GlobalAlloc(GPTR, 1024);
lpvBuffer = GlobalLock(hglb);
    .
    .
    .
GlobalUnlock(hglb);
GlobalFree(hglb);
```

See Also
GlobalAlloc, **GlobalFlags**, **GlobalFree**, **GlobalLock**, **GlobalUnlock**, **UnlockResource**

GlobalUnWire (2.x)

BOOL GlobalUnWire(*hglb***)**

HGLOBAL *hglb;*

This function should not be used in Windows 3.1.

See Also
GlobalUnlock

GlobalWire (2.x)

void FAR* GlobalWire(*hglb***)**

HGLOBAL *hglb;*

This function should not be used in Windows 3.1.

See Also
GlobalLock

hmemcpy (3.1)

void hmemcpy(*hpvDest, hpvSource, cbCopy***)**

```
void _huge* hpvDest;              /* address of destination buffer */
const void _huge* hpvSource;      /* address of source buffer      */
long cbCopy;                      /* number of bytes to copy       */
```

The **hmemcpy** function copies bytes from a source buffer to a destination buffer. This function supports huge memory objects (that is, objects larger than 64K, allocated using the **GlobalAlloc** function).

Parameter	Description
hpvDest	Points to a buffer that receives the copied bytes.
hpvSource	Points to a buffer that contains the bytes to be copied.
cbCopy	Specifies the number of bytes to be copied.

Returns

This function does not return a value.

Comments

The result of the **hmemcpy** function is undefined if the buffers identified by *hpvDest* and *hpvSource* overlap.

See Also

_hread, **_hwrite**, **lstrcpy**

InitAtomTable (2.x)

BOOL InitAtomTable(*cTableEntries***)**

int *cTableEntries;* /* size of atom table */

The **InitAtomTable** function initializes the local atom hash table and sets it to the specified size.

An application need not use this function to use a local atom table. The default size of the local and global atom hash tables is 37 table entries. If an application uses **InitAtomTable**, however, it should call the function before any other atom-management function.

Parameter	Description
cTableEntries	Specifies the size, in table entries, of the atom hash table. This value should be a prime number.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

If an application uses a large number of local atoms, it can increase the size of the local atom table, reducing the time required to add an atom to the local atom table or to find an atom in the table. However, this increases the amount of memory required to maintain the table.

The size of the global atom table cannot be changed from its default size of 37 entries.

Example

The following example uses the **InitAtomTable** function to change the size of the local atom table to 73:

```
BOOL fSuccess;

fSuccess = InitAtomTable(73);

if (fSuccess)
    MessageBox(hwnd, "table initialization succeeded",
        "InitAtomTable", MB_OK);
else
    MessageBox(hwnd, "table initialization failed",
        "InitAtomTable", MB_ICONEXCLAMATION);
```

IsBadCodePtr (3.1)

BOOL IsBadCodePtr(*lpfn***)**

FARPROC *lpfn;* /* pointer to test */

The **IsBadCodePtr** function determines whether a pointer to executable code is valid.

Parameter	Description
lpfn	Points to a function.

Returns

The return value is nonzero if the pointer is bad (that is, if it does not point to executable code). The return value is zero if the pointer is good.

See Also

IsBadHugeReadPtr, **IsBadHugeWritePtr**, **IsBadReadPtr**, **IsBadStringPtr**, **IsBadWritePtr**

IsBadHugeReadPtr (3.1)

BOOL IsBadHugeReadPtr(*lp, cb***)**

```
const void _huge* lp;      /* pointer to test              */
DWORD cb;                  /* number of allocated bytes    */
```

The **IsBadHugeReadPtr** function determines whether a huge pointer to readable memory is valid.

Parameter	Description
lp	Points to the beginning of a block of allocated memory. The data object may reside anywhere in memory and may exceed 64K in size.
cb	Specifies the number of bytes of memory that were allocated.

Returns

The return value is nonzero if the pointer is bad (that is, if it does not point to readable memory of the specified size). The return value is zero if the pointer is good.

See Also

IsBadCodePtr, **IsBadHugeWritePtr**, **IsBadReadPtr**, **IsBadStringPtr**, **IsBadWritePtr**

IsBadHugeWritePtr (3.1)

BOOL IsBadHugeWritePtr(*lp, cb***)**

```
void _huge* lp;      /* pointer to test              */
DWORD cb;            /* number of allocated bytes    */
```

The **IsBadHugeWritePtr** function determines whether a huge pointer to writable memory is valid.

Parameter	Description
lp	Points to the beginning of a block of allocated memory. The data object may reside anywhere in memory and may exceed 64K in size.
cb	Specifies the number of bytes of memory that were allocated.

Returns

The return value is nonzero if the pointer is bad (that is, if it does not point to writable memory of the specified size). The return value is zero if the pointer is good.

See Also

IsBadCodePtr, **IsBadHugeReadPtr**, **IsBadReadPtr**, **IsBadStringPtr**, **IsBadWritePtr**

IsBadReadPtr (3.1)

BOOL IsBadReadPtr(*lp, cb***)**

```
const void FAR* lp;     /* pointer to test              */
UINT cb;                /* number of allocated bytes    */
```

The **IsBadReadPtr** function determines whether a pointer to readable memory is valid.

Parameter	Description
lp	Points to the beginning of a block of allocated memory.
cb	Specifies the number of bytes of memory that were allocated.

Returns

The return value is nonzero if the pointer is bad (that is, if it does not point to readable memory of the specified size). The return value is zero if the pointer is good.

See Also

IsBadCodePtr, **IsBadHugeReadPtr**, **IsBadHugeWritePtr**, **IsBadStringPtr**, **IsBadWritePtr**

IsBadStringPtr (3.1)

BOOL IsBadStringPtr(*lpsz, cchMax***)**

```
const void FAR* lpsz;      /* pointer to test            */
UINT cchMax;               /* maximum size of string     */
```

The **IsBadStringPtr** function determines whether a pointer to a string is valid.

Parameter	Description
lpsz	Points to a null-terminated string.
cchMax	Specifies the maximum size of the string, in bytes.

Returns

The return value is nonzero if the pointer is bad (that is, if it does not point to a string of the specified size). The return value is zero if the pointer is good.

See Also

IsBadCodePtr, **IsBadHugeReadPtr**, **IsBadHugeWritePtr**, **IsBadReadPtr**, **IsBadWritePtr**

IsBadWritePtr (3.1)

BOOL IsBadWritePtr(*lp, cb***)**

```
void FAR* lp;       /* pointer to test              */
UINT cb;            /* number of allocated bytes    */
```

The **IsBadWritePtr** function determines whether a pointer to writable memory is valid.

Parameter	Description
lp	Points to the beginning of a block of allocated memory.
cb	Specifies the number of bytes of memory that were allocated.

Returns

The return value is nonzero if the pointer is bad (that is, if it does not point to writable memory of the specified size). The return value is zero if the pointer is good.

See Also

IsBadCodePtr, **IsBadHugeReadPtr**, **IsBadHugeWritePtr**, **IsBadReadPtr**, **IsBadStringPtr**

IsDBCSLeadByte (3.1)

BOOL IsDBCSLeadByte(*bTestChar***)**

BYTE *bTestChar;* /* character to test */

The **IsDBCSLeadByte** function determines whether a character is a lead byte, the first byte of a character in a double-byte character set (DBCS).

Parameter	Description
bTestChar	Specifies the character to be tested.

Returns
The return value is nonzero if the character is a DBCS lead byte. Otherwise, it is zero.

Comments
The language driver for the current language (the language the user selected at setup or by using Control Panel) determines whether the character is in the set. If no language driver is selected, Windows uses an internal function.

Each double-byte character set has a unique set of lead-byte values. By itself, a lead byte has no character value; together, the lead byte and the following byte represent a single character. The second, or following, byte is called a trailing byte.

See Also
GetKeyboardType

IsTask (3.1)

BOOL IsTask(*htask***)**

HTASK *htask;* /* handle of task */

The **IsTask** function determines whether the given task handle is valid.

Parameter	Description
htask	Identifies a task.

Returns

The return value is nonzero if the task handle is valid. Otherwise, it is zero.

LimitEmsPages (2.x)

void LimitEmsPages(*cAppKB***)**

DWORD *cAppKB;* /* amount of expanded memory available to application */

In Windows version 3.1, this function is obsolete and does nothing.

LoadLibrary (2.x)

HINSTANCE LoadLibrary(*lpszLibFileName***)**

LPCSTR *lpszLibFileName;* /* address of name of library file */

The **LoadLibrary** function loads the specified library module.

Parameter	Description
lpszLibFileName	Points to a null-terminated string that names the library file to be loaded. If the string does not contain a path, Windows searches for the library in this order:

1 The current directory.

2 The Windows directory (the directory containing WIN.COM); the **GetWindowsDirectory** function retrieves the path of this directory.

3 The Windows system directory (the directory containing such system files as GDI.EXE); the **GetSystemDirectory** function retrieves the path of this directory.

4 The directory containing the executable file for the current task; the **GetModuleFileName** function retrieves the path of this directory.

5 The directories listed in the PATH environment variable.

6 The list of directories mapped in a network.

Returns

The return value is the instance handle of the loaded library module if the function is successful. Otherwise, it is an error value less than HINSTANCE_ERROR.

Errors

If the function fails, it returns one of the following error values:

Value	Meaning
0	System was out of memory, executable file was corrupt, or relocations were invalid.
2	File was not found.
3	Path was not found.
5	Attempt was made to dynamically link to a task, or there was a sharing or network-protection error.
6	Library required separate data segments for each task.
8	There was insufficient memory to start the application.
10	Windows version was incorrect.
11	Executable file was invalid. Either it was not a Windows application or there was an error in the .EXE image.
12	Application was designed for a different operating system.
13	Application was designed for MS-DOS 4.0.
14	Type of executable file was unknown.
15	Attempt was made to load a real-mode application (developed for an earlier version of Windows).
16	Attempt was made to load a second instance of an executable file containing multiple data segments that were not marked read-only.
19	Attempt was made to load a compressed executable file. The file must be decompressed before it can be loaded.
20	Dynamic-link library (DLL) file was invalid. One of the DLLs required to run this application

was corrupt.

21 Application requires Microsoft Windows 32-bit extensions.

Comments

If the module has been loaded, **LoadLibrary** increments (increases by one) the module's reference count. If the module has not been loaded, the function loads it from the specified file.

LoadLibrary increments the reference count for a library module each time an application calls the function. When it has finished using the module, the application should use the **FreeLibrary** function to decrement (decrease by one) the reference count.

An application can use the **GetProcAddress** function to access functions in a library that was loaded using **LoadLibrary**.

Example

The following example uses the **LoadLibrary** function to load the Tool Helper Library TOOLHELP.DLL and the **FreeLibrary** function to free it:

```
HINSTANCE hinstToolHelp = LoadLibrary("TOOLHELP.DLL");

if ((UINT) hinstToolHelp > 32) {
        .
        . /* use GetProcAddress to use TOOLHELP functions */
        .
}
else {
    ErrorHandler();
}

if ((UINT) hinstToolHelp > 32)
   FreeLibrary(hinstToolHelp); /* free TOOLHELP.DLL      */
```

See Also

FreeLibrary, **GetProcAddress**

LoadModule (3.0)

HINSTANCE LoadModule(*lpszModuleName, lpvParameterBlock***)**

LPCSTR *lpszModuleName;* /* address of filename to load */
LPVOID *lpvParameterBlock;* /* address of parameter block for new module */

The **LoadModule** function loads and executes a Windows application or creates a new instance of an existing Windows application.

Parameter	Description
lpszModuleName	Points to a null-terminated string that contains the complete filename (including the file extension) of the application to be run. If the string does not contain a path, Windows searches for the executable file in this order:

1 The current directory.

2 The Windows directory (the directory containing WIN.COM), whose path the **GetWindowsDirectory** function retrieves.

3 The Windows system directory (the directory containing such system files as GDI.EXE), whose path the **GetSystemDirectory** function retrieves.

4 The directory containing the executable file for the current task; the **GetModuleFileName** function obtains the path of this directory.

5 The directories listed in the PATH environment variable.

6 The list of directories mapped in a network.

lpvParameterBlock Points to an application-defined LOADPARMS structure that defines the new application's parameter block. The LOADPARMS structure has the following form:

```
struct _LOADPARMS {
    WORD      segEnv;         /* child environment  */
    LPSTR     lpszCmdLine;    /* child command tail */
    UINT FAR* lpShow;         /* how to show child  */
    UINT FAR* lpReserved;     /* must be NULL       */
} LOADPARMS;
```

Member	Description
segEnv	Specifies whether the child application receives a copy of the parent application's environment or a new environment created by the parent application. If this member is zero, the child application receives an exact duplicate of the parent application's environment block. If the member is nonzero, the value entered must be the segment address of a memory object containing a copy of the new environment for the child application.
lpszCommandLine	Points to a null-terminated string that specifies the command line (excluding the child application name). This string must not exceed 120 characters. If there is no command line, this member must point to a zero-length string (it cannot be set to NULL).
lpShow	Points to an array containing two 16-bit values. The first value must always be set to two. The second value specifies how the application window is to be shown. For

	a list of the acceptable values, see the description of the *nCmdShow* parameter of the **ShowWindow** function.
lpReserved	Reserved; must be NULL.

Returns

The return value is the instance handle of the loaded module if the function is successful. If the function fails, it returns an error value less than HINSTANCE_ERROR.

Errors

If the function fails, it returns one of the following error values:

Value	Meaning
0	System was out of memory, executable file was corrupt, or relocations were invalid.
2	File was not found.
3	Path was not found.
5	Attempt was made to dynamically link to a task, or there was a sharing or network-protection error.
6	Library required separate data segments for each task.
8	There was insufficient memory to start the application.
10	Windows version was incorrect.
11	Executable file was invalid. Either it was not a Windows application or there was an error in the .EXE image.
12	Application was designed for a different operating system.
13	Application was designed for MS-DOS 4.0.
14	Type of executable file was unknown.
15	Attempt was made to load a real-mode application (developed for an earlier version of Windows).
16	Attempt was made to load a second instance of an executable file containing multiple data segments that were not marked read-only.
19	Attempt was made to load a compressed executable file. The file must be decompressed before it can be loaded.
20	Dynamic-link library (DLL) file was invalid. One of the DLLs required to run this application was corrupt.
21	Application requires Microsoft Windows 32-bit extensions.

Comments

The **WinExec** function provides an alternative method for executing an application.

Example

The following example uses the **LoadModule** function to run an executable file named DRAW.EXE:

```
struct LOADPARMS {
    WORD    segEnv;                 /* child environment  */
    LPSTR   lpszCmdLine;            /* child command tail */
    LPWORD  lpwShow;                /* how to show child  */
    LPWORD  lpwReserved;            /* must be NULL       */
};

char szMsg[80];
HINSTANCE hinstMod;
struct LOADPARMS parms;
WORD awShow[2] = { 2, SW_SHOWMINIMIZED };

parms.segEnv = 0;               /* child inherits environment */
```

```
parms.lpszCmdLine = (LPSTR) "";     /* no command line        */
parms.lpwShow = (LPWORD) awShow;    /* shows child as an icon */
parms.lpwReserved = (LPWORD) NULL;  /* must be NULL           */

hinstMod = LoadModule("draw.exe", &parms);

if ((UINT) hinstMod < 32) {
    sprintf(szMsg, "LoadModule failed; error code = %d",
        hinstMod);
    MessageBox(hwnd, szMsg, "Error", MB_ICONSTOP);
}
else {
    sprintf(szMsg, "LoadModule returned %d", hinstMod);
    MessageBox(hwnd, szMsg, "", MB_OK);
}
```

See Also

FreeModule, **GetModuleFileName**, **GetSystemDirectory**, **GetWindowsDirectory**, **ShowWindow**, **WinExec**

LoadResource (2.x)

HGLOBAL LoadResource(*hinst, hrsrc***)**

```
HINSTANCE hinst;        /* handle of file containing resource */
HRSRC hrsrc;            /* handle of resource                 */
```

The **LoadResource** function loads the specified resource in global memory.

Parameter	Description
hinst	Identifies an instance of the module whose executable file contains the resource to be loaded.
hrsrc	Identifies the resource to be loaded. This handle must have been created by using the **FindResource** function.

Returns

The return value is the instance handle of the global memory object containing the data associated with the resource. It is NULL if no such resource exists.

Comments

When finished with a resource, an application should free the global memory associated with it by using the **FreeResource** function.

If the specified resource has been loaded, this function simply increments the reference count for the resource.

The resource is not loaded until the **LockResource** function is called to translate the handle returned by **LoadResource** into a far pointer to the resource data.

See Also

FindResource, **FreeResource**, **LockResource**

LocalAlloc (2.x)

HLOCAL LocalAlloc(*fuAllocFlags, fuAlloc***)**

```
UINT fuAllocFlags;      /* allocation attributes          */
UINT fuAlloc;           /* number of bytes to allocate */
```

The **LocalAlloc** function allocates the specified number of bytes from the local heap.

Parameter	Description
fuAllocFlags	Specifies how to allocate memory. This parameter can be a combination of the following values:

Value	Meaning
LHND	Combines the **LMEM_MOVEABLE** and **LMEM_ZEROINIT** flags.
LMEM_DISCARDABLE	Allocates discardable memory.
LMEM_FIXED	Allocates fixed memory. The **LMEM_FIXED** and **LMEM_MOVEABLE** flags cannot be combined.
LMEM_MOVEABLE	Allocates movable memory. The **LMEM_FIXED** and **LMEM_MOVEABLE** flags cannot be combined.
LMEM_NOCOMPACT	Does not compact or discard memory to satisfy the allocation request.
LMEM_NODISCARD	Does not discard memory to satisfy the allocation request.
LMEM_ZEROINIT	Initializes memory contents to zero.
LPTR	Combines the **LMEM_FIXED** and **LMEM_ZEROINIT** flags.
NONZEROLHND	Same as the **LMEM_MOVEABLE** flag.
NONZEROLPTR	Same as the **LMEM_FIXED** flag.

fuAlloc	Specifies the number of bytes to be allocated.

Returns

The return value is the instance handle of the newly allocated local memory object, if the function is successful. Otherwise, it is NULL.

Comments

If **LocalAlloc** allocates movable memory, the return value is a local handle of the memory. To access the memory, an application must use the **LocalLock** function to convert the handle to a pointer.

If **LocalAlloc** allocates fixed memory, the return value is a pointer to the memory. To access the memory, an application can simply cast the return value to a pointer.

Fixed memory will be slightly faster than movable memory. If memory will be allocated and freed without an intervening local allocation or reallocation, then the memory should be allocated as fixed.

If this function is successful, it allocates at least the amount requested. If the amount allocated is greater than the amount requested, the application can use the entire amount. To determine the size of a local memory object, an application can use the **LocalSize** function.

To free a local memory object, an application should use the **LocalFree** function. To change the size or attributes of an allocated memory object, an application can use the **LocalReAlloc** function.

See Also

LocalFree, **LocalLock**, **LocalReAlloc**, **LocalSize**, **LocalUnlock**

LHND (**LMEM_MOVEABLE** | **LMEM_ZEROINIT**)

Combines the **LMEM_MOVEABLE** and **LMEM_ZEROINIT** flags.

LHND (LMEM_MOVEABLE | LMEM_ZEROINIT)

LMEM_DISCARDABLE 0x0F00

Allocates discardable memory.

LMEM_DISCARDABLE 0x0F00

LMEM_FIXED 0x0000

Allocates fixed memory. The LMEM_FIXED and **LMEM_MOVEABLE** flags cannot be combined.

LMEM_FIXED 0x0000

LMEM_MOVEABLE 0x0002

Allocates movable memory. The **LMEM_FIXED** and LMEM_MOVEABLE flags cannot be combined.

LMEM_MOVEABLE 0x0002

LMEM_NOCOMPACT 0x0010

Does not compact or discard memory to satisfy the allocation request.

LMEM_NOCOMPACT 0x0010

LMEM_NODISCARD 0x0020

Does not discard memory to satisfy the allocation request.

LMEM_NODISCARD 0x0020

LMEM_ZEROINIT 0x0040

Initializes memory contents to zero.

LMEM_ZEROINIT 0x0040

LPTR (**LMEM_FIXED** | **LMEM_ZEROINIT**)

Combines the **LMEM_FIXED** and **LMEM_ZEROINIT** flags.

LPTR (LMEM_FIXED | LMEM_ZEROINIT)

NONZEROLHND (**LMEM_MOVEABLE**)

Same as the **LMEM_MOVEABLE** flag.

NONZEROLHND (LMEM_MOVEABLE)

NONZEROLPTR (**LMEM_FIXED**)

Same as the **LMEM_FIXED** flag.

NONZEROLPTR (LMEM_FIXED)

LocalCompact (2.x)

UINT LocalCompact(*uMinFree***)**

UINT *uMinFree;* /* amount of memory requested */

The **LocalCompact** function rearranges the local heap so that the specified amount of memory is free.

Parameter	Description
uMinFree	Specifies the number of contiguous free bytes requested. If this parameter is zero, the function does not compact memory, but the return value is valid.

Returns

The return value specifies the number of bytes in the largest free local memory object. If the *uMinFree* parameter is zero, the return value specifies the number of bytes in the largest free object that Windows can generate if it removes all discardable objects.

Comments

The function first checks the local heap for the specified number of contiguous free bytes. If the bytes do not exist, the function compacts local memory by moving all unlocked, movable objects into high memory. If this does not generate the requested amount of space, the function discards movable and discardable objects that are not locked, until the requested amount of space is generated (if possible).

See Also

LocalAlloc, **LocalLock**

LocalFlags (2.x)

UINT LocalFlags(*hloc***)**

HLOCAL *hloc;* /* handle of local memory object */

The **LocalFlags** function retrieves information about the given local memory object.

Parameter	Description
hloc	Identifies the local memory object.

Returns
The low-order byte of the return value contains the lock count of the object; the high-order byte contains either **LMEM_DISCARDABLE** (object has been marked as discardable) or LMEM_DISCARDED (object has been discarded).

Comments
To retrieve the lock count from the return value, use the LMEM_LOCKCOUNT mask.

See Also
LocalAlloc, **LocalLock**, **LocalReAlloc**, **LocalUnlock**

LocalFree (2.x)

HLOCAL LocalFree(*hloc***)**

HLOCAL *hloc;* /* handle of local memory object */

The **LocalFree** function frees the given local memory object (if the object is not locked) and invalidates its handle.

Parameter	Description
hloc	Identifies the local memory object to be freed.

Returns
The return value is NULL if the function is successful. Otherwise, it is equal to the *hloc* parameter.

Comments
An application cannot use the **LocalFree** function to free a locked memory object--that is, a memory object with a lock count greater than zero.

After freeing the handle of the memory object, an application cannot use the handle again. An attempt to free the same memory object more than once can cause Windows to terminate abnormally.

See Also
LocalFlags, **LocalLock**

LocalHandle (2.x)

HLOCAL LocalHandle(*pvMem***)**

void NEAR* *pvMem;* /* address of local memory object */

The **LocalHandle** function retrieves the handle of the specified local memory object.

Parameter	Description
pvMem	Specifies the address of the local memory object.

Returns

The return value is the handle of the specified local memory object if the function is successful. It is NULL if the specified address has no handle.

See Also

LocalAlloc

LocalInit (2.x)

BOOL LocalInit(*uSegment, uStartAddr, uEndAddr***)**

```
UINT uSegment;      /* segment to contain local heap */
UINT uStartAddr;    /* starting address for heap     */
UINT uEndAddr;      /* ending address for heap       */
```

The **LocalInit** function initializes a local heap in the specified segment.

Parameter	Description
uSegment	Identifies the segment that is to contain the local heap.
uStartAddr	Specifies the starting address of the local heap within the segment.
uEndAddr	Specifies the ending address of the local heap within the segment.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The first 16 bytes of the segment containing a local heap must be reserved for use by the system.

See Also
GlobalLock, **LocalAlloc**, **LocalReAlloc**

Windows 3.1 changes

Removed the discussion of movable data segments (LockData etc.), since this is irrelevant in 3.1. Data segments may or may not move, but Windows maintains their selectors.

LocalLock (2.x)

void NEAR* LocalLock(*hloc***)**

HLOCAL *hloc;* /* handle of local memory object */

The **LocalLock** function retrieves a pointer to the given local memory object. **LocalLock** increments (increases by one) the lock count of movable objects and locks the memory.

Parameter	Description
hloc	Identifies the local memory object to be locked.

Returns

The return value points to the first byte of memory in the local object, if the function is successful. It is NULL if the object has been discarded or an error occurs.

Comments

Each time an application calls **LocalLock** for an object, it must eventually call **LocalUnlock** for the object.

This function will return NULL if an application attempts to lock a memory object with a size of 0 bytes.

The **LocalUnlock** function decrements (decreases by one) the lock count for the object if **LocalLock** incremented the count. Other functions can also affect the lock count of a memory object.

Locked memory will not be moved or discarded unless the memory object is reallocated by the **LocalReAlloc** function. The object remains locked in memory until its lock count is decreased to zero.

Discarded objects always have a lock count of zero.

See Also

LocalFlags, **LocalReAlloc**, **LocalUnlock**

LocalReAlloc (2.x)

HLOCAL LocalReAlloc(*hloc, fuNewSize, fuFlags***)**

```
HLOCAL hloc;        /* handle of local memory object  */
UINT fuNewSize;     /* new size of object             */
UINT fuFlags;       /* new allocation attributes      */
```

The **LocalReAlloc** function changes the size or attributes of the given local memory object.

Parameter	Description
hloc	Identifies the local memory object to be reallocated.
fuNewSize	Specifies the new size of the local memory object.
fuFlags	Specifies how to reallocate the local memory object. If this parameter includes the LMEM_MODIFY and **LMEM_DISCARDABLE** flags, **LocalReAlloc** ignores the *fuNewSize* parameter. The *fuFlags* parameter can be a combination of the following values.

Value	Meaning
LMEM_DISCARDABLE	Causes a previously movable object to become discardable. This flag can be used only with LMEM_MODIFY.
LMEM_MODIFY	Modifies the object's memory flags. This flag can be used only with LMEM_DISCARDABLE.
LMEM_MOVEABLE	If *fuNewSize* is zero, this flag causes a previously fixed object to be freed or a previously movable object to be discarded (if the object's lock count is zero). This flag cannot be used with LMEM_MODIFY. If *fuNewSize* is nonzero and the object identified by the *hloc* parameter is fixed, this flag allows the reallocated object to be moved to a new fixed location.
LMEM_NOCOMPACT	Prevents memory from being compacted or discarded to satisfy the allocation request. This flag cannot be used with LMEM_MODIFY.
LMEM_ZEROINIT	If the object is growing, this flag causes the additional memory contents to be initialized to zero. This flag cannot be used with LMEM_MODIFY.

Returns

The return value is the handle of the reallocated local memory object, if the function is successful. Otherwise, it is NULL.

Comments

If **LocalReAlloc** reallocates a movable object, the return value is a local handle of the memory. To access the memory, an application must use the **LocalLock** function to convert the handle to a pointer.

If **LocalReAlloc** reallocates a fixed object, the return value is a pointer to the memory. To access the memory, an application can simply cast the return value to a pointer.

To free a local memory object, an application should use the **LocalFree** function.

See Also

LocalAlloc, **LocalDiscard**, **LocalFree**, **LocalLock**

LocalShrink (2.x)

UINT LocalShrink(*hloc, cbNewSize***)**

```
HLOCAL hloc;        /* segment containing local heap  */
UINT cbNewSize;     /* new size of local heap         */
```

The **LocalShrink** function shrinks the local heap in the given segment.

Parameter	Description
hloc	Identifies the segment that contains the local heap. If this parameter is zero, the function shrinks the heap in the current data segment.
cbNewSize	Specifies the new size, in bytes, of the local heap.

Returns

The return value specifies the new size of the local heap if the function is successful.

Comments

Windows will not shrink the portion of the data segment that contains the stack and the static variables.

Use the **GlobalSize** function to determine the new size of the data segment.

See Also

GlobalSize

LocalSize (2.x)

UINT LocalSize(*hloc***)**

HLOCAL *hloc;* /* handle of local memory object */

The **LocalSize** function returns the current size, in bytes, of the given local memory object.

Parameter	Description
hloc	Identifies the local memory object.

Returns

The return value specifies the size, in bytes, of the memory object, if the function is successful. It is zero if the specified handle is invalid or if the object has been discarded.

Comments

The size of a memory object sometimes is larger than the size requested when the memory was allocated.

To verify that the memory object has not been discarded, an application should call the **LocalFlags** function prior to calling the **LocalSize** function. If the memory object has been discarded, the return value for **LocalSize** is meaningless.

See Also

LocalAlloc, **LocalFlags**

LocalUnlock (2.x)

BOOL LocalUnlock(*hloc***)**

HLOCAL *hloc;* /* handle of local memory object */

The **LocalUnlock** function unlocks the given local memory object. This function has no effect on fixed memory.

Parameter	Description
hloc	Identifies the local memory object to be unlocked.

Returns
The return value is zero if the function is successful. Otherwise, it is nonzero.

Comments
With discardable memory, this function decrements (decreases by one) the object's lock count. The object is completely unlocked, and subject to discarding, if the lock count is decreased to zero.

See Also
LocalLock

LockResource (2.x)

void FAR* LockResource(*hglb***)**

HGLOBAL *hglb;* /* handle of resource */

The **LockResource** function locks the given resource. The resource is locked in memory and its reference count is incremented (increased by one). The locked resource is not subject to discarding.

Parameter	Description
hglb	Identifies the resource to be locked. This handle must have been created by using the **LoadResource** function.

Returns

The return value points to the first byte of the loaded resource if the function is successful. Otherwise, it is NULL.

Comments

The resource remains locked in memory until its reference count is decreased to zero by calls to the **FreeResource** function.

If the resource identified by the *hglb* parameter has been discarded, the resource-handler function (if any) associated with the resource is called before the **LockResource** function returns. The resource-handler function can recalculate and reload the resource if necessary. After the resource-handler function returns, **LockResource** makes another attempt to lock the resource and returns with the result.

Using the handle returned by the **FindResource** function for the *hglb* parameter causes an error.

Use the **UnlockResource** macro to unlock a resource that was locked by **LockResource**.

See Also

FindResource, **FreeResource**, **SetResourceHandler**

LockSegment (2.x)

HGLOBAL LockSegment(*uSegment***)**

UINT *uSegment;* /* segment to lock */

The **LockSegment** function locks the specified discardable segment. The segment is locked into memory at the given address and its lock count is incremented (increased by one).

Parameter	Description
uSegment	Specifies the segment address of the segment to be locked. If this parameter is -1, the **LockSegment** function locks the current data segment.

Returns

The return value specifies the data segment if the function is successful. It is NULL if the segment has been discarded or an error occurs.

Comments

Locked memory is not subject to discarding except when a portion of the segment is being reallocated by the **GlobalReAlloc** function. The segment remains locked in memory until its lock count is decreased to zero by the **UnlockSegment** function.

Each time an application calls **LockSegment** for a segment, it must eventually call **UnlockSegment** for the segment. The **UnlockSegment** function decrements the lock count for the segment. Other functions also can affect the lock count of a memory object. For a list of these functions, see the description of the **GlobalFlags** function.

See Also

GlobalFlags, **GlobalReAlloc**, **LockData**, **UnlockSegment**

LogError (3.1)

void LogError(*uErr, lpvInfo***)**

UINT *uErr;* /* error type */
void FAR* *lpvInfo;* /* address of error information */

The **LogError** function identifies the most recent system error. An application's interrupt callback function typically calls **LogError** to return error information to the user.

Parameter	Description
uErr	Specifies the type of error that occurred. The *lpvInfo* parameter may point to more information about the error, depending on the value of *uErr.* This parameter may be one or more of the following values:

Value	Meaning
ERR_ALLOCRES	**AllocResource** failed.
ERR_BADINDEX	Bad index to **GetClassLong**, **GetClassWord**, **GetWindowLong**, **GetWindowWord**, **SetClassLong**, **SetClassWord**, **SetWindowLong**, or **SetWindowWord**.
ERR_BYTE	Invalid 8-bit parameter.
ERR_CREATEDC	**CreateCompatibleDC**, **CreateDC**, or **CreateIC** failed.
ERR_CREATEDLG	Could not create dialog box because **LoadMenu** failed.
ERR_CREATEDLG2	Could not create dialog box because **CreateWindow** failed.
ERR_CREATEMENU	Could not create menu.
ERR_CREATEMETA	**CreateMetaFile** failed.
ERR_CREATEWND	Could not create window because the class was not found.
ERR_DCBUSY	Device context (DC) cache is full.
ERR_DELOBJSELECTED	Program is trying to delete a bitmap that is selected into the DC.
ERR_DWORD	Invalid 32-bit parameter.
ERR_GALLOC	**GlobalAlloc** failed.
ERR_GLOCK	**GlobalLock** failed.
ERR_GREALLOC	**GlobalReAlloc** failed.
ERR_LALLOC	**LocalAlloc** failed.
ERR_LLOCK	**LocalLock** failed.
ERR_LOADMENU	**LoadMenu** failed.
ERR_LOADMODULE	**LoadModule** failed.
ERR_LOADSTR	**LoadString** failed.
ERR_LOCKRES	**LockResource** failed.
ERR_LREALLOC	**LocalReAlloc** failed.
ERR_NESTEDBEGINPAINT	Program contains nested **BeginPaint** calls.
ERR_REGISTERCLASS	**RegisterClass** failed because the class is already registered.
ERR_SELBITMAP	Program is trying to select a bitmap that is already selected.

	ERR_SIZE_MASK	Identifies which 2 bits of *uErr* specify the size of the invalid parameter.
	ERR_STRUCEXTRA	Program is using unallocated space.
	ERR_WARNING	A non-fatal error occurred.
	ERR_WORD	Invalid 16-bit parameter.
lpvInfo	Points to more information about the error. The value of *lpvInfo* depends on the value of *uErr.* If the value of (*uErr* & **ERR_SIZE_MASK**) is 0, *lpvInfo* is undefined. Currently, no *uErr* code has defined meanings for *lpvInfo.*	

Returns
This function does not return a value.

Comments
The errors identified by **LogError** may be trapped by the callback function that **NotifyRegister** installs.

Error values whose low 12 bits are less than 0x07FF are reserved for use by Windows.

See Also
LogParamError, **NotifyRegister**

LogParamError (3.1)

void LogParamError(*uErr, lpfn, lpvParam***)**

```
UINT uErr;          /* error type                        */
FARPROC lpfn;       /* address where error occurred      */
void FAR* lpvParam; /* address of more error information */
```

The **LogParamError** function identifies the most recent parameter validation error. An application's interrupt callback function typically calls **LogParamError** to return information about an invalid parameter to the user.

Parameter	Description
uErr	Specifies the type of parameter validation error that occurred. The *lpvParam* parameter may point to more information about the error, depending on the value of *uErr.* This parameter may be one or more of the following values:

Value	Meaning
ERR_BAD_ATOM	Invalid atom.
ERR_BAD_CID	Invalid communications identifier (CID).
ERR_BAD_COORDS	Invalid x,y coordinates.
ERR_BAD_DFLAGS	Invalid 32-bit flags.
ERR_BAD_DINDEX	Invalid 32-bit index or index out-of-range.
ERR_BAD_DVALUE	Invalid 32-bit signed or unsigned value.
ERR_BAD_FLAGS	Invalid bit flags.
ERR_BAD_FUNC_PTR	Invalid function pointer.
ERR_BAD_GDI_OBJECT	Invalid graphics device interface (GDI) object.
ERR_BAD_GLOBAL_HANDLE	Invalid global handle.
ERR_BAD_HANDLE	Invalid generic handle.
ERR_BAD_HBITMAP	Invalid bitmap handle.
ERR_BAD_HBRUSH	Invalid brush handle.
ERR_BAD_HCURSOR	Invalid cursor handle.
ERR_BAD_HDC	Invalid device context (DC) handle.
ERR_BAD_HDRVR	Invalid driver handle.
ERR_BAD_HDWP	Invalid handle of a window-position structure.
ERR_BAD_HFILE	Invalid file handle.
ERR_BAD_HFONT	Invalid font handle.
ERR_BAD_HICON	Invalid icon handle.
ERR_BAD_HINSTANCE	Invalid instance handle.
ERR_BAD_HMENU	Invalid menu handle.
ERR_BAD_HMETAFILE	Invalid metafile handle.
ERR_BAD_HMODULE	Invalid module handle.
ERR_BAD_HPALETTE	Invalid palette handle.
ERR_BAD_HPEN	Invalid pen handle.
ERR_BAD_HRGN	Invalid region handle.
ERR_BAD_HWND	Invalid window handle.
ERR_BAD_INDEX	Invalid index or index out-of-range.
ERR_BAD_LOCAL_HANDLE	Invalid local handle.
ERR_BAD_PTR	Invalid pointer.

ERR_BAD_SELECTOR	Invalid selector.
ERR_BAD_STRING_PTR	Invalid zero-terminated string pointer.
ERR_BAD_VALUE	Invalid 16-bit signed or unsigned value.
ERR_BYTE	Invalid 8-bit parameter.
ERR_DWORD	Invalid 32-bit parameter.
ERR_PARAM	A parameter validation error occurred. This flag is always set.
ERR_SIZE_MASK	Identifies which 2 bits of *uErr* specify the size of the invalid parameter.
ERR_WARNING	An invalid parameter was detected, but the error is not serious enough to cause the function to fail. The invalid parameter is reported, but the call runs as usual.
ERR_WORD	Invalid 16-bit parameter.

lpfn Specifies the address at which the parameter error occurred. This value is NULL if the address is unknown.

lpvParam Points to more information about the error. The value of *lpvParam* depends on the value of *uErr.* If the value of (*uErr* & **ERR_SIZE_MASK**) is 0, *lpvParam* is undefined. Currently, no *uErr* code has defined meanings for *lpvParam.*

Returns
This function does not return a value.

Comments
The errors identified by **LogParamError** may be trapped by the callback function that **NotifyRegister** installs.

Error values whose low 12 bits are less than 0x07FF are reserved for use by Windows.

The size of the value passed in *lpvParam* is determined by the values of the bits selected by **ERR_SIZE_MASK**, as follows:

```
switch (err & ERR_SIZE_MASK)
{
case ERR_BYTE:          /* 8-bit invalid parameter */
    b = LOBYTE(param);
    break;

case ERR_WORD:          /* 16-bit invalid parameter */
    w = LOWORD(param);
    break;

case ERR_DWORD:         /* 32-bit invalid parameter */
    l = (DWORD)param;
    break:

default:                /* invalid parameter value is unknown */
    break;
}
```

See Also
LogError, **NotifyRegister**

ERR_BAD_ATOM 0x6024

Invalid atom.

ERR_BAD_ATOM 0x6024

ERR_BAD_CID 0x6045

Invalid communications identifier (CID).

ERR_BAD_CID 0x6045

ERR_BAD_COORDS 0x7060

Invalid x,y coordinates.

ERR_BAD_COORDS 0x7060

ERR_BAD_DFLAGS 0x7005

Invalid 32-bit flags.

ERR_BAD_DFLAGS 0x7005

ERR_BAD_DINDEX 0x7006

Invalid 32-bit index or index out-of-range.

ERR_BAD_DINDEX 0x7006

ERR_BAD_DVALUE 0x7004

Invalid 32-bit signed or unsigned value.

ERR_BAD_DVALUE 0x7004

ERR_BAD_FLAGS 0x6002

Invalid bit flags.

ERR_BAD_FLAGS 0x6002

ERR_BAD_FUNC_PTR 0x7008

Invalid function pointer.

ERR_BAD_FUNC_PTR 0x7008

ERR_BAD_GDI_OBJECT 0x6061

Invalid graphics device interface (GDI) object.

ERR_BAD_GDI_OBJECT 0x6061

ERR_BAD_GLOBAL_HANDLE 0x6022

Invalid global handle.

ERR_BAD_GLOBAL_HANDLE 0x6022

ERR_BAD_HANDLE 0x600b

Invalid generic handle.

ERR_BAD_HANDLE 0x600b

ERR_BAD_HBITMAP 0x6066

Invalid bitmap handle.

ERR_BAD_HBITMAP 0x6066

ERR_BAD_HBRUSH 0x6065

Invalid brush handle.

ERR_BAD_HBRUSH 0x6065

ERR_BAD_HCURSOR 0x6042

Invalid cursor handle.

ERR_BAD_HCURSOR 0x6042

ERR_BAD_HDC 0x6062

Invalid device context (DC) handle.

ERR_BAD_HDC 0x6062

ERR_BAD_HDRVR 0x6046

Invalid driver handle.

ERR_BAD_HDRVR 0x6046

ERR_BAD_HDWP 0x6044

Invalid handle of a window-position structure.

ERR_BAD_HDWP 0x6044

ERR_BAD_HFILE 0x6025

Invalid file handle.

ERR_BAD_HFILE 0x6025

ERR_BAD_HFONT 0x6064

Invalid font handle.

ERR_BAD_HFONT 0x6064

ERR_BAD_HICON 0x6043

Invalid icon handle.

ERR_BAD_HICON 0x6043

ERR_BAD_HINSTANCE 0x6020

Invalid instance handle.

ERR_BAD_HINSTANCE 0x6020

ERR_BAD_HMENU 0x6041

Invalid menu handle.

ERR_BAD_HMENU 0x6041

ERR_BAD_HMETAFILE 0x6069

Invalid metafile handle.

ERR_BAD_HMETAFILE 0x6069

ERR_BAD_HMODULE 0x6021

Invalid module handle.

ERR_BAD_HMODULE 0x6021

ERR_BAD_HPALETTE 0x6068

Invalid palette handle.

ERR_BAD_HPALETTE 0x6068

ERR_BAD_HPEN 0x6063

Invalid pen handle.

ERR_BAD_HPEN 0x6063

ERR_BAD_HRGN 0x6067

Invalid region handle.

ERR_BAD_HRGN 0x6067

ERR_BAD_HWND 0x6040

Invalid window handle.

ERR_BAD_HWND 0x6040

ERR_BAD_INDEX 0x6003

Invalid index or index out-of-range.

ERR_BAD_INDEX 0x6003

ERR_BAD_LOCAL_HANDLE 0x6023

Invalid local handle.

ERR_BAD_LOCAL_HANDLE 0x6023

ERR_BAD_PTR 0x7007

Invalid pointer.

ERR_BAD_PTR 0x7007

ERR_BAD_SELECTOR 0x6009

Invalid selector.

ERR_BAD_SELECTOR 0x6009

ERR_BAD_STRING_PTR 0x700a

Invalid zero-terminated string pointer.

ERR_BAD_STRING_PTR 0x700a

ERR_BAD_VALUE 0x6001

Invalid 16-bit signed or unsigned value.

ERR_BAD_VALUE 0x6001

ERR_BYTE 0x1000

Invalid 8-bit parameter.

ERR_BYTE 0x1000

ERR_DWORD 0x3000

Invalid 32-bit parameter.

ERR_DWORD 0x3000

ERR_PARAM 0x4000

A parameter validation error occurred. This flag is always set.

ERR_PARAM 0x4000

ERR_SIZE_MASK 0x3000

Identifies which 2 bits of *uErr* specify the size of the invalid parameter.

ERR_SIZE_MASK 0x3000

ERR_WARNING 0x8000

An invalid parameter was detected, but the error is not serious enough to cause the function to fail. The invalid parameter is reported, but the call runs as usual.

ERR_WARNING 0x8000

ERR_WORD 0x2000

Invalid 16-bit parameter.

ERR_WORD 0x2000

lstrcat (2.x)

LPSTR lstrcat(*lpszString1*, *lpszString2***)**

LPSTR *lpszString1;* /* address of buffer for concatenated strings */
LPCSTR *lpszString2;* /* address of string to add to string1 */

The **lstrcat** function appends one string to another.

Parameter	Description
lpszString1	Points to a byte array containing a null-terminated string. The byte array containing the string must be large enough to contain both strings.
lpszString2	Points to the null-terminated string to be appended to the string specified in the *lpszString1* parameter.

Returns
The return value points to *lpszString1* if the function is successful.

Comments
Both strings must be less than 64K in size.

Example
The following example uses the **lstrcat** function to append a test string to a buffer:

```
char szBuf[80] = { "the test string is " };

lstrcat(szBuf, lpsz);
MessageBox(hwnd, szBuf, "lstrcat", MB_OK);
```

See Also
lstrcpy

lstrcpy (2.x)

LPSTR lstrcpy(*lpszString1, lpszString2***)**

```
LPSTR lpszString1;      /* address of buffer          */
LPCSTR lpszString2;     /* address of string to copy  */
```

The **lstrcpy** function copies a string to a buffer.

Parameter	Description
lpszString1	Points to a buffer that will receive the contents of the string pointed to by the *lpszString2* parameter. The buffer must be large enough to contain the string, including the terminating null character.
lpszString2	Points to the null-terminated string to be copied.

Returns

The return value is a pointer to *lpszString1* if the function is successful. Otherwise, it is NULL.

Comments

This function can be used to copy a double-byte character set (DBCS) string.

Both strings must be less than 64K in size.

See Also

lstrcat, **lstrcpyn**, **lstrlen**

lstrcpyn (3.1)

LPSTR lstrcpyn(*lpszString1, lpszString2, cChars***)**

```
LPSTR lpszString1;      /* address of buffer              */
LPCSTR lpszString2;     /* address of string to copy from */
int cChars;             /* number of characters to copy   */
```

The **lstrcpyn** function copies a specified number of characters in a string to a buffer.

Parameter	Description
lpszString1	Points to a buffer that will receive characters from the string pointed to by the *lpszString2* parameter.
lpszString2	Points to the null-terminated string to copy from.
cChars	Specifies the number of characters to copy from the string pointed to by the *lpszString2* parameter.

Returns

The return value is a pointer to *lpszString1* if the function is successful. Otherwise, it is NULL.

See Also

lstrcpy

lstrlen (2.x)

int lstrlen(*lpszString***)**

LPCSTR *lpszString;* /* address of string to count */

The **lstrlen** function returns the length, in bytes, of the specified string (not including the terminating null character).

Parameter	Description
lpszString	Points to a null-terminated string. This string must be less than 64K in size.

Returns

The return value specifies the length, in bytes, of the string pointed to by the *lpszString* parameter. There is no error return.

See Also

lstrcpy

MakeProcInstance (2.x)

FARPROC MakeProcInstance(*lpProc, hinst***)**

```
FARPROC lpProc;         /* address of function          */
HINSTANCE hinst;        /* instance to bind to function */
```

The **MakeProcInstance** function returns the address of the prolog code for an exported function. The prolog code binds an instance data segment to an exported function. When the function is called, it has access to variables and data in that instance data segment.

Parameter	Description
lpProc	Specifies the address of an exported function.
hinst	Identifies the instance associated with the desired data segment.

Returns

The return value points to the prolog code for the specified exported function, if **MakeProcInstance** is successful. Otherwise, it is NULL.

Comments

The **MakeProcInstance** function is used to retrieve a calling address for a function that must be called by Windows, such as an About procedure. This function must be used only to access functions from instances of the current module. If the address specified in the *lpProc* parameter identifies a procedure in a dynamic-link library, **MakeProcInstance** returns the same address specified in *lpProc.*

After **MakeProcInstance** has been called for a particular function, all calls to that function should be made through the retrieved address.

The **FreeProcInstance** function frees the function from the data segment bound to it by the **MakeProcInstance** function.

MakeProcInstance will create more than one procedure instance. To avoid wasting memory, an application should not call **MakeProcInstance** more than once using the same function and instance handle.

If you are using a recent version of a Windows compiler, you may not have to use the **MakeProcInstance** function. Consult your compiler manual for specific information on function prolog and epilog code.

See Also

FreeProcInstance, **GetProcAddress**

MapVirtualKey (3.0)

UINT MapVirtualKey(*uKeyCode, fuMapType***)**

UINT *uKeyCode;* /* virtual-key code or scan code */
UINT *fuMapType;* /* translation to perform */

The **MapVirtualKey** function translates (maps) a virtual-key code into a scan code or ASCII value, or it translates a scan code into a virtual-key code.

Parameter	Description
uKeyCode	Specifies the virtual-key code or scan code for a key. How this parameter is interpreted depends on the value of the *fuMapType* parameter.
fuMapType	Specifies the translation to perform. If this parameter is 0, the *uKeyCode* parameter is a virtual-key code and is translated into its corresponding scan code. If *fuMapType* is 1, *uKeyCode* is a scan code and is translated to a virtual-key code. If *fuMapType* is 2, *uKeyCode* is a virtual-key code and is translated to an unshifted ASCII value. Other values are reserved.

Returns

The return value depends on the value of the *uKeyCode* and *fuMapType* parameters. For more information, see the description of the *fuMapType* parameter.

See Also

OemKeyScan, **VkKeyScan**

MulDiv (3.0)

int MulDiv(*nMultiplicand, nMultiplier, nDivisor***)**

```
int nMultiplicand;    /* 16-bit signed multiplicand */
int nMultiplier;      /* 16-bit signed multiplier   */
int nDivisor;         /* 16-bit signed divisor      */
```

The **MulDiv** function multiplies two 16-bit values and then divides the 32-bit result by a third 16-bit value. The return value is the 16-bit result of the division, rounded up or down to the nearest integer.

Parameter	Description
nMultiplicand	Specifies the multiplicand.
nMultiplier	Specifies the multiplier.
nDivisor	Specifies the number by which the result of the multiplication (*nMultiplicand* * *nMultiplier*) is to be divided.

Returns

The return value is the result of the multiplication and division if the function is successful. The return value is -32,768 if either an overflow occurs or the *nDivisor* parameter is 0.

See Also

CreateFontIndirect, **GetDeviceCaps**

NetBIOSCall (3.0)

The **NetBIOSCall** function allows an application to issue the NETBIOS Interrupt 5Ch. This function can be called only from assembly-language routines. It is exported from KRNL286.EXE and KRNL386.EXE and is not defined in any Windows header files.

Parameters

Registers must be set up as required by Interrupt 5Ch before the application calls the **NetBIOSCall** function.

Returns

The register contents are preserved as they are returned by Interrupt 5Ch.

Comments

Applications should use this function instead of directly issuing a NETBIOS Interrupt 5Ch.

Example

To use this function, an application should declare it in an assembly-language routine, as follows:

```
extrn NETBIOSCALL: far
```

If the application includes CMACROS.INC, the function is declared as follows:

```
externFP NetBIOSCall
```

Following is an example of how to use the **NetBIOSCall** function:

```
extrn NETBIOSCALL: far
                .
                .
                .
        ;set registers

        cCall NetBIOSCall
```

OemKeyScan (3.0)

DWORD OemKeyScan(*uOemChar***)**

UINT *uOemChar;* /* OEM ASCII character */

The **OemKeyScan** function translates (maps) OEM ASCII codes 0 through 0xFF to their corresponding OEM scan codes and shift states.

Parameter	Description
uOemChar	Specifies the ASCII value of the OEM character.

Returns

The low-order word of the return value contains the scan code of the specified OEM character; the high-order word contains flags that indicate the shift state: If bit 1 is set, a SHIFT key is pressed; if bit 2 is set, a CTRL key is pressed. Both the low-order and high-order words of the return value contain -1 if the character is not defined in the OEM character tables.

Comments

The **OemKeyScan** function does not translate characters that require CTRL+ALT or dead keys. Characters not translated by this function must be copied by simulating input, using the ALT+ keypad mechanism. For this to work, the NUM LOCK key must be off.

This function calls the **VkKeyScan** function in recent versions of the keyboard device drivers.

OemKeyScan allows an application to send OEM text to another application by simulating keyboard input. It is used specifically for this purpose by Windows in 386 enhanced mode.

See Also

VkKeyScan

OemToAnsi (2.x)

void OemToAnsi(*hpszOemStr, hpszWindowsStr***)**

```
const char _huge* hpszOemStr;      /* address of string to translate       */
char _huge* hpszWindowsStr;        /* address of translated string buffer */
```

The **OemToAnsi** function translates a string from the OEM-defined character set into the Windows character set.

Parameter	Description
hpszOemStr	Points to a null-terminated string of characters from the OEM-defined character set.
hpszWindowsStr	Points to the location where the translated string is to be copied. To translate the string in place, the *hpszWindowsStr* parameter can be the same as the *hpszOemStr* parameter.

Returns

This function does not return a value.

See Also

AnsiToOem, **OemToAnsiBuff**

OemToAnsiBuff (2.x)

void OemToAnsiBuff(*lpszOemStr, lpszWindowsStr, cbOemStr***)**

```
LPCSTR lpszOemStr;      /* address of OEM character string     */
LPSTR lpszWindowsStr;   /* address of buffer for Windows string */
UINT cbOemStr;          /* length of OEM string                */
```

The **OemToAnsiBuff** function translates a string from the OEM-defined character set into the Windows character set.

Parameter	Description
lpszOemStr	Points to a buffer containing one or more characters from the OEM-defined character set.
lpszWindowsStr	Points to the location where the translated string is to be copied. To translate the string in place, the *lpszWindowsStr* parameter can be the same as the *lpszOemStr* parameter.
cbOemStr	Specifies the length, in bytes, of the buffer pointed to by *lpszOemStr.* If *cbOemStr* is 0, the length is 64K.

Returns

This function does not return a value.

See Also

AnsiToOem, **OemToAnsi**

OpenFile (2.x)

HFILE OpenFile(*lpszFileName, lpOpenBuff, fuMode***)**

```
LPCSTR lpszFileName;          /* address of filename                  */
OFSTRUCT FAR* lpOpenBuff;     /* address of buffer for file information */
UINT fuMode;                  /* action and attributes                */
```

The **OpenFile** function creates, opens, reopens, or deletes a file.

Parameter	Description
lpszFileName	Points to a null-terminated string that names the file to be opened. The string must consist of characters from the Windows character set and cannot contain wildcards.
lpOpenBuff	Points to the **OFSTRUCT** structure that will receive information about the file when the file is first opened. The structure can be used in subsequent calls to the **OpenFile** function to refer to the open file.
fuMode	Specifies the action to take and the attributes for the file. This parameter can be a combination of the following values:

Value	Meaning
OF_CANCEL	Adds a Cancel button to the **OF_PROMPT** dialog box. Pressing the Cancel button directs **OpenFile** to return a file-not-found error message.
OF_CREATE	Creates a new file. If the file already exists, it is truncated to zero length. When this flag is specified, the sharing flags are ignored. If a file must be shared it should be closed after it is created and then reopened with the appropriate sharing flags.
OF_DELETE	Deletes the file.
OF_EXIST	Opens the file, and then closes it. This value is used to test for file existence. Using this value does not change the file date.
OF_PARSE	Fills the **OFSTRUCT** structure but carries out no other action.
OF_PROMPT	Displays a dialog box if the requested file does not exist. The dialog box informs the user that Windows cannot find the file and prompts the user to insert the file in drive A.
OF_READ	Opens the file for reading only.
OF_READWRITE	Opens the file for reading and writing.
OF_REOPEN	Opens the file using information in the reopen buffer.
OF_SEARCH	Windows searches in directories even when the file name includes a full path.
OF_SHARE_COMPAT	Opens the file with compatibility mode, allowing any program on a given machine to open the file any number of times. **OpenFile** fails if the file has been opened with any of the other sharing modes.
OF_SHARE_DENY_NONE	Opens the file without denying other programs read or write access to the file. **OpenFile** fails if the file has been opened in compatibility mode by any other program.

OF_SHARE_DENY_READ	Opens the file and denies other programs read access to the file. **OpenFile** fails if the file has been opened in compatibility mode or for read access by any other program.
OF_SHARE_DENY_WRITE	Opens the file and denies other programs write access to the file. **OpenFile** fails if the file has been opened in compatibility or for write access by any other program.
OF_SHARE_EXCLUSIVE	Opens the file with exclusive mode, denying other programs both read and write access to the file. **OpenFile** fails if the file has been opened in any other mode for read or write access, even by the current program.
OF_VERIFY	Compares the time and date in the OF_STRUCT with the time and date of the specified file. The function returns HFILE_ERROR if the dates and times do not agree.
OF_WRITE	Opens the file for writing only.

Returns

The return value is an MS-DOS file handle if the function is successful. (This handle is not necessarily valid; for example, if the *fuMode* parameter is **OF_EXIST**, the handle does not identify an open file, and if the *fuMode* parameter is **OF_DELETE**, the handle is invalid.) The return value is HFILE_ERROR if an error occurs.

Comments

If the *lpszFileName* parameter specifies a filename and extension only (or if the **OF_SEARCH** flag is specified), the **OpenFile** function searches for a matching file in the following directories (in this order):

1 The current directory.

2 The Windows directory (the directory containing WIN.COM), whose path the **GetWindowsDirectory** function retrieves.

3 The Windows system directory (the directory containing such system files as GDI.EXE), whose path the **GetSystemDirectory** function retrieves.

4 The directory containing the executable file for the current task; the **GetModuleFileName** function obtains the path of this directory.

5 The directories listed in the PATH environment variable.

6 The list of directories mapped in a network.

To close the file after use, the application should call the **_lclose** function.

See Also

GetSystemDirectory, **GetWindowsDirectory**, **OFSTRUCT**

OF_CANCEL 0x0800

Adds a Cancel button to the **OF_PROMPT** dialog box. Pressing the Cancel button directs **OpenFile** to return a file-not-found error message.

OF_CANCEL 0x0800

OF_CREATE 0x1000

Creates a new file. If the file already exists, it is truncated to zero length. When this flag is specified, the sharing flags are ignored. If a file must be shared it should be closed after it is created and then reopened with the appropriate sharing flags.

OF_CREATE 0x1000

OF_DELETE 0x0200

Deletes the file.

OF_DELETE 0x0200

OF_EXIST 0x4000

Opens the file, and then closes it. This value is used to test for file existence. Using this value does not change the file date.

OF_EXIST 0x4000

OF_PARSE 0x0100

Fills the **OFSTRUCT** structure but carries out no other action.

OF_PARSE 0x0100

OF_PROMPT 0x2000

Displays a dialog box if the requested file does not exist. The dialog box informs the user that Windows cannot find the file and prompts the user to insert the file in drive A.

OF_PROMPT 0x2000

OF_READ 0x0000

Opens the file for reading only.

OF_READ 0x0000

OF_READWRITE 0x0002

Opens the file for reading and writing.

OF_READWRITE 0x0002

OF_REOPEN 0x8000

Opens the file using information in the reopen buffer.

OF_REOPEN 0x8000

OF_SEARCH 0x0400

Windows searches in directories even when the file name includes a full path.

OF_SEARCH 0x0400

OF_SHARE_COMPAT 0x0000

Opens the file with compatibility mode, allowing any program on a given machine to open the file any number of times. **OpenFile** fails if the file has been opened with any of the other sharing modes.

OF_SHARE_COMPAT 0x0000

OF_SHARE_DENY_NONE 0x0040

Opens the file without denying other programs read or write access to the file. **OpenFile** fails if the file has been opened in compatibility mode by any other program.

OF_SHARE_DENY_NONE 0x0040

OF_SHARE_DENY_READ 0x0030

Opens the file and denies other programs read access to the file. **OpenFile** fails if the file has been opened in compatibility mode or for read access by any other program.

OF_SHARE_DENY_READ 0x0030

OF_SHARE_DENY_WRITE 0x0020

Opens the file and denies other programs write access to the file. **OpenFile** fails if the file has been opened in compatibility or for write access by any other program.

OF_SHARE_DENY_WRITE 0x0020

OF_SHARE_EXCLUSIVE 0x0010

Opens the file with exclusive mode, denying other programs both read and write access to the file. **OpenFile** fails if the file has been opened in any other mode for read or write access, even by the current program.

OF_SHARE_EXCLUSIVE 0x0010

OF_VERIFY 0x0400

Compares the time and date in the OF_STRUCT with the time and date of the specified file. The function returns HFILE_ERROR if the dates and times do not agree.

OF_VERIFY 0x0400

OF_WRITE 0x0001

Opens the file for writing only.

OF_WRITE 0x0001

OpenSound (2.x)

int OpenSound(void)

This function is obsolete. Use the Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

OutputDebugString (3.0)

void OutputDebugString(*lpszOutputString***)**

LPCSTR *lpszOutputString;* /* address of string to display */

The **OutputDebugString** function displays the specified character string on the debugging terminal if a debugger is running.

Parameter	Description
lpszOutputString	Points to a null-terminated string to be displayed.

Returns
This function does not return a value.

Comments
This function preserves all registers.

Example
The following example uses the **OutputDebugString** function to display information on the debugging terminal:

```
OutputDebugString("\n\rcalling ValidateCodeSegments");

ValidateCodeSegments();

OutputDebugString("\n\rdone");
```

See Also
DebugOutput

Correction

The previous description of this function indicated that it worked only with the debugging version of Windows. **OutputDebugString** works with both the debugging and retail version of Windows.

PrestoChangoSelector (3.0)

UINT PrestoChangoSelector(*uSourceSelector, uDestSelector***)**

```
UINT uSourceSelector;     /* selector to convert                        */
UINT uDestSelector;       /* converted selector (allocated by AllocSelector)  */
```

The **PrestoChangoSelector** function generates a code selector that corresponds to a given data selector, or it generates a data selector that corresponds to a given code selector.

An application should not use this function unless it is absolutely necessary, because its use violates preferred Windows programming practices.

Parameter	Description
uSourceSelector	Specifies the selector to be converted.
uDestSelector	Specifies a selector previously allocated by the **AllocSelector** function. This previously allocated selector receives the converted selector.

Returns

The return value is the copied and converted selector if the function is successful. Otherwise, it is zero.

Comments

Windows does not track changes to the source selector. Consequently, before any memory can be moved, the application should use the converted destination selector immediately after it is returned by this function.

The **PrestoChangoSelector** function modifies the destination selector to have the same properties as the source selector, but with the opposite code or data attribute. This function changes only the attributes of the selector, not the value of the selector.

This function was named **ChangeSelector** in the Windows 3.0 documentation.

See Also

AllocDStoCSAlias, **AllocSelector**

ProfClear (3.0)

void ProfClear(void)

The **ProfClear** function discards all Microsoft Windows Profiler samples currently in the sampling buffer.

Returns
This function does not return a value.

Example
The following example uses the **ProfClear** function to clear the Profiler sampling buffer before changing the sampling rate:

```
ProfClear();                /* clears existing buffer */
ProfSampRate(5, 1);         /* changes sampling rate  */
```

ProfFinish (3.0)

void ProfFinish(void)

The **ProfFinish** function stops Microsoft Windows Profiler sampling and flushes the output buffer to disk.

Returns
This function does not return a value.

Comments
If Profiler is running in 386 enhanced mode, the **ProfFinish** function also frees the buffer for system use.

Example
The following example uses the **ProfFinish** function to stop sampling and flush the output buffer during **WM_DESTROY** message processing:

```
case WM_DESTROY:
    ProfFinish();
    PostQuitMessage(0);
    break;
```

ProfFlush (3.0)

void ProfFlush(void)

The **ProfFlush** function flushes the Microsoft Windows Profiler sampling buffer to disk.

Returns
This function does not return a value.

Comments
Excessive use of the **ProfFlush** function can seriously impair application performance. An application should not use **ProfFlush** when MS-DOS may be unstable (inside an interrupt handler, for example).

Example
The following example uses the **ProfFlush** function to flush the Profiler buffer before changing the buffer size:

```
ProfFlush();                /* flushes existing buffer */
ProfSetup(1024, 0);         /* uses a 1024K buffer     */
```

ProfInsChk (3.0)

int ProfInsChk(void)

The **ProfInsChk** function determines whether Microsoft Windows Profiler is installed.

Returns

The return value is 1 if Profiler is installed for a mode other than 386 enhanced mode, or it is 2 if Profiler is installed for 386 enhanced mode. Otherwise, the return value is 0, indicating that Profiler is not installed.

Example

The following example uses the **ProfInsChk** function to determine whether the Profiler is installed:

```
int ick;
char szMsg[80];

if ((ick = ProfInsChk()) == 0)
    MessageBox(hwnd, "Profiler is not installed!",
        "ProfInsChk", MB_ICONSTOP);
else {
    strcpy(szMsg, "Profiler is installed");
    if (ick == 2) {
        strcat(szMsg, " in 386 enhanced mode");
        ProfSetup(128, 0);      /* uses a 128K buffer */
    }
    MessageBox(hwnd, szMsg, "ProfInsChk", MB_OK);
}
```

ProfSampRate (3.0)

void ProfSampRate(*nRate286, nRate386***)**

int *nRate286;* /* sample rate for non-386 enhanced mode */
int *nRate386;* /* sample rate for 386 enhanced mode */

The **ProfSampRate** function sets the Microsoft Windows Profiler code-sampling rate.

Parameter	Description
nRate286	Specifies the sampling rate if the application is not running in 386 enhanced mode. The *nRate286* parameter can be one of the following values:

Value	Sampling rate
1	122.070 microseconds
2	244.141 microseconds
3	488.281 microseconds
4	976.562 microseconds
5	1.953125 milliseconds
6	3.90625 milliseconds
7	7.8125 milliseconds
8	15.625 milliseconds
9	31.25 milliseconds
10	62.5 milliseconds
11	125 milliseconds
12	250 milliseconds
13	500 milliseconds

nRate386	Specifies the sampling rate, in milliseconds if the application is running in 386 enhanced mode. This value is in the range 1 through 1000.

Returns

This function does not return a value.

Comments

Only the rate parameter appropriate to the current mode is used; the other parameter is ignored.

The default rate is 2 milliseconds in 386 enhanced mode; in any other mode, the value is 5, which specifies a rate of 1.953125 milliseconds.

Example

The following example uses the **ProfSampRate** function to change the Profiler sampling rate to 1 millisecond in 386 enhanced mode:

```
ProfClear();                /* clears existing buffer */
ProfSampRate(5, 1);         /* changes sampling rate  */
```

ProfSetup (3.0)

void ProfSetup(*nBufferKB, nSamplesKB***)**

int *nBufferKB;* /* size of output buffer */
int *nSamplesKB;* /* amount of sample data written to disk */

The **ProfSetup** function specifies the size of the Microsoft Windows Profiler output buffer and how much sampling data Profiler is to write to the disk.

Profiler ignores the **ProfSetup** function when running with Windows in any mode other than 386 enhanced mode.

Parameter	Description
nBufferKB	Specifies the size, in kilobytes, of the output buffer. This value is in the range 1 through 1064. The default value is 64.
nSamplesKB	Specifies the amount, in kilobytes, of sampling data Profiler writes to the disk. A value of zero (the default value) specifies unlimited sampling data.

Returns
This function does not return a value.

Comments
Do not call the **ProfSetup** function after calling **ProfStart**. To resize memory after **ProfStart** has been called, first call the **ProfStop** function.

Example
The following example uses the **ProfSetup** function to set the output buffer size to 128K if Profiler is installed in 386 enhanced mode:

```
int ick;
char szMsg[80];

if ((ick = ProfInsChk()) == 0)
    MessageBox(hwnd, "Profiler is not installed!",
        "ProfInsChk", MB_ICONSTOP);
else {
    strcpy(szMsg, "Profiler is installed");
    if (ick == 2) {
        strcat(szMsg, " in 386 enhanced mode");
        ProfSetup(128, 0);      /* uses a 128K buffer */
    }
    MessageBox(hwnd, szMsg, "ProfInsChk", MB_OK);
}
```

See Also
ProfStart, **ProfStop**

ProfStart (3.0)

void ProfStart(void)

The **ProfStart** function starts Microsoft Windows Profiler sampling.

Returns
This function does not return a value.

Example
The following example uses the **ProfStart** and **ProfStop** functions to sample during the message-queue dispatch process:

```
/* Acquire and dispatch messages until WM_QUIT is received. */

while (GetMessage(&msg, /* message structure                  */
        (HWND) NULL,    /* handle of window receiving message */
        0,              /* lowest message to examine          */
        0))             /* highest message to examine         */
    {
    ProfStart();

    TranslateMessage(&msg); /* translates virtual-key codes   */
    DispatchMessage(&msg);  /* dispatches message to window   */

    ProfStop();
}
```

See Also
ProfStop

ProfStop (3.0)

void ProfStop(void)

The **ProfStop** function stops Microsoft Windows Profiler sampling.

Returns
This function does not return a value.

Example
The following example uses the **ProfStart** and **ProfStop** functions to sample during the message-queue dispatch process:

```
/* Acquire and dispatch messages until WM_QUIT is received. */

while (GetMessage(&msg, /* message structure                  */
        (HWND) NULL,    /* handle of window receiving message */
        0,              /* lowest message to examine          */
        0))             /* highest message to examine         */
    {
    ProfStart();

    TranslateMessage(&msg); /* translates virtual-key codes   */
    DispatchMessage(&msg);  /* dispatches message to window   */

    ProfStop();
}
```

See Also
ProfStart

SetErrorMode (2.x)

UINT SetErrorMode(*fuErrorMode***)**

UINT *fuErrorMode;* /* specifies the error-mode flag */

The **SetErrorMode** function controls whether Windows handles MS-DOS Interrupt 24h errors or allows the calling application to handle them.

Parameter	Description
fuErrorMode	Specifies the error-mode flag. The flag can be a combination of the following values:

Value	Meaning
SEM_FAILCRITICALERRORS	Windows does not display the critical-error-handler message box and returns the error to the calling application.
SEM_NOGPFAULTERRORBOX	Windows does not display the general-protection-fault message box. This flag should be set *only* by debugging applications that handle GP faults themselves.
SEM_NOOPENFILEERRORBOX	Windows does not display a message box when it fails to find a file.

Returns

The return value is the previous state of the error-mode flag, if the function is successful.

Example

The following example uses the **SetErrorMode** function to turn off the file-not-found message box (the application handles this error itself):

```
/* Turn off the "File not found" error box. */

SetErrorMode(SEM_NOOPENFILEERRORBOX);

/* Load the TOOLHELP.DLL library module. */

hinstToolHelp = LoadLibrary("TOOLHELP.DLL");

if (hinstToolHelp > HINSTANCE_ERROR) {    /* loaded successfully */

    .
    . /* Use the DLL here. */
    .

}
else {
    strcpy(szBuf, "LoadLibrary failed");
}

MessageBox(NULL, szBuf, "Library Functions", MB_ICONHAND);
```

SEM_FAILCRITICALERRORS 0x0001

Windows does not display the critical-error-handler message box and returns the error to the calling application.

SEM_FAILCRITICALERRORS 0x0001

SEM_NOGPFAULTERRORBOX 0x0002

Windows does not display the general-protection-fault message box. This flag should be set *only* by debugging applications that handle GP faults themselves.

SEM_NOGPFAULTERRORBOX 0x0002

SEM_NOOPENFILEERRORBOX 0x8000

Windows does not display a message box when it fails to find a file.

SEM_NOOPENFILEERRORBOX 0x8000

SetHandleCount (3.0)

UINT SetHandleCount(*cHandles***)**

UINT *cHandles;* /* number of file handles needed */

The **SetHandleCount** function changes the number of file handles available to a task.

Parameter	Description
cHandles	Specifies the number of file handles the application requires. This count cannot be greater than 255.

Returns

The return value is the number of file handles available to the application, if the function is successful. This number may be less than the number of handles specified.

Comments

By default, the maximum number of file handles available to a task is 20.

Example

The following example uses the **SetHandleCount** function to set the number of available file handles to 30:

```
UINT cHandles;
char szBuf[80];

cHandles = SetHandleCount(30);

sprintf(szBuf, "%d handles available", cHandles);
MessageBox(hwnd, szBuf, "SetHandleCount", MB_OK);
```

SetResourceHandler (2.x)

RSRCHDLRPROC SetResourceHandler(*hinst, lpszType, lpLoadProc***)**

```
HINSTANCE hinst;          /* handle of application instance          */
LPCSTR lpszType;          /* address of resource-type identifier     */
RSRCHDLRPROC lpLoadProc;  /* callback procedure-instance address     */
```

The **SetResourceHandler** function installs a callback function that loads resources.

Parameter	Description
hinst	Identifies the instance of the module whose executable file contains the resource.
lpszType	Points to a null-terminated string that specifies a resource type. For predefined resource types, the high-order word should be zero and the low-order word should indicate the resource type.
lpLoadProc	Specifies the procedure-instance address of the application-supplied callback function. For more information, see the description of the **LoadProc** callback function.

Returns

The return value is a pointer to the previously installed resource handler, if the function is successful. If no resource handler has been explicitly installed, the return value is a pointer to the default resource handler.

Comments

An application may find this function useful for handling its own resource types, but the use of this function is not required.

The address passed as the *lpLoadProc* parameter must be created by using the **MakeProcInstance** function.

See Also

FindResource, **LoadProc**, **LockResource**, **MakeProcInstance**

Correction

The second parameter points to a null-terminated string that specifies the resource type. Previous documentation stated that it pointed to a short integer.

SetSelectorBase (3.1)

UINT SetSelectorBase(*selector, dwBase***)**

UINT *selector;* /* selector to modify */
DWORD *dwBase;* /* new base */

The **SetSelectorBase** function sets the base address of a selector.

Parameter	Description
selector	Specifies the selector value to modify.
dwBase	Specifies the new base value. This value is the starting linear address that *selector* will reference.

Returns
The return value is the selector value, if the function is successful. If an error occurred, the return value is zero.

Comments
Because this function is selector-based, it will not exist in the Win32 API.

See Also
GetSelectorBase, **GetSelectorLimit**, **SetSelectorLimit**

SetSelectorLimit (3.1)

UINT SetSelectorLimit(*selector, dwLimit***)**

UINT *selector;* /* selector to modify */
DWORD *dwLimit;* /* new limit */

The **SetSelectorLimit** function sets the limit of a selector.

Parameter	Description
selector	Specifies the selector to modify.
dwLimit	Specifies the new limit value for *selector.* On a 80286, this value must be less than 0x10000.

Returns
The return value is always zero.

Comments
Because this function is selector-based, it will not exist in the Win32 API.

See Also
GetSelectorBase, **GetSelectorLimit**, **SetSelectorBase**

SetSoundNoise (2.x)

int SetSoundNoise(*fnSource, nDuration***)**

int *fnSource;* /* source of noise */
int *nDuration;* /* duration of noise */

This function is obsolete. Use the Microsoft Windows multimedia audio functions instead. For information about audio functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

SetSwapAreaSize (2.x)

LONG SetSwapAreaSize(*cCodeParagraphs***)**

UINT *cCodeParagraphs;* /* number of paragraphs for code */

The **SetSwapAreaSize** function sets the amount of memory that an application uses for its code segments.

Parameter	Description
cCodeParagraphs	Specifies the number of 16-byte paragraphs requested by the application for use as code segments. If this parameter is zero, the return value specifies the current size of the code-segment space.

Returns

The return value is the amount of space available for the code segment, if the function is successful. The low-order word specifies the number of paragraphs obtained for use as a code-segment space (or the current size if the *cCodeParagraphs* parameter is zero); the high-order word specifies the maximum size available.

Comments

If *cCodeParagraphs* specifies a size larger than is available, this function sets the size to the available amount. The maximum amount of memory available is one half the space remaining after Windows is loaded.

Calling this function can improve an application's performance by preventing Windows from swapping code segments to the hard disk. However, increasing the code-segment space reduces the amount of memory available for data objects and can reduce the performance of other applications.

See Also

GetNumTasks, **GlobalAlloc**

SetVoiceAccent (2.x)

int SetVoiceAccent(*nVoice, nTempo, nVolume, fnMode, nPitch***)**

```
int nVoice;     /* voice queue                          */
int nTempo;     /* number of quarter notes per minute*/
int nVolume;    /* volume level                         */
int fnMode;     /* how notes are to be played           */
int nPitch;     /* pitch                                */
```

This function is obsolete. Use the Microsoft Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

SetVoiceEnvelope (2.x)

int SetVoiceEnvelope(*nVoice, nShape, nRepeat***)**

```
int nVoice;     /* voice queue                          */
int nShape;     /* index into an OEM wave-shape table*/
int nRepeat;    /* repetition count                     */
```

This function is obsolete. Use the Microsoft Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

SetVoiceNote (2.x)

int SetVoiceNote(*voice, value, length, cdots***)**

```
int voice;      /* voice queue      */
int value;      /* note             */
int length;     /* length of note   */
int cdots;      /* duration of note */
```

This function is obsolete. Use the Microsoft Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

SetVoiceQueueSize (2.x)

int SetVoiceQueueSize(*nVoice, cbQueue***)**

int *nVoice;* /* voice queue */
int *cbQueue;* /* size of queue */

This function is obsolete. Use the Microsoft Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

SetVoiceSound (2.x)

int SetVoiceSound(*nVoice, dwFrequency, nDuration***)**

```
int nVoice;          /* voice queue       */
DWORD dwFrequency;   /* frequency         */
int nDuration;       /* duration of sound */
```

This function is obsolete. Use the Microsoft Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

SetVoiceThreshold (2.x)

int SetVoiceThreshold(*voice, cNotesThreshold***)**

int *voice;* /* voice queue */
int *cNotesThreshold;* /* threshold level */

This function is obsolete. Use the Microsoft Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

SetWinDebugInfo (3.1)

BOOL SetWinDebugInfo(*lpwdi***)**

const WINDEBUGINFO FAR* *lpwdi;* /* address of WINDEBUGINFO structure */

The **SetWinDebugInfo** function sets current system-debugging information for the debugging version of the Windows 3.1 operating system.

Parameter	Description
lpwdi	Points to a **WINDEBUGINFO** structure that specifies the type of debugging information to be set.

Returns

The return value is nonzero if the function is successful. It is zero if the pointer specified in the *lpwdi* parameter is invalid, the **flags** member of the **WINDEBUGINFO** structure is invalid, or the function is not called in the debugging version of Windows 3.1.

Comments

The **flags** member of the **WINDEBUGINFO** structure specifies which debugging information should be set. Applications need initialize only those members of the **WINDEBUGINFO** structure that correspond to the flags set in the **flags** member.

Changes to debugging information made by calling **SetWinDebugInfo** apply only until you exit the system or restart your computer.

See Also

GetWinDebugInfo, **WINDEBUGINFO**

SizeofResource (2.x)

DWORD SizeofResource(*hinst, hrsrc***)**

```
HINSTANCE hinst;        /* handle of module with resource */
HRSRC hrsrc;            /* handle of resource             */
```

The **SizeofResource** function returns the size, in bytes, of the given resource.

Parameter	Description
hinst	Identifies the instance of the module whose executable file contains the resource.
hrsrc	Identifies the resource. This handle must have been created by using the **FindResource** function.

Returns

The return value specifies the number of bytes in the resource, if the function is successful. It is zero if the resource cannot be found.

Comments

The value returned may be larger than the resource due to alignment. An application should not rely upon this value for the exact size of a resource.

See Also

AccessResource, **FindResource**

Windows 3.1 changes

The return value is now a **DWORD** instead of a WORD.

StartSound (2.x)

int StartSound(void)

This function is obsolete. Use the Microsoft Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

StopSound (2.x)

int StopSound(void)

This function is obsolete. Use the Microsoft Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

SwapRecording (3.0)

void SwapRecording(*fuFlag***)**

UINT *fuFlag;* /* whether to start or stop swap recording */

The **SwapRecording** function starts or stops recording data about memory swapping. Because this function can be used only in real mode, it cannot be used with Windows 3.1.

SwitchStackBack (3.0)

void SwitchStackBack(void)

The **SwitchStackBack** function restores the stack of the current task, canceling the effect of the **SwitchStackTo** function.

Returns
This function does not return a value.

Comments
SwitchStackBack preserves the contents of the AX:DX registers when it returns.

See Also
SwitchStackTo

SwitchStackTo (3.0)

void SwitchStackTo(*uStackSegment, uStackPointer, uStackTop***)**

```
UINT uStackSegment;     /* new stack data segment     */
UINT uStackPointer;     /* offset of beginning of stack */
UINT uStackTop;         /* offset of top of stack     */
```

The **SwitchStackTo** function changes the stack of the current task to the specified data segment.

Parameter	Description
uStackSegment	Specifies the data segment to contain the stack.
uStackPointer	Specifies the offset to the beginning of the stack in the data segment.
uStackTop	Specifies the offset to the top of the stack from the beginning of the stack.

Returns

This function does not return a value.

Comments

Dynamic-link libraries (DLLs) do not have private stacks; instead, a DLL uses the stack of the task that calls the library. As a result, a DLL function fails if it treats the contents of the data-segment (DS) and stack-segment (SS) registers as equal. A task can call **SwitchStackTo** before calling a function in a DLL that treats the SS and DS registers as equal. When the DLL function returns, the task must then call the **SwitchStackBack** function to redirect its stack to its own data segment.

A DLL can also call **SwitchStackTo** before calling a function that assumes SS and DS to be equal and then call **SwitchStackBack** before returning to the task that called the DLL function.

Calls to **SwitchStackTo** and **SwitchStackBack** cannot be nested. That is, after calling **SwitchStackTo**, an application must call **SwitchStackBack** before calling **SwitchStackTo** again.

See Also

SwitchStackBack

SyncAllVoices (2.x)

int SyncAllVoices(void)

This function is obsolete. Use the Microsoft Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

Throw (2.x)

void Throw(*lpCatchBuf, nErrorReturn***)**

const int FAR* *lpCatchBuf;* /* address of CATCHBUF saved by Catch */
int *nErrorReturn;* /* value to return from Catch function */

The **Throw** function restores the execution environment to the values saved in the specified array. Execution then transfers to the **Catch** function that copied the environment to the array.

Parameter	Description
lpCatchBuf	Points to a **CATCHBUF** array that contains the execution environment. This array must have been set by a previous call to the **Catch** function.
nErrorReturn	Specifies the value to be returned to the **Catch** function. The meaning of the value is determined by the application. The value should be nonzero, so that the call to the **Catch** function can distinguish between a return from **Catch** (which returns zero) and a return from **Throw**.

Returns

This function does not return a value.

Comments

The **Throw** function is similar to the C run-time function **longjmp**.

The function that calls **Catch** must free any resources allocated between the time **Catch** was called and the time **Throw** was called.

Do not use the **Throw** function across messages. For example, if an application calls **Catch** while processing a **WM_CREATE** message and then calls **Throw** while processing a **WM_PAINT** message, the application will terminate.

Example

The following example calls the **Catch** function to save the current execution environment before calling a recursive sort function. The first return from **Catch** is zero. If the doSort function calls the **Throw** function, execution will again return to the **Catch** function. This time, **Catch** returns the STACKOVERFLOW error passed by the doSort function. The doSort function is recursive--that is, it calls itself. It maintains a variable, wStackCheck, that is used to check the amount of stack space used. If more than 3K of the stack has been used, doSort calls **Throw** to drop out of all the nested function calls back into the function that called **Catch**.

```
#define STACKOVERFLOW 1

UINT uStackCheck;
CATCHBUF catchbuf;

{
    int iReturn;
    char szBuf[80];

    if ((iReturn = Catch((int FAR*) catchbuf)) != 0) {
        .
        . /* Error processing goes here. */
        .
    }
    else {
        uStackCheck = 0;       /* initializes stack-usage count */
        doSort(1, 100);        /* calls sorting function        */
    }
```

```
    break;
}

void doSort(int sLeft, int sRight)
{
    int sLast;

    /*
     * Determine whether more than 3K of the stack has been
     * used, and if so, call Throw to drop back into the
     * original calling application.
     *
     * The stack is incremented by the size of the two parameters,
     * the two local variables, and the return value (2 for a near
     * function call).
     */

    uStackCheck += (sizeof(int) * 4) + 2;

    if (uStackCheck > (3 * 1024))
        Throw((int FAR*) catchbuf, STACKOVERFLOW);
    .
    . /* A sorting algorithm goes here. */
    .

    doSort(sLeft, sLast - 1);   /* note recursive call          */
    uStackCheck -= 10;          /* updates stack-check variable */
}
```

See Also

Catch

ToAscii (3.0)

int ToAscii(*uVirtKey, uScanCode, lpbKeyState, lpdwTransKey, fuState***)**

```
UINT uVirtKey;                  /* virtual-key code                */
UINT uScanCode;                 /* scan code                       */
BYTE FAR* lpbKeyState;          /* address of key-state array      */
DWORD FAR* lpdwTransKey;        /* 32-bit buffer for translated key */
UINT fuState;                   /* active-menu flag                */
```

The **ToAscii** function translates the specified virtual-key code and keyboard state to the corresponding Windows character or characters.

Parameter	Description
uVirtKey	Specifies the virtual-key code to be translated.
uScanCode	Specifies the hardware scan code of the key to be translated. The high-order bit of this value is set if the key is not pressed (is up).
lpbKeyState	Points to a 256-byte array that contains the current keyboard state. Each element (byte) in the array contains the state of one key. If the high-order bit of a byte is set, the key is pressed (is down).
lpdwTransKey	Points to a doubleword buffer to receive the translated Windows character or characters.
fuState	Specifies whether a menu is active. This parameter must be 1 if a menu is active, or zero otherwise.

Returns

The return value is a negative value if the specified key is a dead key. Otherwise, it is one of the following values:

Value	Meaning
2	Two characters were copied to the buffer. This is usually an accent and a dead-key character, when the dead key cannot be translated otherwise.
1	One Windows character was copied to the buffer.
0	The specified virtual key has no translation for the current state of the keyboard.

Comments

If a previous dead key is stored in the keyboard driver, the parameters supplied to the **ToAscii** function might not be sufficient to translate the virtual-key code.

Typically, **ToAscii** performs the translation based on the virtual-key code. In some cases, however, the *uScanCode* parameter may be used to distinguish between a key press and a key release. The scan code is used for translating ALT+*number* key combinations.

See Also

OemKeyScan, **VkKeyScan**

UnlockSegment (2.x)

void UnlockSegment(*uSegment***)**

UINT *uSegment;* /* specifies segment to unlock */

The **UnlockSegment** function unlocks the specified discardable memory segment. The function decrements (decreases by one) the segment's lock count. The segment is completely unlocked and subject to discarding when the lock count reaches zero.

Parameter	Description
uSegment	Specifies the segment address of the segment to be unlocked. If this parameter is -1, the **UnlockSegment** function unlocks the current data segment.

Returns

The return value is the lock count for the segment, if the function is successful. This function returns its result in the CX register. When the CX register contains zero, the segment is completely unlocked.

The value returned when the function is called in C should be ignored, because the return value can be checked only in assembly language.

Comments

An application should not rely on the return value to determine the number of times it must subsequently call **UnlockSegment** for the segment.

Other functions also can affect the lock count of a memory object. For a list of these functions, see the description of the **GlobalFlags** function.

Each time an application calls **LockSegment** for a segment, it must eventually call **UnlockSegment** for the segment.

See Also

GlobalFlags, **LockSegment**, **UnlockData**

ValidateCodeSegments (3.0)

void ValidateCodeSegments(void)

The **ValidateCodeSegments** function tests all code segments for random memory overwrites. The function works only in real mode (for Windows versions earlier than 3.1) and only with the debugging version of Windows.

Returns
This function does not return a value.

Comments
Because code segments are not writeable in protected mode (standard or enhanced), this function does nothing in Windows 3.1.

See Also
ValidateFreeSpaces

ValidateFreeSpaces (2.x)

void ValidateFreeSpaces(void)

The **ValidateFreeSpaces** function checks free segments in memory for valid contents. This function is available only in the debugging version of Windows.

Returns
This function does not return a value.

Comments
In the debugging version of Windows, the kernel fills all the bytes in free segments with the hexadecimal value 0x0CC. This function begins checking for valid contents in the free segment with the lowest address; it continues checking until it finds an invalid byte or until it has determined that all free space contains valid contents. Before calling this function, put the following lines in the WIN.INI file:

```
[KERNEL]
EnableFreeChecking=1
EnableHeapChecking=1
```

Windows sends debugging information to the debugging terminal if an invalid byte is encountered, and then it performs a fatal exit.

The [**KERNEL**] entries in WIN.INI cause automatic checking of free memory. Before returning a memory object to the application in response to a call to the **GlobalAlloc** function, Windows checks that memory to make sure it is filled with 0x0CC. Before a call to the **GlobalCompact** function, all free memory is checked. Note that using this function slows Windows systemwide by about twenty percent.

See Also
GlobalAlloc, **GlobalCompact**, **ValidateCodeSegments**

VkKeyScan (2.x)

UINT VkKeyScan(*uChar***)**

UINT *uChar;* /* character to translate */

The **VkKeyScan** function translates a Windows character to the corresponding virtual-key code and shift state for the current keyboard.

Parameter	Description
uChar	Specifies the character to be translated to a virtual-key code.

Returns

The return value is the virtual-key code and shift state, if the function is successful. The low-order byte contains the virtual-key code; the high-order byte contains the shift state, which can be one of the following:

Value	Meaning
1	Character is shifted.
2	Character is a control character.
3-5	Shift-key combination that is not used for characters.
6	Character is generated by the CTRL+ALT key combination.
7	Character is generated by the SHIFT+CTRL+ALT key combination.

If no key is found that translates to the passed Windows code, the return value is -1.

Comments

Translations for the numeric keypad (VK_NUMPAD0 through VK_DIVIDE) are ignored. This function is intended to force a translation for the main keyboard only.

Applications that send characters by using the **WM_KEYUP** and **WM_KEYDOWN** messages use this function.

See Also

OemKeyScan

WaitSoundState (2.x)

int WaitSoundState(*fnState***)**

int *fnState;* /* state to wait for*/

This function is obsolete. Use the Microsoft Windows multimedia audio functions instead. For information about these functions, see the *Microsoft Windows Multimedia Programmer's Reference.*

WinExec (3.0)

UINT WinExec(*lpszCmdLine, fuCmdShow***)**

LPCSTR *lpszCmdLine;* /* address of command line */
UINT *fuCmdShow;* /* window state of new app. */

The **WinExec** function runs the specified application.

Parameter	Description
lpszCmdLine	Points to a null-terminated Windows character string that contains the command line (filename plus optional parameters) for the application to be run. If the string does not contain a path, Windows searches the directories in this order:

1 The current directory.

2 The Windows directory (the directory containing WIN.COM); the **GetWindowsDirectory** function retrieves the path of this directory.

3 The Windows system directory (the directory containing such system files as GDI.EXE); the **GetSystemDirectory** function retrieves the path of this directory.

4 The directory containing the executable file for the current task; the **GetModuleFileName** function retrieves the path of this directory.

5 The directories listed in the PATH environment variable.

6 The directories mapped in a network.

fuCmdShow	Specifies how a Windows application window is to be shown. See the description of the **ShowWindow** function for a list of the acceptable values for the *fuCmdShow* parameter. For a non-Windows application, the program-information file (PIF), if any, for the application determines the window state.

Returns

The return value identifies the instance of the loaded module, if the function is successful. Otherwise, the return value is an error value less than 32.

Errors

The error value may be one of the following:

Value	Meaning
0	System was out of memory, executable file was corrupt, or relocations were invalid.
2	File was not found.
3	Path was not found.
5	Attempt was made to dynamically link to a task, or there was a sharing or network-protection error.
6	Library required separate data segments for each task.
8	There was insufficient memory to start the application.
10	Windows version was incorrect.
11	Executable file was invalid. Either it was not a Windows application or there was an error in the .EXE image.
12	Application was designed for a different operating system.
13	Application was designed for MS-DOS 4.0.
14	Type of executable file was unknown.
15	Attempt was made to load a real-mode application (developed for an earlier version of Windows).

16 Attempt was made to load a second instance of an executable file containing multiple data segments that were not marked read-only.

19 Attempt was made to load a compressed executable file. The file must be decompressed before it can be loaded.

20 Dynamic-link library (DLL) file was invalid. One of the DLLs required to run this application was corrupt.

21 Application requires Microsoft Windows 32-bit extensions.

Comments

The **LoadModule** function provides an alternative method for running an application.

Example

The following example uses the **WinExec** function to run DRAW.EXE:

```
WORD wReturn;
char szMsg[80];

wReturn = WinExec("draw", SW_SHOW);

if (wReturn < 32) {
    sprintf(szMsg, "WinExec failed; error code = %d", wReturn);
    MessageBox(hwnd, szMsg, "Error", MB_ICONSTOP);
}
else {
    sprintf(szMsg, "WinExec returned %d", wReturn);
    MessageBox(hwnd, szMsg, "", MB_OK);
}
```

See Also

GetModuleFileName, **GetSystemDirectory**, **GetWindowsDirectory**, **LoadModule**, **ShowWindow**

WritePrivateProfileString (3.0)

BOOL WritePrivateProfileString(*lpszSection, lpszEntry, lpszString, lpszFilename***)**

```
LPCSTR lpszSection;      /* address of section                */
LPCSTR lpszEntry;        /* address of entry                  */
LPCSTR lpszString;       /* address of string to add          */
LPCSTR lpszFilename;     /* address of initialization filename */
```

The **WritePrivateProfileString** function copies a character string into the specified section of the specified initialization file.

Parameter	Description
lpszSection	Points to a null-terminated string that specifies the section to which the string will be copied. If the section does not exist, it is created. The name of the section is case-independent; the string may be any combination of uppercase and lowercase letters.
lpszEntry	Points to the null-terminated string containing the entry to be associated with the string. If the entry does not exist in the specified section, it is created. If this parameter is NULL, the entire section, including all entries within the section, is deleted.
lpszString	Points to the null-terminated string to be written to the file. If this parameter is NULL, the entry specified by the *lpszEntry* parameter is deleted.
lpszFilename	Points to a null-terminated string that names the initialization file.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

To improve performance, Windows keeps a cached version of the most-recently accessed initialization file. If that filename is specified and the other three parameters are NULL, Windows flushes the cache.

Sections in the initialization file have the following form:

[*section***]**
*entry***=***string*
.
.
.

If *lpszFilename* does not contain a fully qualified path and filename for the file, **WritePrivateProfileString** searches the Windows directory for the file. If the file does not exist, this function creates the file in the Windows directory.

If *lpszFilename* contains a fully qualified path and filename and the file does not exist, this function creates the file. The specified directory must already exist.

An application should use a private (application-specific) initialization file to record information that affects only that application. This improves the performance of both the application and Windows itself by reducing the amount of information that Windows must read when it accesses the initialization file. The exception to this is that device drivers should use the SYSTEM.INI file, to reduce the number of initialization files Windows must open and read during the startup process.

An application can use the **WriteProfileString** function to add a string to the WIN.INI file.

Example

The following example uses the **WritePrivateProfileString** function to add the string "testcode.c" to the LastFile entry in the [MyApp] section of the TESTCODE.INI initialization file:

```
BOOL fSuccess;
```

```
DebugBreak();

fSuccess = WritePrivateProfileString("MyApp",
    "LastFile", "testcode.c", "testcode.ini");

if (fSuccess)
    MessageBox(hwnd, "String added successfully",
            "WritePrivateProfileString", MB_OK);
else
    MessageBox(hwnd, "String could not be added",
            "WritePrivateProfileString", MB_ICONSTOP);
```

See Also

WriteProfileString

Correction

The Windows 3.0 documentation stated that this function would fail if the *lpszFilename* parameter specified a full path and the file did not exist. In fact, Windows will create the specified file. The directory where the file is to be created must exist, however; Windows will not create the directory.

WriteProfileString (2.x)

BOOL WriteProfileString(*lpszSection, lpszEntry, lpszString***)**

LPCSTR *lpszSection;* /* address of section */
LPCSTR *lpszEntry;* /* address of entry */
LPCSTR *lpszString;* /* address of string to write */

The **WriteProfileString** function copies a string into the specified section of the Windows initialization file, WIN.INI.

Parameter	Description
lpszSection	Points to a null-terminated string that specifies the section to which the string is to be copied. If the section does not exist, it is created. The name of the section is case-independent; the string may be any combination of uppercase and lowercase letters.
lpszEntry	Points to the null-terminated string containing the entry to be associated with the string. If the entry does not exist in the specified section, it is created. If this parameter is NULL, the entire section, including all entries within the section, is deleted.
lpszString	Points to the null-terminated string to be written to the file. If this parameter is NULL, the entry specified by the *lpszEntry* parameter is deleted.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

Windows keeps a cached version of WIN.INI to improve performance. If all three parameters are NULL, Windows flushes the cache.

Sections in the WIN.INI initialization file have the following form:

[*section***]**
*entry***=***string*
.
.
.

Example

The following example calls the **GetWindowRect** function to retrieve the dimensions of the current window, converts the dimensions of a string, and writes the string to WIN.INI by using the **WriteProfileString** function. The next time the application is run, it could call the **GetProfileString** function to read the string, convert it to numbers, and pass the numbers as parameters to the **CreateWindow** function, thereby creating the window again with the same dimensions it had when the application terminated.

```
RECT rect;
BOOL fSuccess;
char szBuf[20];

GetWindowRect(hwnd, &rect);

sprintf(szBuf, "%u %u %u %u",
    rect.left, rect.right - rect.left,
    rect.top, rect.bottom - rect.top);

fSuccess = WriteProfileString("MySection",
        "Window dimensions", szBuf);
```

```
if (fSuccess)
    MessageBox(hwnd, "String added successfully",
            "WriteProfileString", MB_OK);
else
    MessageBox(hwnd, "String could not be added",
            "WriteProfileString", MB_ICONSTOP);
```

See Also

GetProfileString, **WritePrivateProfileString**

wsprintf (3.0)

int _cdecl wsprintf(*lpszOutput, lpszFormat,* **...)**

LPSTR *lpszOutput;* /* address of string for output */
LPSTR *lpszFormat;* /* address of format-control string */

The **wsprintf** function formats and stores a series of characters and values in a buffer. Each argument (if any) is converted according to the corresponding format specified in the format string.

Parameter	Description
lpszOutput	Points to a null-terminated string to receive the string formatted as specified in the *lpszFormat* parameter.
lpszFormat	Points to a null-terminated string that contains the format-control string. In addition to the standard ASCII characters, a format specification for each argument appears in this string. For more information about the format specification, see the following Comments section.
. . .	Specifies zero or more optional arguments. The number and type of the optional arguments depend on the corresponding format-control character sequences specified in the *lpszFormat* parameter.

Returns

The return value is the number of bytes stored in the *lpszOutput* string, not counting the terminating null character, if the function is successful.

Comments

The largest buffer that **wsprintf** can create is 1K.

Unlike most Windows functions, **wsprintf** uses the C calling convention (**_cdecl**) rather than the Pascal calling convention. As a result, the calling function must pop arguments off the stack. Also, arguments must be pushed on the stack from right to left. In C-language modules, the C compiler performs this task. (The **wvsprintf** function uses the Pascal calling convention.)

The format-control string contains format specifications that determine the output format for the arguments that follow the *lpszFormat* parameter. Format specifications always begin with a percent sign (**%**). If a percent sign is followed by a character that has no meaning as a format field, the character is not formatted. For example, **%%** produces a single percent-sign character.

The format-control string is read from left to right. When the first format specification is encountered, it causes the value of the first argument after the format-control string to be converted according to the format specification. The second format specification causes the second argument to be converted, and so on. If there are more arguments than there are format specifications, the extra arguments are ignored. The results are undefined if there are not enough arguments for all of the format specifications.

A format specification has the following form:

%[**-**][*#*][**0**][*width*][**.***precision*]*type*

Each field of the format specification is a single character or number signifying a particular format option. The *type* characters, for example, determine whether the associated argument is interpreted as a character, a string, or a number. The simplest format specification contains only the percent sign and a *type* character (for example, **%s**). The optional fields (in brackets) control other aspects of the formatting. Following are the optional and required fields and their meanings:

Field	Meaning
-	Pad the output value with blanks or zeros to the right to fill the field width, aligning the output value to the left. If this field is omitted, the output value is padded to the left, aligning it to the right.
#	Prefix hexadecimal values with 0x (lowercase) or 0X (uppercase).

0 Pad the output value with zeros to fill the field width. If this field is omitted, the output value is padded with blank spaces.

width Convert the specified minimum number of characters. The *width* field is a nonnegative integer. The width specification never causes a value to be truncated; if the number of characters in the output value is greater than the specified width, or if the *width* field is not present, all characters of the value are printed, subject to the value of the *precision* field.

precision Convert the specified minimum number of digits. If there are fewer digits in the argument than the specified value, the output value is padded on the left with zeros. The value is not truncated when the number of digits exceeds the specified precision. If the specified precision is zero or omitted entirely, or if the period (**.**) appears without a number following it, the precision is set to 1.

For strings, convert the specified maximum number of characters.

type Format the corresponding argument as a character, a string, or a number. This field may be any of the following character sequences:

Sequence	Meaning
c	Insert a single character argument. The **wsprintf** function ignores character arguments with a numeric value of zero.
d, **i**	Insert a signed decimal integer argument.
ld, **li**	Insert a long signed decimal integer argument.
u	Insert an unsigned integer argument.
lu	Insert a long unsigned integer argument.
lx, **lX**	Insert a long unsigned hexadecimal integer argument in lowercase or uppercase.
s	Insert a string.

See Also
wvsprintf

Yield (2.x)

void Yield(void)

The **Yield** function stops the current task and starts any waiting task.

Returns
This function does not return a value.

Comments
The **Yield** function should be used only when the application is guaranteed not to receive any messages.

Applications that contain windows should use a **DispatchMessage**, **PeekMessage**, or **TranslateMessage** loop rather than call the **Yield** function directly. The message-loop functions handle message synchronization properly and yield at the appropriate times.

See Also
DirectedYield, **DispatchMessage**, **PeekMessage**, **TranslateMessage**

Kernel functions (3.1)

_hread	Reads from a file
_hwrite	Writes to a file
_lclose	Closes an open file
_lcreat	Creates or opens a file
_llseek	Repositions the file pointer
_lopen	Opens a file
_lread	Reads from a file
_lwrite	Writes to a file
AccessResource	Opens a resource file and locates a resource
AddAtom	Adds a string to the local atom table
AllocDStoCSAlias	Translates a data segment to a code segment
AllocResource	Allocates memory for a resource
AllocSelector	Allocates a new selector
AnsiToOem	Translates a Windows string to an OEM string
AnsiToOemBuff	Translates a Windows string to an OEM string
Catch	Captures the current execution environment
CloseSound	Not used in Windows 3.1
CountVoiceNotes	Not used in Windows 3.1
DebugBreak	Causes a breakpoint exception
DebugOutput	Sends messages to the debugging terminal
DeleteAtom	Decrements the reference count of a local atom
DirectedYield	Forces execution of a specified task to continue
DOS3Call	Issues a DOS Int 21h function request
FatalAppExit	Terminates an application
FatalExit	Displays debug info after breakpoint exception
FindAtom	Retrieves string atom from local atom table
FindResource	Locates a resource in a resource file
FreeLibrary	Unloads a library module instance
FreeModule	Unloads a module instance
FreeProcInstance	Frees a function instance
FreeResource	Unloads a resource instance
FreeSelector	Frees an allocated selector
GetAtomHandle	Retrieves an atom handle
GetAtomName	Retrieves a local atom string
GetCodeHandle	Determines the location of a function
GetCodeInfo	Retrieves code-segment information
GetCurrentPDB	Returns the selector address of the current PDB
GetCurrentTask	Returns the current task handle
GetDOSEnvironment	Returns a far pointer to the current environment
GetDriveType	Determines the drive type
GetFreeSpace	Returns number of free bytes in global heap
GetInstanceData	Copies data from previous instance to current one
GetKBCodePage	Returns the current code page
GetKeyboardType	Retrieves keyboard information
GetKeyNameText	Retrieves a string representing the key name
GetModuleFileName	Returns the filename for a module handle
GetModuleHandle	Returns a module handle for a named module
GetModuleUsage	Returns the reference count for a module
GetNumTasks	Returns the current number of tasks
GetPrivateProfileInt	Retrieves integer value from initialization file
GetPrivateProfileString	Retrieves a string from an initialization file
GetProcAddress	Returns the address of an exported DLL function
GetProfileInt	Retrieves an integer value from WIN.INI
GetProfileString	Retrieves a string from WIN.INI
GetSelectorBase	Retrieves the base address of a selector

GetSelectorLimit	Retrieves the limit of a selector
GetSystemDirectory	Returns the Windows system directory
GetTempDrive	Returns a disk drive letter for temporary files
GetTempFileName	Creates a temporary filename
GetThresholdEvent	Not used in Windows 3.1
GetThresholdStatus	Not used in Windows 3.1
GetVersion	Returns the current DOS and Windows versions
GetWinDebugInfo	Retrieves current system-debugging information
GetWindowsDirectory	Returns the Windows directory
GetWinFlags	Returns the current system configuration flags
GlobalAlloc	Allocates memory from the global heap
GlobalCompact	Generates free global memory by compacting
GlobalDosAlloc	Allocates memory available to DOS in real mode
GlobalDosFree	Frees global memory allocated by GlobalDosAlloc
GlobalFix	Locks a global memory object in linear memory
GlobalFlags	Returns information about a global memory object
GlobalFree	Frees a global memory object
GlobalHandle	Retrieves a handle for a specified selector
GlobalLock	Locks global memory object and returns pointer
GlobalLRUNewest	Moves global memory object to newest LRU position
GlobalLRUOldest	Moves global memory object to oldest LRU position
GlobalNotify	Installs a notification procedure
GlobalPageLock	Increments global memory page-lock count
GlobalPageUnlock	Decrements global memory page-lock count
GlobalReAlloc	Changes size/attributes of global memory object
GlobalSize	Returns the size of a global memory object
GlobalUnfix	Unlocks a global memory object in linear memory
GlobalUnlock	Unlocks a global memory object
GlobalUnWire	Not used in Windows 3.1
GlobalWire	Not used in Windows 3.1
hmemcpy	Copies bytes from source to destination buffer
InitAtomTable	Sets the size of the local atom table
IsBadCodePtr	Determines whether a code pointer is valid
IsBadHugeReadPtr	Determines whether a huge read pointer is valid
IsBadHugeWritePtr	Determines whether a huge write pointer is valid
IsBadReadPtr	Determines whether a read pointer is valid
IsBadStringPtr	Determines whether a string pointer is valid
IsBadWritePtr	Determines whether a write pointer is valid
IsDBCSLeadByte	Determines whether character is DBCS lead byte
IsTask	Determines whether a task handle is valid
LimitEmsPages	Not used in Windows 3.1
LoadLibrary	Loads the specified library module
LoadModule	Loads and executes a program
LoadResource	Loads the specified resource in global memory
LocalAlloc	Allocates memory from the local heap
LocalCompact	Generates free local memory by compacting
LocalFlags	Returns local memory object information
LocalFree	Frees a local memory object
LocalHandle	Returns the handle of a local memory object
LocalInit	Initializes a local heap
LocalLock	Locks local memory object and returns pointer
LocalReAlloc	Changes size or attributes of local memory object
LocalShrink	Shrinks the specified local heap
LocalSize	Returns the size of a local memory object
LocalUnlock	Unlocks a local memory object
LockResource	Returns the address of a resource

LockSegment	Locks a discardable memory segment
LogError	Identifies an error message
LogParamError	Identifies a parameter validation error
lstrcat	Appends one string to another
lstrcpy	Copies a string to a buffer
lstrcpyn	Copies characters in a string to a buffer
lstrlen	Returns the number of characters in a string
MakeProcInstance	Returns address of prolog code for function
MapVirtualKey	Translates a virtual-key code or scan code
MulDiv	Multiplies two values and divides the result
NetBIOSCall	Issues a NETBIOS Interrupt 5Ch call
OemKeyScan	Maps OEM ASCII to scan codes
OemToAnsi	Translates an OEM string to a Windows string
OemToAnsiBuff	Translates an OEM string to a Windows string
OpenFile	Creates, opens, reopens, or deletes a file
OpenSound	Not used in Windows 3.1
OutputDebugString	Sends a character string to the debugger
PrestoChangoSelector	Converts code or data selector
ProfClear	Discards all buffered Profiler samples
ProfFinish	Stops Profiler sampling and flushes buffer
ProfFlush	Flushes the Profiler sampling buffer to a disk
ProfInsChk	Determines whether Profiler is installed
ProfSampRate	Sets the Profiler sampling rate
ProfSetup	Sets the Profiler buffer size and sample quantity
ProfStart	Starts Profiler sampling
ProfStop	Stops Profiler sampling
SetErrorMode	Controls Interrupt 24h error handling
SetHandleCount	Changes the number of available file handles
SetResourceHandler	Installs a load-resource callback function
SetSelectorBase	Sets the base of an existing selector
SetSelectorLimit	Sets the limit of a selector
SetSoundNoise	Not used in Windows 3.1
SetSwapAreaSize	Sets the amount of memory used for code segments
SetVoiceAccent	Not used in Windows 3.1
SetVoiceEnvelope	Not used in Windows 3.1
SetVoiceNote	Not used in Windows 3.1
SetVoiceQueueSize	Not used in Windows 3.1
SetVoiceSound	Not used in Windows 3.1
SetVoiceThreshold	Not used in Windows 3.1
SetWinDebugInfo	Sets the current system-debugging information
SizeofResource	Returns the size of a resource
StartSound	Not used in Windows 3.1
StopSound	Not used in Windows 3.1
SwapRecording	Starts or stops recording of memory swapping
SwitchStackBack	Restores the current task stack
SwitchStackTo	Changes the location of the stack
SyncAllVoices	Not used in Windows 3.1
Throw	Restores the execution environment
ToAscii	Translates virtual-key code to Windows character
UnlockSegment	Unlocks a discardable memory segment
ValidateCodeSegments	Tests for memory overwrites
ValidateFreeSpaces	Checks free memory for valid contents
VkKeyScan	Translates Windows character to virtual-key code
WaitSoundState	Not used in Windows 3.1
WinExec	Runs a program
WritePrivateProfileString	Writes a string to an initialization file

WriteProfileString	Writes a string to WIN.INI
wsprintf	Formats a string
Yield	Stops the current task

CopyLZFile (3.1)

#include lzexpand.h

LONG CopyLZFile(*hfSource, hfDest***)**

HFILE *hfSource;* /* handle of source file */
HFILE *hfDest;* /* handle of destination file */

The **CopyLZFile** function copies a source file to a destination file. If the source file is compressed, this function creates a decompressed destination file. If the source file is not compressed, this function duplicates the original file.

Parameter	Description
hfSource	Identifies the source file.
hfDest	Identifies the destination file.

Returns

The return value specifies the size, in bytes, of the destination file if the function is successful. Otherwise, it is an error value less than zero; it may be one of the following:

Value	Meaning
LZERROR_BADINHANDLE	The handle identifying the source file was not valid.
LZERROR_BADOUTHANDLE	The handle identifying the destination file was not valid.
LZERROR_BADVALUE	The input parameter is out of the allowable range.
LZERROR_GLOBALLOC	There is insufficient memory for the required buffers.
LZERROR_GLOBLOCK	The handle identifying the internal data structures is invalid.
LZERROR_READ	The source file format was not valid.
LZERROR_UNKNOWNALG	The source file was compressed with an unrecognized compression algorithm.
LZERROR_WRITE	There is insufficient space for the output file.

Comments

This function is identical to the **LZCopy** function.

The **CopyLZFile** function is designed for copying or decompressing multiple files, or both. To allocate required buffers, an application should call the **LZStart** function prior to calling **CopyLZFile**. To free these buffers, an application should call the **LZDone** function after copying the files.

If the function is successful, the file identified by *hfDest* is decompressed.

If the source or destination file is opened by using a C run-time function (rather than by using the **_lopen** or **OpenFile** function), it must be opened in binary mode.

Example

The following example uses the **CopyLZFile** function to create copies of four text files:

```
#define STRICT

#include <windows.h>
#include <lzexpand.h>

#define NUM_FILES   4

char *szSrc[NUM_FILES] =
    {"readme.txt", "data.txt", "update.txt", "list.txt"};
char *szDest[NUM_FILES] =
    {"readme.bak", "data.bak", "update.bak", "list.bak"};
```

```
OFSTRUCT ofStrSrc;
OFSTRUCT ofStrDest;
HFILE hfSrcFile, hfDstFile;
int i;

/* Allocate internal buffers for the CopyLZFile function. */

LZStart();

/* Open, copy, and then close the files. */

for (i = 0; i < NUM_FILES; i++) {
    hfSrcFile = LZOpenFile(szSrc[i], &ofStrSrc, OF_READ);
    hfDstFile = LZOpenFile(szDest[i], &ofStrDest, OF_CREATE);
    CopyLZFile(hfSrcFile, hfDstFile);
    LZClose(hfSrcFile);
    LZClose(hfDstFile);
}

LZDone(); /* free the internal buffers */
```

See Also

_lopen, **LZCopy**, **LZDone**, **LZStart**, **OpenFile**

GetExpandedName (3.1)

#include lzexpand.h

int GetExpandedName(*lpszSource, lpszBuffer***)**

LPCSTR *lpszSource;* /* specifies name of compressed file */
LPSTR *lpszBuffer;* /* points to buffer receiving original filename */

The **GetExpandedName** function retrieves the original name of a compressed file if the file was compressed with the COMPRESS.EXE utility and the ***/r*** option was specified.

Parameter	Description
lpszSource	Points to a string that specifies the name of a compressed file.
lpszBuffer	Points to a buffer that receives the name of the compressed file.

Returns

The return value is TRUE if the function is successful. Otherwise, it is an error value that is less than zero, and it may be **LZERROR_BADINHANDLE**, which means that the handle identifying the source file was not valid.

Example

The following example uses the **GetExpandedName** function to retrieve the original filename of a compressed file:

```
char szSrc[] = {"readme.cmp"};
char szFileName[128];
OFSTRUCT ofStrSrc;
OFSTRUCT ofStrDest;
HFILE hfSrcFile, hfDstFile, hfCompFile;
int cbRead;
BYTE abBuf[512];

/* Open the compressed source file. */

hfSrcFile = OpenFile(szSrc, &ofStrSrc, OF_READ);

/*
 * Initialize internal data structures for the decompression
 * operation.
 */

hfCompFile = LZInit(hfSrcFile);

/* Retrieve the original name for the compressed file. */

GetExpandedName(szSrc, szFileName);

/* Create the destination file using the original name. */

hfDstFile = LZOpenFile(szFileName, &ofStrDest, OF_CREATE);

/* Copy the compressed source file to the destination file. */

do {
    if ((cbRead = LZRead(hfCompFile, abBuf, sizeof(abBuf))) > 0)
        _lwrite(hfDstFile, abBuf, cbRead);
    else {
```

```
        .
        . /* handle error condition */
        .
    }
} while (cbRead == sizeof(abBuf));

/* Close the files. */

LZClose(hfSrcFile);
LZClose(hfDstFile);
```

Comments

This function retrieves the original filename from the header of the compressed file. If the source file is not compressed, the filename to which *lpszSource* points is copied to the buffer to which *lpszBuffer* points.

If the ***l*r** option was not set when the file was compressed, the string in the buffer to which *lpszBuffer* points is invalid.

LZClose (3.1)

#include lzexpand.h

void LZClose(*hf*)

HFILE *hf;* /* handle of file to be closed */

The **LZClose** function closes a file that was opened by the **LZOpenFile** or **OpenFile** function.

Parameter	Description
hf	Identifies the source file.

Returns
This function does not return a value.

Comments
If the file was compressed by Microsoft File Compression Utility (COMPRESS.EXE) and opened by the **LZOpenFile** function, **LZClose** frees any global heap space that was required to expand the file.

Example
The following example uses **LZClose** to close a file opened by **LZOpenFile**:

```
char szSrc[] = {"readme.txt"};
char szDst[] = {"readme.bak"};
OFSTRUCT ofStrSrc;
OFSTRUCT ofStrDest;
HFILE hfSrcFile, hfDstFile;

/* Open the source file. */

hfSrcFile = LZOpenFile(szSrc, &ofStrSrc, OF_READ);

/* Create the destination file. */

hfDstFile = LZOpenFile(szDst, &ofStrDest, OF_CREATE);

/* Copy the source file to the destination file. */

LZCopy(hfSrcFile, hfDstFile);

/* Close the files. */

LZClose(hfSrcFile);
LZClose(hfDstFile);
```

See Also
OpenFile, **LZOpenFile**

LZCopy (3.1)

#include lzexpand.h

LONG LZCopy(*hfSource, hfDest***)**

HFILE *hfSource;* /* handle of source file */
HFILE *hfDest;* /* handle of destination file */

The **LZCopy** function copies a source file to a destination file. If the source file was compressed by Microsoft File Compression Utility (COMPRESS.EXE), this function creates a decompressed destination file. If the source file was not compressed, this function duplicates the original file.

Parameter	Description
hfSource	Identifies the source file. (This handle is returned by the **LZOpenFile** function when a compressed file is opened.)
hfDest	Identifies the destination file.

Returns

The return value is the size, in bytes, of the destination file if the function is successful. Otherwise, it is an error value that is less than zero and may be one of the following:

Value	Meaning
LZERROR_BADINHANDLE	The handle identifying the source file was not valid.
LZERROR_BADOUTHANDLE	The handle identifying the destination file was not valid.
LZERROR_BADVALUE	The input parameter is out of the allowable range.
LZERROR_GLOBALLOC	There is insufficient memory for the required buffers.
LZERROR_GLOBLOCK	The handle identifying the internal data structures is invalid.
LZERROR_READ	The source file format was not valid.
LZERROR_UNKNOWNALG	The source file was compressed with an unrecognized compression algorithm.
LZERROR_WRITE	There is insufficient space for the output file.

Comments

This function is identical to the **CopyLZFile** function.

If the function is successful, the file identified by *hfDest* is uncompressed.

If the source or destination file is opened by a C run-time function (rather than the **_lopen** or **OpenFile** function), it must be opened in binary mode.

Example

The following example uses the **LZCopy** function to copy a file:

```
char szSrc[] = {"readme.txt"};
char szDst[] = {"readme.bak"};
OFSTRUCT ofStrSrc;
OFSTRUCT ofStrDest;
HFILE hfSrcFile, hfDstFile;

/* Open the source file. */

hfSrcFile = LZOpenFile(szSrc, &ofStrSrc, OF_READ);

/* Create the destination file. */

hfDstFile = LZOpenFile(szDst, &ofStrDest, OF_CREATE);
```

```
/* Copy the source file to the destination file. */

LZCopy(hfSrcFile, hfDstFile);

/* Close the files. */

LZClose(hfSrcFile);
LZClose(hfDstFile);
```

See Also

CopyLZFile, **_lopen**, **LZOpenFile**, **OpenFile**

LZERROR_BADINHANDLE (-1)

The handle identifying the source file was not valid.

LZERROR_BADINHANDLE (-1)

LZERROR_BADOUTHANDLE (-2)

The handle identifying the destination file was not valid.

LZERROR_BADOUTHANDLE (-2)

LZERROR_BADVALUE (-7)

The input parameter is out of the allowable range.

LZERROR_BADVALUE (-7)

LZERROR_GLOBALLOC (-5)

There is insufficient memory for the required buffers.

LZERROR_GLOBALLOC (-5)

LZERROR_GLOBLOCK (-6)

The handle identifying the internal data structures is invalid.

LZERROR_GLOBLOCK (-6)

LZERROR_READ (-3)

The source file format was not valid.

LZERROR_READ (-3)

LZERROR_UNKNOWNALG (-8)

The source file was compressed with an unrecognized compression algorithm.

LZERROR_UNKNOWNALG (-8)

LZERROR_WRITE (-4)

There is insufficient space for the output file.

LZERROR_WRITE (-4)

LZDone (3.1)

#include lzexpand.h

void LZDone(void)

The **LZDone** function frees buffers that the **LZStart** function allocated for multiple-file copy operations.

Returns

This function does not return a value.

Comments

Applications that copy multiple files should call **LZStart** before copying the files with the **CopyLZFile** function. **LZStart** allocates buffers for the file copy operations.

Example

The following example uses **LZDone** to free buffers allocated by **LZStart**:

```
#define NUM_FILES   4

char *szSrc[NUM_FILES] =
    {"readme.txt", "data.txt", "update.txt", "list.txt"};
char *szDest[NUM_FILES] =
    {"readme.bak", "data.bak", "update.bak", "list.bak"};
OFSTRUCT ofStrSrc;
OFSTRUCT ofStrDest;
HFILE hfSrcFile, hfDstFile;
int i;

/* Allocate internal buffers for the CopyLZFile function. */

LZStart();

/* Open, copy, and then close the files. */

for (i = 0; i < NUM_FILES; i++) {
    hfSrcFile = LZOpenFile(szSrc[i], &ofStrSrc, OF_READ);
    hfDstFile = LZOpenFile(szDest[i], &ofStrDest, OF_CREATE);
    CopyLZFile(hfSrcFile, hfDstFile);
    LZClose(hfSrcFile);
    LZClose(hfDstFile);
}

LZDone(); /* free the internal buffers */
```

See Also

CopyLZFile, **LZCopy**, **LZStart**

LZInit (3.1)

#include lzexpand.h

HFILE LZInit(*hfSrc***)**

HFILE *hfSrc;* /* handle of source file */

The **LZInit** function allocates memory for, creates, and initializes the internal data structures that are required to decompress files.

Parameter	Description
hfSrc	Identifies the source file.

Returns

The return value is the original file handle if the function is successful and the file is not compressed. If the function is successful and the file is compressed, the return value is a new file handle. If the function fails, the return value is an error value that is less than zero and may be one of the following:

Value	Meaning
LZERROR_BADINHANDLE	The handle identifying the source file is invalid.
LZERROR_GLOBALLOC	There is insufficient memory for the required internal data structures. This value is returned when an application attempts to open more than 16 files.
LZERROR_GLOBLOCK	The handle identifying global memory is invalid. (The internal call to the **GlobalLock** function failed.)
LZERROR_READ	The source file format is invalid.
LZERROR_UNKNOWNALG	The file was compressed with an unrecognized compression algorithm.

Comments

A maximum of 16 compressed files can be open at any given time.

Example

The following example uses **LZInit** to initialize the internal structures that are required to decompress a file:

```
char szSrc[] = {"readme.cmp"};
char szFileName[128];
OFSTRUCT ofStrSrc;
OFSTRUCT ofStrDest;
HFILE hfSrcFile, hfDstFile, hfCompFile;
int cbRead;
BYTE abBuf[512];

/* Open the compressed source file. */

hfSrcFile = OpenFile(szSrc, &ofStrSrc, OF_READ);

/*
 * Initialize internal data structures for the decompression
 * operation.
 */

hfCompFile = LZInit(hfSrcFile);

/* Retrieve the original name for the compressed file. */
```

```
GetExpandedName(szSrc, szFileName);

/* Create the destination file using the original name. */

hfDstFile = LZOpenFile(szFileName, &ofStrDest, OF_CREATE);

/* Copy the compressed source file to the destination file. */

do {
    if ((cbRead = LZRead(hfCompFile, abBuf, sizeof(abBuf))) > 0)
        _lwrite(hfDstFile, abBuf, cbRead);
    else {
        .
        . /* handle error condition */
        .
    }
} while (cbRead == sizeof(abBuf));

/* Close the files. */

LZClose(hfSrcFile);
LZClose(hfDstFile);
```

LZOpenFile (3.1)

#include lzexpand.h

HFILE LZOpenFile(*lpszFile, lpof, style***)**

```
LPCSTR lpszFile;          /* address of filename              */
OFSTRUCT FAR* lpof;       /* address of structure for file info*/
UINT style;               /* action to be taken               */
```

The **LZOpenFile** function creates, opens, reopens, or deletes the file specified by the string to which *lpszFile* points.

Parameter	Description
lpszFile	Points to a string that specifies the name of a file.
lpof	Points to the **OFSTRUCT** structure that is to receive information about the file when the file is opened. The structure can be used in subsequent calls to **LZOpenFile** to refer to the open file. The **szPathName** member of this structure contains characters from the OEM character set.
style	Specifies the action to be taken. These styles can be combined by using the bitwise OR operator:

Value	Meaning
OF_CANCEL	Adds a Cancel button to the **OF_PROMPT** dialog box. Choosing the Cancel button directs **LZOpenFile** to return a file-not-found error message.
OF_CREATE	Directs **LZOpenFile** to create a new file. If the file already exists, it is truncated to zero length.
OF_DELETE	Deletes the file.
OF_EXIST	Opens the file, and then closes it. This action is used to test for file existence.
OF_PARSE	Fills the **OFSTRUCT** structure, but carries out no other action.
OF_PROMPT	Displays a dialog box if the requested file does not exist. The dialog box informs the user that Windows cannot find the file and prompts the user to insert the disk containing the file in drive A.
OF_READ	Opens the file for reading only.
OF_READWRITE	Opens the file for reading and writing.
OF_REOPEN	Opens the file using information in the reopen buffer.
OF_SHARE_DENY_NONE	Opens the file without denying other programs read access or write access to the file. **LZOpenFile** fails if the file has been opened in compatibility mode by any other program.
OF_SHARE_DENY_READ	Opens the file and denies other programs read access to the file. **LZOpenFile** fails if the file has been opened in compatibility mode or for read access by any other program.
OF_SHARE_DENY_WRITE	Opens the file and denies other programs write access to the file. **LZOpenFile** fails if the file has been opened in compatibility mode or for write access by any other program.

OF_SHARE_EXCLUSIVE	Opens the file in exclusive mode, denying other programs both read access and write access to the file. **LZOpenFile** fails if the file has been opened in any other mode for read access or write access, even by the current program.
OF_WRITE	Opens the file for writing only.

Returns

The return value is a handle identifying the file if the function is successful and the value specified by *style* is not OF_READ. If the file is compressed and opened with *style* set to the **OF_READ** value, the return value is a special file handle. If the function fails, the return value is -1.

Comments

If *style* is **OF_READ** (or OF_READ and any of the OF_SHARE_ flags) and the file is compressed, **LZOpenFile** calls the **LZInit** function, which performs the required initialization for the decompression operations.

Example

The following example uses **LZOpenFile** to open a source file and create a destination file into which the source file can be copied:

```
char szSrc[] = {"readme.txt"};
char szDst[] = {"readme.bak"};
OFSTRUCT ofStrSrc;
OFSTRUCT ofStrDest;
HFILE hfSrcFile, hfDstFile;

/* Open the source file. */

hfSrcFile = LZOpenFile(szSrc, &ofStrSrc, OF_READ);

/* Create the destination file. */

hfDstFile = LZOpenFile(szDst, &ofStrDest, OF_CREATE);

/* Copy the source file to the destination file. */

LZCopy(hfSrcFile, hfDstFile);

/* Close the files. */

LZClose(hfSrcFile);
LZClose(hfDstFile);
```

See Also

LZInit

LZRead (3.1)

#include lzexpand.h

int LZRead(*hf, lpvBuf, cb***)**

HFILE *hf;* /* handle of the file */
void FAR* *lpvBuf;* /* address of buffer for file data */
int *cb;* /* number of bytes to read */

The **LZRead** function reads into a buffer bytes from a file.

Parameter	Description
hf	Identifies the source file.
lpvBuf	Points to a buffer that is to receive the bytes read from the file.
cb	Specifies the maximum number of bytes to be read.

Returns

The return value is the actual number of bytes read if the function is successful. Otherwise, it is an error value that is less than zero and may be any of the following:

Value	Meaning
LZERROR_BADINHANDLE	The handle identifying the source file was invalid.
LZERROR_BADVALUE	The *cb* parameter specified a negative value.
LZERROR_GLOBLOCK	The handle identifying required initialization data is invalid.
LZERROR_READ	The format of the source file was invalid.
LZERROR_UNKNOWNALG	The file was compressed with an unrecognized compression algorithm.

Comments

If the file is not compressed, **LZRead** calls the **_lread** function, which performs the read operation.

If the file is compressed, **LZRead** emulates **_lread** on an expanded image of the file and copies the bytes of data into the buffer to which *lpvBuf* points.

If the source file was compressed by Microsoft File Compression Utility (COMPRESS.EXE), the **LZOpenFile**, **LZSeek**, and **LZRead** functions can be called instead of the **OpenFile**, **_llseek**, and **_lread** functions.

Example

The following example uses **LZRead** to copy and decompress a compressed file:

```
char szSrc[] = {"readme.cmp"};
char szFileName[128];
OFSTRUCT ofStrSrc;
OFSTRUCT ofStrDest;
HFILE hfSrcFile, hfDstFile, hfCompFile;
int cbRead;
BYTE abBuf[512];

/* Open the compressed source file. */

hfSrcFile = OpenFile(szSrc, &ofStrSrc, OF_READ);

/*
 * Initialize internal data structures for the decompression
 * operation.
 */
```

```
hfCompFile = LZInit(hfSrcFile);

/* Retrieve the original name for the compressed file. */

GetExpandedName(szSrc, szFileName);

/* Create the destination file using the original name. */

hfDstFile = LZOpenFile(szFileName, &ofStrDest, OF_CREATE);

/* Copy the compressed source file to the destination file. */

do {
    if ((cbRead = LZRead(hfCompFile, abBuf, sizeof(abBuf))) > 0)
        _lwrite(hfDstFile, abBuf, cbRead);
    else {
        .
        . /* handle error condition */
        .
    }
} while (cbRead == sizeof(abBuf));

/* Close the files. */

LZClose(hfSrcFile);
LZClose(hfDstFile);
```

See Also

_llseek, **_lread**, **LZOpenFile**, **LZRead**, **LZSeek**

LZSeek (3.1)

#include lzexpand.h

LONG LZSeek(*hf, lOffset, nOrigin***)**

```
HFILE hf;       /* handle of file              */
LONG lOffset;   /* number of bytes to move     */
int nOrigin;    /* original position           */
```

The **LZSeek** function moves a file pointer from its original position to a new position.

Parameter	Description
hf	Identifies the source file.
lOffset	Specifies the number of bytes by which the file pointer should be moved.
nOrigin	Specifies the starting position of the pointer. This parameter must be one of the following values:

Value	Meaning
0	Move the file pointer *lOffset* bytes from the beginning of the file.
1	Move the file pointer *lOffset* bytes from the current position.
2	Move the file pointer *lOffset* bytes from the end of the file.

Returns

The return value is the offset from the beginning of the file to the new pointer position, if the function is successful. Otherwise, it is an error value that is less than zero and may be one of the following:

Value	Meaning
LZERROR_BADINHANDLE	The handle identifying the source file was invalid.
LZERROR_BADVALUE	One of the parameters exceeds the range of valid values.
LZERROR_GLOBLOCK	The handle identifying the initialization data is invalid.

Comments

If the file is not compressed, **LZSeek** calls the **_llseek** function and moves the file pointer by the specified offset.

If the file is compressed, **LZSeek** emulates **_llseek** on an expanded image of the file.

See Also

_llseek

LZStart (3.1)

#include lzexpand.h

int LZStart(void)

The **LZStart** function allocates the buffers that the **CopyLZFile** function uses to copy a source file to a destination file.

Returns

The return value is nonzero if the function is successful. Otherwise, it is LZERROR_GLOBALLOC.

Comments

Applications that copy (or copy and decompress) multiple consecutive files should call the **LZStart**, **CopyLZFile**, and **LZDone** functions. Applications that copy a single file should call the **LZCopy** function.

Example

The following example uses **LZStart** to allocate buffers used by **CopyLZFile**:

```
#define NUM_FILES   4

char *szSrc[NUM_FILES] =
    {"readme.txt", "data.txt", "update.txt", "list.txt"};
char *szDest[NUM_FILES] =
    {"readme.bak", "data.bak", "update.bak", "list.bak"};
OFSTRUCT ofStrSrc;
OFSTRUCT ofStrDest;
HFILE hfSrcFile, hfDstFile;
int i;

/* Allocate internal buffers for the CopyLZFile function. */

LZStart();

/* Open, copy, and then close the files. */

for (i = 0; i < NUM_FILES; i++) {
    hfSrcFile = LZOpenFile(szSrc[i], &ofStrSrc, OF_READ);
    hfDstFile = LZOpenFile(szDest[i], &ofStrDest, OF_CREATE);
    CopyLZFile(hfSrcFile, hfDstFile);
    LZClose(hfSrcFile);
    LZClose(hfDstFile);
}

LZDone(); /* free the internal buffers */
```

See Also

CopyLZFile, **LZCopy**, **LZDone**

Lempel-Ziv Encoding functions

CopyLZFile	Copies files and decompresses them if compressed
GetExpandedName	Retrieves the original filename of a compressed file
LZClose	Closes a file
LZCopy	Copies a file and decompresses it if compressed
LZDone	Frees buffers allocated by the LZStart function
LZInit	Initializes structures needed for decompression
LZOpenFile	Opens a file (both compressed and uncompressed)
LZRead	Reads a specified number of bytes from a compressed file
LZSeek	Repositions a pointer in a file
LZStart	Allocates buffers for the CopyLZFile function

DECLARE_HANDLE (3.1)

DECLARE_HANDLE(*name***)**

The **DECLARE_HANDLE** macro creates a data type that can be used to define 16-bit handles.

Parameter	Description
name	Specifies the name of the new data type.

Comments

The **DECLARE_HANDLE** macro is defined in WINDOWS.H as follows:

```
#define DECLARE_HANDLE(name) struct name##__ { int unused; }; \
                             typedef const struct name##__ NEAR* name
```

See Also

DECLARE_HANDLE32

DECLARE_HANDLE32 (3.1)

#include ddeml.h

DECLARE_HANDLE32(*name***)**

The **DECLARE_HANDLE32** macro creates a data type that can be used to define 32-bit handles.

Parameter	Description
name	Specifies the name of the new data type.

Parameter	Description
name	Specifies the name of the variable for which a pointer is created.

Comments

The **DECLARE_HANDLE32** macro is defined in DDEML.H as follows:

```
#define DECLARE_HANDLE32(name) struct name##__ { int unused; }; \
                               typedef const struct name##__ _far* name
```

See Also

DECLARE_HANDLE

FIELDOFFSET (3.1)

int FIELDOFFSET(*type, field***)**

The **FIELDOFFSET** macro computes the address offset of the specified member in the structure specified by the *type* parameter.

Parameter	Description
type	Specifies the name of the structure.
field	Specifies the name of the member defined within the given structure.

Returns

The return value is the address offset of the given structure member.

Comments

The **FIELDOFFSET** macro is defined in WINDOWS.H as follows:

```
#define FIELDOFFSET(type, field)    ((int)(&((type NEAR*)1)->field)-1)
```

GetBValue (3.1)

BYTE GetBValue(*rgb***)**

DWORD *rgb;* /* RGB color value */

The **GetBValue** macro extracts the intensity value of the blue color field from the 32-bit integer value specified by the *rgb* parameter.

Parameter	Description
rgb	Specifies the **RGB** color value.

Returns
The return value specifies the intensity of the blue color field.

Comments
The **GetBValue** macro is defined in WINDOWS.H as follows:

```
#define GetBValue(rgb)  ((BYTE)((rgb)>>16))
```

See Also
GetGValue, **GetRValue**, **RGB**

GetGValue (3.1)

BYTE GetGValue(*rgb***)**

DWORD *rgb;* /* RGB color value */

The **GetGValue** macro extracts the intensity value of the green color field from the 32-bit integer value specified by the *rgb* parameter.

Parameter	Description
rgb	Specifies the **RGB** color value.

Returns
The return value specifies the intensity of the green color field.

Comments
The **GetGValue** macro is defined in WINDOWS.H as follows:

```
#define GetGValue(rgb)  ((BYTE)(((WORD)(rgb)) >> 8))
```

See Also
GetBValue, **GetRValue**, **RGB**

GetRValue (3.1)

BYTE GetRValue(*rgb***)**

DWORD *rgb;* /* RGB color value */

The **GetRValue** macro extracts the intensity value of the red color field from the 32-bit integer value specified by the *rgb* parameter.

Parameter	Description
rgb	Specifies the **RGB** color value.

Returns
The return value specifies the intensity of the red color field.

Comments
The **GetRValue** macro is defined in WINDOWS.H as follows:

```
#define GetRValue(rgb)  ((BYTE)(rgb))
```

See Also
GetBValue, **GetGValue**, **RGB**

GlobalDiscard (2.x)

HGLOBAL GlobalDiscard(*hglb***)**

HGLOBAL *hglb;* /* handle of object to discard */

The **GlobalDiscard** macro discards the given global memory object. The lock count of the memory object must be zero.

Parameter	Description
hglb	Identifies the global memory object to be discarded.

Returns
The return value is a handle of the discarded object if the macro is successful. Otherwise, it is NULL.

Comments
The **GlobalDiscard** macro discards only global objects that an application allocated with the **GMEM_DISCARDABLE** and **GMEM_MOVEABLE** flags set. The macro fails if an application attempts to discard a fixed or locked object.

Although **GlobalDiscard** removes the global memory object from memory, the object's handle remains valid. An application can subsequently pass the handle to the **GlobalReAlloc** function to allocate another global memory object identified by the same handle.

The **GlobalDiscard** macro is defined in WINDOWS.H as follows:

```
#define GlobalDiscard(h)  GlobalReAlloc(h, 0L, GMEM_MOVEABLE)
```

See Also
GlobalFree, **GlobalReAlloc**

HIBYTE (2.x)

BYTE HIBYTE(*wInteger***)**

UINT *uVal;* /* value from which high byte is retrieved */

The **HIBYTE** macro retrieves the high-order byte from the integer value specified by the *wInteger* parameter.

Parameter	Description
uVal	Specifies the value to be converted.

Returns
The return value specifies the high-order byte of the given value.

Comments
The **HIBYTE** macro is defined in WINDOWS.H as follows:

```
#define HIBYTE(w)   ((BYTE)(((UINT)(w) >> 8) & 0xFF))
```

HIWORD (2.x)

WORD HIWORD(*dwInteger***)**

DWORD *dwInteger;* /* value from which high word is retrieved */

The **HIWORD** macro retrieves the high-order word from the 32-bit integer value specified by the *dwInteger* parameter.

Parameter	Description
dwInteger	Specifies the value to be converted.

Returns

The return value specifies the high-order word of the given 32-bit integer value.

Comments

The **HIWORD** macro is defined in WINDOWS.H as follows:

```
#define HIWORD(l)  ((WORD)((((DWORD)(l)) >> 16) & 0xFFFF))
```

LOBYTE (2.x)

BYTE LOBYTE(*uVal***)**

UINT *uVal;* /* value from which low byte is retrieved */

The **LOBYTE** macro extracts the low-order byte from the 16-bit integer value specified by the *uVal* parameter.

Parameter	Description
uVal	Specifies the value to be converted.

Returns
The return value specifies the low-order byte of the value.

Comments
The **LOBYTE** macro is defined in WINDOWS.H as follows:

```
#define LOBYTE(w)   ((BYTE)(w))
```

See Also
LOWORD

LocalDiscard (2.x)

HLOCAL LocalDiscard(*hloc***)**

HLOCAL *hloc;* /* handle of object to discard */

The **LocalDiscard** macro discards the given local memory object. The lock count of the memory object must be zero.

Parameter	Description
hloc	Identifies the local memory object to be discarded.

Returns
The return value is equal to the *hloc* parameter if the macro is successful. Otherwise, it is NULL.

Comments
Although the **LocalDiscard** macro removes the local memory object from memory, the object's handle remains valid. An application can subsequently pass the handle to the **LocalReAlloc** function to allocate another local memory object identified by the same handle.

The **LocalLock** function increments (increases by one) a memory object's lock count. The **LocalUnlock** function decrements (decreases by one) the lock count.

The **LocalDiscard** macro is defined in WINDOWS.H as follows:

```
#define LocalDiscard(h)   LocalReAlloc(h, 0, LMEM_MOVEABLE)
```

See Also
LocalLock, **LocalReAlloc**, **LocalUnlock**

LockData (2.x)

HANDLE LockData(*dummy***)**

The **LockData** macro locks the current data segment in memory. It is intended to be used in modules that have movable data segments.

Parameter	Description
dummy	This parameter is ignored.

Returns
The return value identifies the locked data segment if the function is successful. Otherwise, it is NULL.

Comments
The **LockData** macro is defined in WINDOWS.H as follows:

```
#define LockData(dummy)  LockSegment((UINT)-1)
```

See Also
LockSegment

LOWORD (2.x)

WORD LOWORD(*dwVal***)**

DWORD *dwVal;* /* value from which low word is retrieved */

The **LOWORD** macro extracts the low-order word from the 32-bit integer value specified by the *dwVal* parameter.

Parameter	Description
dwVal	Specifies the value to be converted.

Returns
The return value specifies the low-order word of the 32-bit integer value.

Comments
The **LOWORD** macro is defined in WINDOWS.H as follows:

```
#define LOWORD(l)   ((WORD)(DWORD)(l))
```

See Also
LOBYTE

MAKEINTATOM (2.x)

LPCSTR MAKEINTATOM(*wInteger***)**

WORD *wInteger;* /* integer to make into atom */

The **MAKEINTATOM** macro creates an integer atom that represents a character string of decimal digits.

Integer atoms created by this macro can be added to the atom table using the **AddAtom** function.

Parameter	Description
wInteger	Specifies the numeric value to be made into an integer atom.

Returns
The return value is a pointer to the atom created for the given integer.

Comments
Although the return value of the **MAKEINTATOM** macro is cast as an **LPCSTR**, the return value cannot be used as a string pointer, except when it is passed to atom-management functions that require an **LPCSTR** parameter.

The **DeleteAtom** function always succeeds for integer atoms, even though it does nothing. The string returned by the **GetAtomName** function for an integer atom will be a null-terminated string where the first character is a pound sign (#) and the remaining characters are the word used in the **MAKEINTATOM** macro.

The **MAKEINTATOM** macro is defined in WINDOWS.H as follows:

```
#define MAKEINTATOM(i)  ((LPCSTR)MAKELP(NULL, (i)))
```

Example
The following example uses the **MAKEINTATOM** macro to convert the number 32,565 into an integer atom. The atom is then added to the local atom table by the **AddAtom** function:

```
ATOM at;
char szMsg[80];
LPCSTR lpszAtom;

lpszAtom = MAKEINTATOM(32565);
at = AddAtom(lpszAtom);

if (at == 0)
    MessageBox(hwnd, "AddAtom failed", "", MB_ICONSTOP);
else {
    wsprintf(szMsg, "AddAtom returned %u", at);
    MessageBox(hwnd, szMsg, "", MB_OK);
}
```

See Also
AddAtom, **DeleteAtom**, **GetAtomName**

MAKEINTRESOURCE (2.x)

LPCSTR MAKEINTRESOURCE(*idResource***)**

WORD *idResource;* /* resource identifier to convert */

The **MAKEINTRESOURCE** macro converts an integer resource identifier into a value compatible with Windows resource-management functions. This macro is used in place of a string containing the name of the resource.

Parameter	Description
idResource	Specifies the integer resource identifier to be converted.

Returns

The return value contains the *idResource* parameter in the low-order word and zero in the high-order word.

Comments

The **MAKEINTRESOURCE** macro is defined in WINDOWS.H as follows:

```
#define MAKEINTRESOURCE(i)  ((LPCSTR)MAKELP(NULL, (i)))
```

See Also

MAKELP

MAKELONG (2.x)

DWORD MAKELONG(*uLow, uHigh***)**

UINT *uLow;* /* low-order word of long value */
UINT *uHigh;* /* high-order word of long value */

The **MAKELONG** macro creates an unsigned long integer by concatenating two integer values, specified by the *uLow* and *uHigh* parameters.

Parameter	Description
uLow	Specifies the low-order word of the new long value.
uHigh	Specifies the high-order word of the new long value.

Returns
The return value specifies an unsigned long-integer value.

Comments
The **MAKELONG** macro is defined in WINDOWS.H as follows:

```
#define MAKELONG(low, high) \
     ((LONG)(((WORD)(low)) | (((DWORD)((WORD)(high))) << 16)))
```

MAKELP (3.1)

void FAR* MAKELP(*wSel, wOff***)**

WORD *wSel;* /* selector */
WORD *wOff;* /* offset */

The **MAKELP** macro combines a segment selector and an address offset to create a long (32-bit) pointer to a memory address.

Parameter	Description
wSel	Specifies a segment selector.
wOff	Specifies an offset from the beginning of the given segment to the desired byte.

Returns
The return value is a long pointer to an unspecified data type.

Comments
The **MAKELP** macro is defined in WINDOWS.H as follows:

```
#define MAKELP(sel, off)    ((void FAR*)MAKELONG((off), (sel)))
```

See Also
MAKELONG

MAKELPARAM (3.1)

LPARAM MAKELPARAM(*wLow, wHigh***)**

WORD *wLow;* /* low-order word */
WORD *wHigh;* /* high-order word */

The **MAKELPARAM** macro creates an unsigned long integer for use as an *lParam* parameter in a message. The macro concatenates two integer values, specified by the *wLow* and *wHigh* parameters.

Parameter	Description
wLow	Specifies the low-order word of the new long value.
wHigh	Specifies the high-order word of the new long value.

Returns
The return value specifies an unsigned long-integer value.

Comments
The **MAKELPARAM** macro is defined in WINDOWS.H as follows:

```
#define MAKELPARAM(low, high)   ((LPARAM)MAKELONG(low, high))
```

See Also
MAKELONG, **MAKELRESULT**

MAKELRESULT (3.1)

LRESULT MAKELRESULT(*wLow, wHigh***)**

WORD *wLow;* /* low-order word */
WORD *wHigh;* /* high-order word */

The **MAKELRESULT** macro creates an unsigned long integer for use as a return value from a window procedure. The macro concatenates two integer values, specified by the *wLow* and *wHigh* parameters.

Parameter	Description
wLow	Specifies the low-order word of the new long value.
wHigh	Specifies the high-order word of the new long value.

Returns
The return value specifies an unsigned long-integer value.

Comments
The **MAKELRESULT** macro is defined in WINDOWS.H as follows:

```
#define MAKELRESULT(low, high)  ((LRESULT)MAKELONG(low, high))
```

See Also
MAKELONG, **MAKELPARAM**

MAKEPOINT (2.x)

POINT MAKEPOINT(*lval***)**

DWORD *lval;* /* coordinates of a point */

The **MAKEPOINT** macro converts a long value that contains the x- and y-coordinates of a point into a **POINT** structure. This macro is useful for converting the long value returned by the **GetMessagePos** function into a **POINT** structure and for converting the *lParam* value passed with mouse messages into a **POINT** structure containing the mouse coordinates.

Parameter	Description
lval	Specifies the coordinates of a point. The x-coordinate is in the low-order word, and the y-coordinate is in the high-order word.

Returns
The return value is a pointer to a **POINT** structure.

Comments
The **MAKEPOINT** macro is defined in WINDOWS.H as follows:

```
#define MAKEPOINT(l)   (*((POINT FAR*)&(l)))
```

The **MAKEPOINT** macro is not compatible with the Windows 32-bit application programming interface (API).

See Also
GetMessagePos, **POINT**

max (2.x)

int max(*value1, value2***)**

The **max** macro compares two values and returns the value of the larger one. The data type can be any numerical data type, signed or unsigned. The type of the arguments and the return value is the same.

Parameter	Description
value1	Specifies the first of two values.
value2	Specifies the second of two values.

Returns
The return value is *value1* or *value2,* whichever is greater.

Comments
The **max** macro is defined in WINDOWS.H as follows:

```
#define max(a, b)  (((a) > (b)) ? (a) : (b))
```

See Also
min

min (2.x)

int min(*value1, value2***)**

The **min** macro compares two values and returns the value of the smaller one. The data type can be any numerical data type, signed or unsigned. The type of the arguments and the return value is the same.

Parameter	Description
value1	Specifies the first of two values.
value2	Specifies the second of two values.

Returns
The return value is *value1* or *value2,* whichever is smaller.

Comments
The **min** macro is defined in WINDOWS.H as follows:

```
#define min(a, b)  (((a) < (b)) ? (a) : (b))
```

See Also
max

OFFSETOF (3.1)

WORD OFFSETOF(*lp*)

void FAR* *lp;* /* long pointer */

The **OFFSETOF** macro retrieves the address offset of the specified long pointer.

Parameter	Description
lp	Specifies a long pointer.

Returns
The return value is the offset address.

Comments
The **OFFSETOF** macro is defined in WINDOWS.H as follows:

```
#define OFFSETOF(lp)        LOWORD(lp)
```

See Also
LOWORD, **SELECTOROF**

PALETTEINDEX (3.0)

COLORREF PALETTEINDEX(*wPaletteIndex***)**

WORD *wPaletteIndex;* /* index to palette entry */

The **PALETTEINDEX** macro accepts an index to a logical-color palette entry and returns a value consisting of 1 in the high-order byte and the palette-entry index in the low-order byte. This is called a palette-entry specifier. An application using a color palette can pass this specifier instead of an explicit **RGB** value to functions that expect a color. This allows the function to use the color in the specified palette entry.

Parameter	Description
wPaletteIndex	Specifies an index to the palette entry containing the color to be used for a graphics operation.

Returns

The return value is a logical-palette index specifier. When using a logical palette, an application can use this specifier in place of an explicit **RGB** value for graphics-device interface (GDI) functions that require a color.

Comments

The **PALETTEINDEX** macro is defined in WINDOWS.H as follows:

```
#define PALETTEINDEX(i)  ((COLORREF)(0x01000000L | (DWORD)(WORD)(i)))
```

See Also

PALETTERGB, **RGB**

PALETTERGB (3.0)

COLORREF PALETTERGB(*cRed, cGreen, cBlue***)**

BYTE *cRed;* /* red component of palette-relative RGB */
BYTE *cGreen;* /* green component of palette-relative RGB */
BYTE *cBlue;* /* blue component of palette-relative RGB */

The **PALETTERGB** macro accepts three values representing relative intensities of red, green, and blue and returns a value consisting of 2 in the high-order byte and an **RGB** value in the three low-order bytes. This is called a palette-relative RGB specifier. An application using a color palette can pass this specifier instead of an explicit RGB value to functions that expect a color.

For output devices that support logical palettes, Windows matches a palette-relative **RGB** value to the nearest color in the logical palette of the device context as though the application had specified an index to that palette entry. If an output device does not support a system palette, then Windows uses the palette-relative RGB as though it were a conventional RGB doubleword returned by the **RGB** macro.

Parameter	Description
cRed	Specifies the intensity of the red color field.
cGreen	Specifies the intensity of the green color field.
cBlue	Specifies the intensity of the blue color field.

Returns
The return value specifies a palette-relative **RGB** value.

Comments
The **PALETTERGB** macro is defined in WINDOWS.H as follows:

```
#define PALETTERGB(r,g,b)    (0x02000000L | RGB(r,g,b))
```

See Also
PALETTEINDEX, **RGB**

RGB (2.x)

COLORREF RGB(*cRed, cGreen, cBlue***)**

BYTE *cRed;* /* red component of color */
BYTE *cGreen;* /* green component of color */
BYTE *cBlue;* /* blue component of color */

The **RGB** macro selects an RGB color based on the parameters supplied and the color capabilities of the output device.

Parameter	Description
cRed	Specifies the intensity of the red color field.
cGreen	Specifies the intensity of the green color field.
cBlue	Specifies the intensity of the blue color field.

Returns
The return value specifies the resultant RGB color.

Comments
The intensity for each argument can range from 0 through 255. If all three intensities are specified as zero, the result is black. If all three intensities are specified as 255, the result is white.

Comments
The **RGB** macro is defined in WINDOWS.H as follows:

```
#define RGB(r,g,b)    ((COLORREF)(((BYTE)(r)|((WORD)(g)<<8))| \
     (((DWORD)(BYTE)(b))<<16)))
```

See Also
GetBValue, **GetGValue**, **GetRValue**, **PALETTEINDEX**, **PALETTERGB**

SELECTOROF (3.1)

WORD SELECTOROF(*lp*)

void FAR* *lp;* /* long pointer */

The **SELECTOROF** macro retrieves the segment selector from the specified long pointer.

Parameter	Description
lp	Specifies a long pointer.

Returns
The return value is the segment selector.

Comments
The **SELECTOROF** macro is defined in WINDOWS.H as follows:

```
#define SELECTOROF(lp)      HIWORD(lp)
```

See Also
HIWORD, **OFFSETOF**

UnlockData (2.x)

HANDLE UnlockData(*dummy***)**

The **UnlockData** macro unlocks the current data segment. It is intended to be used by modules that have movable data segments.

Parameter	Description
dummy	This parameter is ignored.

Returns
The return value specifies the outcome of the **UnlockSegment** function. It is zero if the segment's lock count was decreased to zero. Otherwise, the return value is nonzero.

Comments
The **UnlockData** macro is defined in WINDOWS.H as follows:

```
#define UnlockData(dummy)    UnlockSegment((UINT)-1)
```

See Also
LockData, **UnlockSegment**

UnlockResource (2.x)

BOOL UnlockResource(*hglblResData***)**

HGLOBAL *hglblResData;* /* handle of memory object to unlock */

The **UnlockResource** macro unlocks the resource specified by the *hglblResData* parameter and decreases the reference count of the resource by one.

Parameter	Description
hglblResData	Identifies the global memory object to be unlocked.

Returns
The return value is zero if the object's reference count is decreased to zero. Otherwise, it is nonzero.

Comments
The **UnlockResource** macro is defined in WINDOWS.H as follows:

```
#define UnlockResource(h)   GlobalUnlock(h)
```

See Also
GlobalUnlock

Windows macros (3.1)

DECLARE_HANDLE	Creates a 32-bit handle data type
DECLARE_HANDLE32	Creates a 16-bit handle data type
FIELDOFFSET	Computes the address offset of a structure member
GetBValue	Retrieves the blue color field of an **RGB** value
GetGValue	Retrieves the green color field of an **RGB** value
GetRValue	Retrieves the red color field of an **RGB** value
GlobalDiscard	Discards a global memory object
HIBYTE	Retrieves the high-order byte of an integer
HIWORD	Retrieves the high-order word of a 32-bit integer
LOBYTE	Retrieves the low-order byte of a 16-bit integer
LocalDiscard	Discards a local memory object
LockData	Locks the current data segment in memory
LOWORD	Retrieves the low-order word of a 32-bit integer
MAKEINTATOM	Creates an integer atom
MAKEINTRESOURCE	Converts a resource identifier into a string
MAKELONG	Creates a 32-bit integer from two 16-bit integers
MAKELP	Creates a long pointer to a memory address
MAKELPARAM	Creates unsigned long-integer message parameter
MAKELRESULT	Creates unsigned long-integer message result
MAKEPOINT	Converts a long value into a **POINT** structure
max	Returns the larger of two values
min	Returns the smaller of two values
OFFSETOF	Retrieves the address offset of a long pointer
PALETTEINDEX	Returns a logical-palette index specifier
PALETTERGB	Returns a palette-relative **RGB** specifier
RGB	Creates an **RGB** value from three colors
SELECTOROF	Retrieves the segment selector from a long pointer
UnlockData	Unlocks the current data segment
UnlockResource	Unlocks a resource and decreases its reference count

MS Windows (3.1)

New 3.1 API

Microsoft Windows
Software Development Kit

Version 3.1

Windows function groups (3.1)

32-bit Memory Manager Functions

GetWinMem32Version	Retrieves the version of the 32-bit memory API
Global16PointerAlloc	Converts a 16:32 pointer to a 16:16 pointer alias
Global16PointerFree	Frees a 16:16 pointer alias
Global32Alloc	Allocates a USE32 memory object
Global32CodeAlias	Creates a USE32 alias selector for 32-bit object
Global32CodeAliasFree	Frees a USE32 code-segment alias selector
Global32Free	Frees a USE32 memory object
Global32Realloc	Changes the size of a USE32 memory object

Alphabetical functions

Caret Functions (3.1)

CreateCaret	Creates a new shape for the system caret
DestroyCaret	Destroys the current caret shape
GetCaretBlinkTime	Retrieves the caret blink rate
GetCaretPos	Retrieves the current caret position
HideCaret	Removes the caret from the screen
SetCaretBlinkTime	Sets the caret blink rate
SetCaretPos	Sets the caret position
ShowCaret	Shows (unhides) the caret on the screen

Clipboard Functions (3.1)

The clipboard provides a mechanism that makes it possible for applications to pass data handles to other applications. Clipboard functions carry out data interchange between Windows applications.

ChangeClipboardChain	Removes window from clipboard-viewer chain
CloseClipboard	Closes the clipboard
CountClipboardFormats	Retrieves the number of clipboard formats
EmptyClipboard	Empties the clipboard and frees data handles
EnumClipboardFormats	Returns the available clipboard formats
GetClipboardData	Retrieves a handle to clipboard data
GetClipboardFormatName	Retrieves the registered clipboard-format name
GetClipboardOwner	Retrieves clipboard-owner window handle
GetClipboardViewer	Retrieves first clipboard-viewer window handle
GetPriorityClipboardFormat	Retrieves first clipboard format in priority list
IsClipboardFormatAvailable	Determines whether format data is available
OpenClipboard	Opens the clipboard
RegisterClipboardFormat	Registers a new clipboard format
SetClipboardData	Sets the data in the clipboard
SetClipboardViewer	Adds a window to the clipboard-viewer chain

Cursor Functions (3.1)

ClipCursor	Confines the cursor to a specified rectangle
CreateCursor	Creates a cursor with specified dimensions
DestroyCursor	Destroys a cursor created by CreateCursor or LoadCursor
GetCursorPos	Retrieves the current cursor position in screen coordinates
LoadCursor	Loads a cursor resource
SetCursor	Changes the mouse cursor
SetCursorPos	Sets the mouse-cursor position in screen coordinates
ShowCursor	Shows or hides the mouse cursor

Dialog-Box Functions (3.1)

CheckDlgButton	Changes a check mark by a dialog box button
CheckRadioButton	Adds a check mark to a radio button
CreateDialog	Creates a modeless dialog box
CreateDialogIndirect	Creates modeless dialog box from memory template
CreateDialogIndirectParam	Creates modeless dialog box from memory template
CreateDialogParam	Creates a modeless dialog box
DefDlgProc	Provides default window message processing
DialogBox	Creates a modal dialog box
DialogBoxIndirect	Creates modal dialog box from memory template
DialogBoxIndirectParam	Creates modal dialog box from memory template
DialogBoxParam	Creates a modal dialog box
DlgDirList	Fills a directory list box
DlgDirListComboBox	Fills a directory list box
DlgDirSelect	Retrieves a selection from a directory list box
DlgDirSelectEx	Retrieves a selection from a directory list box
DlgDirSelectComboBox	Retrieves a selection from a directory list box
DlgDirSelectComboBoxEx	Retrieves a selection from a directory list box
EndDialog	Hides a modal dialog box
GetDialogBaseUnits	Returns dialog base units
GetDlgCtrlID	Returns the handle of a child window
GetDlgItem	Retrieves the handle of a dialog box control
GetDlgItemInt	Translates control text into an integer
GetDlgItemText	Retrieves control text or title
GetNextDlgGroupItem	Returns handle of previous or next group control
GetNextDlgTabItem	Returns the next or previous **WS_TABSTOP** control
IsDialogMessage	Determines if message is for modeless dialog box
IsDlgButtonChecked	Determines the state of a button
MapDialogRect	Maps dialog box units to pixels
SendDlgItemMessage	Sends a message to a dialog box control
SetDlgItemInt	Converts an integer to a dialog box string
SetDlgItemText	Sets title or text of a control

Display and Movement Functions (3.1)

ArrangeIconicWindows	Arranges minimized child windows
BeginDeferWindowPos	Creates a window-position structure
BringWindowToTop	Uncovers an overlapped window
CloseWindow	Minimizes (but does not destroy) a window
DeferWindowPos	Updates a window-position structure
EndDeferWindowPos	Updates the position and size of multiple windows
GetClientRect	Retrieves a window's client coordinates
GetWindowRect	Retrieves a window's screen coordinates
GetWindowText	Copies window title or control text to a buffer
GetWindowTextLength	Returns length of window title or control text
IsIconic	Determines whether a window is minimized
IsWindowVisible	Determines the visibility state of a window
IsZoomed	Determines whether a window is maximized
MoveWindow	Changes the position and dimensions of a window
OpenIcon	Activates and displays a minimized window
SetWindowPos	Sets a window's size, position, and z-order
SetWindowText	Sets control text or window title
ShowOwnedPopups	Shows or hides pop-up windows
ShowWindow	Sets a window's visibility state

Error Functions (3.1)

FlashWindow	Flashes a window once
MessageBeep	Generates a beep sound
MessageBox	Creates and displays a message-box window

Hardware Functions (3.1)

EnableHardwareInput	Controls mouse and keyboard input queuing
GetAsyncKeyState	Determines the key state
GetInputState	Determines mouse, keyboard and timer queuing status
GetKeyboardState	Copies virtual-keyboard keys status to a buffer
GetKeyNameText	Retrieves the string representing the name of a key
GetKeyState	Retrieves the virtual-key state
GetKBCodePage	Returns the current Windows code page
OemKeyScan	Translates OEM ASCII to scan codes
SetKeyboardState	Sets the Windows keyboard-state table
MapVirtualKey	Translates a virtual-key code or scan code
VkKeyScan	Translates a Windows character to a virtual-key code

Hook Functions (3.1)

CallMsgFilter	Passes a message to a message-filter function
DefHookProc	Calls the next function in a hook-function chain
SetWindowsHook	Installs an application-defined hook function
SetWindowsHookEx	Installs an application-defined hook function
UnhookWindowsHook	Removes an application-defined hook function

Icon Functions (3.1)

ArrangeIconicWindows	Arranges minimized child windows
CopyIcon	Copies an icon
CreateIcon	Creates an icon with the specified dimensions
DestroyIcon	Destroys an icon created by CreateIcon or LoadIcon
DrawIcon	Draws an icon in the specified device context
IsIconic	Determines whether a window is minimized
LoadIcon	Loads an icon resource
OpenIcon	Activates and displays a minimized window

Information Functions (3.1)

AnyPopup	Indicates whether pop-up or overlapped window exists
ChildWindowFromPoint	Determines which child window contains a point
EnumChildWindows	Enumerates child windows
EnumTaskWindows	Enumerates windows associated with task on screen
EnumWindows	Enumerates parent windows
FindWindow	Returns window handle for class name and window name
GetNextWindow	Returns handle of window in window manager's list
GetParent	Returns parent window handle
GetTopWindow	Returns handle for top-level child of given window
GetWindow	Returns handle of window with specified relationship
GetWindowTask	Returns the task handle associated with a window
IsChild	Determines whether a window is a child
IsWindow	Determines whether a window handle is valid
SetParent	Changes a child's parent window
WindowFromPoint	Returns the handle of window containing a point

Input Functions (3.1)

EnableWindow	Enables or disables input to a window or control
GetActiveWindow	Retrieves the handle of the active window
GetCapture	Returns the handle for the mouse-capture window
GetCurrentTime	Retrieves the elapsed time since Windows started
GetDoubleClickTime	Retrieves mouse double-click time
GetFocus	Returns handle of window with input focus
GetTickCount	Retrieves the amount of time Windows has been running
IsWindowEnabled	Determines whether a window accepts user input
KillTimer	Removes a timer
ReleaseCapture	Releases the mouse capture
SetActiveWindow	Makes a top-level window active
SetCapture	Sets the mouse capture to a window
SetDoubleClickTime	Sets the mouse double-click time
SetFocus	Sets the input focus to a window
SetSysModalWindow	Makes a window the system-modal window
SetTimer	Installs a system timer
SwapMouseButton	Reverses the meaning of mouse buttons

Installable-Driver Functions (3.1)

CloseDriver	Closes an installable driver
DefDriverProc	Default processing of installable-driver messages
DriverProc	Processes installable-driver messages
GetDriverModuleHandle	Returns an installable-driver instance handle
GetDriverInfo	Retrieves installable-driver data
GetNextDriver	Enumerates installable-driver instances
OpenDriver	Opens an installable driver
SendDriverMessage	Sends a message to an installable driver

Menu Functions (3.1)

A menu is an input tool in a Windows application that offers users one or more items, which they can select with the mouse or keyboard. An item in a menu bar can display a pop-up menu, and any item in a pop-up menu can display another pop-up menu. In addition, a pop-up menu can appear anywhere on the screen.

AppendMenu	Appends a new item to the end of a menu
CheckMenuItem	Changes a check mark by a menu item
CreateMenu	Creates a menu
CreatePopupMenu	Creates an empty pop-up window
DeleteMenu	Deletes an item from a menu
DestroyMenu	Destroys a menu
DrawMenuBar	Redraws the menu bar of a window
EnableMenuItem	Enables, disables, or grays a menu item
GetMenu	Returns a menu handle for the specified window
GetMenuCheckMarkDimensions	Retrieves default check mark bitmap dimensions
GetMenuItemCount	Retrieves the number of items in a menu
GetMenuItemID	Returns the handle of a menu item
GetMenuState	Retrieves status flags for a menu item
GetMenuString	Copies a menu-item label into a buffer
GetSubMenu	Returns a pop-up menu handle
GetSystemMenu	Provides access to the System menu
HiliteMenuItem	Changes highlighting of top-level menu item
InsertMenu	Inserts a new item in a menu
LoadMenuIndirect	Returns a menu handle for a menu template
ModifyMenu	Changes an existing menu item
RemoveMenu	Deletes a menu item and pop-up menu
SetMenu	Sets the menu for a window
SetMenuItemBitmaps	Associates bitmaps with a menu item
TrackPopupMenu	Displays and tracks a pop-up menu

Message functions (3.1)

CallWindowProc	Passes message information to a window procedure
DispatchMessage	Dispatches a message to a window
GetMessage	Retrieves a message from the message queue
GetMessagePos	Retrieves the cursor position for the last message
GetMessageTime	Retrieves the time for the last message
InSendMessage	Determines whether window is processing SendMessage
PeekMessage	Checks an application's message queue
PostAppMessage	Posts a message to an application (task)
PostMessage	Places a message in a window's message queue
PostQuitMessage	Informs Windows that an application is exiting
ReplyMessage	Replies to a message sent through SendMessage
SendMessage	Sends a message to a window
SetMessageQueue	Creates a new message queue
TranslateAccelerator	Processes accelerator keys for menu commands
TranslateMDISysAccel	Processes MDI keyboard accelerators
TranslateMessage	Translates virtual-key messages
WaitMessage	Suspends an application and yields control

Network functions (3.1)

WNetAddConnection	Adds a network connection
WNetCancelConnection	Removes a network connection
WNetGetConnection	Lists the network connection

Painting Functions (3.1)

BeginPaint	Prepares a window for painting
DrawFocusRect	Draws a rectangle in the focus style
DrawIcon	Draws an icon in the specified device context
EndPaint	Marks the end of painting in the specified window
ExcludeUpdateRgn	Excludes an updated region from a clipping region
FrameRect	Draws a window border with the specified brush
GetDC	Returns a window device-context handle
GetUpdateRect	Retrieves window update-region dimensions
GetUpdateRgn	Retrieves the window update region
GetWindowDC	Retrieves the window device context
GrayString	Draws gray text at the specified location
InvalidateRect	Adds a rectangle to a window's update region
InvalidateRgn	Adds a region to a window's update region
InvertRect	Inverts a rectangular area
ReleaseDC	Frees a device context
UpdateWindow	Updates a window's client area
ValidateRect	Removes a rectangle from a window's update region
ValidateRgn	Removes a region from a window's update region

Property Functions (3.1)

EnumProps	Enumerates property-list entries
GetProp	Returns a data handle from a window property list
RemoveProp	Removes a property-list entry
SetProp	Adds or changes a property-list entry

Scrolling Functions (3.1)

GetScrollPos	Retrieves the current scroll-bar thumb position
GetScrollRange	Retrieves the minimum and maximum scroll-bar positions
ScrollDC	Scrolls a rectangle of bits horizontally and vertically
ScrollWindow	Scrolls the contents of a window's client area
ScrollWindowEx	Scrolls the contents of a window's client area
SetScrollPos	Sets the scroll-bar thumb position
SetScrollRange	Sets minimum and maximum scroll-bar positions
ShowScrollBar	Shows or hides a scroll bar

System Functions (3.1)

GetSysColor	Retrieves the display-element color
GetSystemMetrics	Retrieves the system metrics
GetTickCount	Retrieves the amount of time Windows has been running
SetSysColors	Sets one or more system colors

Window-Creation Functions (3.1)

AdjustWindowRect	Computes the required size of a window rectangle
AdjustWindowRectEx	Computes the required size of a window rectangle
CreateWindow	Creates an overlapped, pop-up, or child window
CreateWindowEx	Creates an overlapped, pop-up, or child window
DefDlgProc	Provides default window message processing
DefFrameProc	Provides default MDI frame window message processing
DefMDIChildProc	Provides default MDI child window message processing
DefWindowProc	Calls the default window procedure
DestroyWindow	Destroys a window
GetClassInfo	Returns window class information
GetClassLong	Retrieves a long value from extra class memory window class
GetClassName	Retrieves class name of a window
GetClassWord	Retrieves a word value from extra class memory window class memory word
GetLastActivePopup	Determines most recently active pop-up window
GetWindowLong	Retrieves a long value from extra window memory
GetWindowWord	Retrieves a word value from extra window memory
RegisterClass	Registers a window class
SetClassLong	Sets a long value in extra class memory
SetClassWord	Sets a word value in extra class memory
SetWindowLong	Sets a long value in extra window memory
SetWindowWord	Sets a word value in extra window memory
UnregisterClass	Frees a window class

New 3.1 user functions

CallNextHookEx	Passes hook information down the hook chain
CloseDriver	Closes an installable driver
CopyCursor	Copies a cursor
CopyIcon	Copies an icon
DefDriverProc	Provides default processing of installable-driver messages
EnableCommNotification	Enables or disables **WM_COMMNOTIFY** posting
EnableScrollBar	Enables or disables scroll-bar arrows
GetClipCursor	Retrieves screen coordinates for cursor-confining rectangle
GetCursor	Returns current cursor handle
GetDCEx	Returns the handle of a device context
GetDriverInfo	Retrieves installable-driver data
GetDriverModuleHandle	Returns an installable-driver instance handle
GetFreeSystemResources	Returns percentage of free system resource space
GetMessageExtraInfo	Retrieves information about a hardware message
GetNextDriver	Enumerates installable-driver instances
GetOpenClipboardWindow	Returns handle to window that opened clipboard
GetQueueStatus	Determines queued message type
GetSystemDebugState	Returns system-state information to a debugger
GetTimerResolution	Retrieves the timer resolution
GetWindowPlacement	Retrieves window show state and min/max positions
IsMenu	Determines whether a menu handle is valid
LockInput	Locks input to all tasks except the current one
LockWindowUpdate	Disables or reenables drawing in a window
MapWindowPoints	Converts points to another coordinate system
OpenDriver	Opens an installable driver
QuerySendMessage	Determines whether message originated in task
RedrawWindow	Updates rectangle or region in window's client area
ScrollWindowEx	Scrolls the contents of a window's client area
SendDriverMessage	Sends a message to an installable driver
SetWindowPlacement	Sets window show state and min/max position
SetWindowsHookEx	Installs an application defined hook function
SubtractRect	Creates a rectangle from the difference of two
SystemParametersInfo	Queries or sets system-wide parameters
UnhookWindowsHookEx	Removes a function from the hook chain
WNetAddConnection	Adds a network connection
WNetCancelConnection	Removes a network connection
WNetGetConnection	Lists a network connection

Bitmap Functions (3.1)

BitBlt	Copies a bitmap between device contexts
CreateBitmap	Creates a device-dependent memory bitmap
CreateBitmapIndirect	Creates a bitmap using a **BITMAP** structure
CreateCompatibleBitmap	Creates a bitmap compatible with a device context
CreateDIBitmap	Creates a bitmap handle from DIB specification
CreateDiscardableBitmap	Creates a discardable bitmap
GetBitmapBits	Copies bitmap bits into a buffer
GetBitmapDimension	Retrieves the width and height of a bitmap
GetBitmapDimensionEx	Retrieves the width and height of a bitmap
GetDIBits	Copies DIB bits into a buffer
GetPixel	Retrieves the **RGB** color of a specified pixel
LoadBitmap	Loads a bitmap resource
PatBlt	Creates a bit pattern on a device
SetBitmapBits	Sets bitmap bits from an array of bytes
SetBitmapDimension	Sets the width and height of bitmap
SetBitmapDimensionEx	Sets the width and height of bitmap
SetDIBits	Sets the bits of a bitmap
SetDIBitsToDevice	Sets DIB bits to a device
SetPixel	Sets a pixel to a specified color
StretchBlt	Sets the bitmap-stretching mode
StretchDIBits	Moves DIB from source to destination rectangle

Clipping Functions (3.1)

ExcludeClipRect	Creates new clipping region, excluding rectangle
GetClipBox	Retrieves a rectangle for the clipping region
IntersectClipRect	Creates a clipping region from an intersection
OffsetClipRgn	Moves a clipping region
PtVisible	Queries whether a point is within the clipping region
RectVisible	Queries whether a rectangle is within the clipping region
SelectClipRgn	Selects a clipping region for the device context

Coordinate Functions (3.1)

ChildWindowFromPoint	Determines which child window contains a point
ClientToScreen	Converts client point to screen coordinates
DPtoLP	Converts device points to logical coordinates
GetCurrentPosition	Retrieves position in logical coordinates
GetCurrentPositionEx	Retrieves position in logical coordinates
LPtoDP	Converts logical points to device coordinates
MapWindowPoints	Converts points to another coordinate system
ScreenToClient	Converts screen points to client coordinates
WindowFromPoint	Returns the handle of a window containing a point

Device-Context Functions (3.1)

CreateCompatibleDC	Creates a DC compatible with a specified device
CreateDC	Creates a device context
CreateIC	Creates an information context
DeleteDC	Deletes a device context
GetDC	Retrieves the handle of a device context
GetDCEx	Retrieves the handle of a device context
GetDCOrg	Retrieves the translation origin for a device context
ResetDC	Updates a device context
RestoreDC	Restores a device context
ReleaseDC	Frees a device context
SaveDC	Saves the current state of a device context

Drawing-Attribute Functions (3.1)

GetBkColor	Retrieves the current background color
GetBkMode	Retrieves the background mode
GetPolyFillMode	Retrieves the current polygon-filling mode
GetROP2	Retrieves the current drawing mode
GetStretchBltMode	Retrieves the current bitmap-stretching mode
GetTextColor	Retrieves the current text color
SetBkColor	Sets the background color
SetBkMode	Sets the background mode
SetPolyFillMode	Sets the polygon-filling mode
SetROP2	Sets the drawing mode
SetStretchBltMode	Sets the bitmap-stretching mode
SetTextColor	Sets the foreground color of text

Drawing-Tool Functions (3.1)

CreateBrushIndirect	Creates a brush with the specified attributes
CreateDIBPatternBrush	Creates a pattern brush from a DIB
CreateHatchBrush	Creates a hatched brush
CreatePatternBrush	Creates a pattern brush from a bitmap
CreatePen	Creates a pen with the specified attributes
CreatePenIndirect	Creates a pen using a **LOGPEN** structure
CreateSolidBrush	Creates a solid brush with a specified color
DeleteObject	Deletes an object from memory
EnumObjects	Enumerates the pens and brushes in a device context
GetBrushOrg	Retrieves the origin of the current brush
GetObject	Retrieves information about an object
GetStockObject	Retrieves the handle of a stock pen, brush, or font
IsGDIObject	Determines if handle is not handle of **GDI** object
SelectObject	Selects an object into a device context
SetBrushOrg	Sets the origin of the current brush
UnrealizeObject	Resets brush origins or logical palettes

Ellipse and Polygon Functions (3.1)

Chord	Draws a chord
DrawFocusRect	Draws a rectangle in the focus style
Ellipse	Draws an ellipse
Pie	Draws a pie-shaped wedge
Polygon	Draws a polygon
PolyPolygon	Draws a series of polygons
Rectangle	Draws a rectangle
RoundRect	Draws a rectangle with rounded corners

Font Functions (3.1)

AddFontResource	Adds a font resource to the font table
CreateFont	Creates a logical font
CreateFontIndirect	Creates a font using the **LOGFONT** structure
CreateScalableFontResource	Creates a resource file with font information
EnumFontFamilies	Enumerates fonts in a specified family
EnumFonts	Enumerates fonts on a specified device
GetAspectRatioFilter	Retrieves the current aspect-ratio filter
GetAspectRatioFilterEx	Retrieves the current aspect-ratio filter
GetCharABCWidths	Retrieves the widths of consecutive characters
GetCharWidth	Retrieves character widths
GetFontData	Retrieves font-metric information
GetGlyphOutline	Retrieves data for individual outline character
GetKerningPairs	Retrieves kerning pairs for the current font
GetOutlineTextMetrics	Retrieves metrics for TrueType fonts
GetRasterizerCaps	Retrieves status of TrueType fonts on system
RemoveFontResource	Removes an added font resource
SetMapperFlags	Sets the font-mapper flag

Line-Output Functions (3.1)

Arc	Draws an arc
LineDDA	Computes successive points in a line
LineTo	Draws a line from the current position
MoveTo	Moves the current position
MoveToEx	Moves the current position
Polyline	Draws line segments to connect specified points

Mapping Functions (3.1)

GetMapMode	Retrieves the mapping mode
GetViewportExt	Retrieves viewport extents
GetViewportExtEx	Retrieves viewport extents
GetViewportOrg	Retrieves the viewport origin
GetViewportOrgEx	Retrieves the viewport origin
GetWindowExt	Retrieves the window extents
GetWindowExtEx	Retrieves the window extents
GetWindowOrg	Retrieves the window origin
GetWindowOrgEx	Retrieves the window origin
OffsetViewportOrg	Moves the viewport origin
OffsetViewportOrgEx	Moves the viewport origin
OffsetWindowOrg	Moves the window origin
OffsetWindowOrgEx	Moves the window origin
ScaleViewportExt	Scales the viewport extents
ScaleViewportExtEx	Scales the viewport extents
ScaleWindowExt	Scales the window extents
ScaleWindowExtEx	Scales the window extents
SetMapMode	Sets the mapping mode
SetViewportExt	Sets the viewport extents
SetViewportExtEx	Sets the viewport extents
SetViewportOrg	Sets the viewport origin
SetViewportOrgEx	Sets the viewport origin
SetWindowExt	Sets the window extents
SetWindowExtEx	Sets the window extents
SetWindowOrg	Sets the window origin
SetWindowOrgEx	Sets the window origin

Metafile Functions (3.1)

CloseMetaFile	Closes a metafile device context and creates a handle
CopyMetaFile	Copies a source metafile to a file
CreateMetaFile	Creates a metafile device context
DeleteMetaFile	Invalidates a metafile handle
EnumMetaFile	Enumerates the metafile records in a metafile
GetMetaFile	Creates a handle to a metafile
GetMetaFileBits	Creates a memory object from a metafile
PlayMetaFile	Plays a metafile
PlayMetaFileRecord	Plays a metafile record
SetMetaFileBits	Creates a memory object from a metafile
SetMetaFileBitsBetter	Creates a memory object from a metafile

Palette Functions (3.1)

AnimatePalette	Replaces entries in a logical palette
CreatePalette	Creates a logical color palette
GetNearestColor	Retrieves the closest available color
GetNearestPaletteIndex	Retrieves the nearest match for a color
GetPaletteEntries	Retrieves a range of palette entries
GetSystemPaletteEntries	Retrieves entries from the system palette
GetSystemPaletteUse	Determines access to the entire system palette
RealizePalette	Maps entries from logical to system palette
ResizePalette	Changes the size of a logical palette
SelectPalette	Selects a palette into a device context
SetPaletteEntries	Sets colors and flags for a logical palette
SetSystemPaletteUse	Sets the use of static colors in the system palette

Printer-Control Functions (3.1)

AbortDoc	Terminates a print job
DeviceCapabilities	Retrieves the capabilities of a device
DeviceMode	Displays a dialog box for the printing modes
EndDoc	Ends a print job
EndPage	Ends a page
Escape	Allows access to device capabilities
ExtDeviceMode	Displays a dialog box for the printing modes
GetDeviceCaps	Retrieves the device capabilities
SetAbortProc	Sets the abort function for a print job
SpoolFile	Puts a file in the spooler queue
StartDoc	Starts a print job
StartPage	Prepares the printer driver to accept data
QueryAbort	Queries whether to terminate a print job

Rectangle Functions (3.1)

CopyRect	Copies the dimensions of a rectangle
EqualRect	Determines whether two rectangles are equal
FrameRect	Draws a window border with the specified brush
FillRect	Fills a rectangle with the specified brush
GetBoundsRect	Returns current accumulated bounding rectangle
InflateRect	Changes rectangle dimensions
IntersectRect	Calculates the intersection of two rectangles
InvertRect	Inverts a rectangular area
IsRectEmpty	Determines whether a rectangle is empty
OffsetRect	Moves a rectangle by the specified offsets
PtInRect	Determines whether a point is in a rectangle
SetBoundsRect	Controls bounding-rectangle accumulation
SetRect	Sets rectangle coordinates
SetRectEmpty	Creates an empty rectangle
SubtractRect	Creates rectangle from difference of two others
UnionRect	Creates the union of two rectangles

Region Functions (3.1)

CombineRgn	Creates a region by combining two regions
CreateEllipticRgn	Creates an elliptical region
CreateEllipticRgnIndirect	Creates an elliptical region
CreatePolygonRgn	Creates a polygonal region
CreatePolyPolygonRgn	Creates a region consisting of polygons
CreateRectRgn	Creates a rectangular region
CreateRectRgnIndirect	Creates a region using a **RECT** structure
CreateRoundRectRgn	Creates a rectangular region with round corners
EqualRgn	Compares two regions for equality
FillRgn	Fills a region with the specified brush
FrameRgn	Draws a border around a region
GetRgnBox	Retrieves the bounding rectangle for a region
InvertRgn	Inverts the colors in a region
OffsetRgn	Moves a region by the specified offsets
PaintRgn	Fills region with brush in device context
PtInRegion	Queries whether a point is in a region
RectInRegion	Queries whether a rectangle overlaps a region
SetRectRgn	Changes a region into the specified rectangle

Text Functions (3.1)

DrawText	
ExtTextOut	Writes a character string in a rectangular region
GetTabbedTextExtent	Determines the dimensions of a tabbed string
GetTextAlign	Retrieves the status of text-alignment flags
GetTextCharacterExtra	Retrieves the intercharacter spacing
GetTextExtent	Computes the dimensions of a string
GetTextExtentPoint	Computes the dimensions of a string
GetTextFace	Retrieves the typeface name of the current font
GetTextMetrics	Retrieves the metrics for the current font
SetTextAlign	Sets text-alignment flags for the device context
SetTextCharacterExtra	Sets the intercharacter spacing
SetTextJustification	Sets the justification for text output
TabbedTextOut	Writes a tabbed character string
TextOut	Writes a character string at the specified location

TrueType Functions (3.1)

CreateScalableFontResource	Creates a resource file with font information
GetCharABCWidths	Retrieves the widths of consecutive characters
GetFontData	Retrieves font-metric information
GetGlyphOutline	Retrieves data for individual outline character
GetKerningPairs	Retrieves kerning pairs for the current font
GetOutlineTextMetrics	Retrieves metric information for TrueType fonts
GetRasterizerCaps	Retrieves status of TrueType fonts on system

Pen Functions (3.1)

CreatePen	Creates a pen with the specified attributes
CreatePenIndirect	Creates a pen using a **LOGPEN** structure
GetStockObject	Retrieves the handle of a stock pen, brush, or font
LineTo	Draws a line from the current position

Brush Functions (3.1)

CreateBrushIndirect	Creates a brush with the specified attributes
CreateHatchBrush	Creates a hatched brush
CreatePatternBrush	Creates a pattern brush from a bitmap
CreateSolidBrush	Creates a solid brush with a specified color
GetBrushOrg	Retrieves the origin of the current brush
GetBrushOrgEx	Retrieves the origin of the current brush
GetStockObject	Retrieves the handle of a stock pen, brush, or font
SetBrushOrg	Sets the origin of the current brush

New 3.1 GDI functions

AbortDoc	Terminates a print job
CreateScalableFontResource	Creates a resource file with font information
EndDoc	Ends a print job
EndPage	Ends a page
EnumFontFamilies	Enumerates fonts in a specified family
GetAspectRatioFilterEx	Retrieves the current aspect-ratio filter
GetBoundsRect	Returns current accumulated bounding rectangle
GetBrushOrgEx	Retrieves the origin of the current brush
GetCharABCWidths	Retrieves the widths of consecutive characters
GetCurrentPositionEx	Retrieves the current position in logical units
GetFontData	Retrieves font-metric information
GetGlyphOutline	Retrieves data for individual outline character
GetKerningPairs	Retrieves kerning pairs for the current font
GetOutlineTextMetrics	Retrieves metrics for TrueType fonts
GetRasterizerCaps	Retrieves status of TrueType fonts on system
GetTextExtentPoint	Computes the dimensions of a string
GetViewportExtEx	Retrieves the viewport extents
GetViewportOrgEx	Retrieves the viewport origin
GetWindowExtEx	Retrieves the window extents
GetWindowOrgEx	Retrieves the window origin
IsGDIObject	Determines whether handle is not a **GDI** object
MoveToEx	Moves the current position
OffsetViewportOrgEx	Moves the viewport origin
OffsetWindowOrgEx	Moves the window origin
QueryAbort	Queries whether to terminate a print job
ResetDC	Updates a device context
ScaleViewportExtEx	Scales the viewport extents
ScaleWindowExtEx	Scales the window extents
SetAbortProc	Sets the abort function for a print job
SetBitmapDimensionEx	Sets the width and height of a bitmap
SetBoundsRect	Controls bounding-rectangle accumulation
SetMetaFileBitsBetter	Creates a memory object from a metafile
SetViewportExtEx	Sets the viewport extents
SetViewportOrgEx	Sets the viewport origin
SetWindowExtEx	Sets the window extents
SetWindowOrgEx	Sets the window origin
SpoolFile	Puts a file in the spooler queue
StartDoc	Starts a print job
StartPage	Prepares a printer driver to accept data

Application Execution Functions (3.1)

LoadModule	Loads and executes Windows application
WinExec	Runs the specified application
WinHelp	Invokes Windows Help

Atom-management Functions (3.1)

Atom-management functions create and manipulate atoms. Atoms are integers that uniquely identify character strings. They are useful in applications that use many character strings and in applications that need to conserve memory. Windows stores atoms in atom tables. A local atom table is allocated in an application's data segment; it cannot be accessed by other applications. The global atom table can be shared and is useful in applications that use dynamic data exchange (DDE).

AddAtom	Adds a string to the local atom table
DeleteAtom	Decrements the reference count of a local atom
FindAtom	Retrieves a string atom from a local atom table
GetAtomHandle	Retrieves an atom handle
GetAtomName	Retrieves a local atom string
GlobalAddAtom	Adds a string to the system atom table
GlobalDeleteAtom	Decrements the reference count of a global atom
GlobalFindAtom	Retrieves a string atom from a global atom table
GlobalGetAtomName	Retrieves a global atom string
InitAtomTable	Sets the size of the local atom hash table

Communication Functions (3.1)

BuildCommDCB	Translates a device-definition string to a **DCB**
ClearCommBreak	Restores character transmission
CloseComm	Closes a communications device
EnableCommNotification	Enables or disables **WM_COMMNOTIFY** posting
EscapeCommFunction	Passes an extended function to a device
FlushComm	Flushes a transmission or receiving queue
GetCommError	Retrieves the communications-device status
GetCommEventMask	Retrieves the device event word
GetCommState	Retrieves the device control block
OpenComm	Opens a communications device
ReadComm	Reads from a communications device
SetCommBreak	Suspends character transmission
SetCommEventMask	Enables events in a device event word
SetCommState	Sets the communications-device state
TransmitCommChar	Places a character in the transmission queue
UngetCommChar	Puts a character back in the receiving queue
WriteComm	Writes to a communications device

Debugging Functions (3.1)

DebugBreak	Causes a breakpoint exception
DebugOutput	Sends messages to the debugging terminal
DirectedYield	Forces execution of a specified task
FatalAppExit	Terminates an application
FatalExit	Sends current state of Windows to the debugger
GetSystemDebugState	Returns system-state information to a debugger
GetWinDebugInfo	Retrieves current system-debugging information
LockInput	Locks input to all tasks except the current one
LogError	Identifies the most recent system error
LogParamError	Identifies a parameter validation error
OutputDebugString	Sends a character string to the debugger
QuerySendMessage	Determines whether a message originated in a task
SetWinDebugInfo	Sets the current system-debugging information
ValidateCodeSegments	Tests for random memory overwrites
ValidateFreeSpaces	Checks free memory for valid contents

File I/O Functions (3.1)

GetDriveType	Determines the drive type
GetSystemDirectory	Returns the path of the Windows system directory
GetTempDrive	Returns a disk drive letter for temporary files
GetTempFileName	Creates a temporary filename
GetWindowsDirectory	Returns the path of the Windows directory
_hread	Reads data from a file
_hwrite	Writes data to a file
_lclose	Closes an open file
_lcreat	Creates or opens a file
_llseek	Repositions the file pointer
_lopen	Opens an existing file
_lread	Reads data from a file
_lwrite	Writes data to a file
hmemcpy	Copies bytes from source to destination buffer
OpenFile	Creates, opens, reopens, or deletes a file
SetHandleCount	Changes the number of available file handles

Initialization-File Functions (3.1)

Initialization-file functions obtain information from and copy information to a Windows or private (application-specific) initialization file. The Windows initialization file (WIN.INI) is a special ASCII file that contains entry-value pairs representing run-time options for applications.

An application should use a private initialization file to record information that affects it alone. This improves the performance of the application and Windows by reducing the amount of information that Windows must read when it accesses the initialization file. An application should record information in WIN.INI only if the information affects the Windows environment or other applications and should send the **WM_WININICHANGE** message to all top-level windows.

The WININI.WRI and SYSINI.WRI files supplied with the retail version of Windows describe the contents of the WIN.INI and SYSTEM.INI files, respectively.

GetPrivateProfileInt	Retrieves integer value from initialization file
GetPrivateProfileString	Retrieves a string from an initialization file
GetProfileInt	Retrieves an integer value from WIN.INI
GetProfileString	Retrieves a string from WIN.INI
WritePrivateProfileString	Writes a string to an initialization file
WriteProfileString	Writes a string to WIN.INI

Memory-Management Functions (3.1)

Memory-management functions manage system memory. There are two categories of memory-management functions: those that manage global memory and those that manage local memory. Global memory is all memory in the system that has not been allocated by an application or reserved by the system. Local memory is the memory in the data segment of a Windows application.

GetFreeSpace	Returns the number of free bytes in the global heap
GetFreeSystemResources	Returns the percentage of free system-resource space
GetSelectorBase	Retrieves the base address of a selector
GetSelectorLimit	Retrieves the limit of a selector
GetWinFlags	Returns the current system configuration flags
GlobalAlloc	Allocates memory from the global heap
GlobalCompact	Generates free global memory by compacting
GlobalDosAlloc	Allocates memory available to MS-DOS in real mode
GlobalDosFree	Frees global memory allocated by GlobalDosAlloc
GlobalFlags	Returns information about a global memory object
GlobalFree	Frees a global memory object
GlobalHandle	Retrieves the handle for a specified selector
GlobalLock	Locks global memory object and returns pointer
GlobalLRUNewest	Moves global memory object to newest LRU position
GlobalLRUOldest	Moves global memory object to oldest LRU position
GlobalNotify	Installs a notification procedure
GlobalReAlloc	Changes size or attributes of global memory object
GlobalSize	Returns the size of a global memory object
GlobalUnlock	Unlocks a global memory object
GlobalUnwire	Not used in Windows 3.1
GlobalWire	Not used in Windows 3.1
LimitEMSPages	Not used in Windows 3.1
LocalAlloc	Allocates memory from the local heap
LocalCompact	Generates free local memory by compacting
LocalFlags	Returns local memory object information
LocalFree	Frees a local memory object
LocalHandle	Returns the handle of a local memory object
LocalInit	Initializes the specified local heap
LocalLock	Locks local memory object and returns pointer
LocalReAlloc	Changes size or attributes of local memory object
LocalShrink	Shrinks the specified local heap
LocalSize	Returns the size of a local memory object
LocalUnlock	Unlocks a local memory object
LockSegment	Locks a discardable memory segment
SetSelectorBase	Sets the base address of a selector
SetSelectorLimit	Sets the limit of a selector
SetSwapAreaSize	Sets the amount of memory used for code segments
SwitchStackBack	Restores the current task stack
SwitchStackTo	Changes the location of the current task stack
UnLockSegment	Unlocks a discardable memory segment

Module-Management Functions (3.1)

Module-management functions alter and retrieve information about Windows modules, which are loadable, executable units of code and data.

FreeLibrary	Frees a loaded library module
FreeModule	Frees a loaded module
FreeProcInstance	Frees a function instance
GetCodeHandle	Determines the location of a function
GetInstanceData	Copies data from previous instance to current one
GetModuleFileName	Returns the filename for a module
GetModuleHandle	Retrieves a handle for the specified module
GetModuleUsage	Retrieves the reference count of a module
GetProcAddress	Returns the address of an exported DLL function
GetVersion	Returns the current MS-DOS and Windows versions
LoadLibrary	Loads the specified library module
MakeProcInstance	Returns address of prolog code for function

Optimization-Tool Functions (3.1)

ProfClear	Discards all buffered Profiler samples
ProfFinish	Stops Profiler sampling and flushes the buffer
ProfFlush	Flushes the Profiler sampling buffer to a disk
ProfInsChk	Determines whether Profiler is installed
ProfSampRate	Sets the Profiler code-sampling rate
ProfSetup	Sets the Profiler buffer size and sample quantity
ProfStart	Starts Profiler sampling
ProfStop	Stops Profiler sampling
SwapRecording	Starts or stops recording of memory swapping

Pointer-Validation Functions (3.1)

IsBadCodePtr	Determines whether a code pointer is valid
IsBadHugeReadPtr	Determines whether a huge read pointer is valid
IsBadHugeWritePtr	Determines whether a huge write pointer is valid
IsBadReadPtr	Determines whether a read pointer is valid
IsBadStringPtr	Determines whether a string pointer is valid
IsBadWritePtr	Determines whether a write pointer is valid

Resource-Management Functions (3.1)

Resource-management functions find and load application resources from a Windows executable file. A resource can be a cursor, icon, bitmap, string, or font.

AccessResource	Opens an executable file and locates a resource
AllocResource	Allocates memory for a resource
FindResource	Locates a resource in a resource file
FreeResource	Frees a loaded resource
LoadAccelerators	Loads an accelerator table
LoadBitmap	Loads a bitmap resource
LoadCursor	Loads a cursor resource
LoadIcon	Loads an icon resource
LoadMenu	Loads a menu resource
LoadResource	Loads the specified resource in global memory
LoadString	Loads a string resource
LockResource	Locks a resource in memory
SetResourceHandler	Installs a callback function that loads resources
SizeofResource	Returns the size of a resource

Segment Functions (3.1)

Segment functions allocate, free, and convert selectors; lock and unlock memory objects referenced by selectors; and retrieve information about segments.

An application should not use these functions unless it is absolutely necessary. Use of these functions violates preferred Windows programming practices.

AllocDStoCSAlias	Translates a data segment to a code segment
AllocSelector	Allocates a new selector
FreeSelector	Frees an allocated selector
GetCodeInfo	Retrieves code-segment information
GlobalFix	Locks a global memory object in linear memory
GlobalPageLock	Increments the global memory page-lock count
GlobalPageUnlock	Decrements the global memory page-lock count
GlobalUnfix	Unlocks a global memory object in linear memory
LockSegment	Locks a discardable memory segment
PrestoChangoSelector	Converts a code or data selector
UnlockSegment	Unlocks a discardable memory segment

String-Manipulation Functions (3.1)

String-manipulation functions translate strings from one character set to another, determine and convert the case of strings, determine whether a character is alphabetic or alphanumeric, find adjacent characters in a string, and perform other string manipulations.

AnsiLower	Converts a string to lowercase
AnsiLowerBuff	Converts a buffer string to lowercase
AnsiNext	Moves to the next character in a string
AnsiPrev	Moves to the previous character in a string
AnsiToOem	Translates a Windows string to an OEM string
AnsiToOemBuff	Translates a Windows string to an OEM string
AnsiUpper	Converts a string to uppercase
AnsiUpperBuff	Converts a buffer string to uppercase
IsCharAlpha	Determines whether a character is alphabetic
IsCharAlphaNumeric	Determines whether a character is alphanumeric
IsCharLower	Determines whether a character is lowercase
IsCharUpper	Determines whether a character is uppercase
lstrcat	Appends one string to another
lstrcmp	Compares two character strings
lstrcmpi	Compares two character strings
lstrcpy	Copies a string to a buffer
lstrcpyn	Copies characters from a string to a buffer
lstrlen	Returns the length, in bytes, of a string
OemToAnsi	Translates an OEM string to a Windows string
OemToAnsiBuff	Translates an OEM string to a Windows string
ToAscii	Translates virtual-key code to Windows character
wsprintf	Formats and stores a string in a buffer
wvsprintf	Formats and stores a string in a buffer

Task Functions (3.1)

Task functions alter the execution status of tasks, return information associated with a task, and retrieve information about the environment in which the task is being executed. A task is a single Windows application call.

Catch	Captures the current execution environment
ExitWindows	Restarts or terminates Windows
GetCurrentPDB	Returns the selector address of the current PDB
GetCurrentTask	Returns the current task handle
GetDOSEnvironment	Returns a far pointer to the current environment
GetNumTasks	Retrieves the current number of tasks
IsTask	Determines whether a task handle is valid
SetErrorMode	Controls Interrupt 24h error handling
Throw	Restores the execution environment
Yield	Stops the current task

New 3.1 kernel functions

_hread	Reads data from a file
_hwrite	Writes data to a file
DebugOutput	Sends messages to the debugging terminal
DirectedYield	Forces execution to continue with specified task
GetSelectorBase	Retrieves the base address of a selector
GetSelectorLimit	Retreives the limit of a selector
GetWinDebugInfo	Queries current system-debugging information
hmemcpy	Copies bytes from source to destination buffer
IsBadCodePtr	Determines whether a code pointer is valid
IsBadHugeReadPtr	Determines whether huge read pointer is valid
IsBadHugeWritePtr	Determines whether a huge write pointer is valid
IsBadReadPtr	Determines whether a read pointer is valid
IsBadStringPtr	Determines whether a string pointer is valid
IsBadWritePtr	Determines whether a write pointer is valid
IsDBCSLeadByte	Determines whether character is DBCS lead byte
IsTask	Determines whether a task handle is valid
LogError	Identifies a system error
LogParamError	Identifies a parameter validation error
SetSelectorBase	Sets the base address of a selector
SetSelectorLimit	Sets the limit of a selector
SetWinDebugInfo	Sets the current system-debugging information

OLE function groups (3.1)

Document Functions
Link Functions
Object-creation Functions
Object-management Functions
Server Functions (Client)
Server Functions (Server)

Document Functions (3.1)

OleEnumObjects	Enumerates objects in a document
OleRegisterClientDoc	Registers a document with the library
OleRegisterServerDoc	Registers a document with the server library
OleRename	Informs the library that an object is renamed
OleRenameClientDoc	Informs the library that a document is renamed
OleRenameServerDoc	Informs the library that a document is renamed
OleRevertClientDoc	Informs library that document reverted to saved state
OleRevertServerDoc	Informs library that document is reset to saved state
OleRevokeClientDoc	Informs the library that a document is not open
OleRevokeServerDoc	Revokes the specified document
OleSavedClientDoc	Informs library that a document has been saved
OleSavedServerDoc	Informs library that a document has been saved

Link Functions (3.1)

OleGetLinkUpdateOptions	Retrieves update options for an object
OleQueryLinkFromClip	Retrieves link data for clipboard object
OleQueryOutOfDate	Determines whether an object is out-of-date
OleSetLinkUpdateOptions	Sets link-update options for an object
OleUpdate	Updates the specified object

Object-creation Functions (3.1)

OleClone	Makes a copy of an object
OleCopyFromLink	Makes an embedded copy of a linked object
OleCreate	Creates an object of a specified class
OleCreateFromClip	Creates an object from the clipboard
OleCreateFromFile	Creates an object from a file
OleCreateFromTemplate	Creates an object from a template
OleCreateInvisible	Creates an object without displaying it
OleCreateLinkFromClip	Creates a link to an object from the clipboard
OleCreateLinkFromFile	Creates a link to an object in a file
OleLoadFromStream	Loads an object from the containing document
OleObjectConvert	Creates a new object using a specified protocol
OleQueryCreateFromClip	Retrieves protocol data for clipboard object

Object-management Functions (3.1)

OleActivate	Opens an object for an operation
OleCopyToClipboard	Puts the specified object on the clipboard
OleDelete	Deletes an object
OleDraw	Draws an object into a device context
OleEnumFormats	Enumerates data formats for an object
OleEqual	Compares two objects for equality
OleGetData	Retrieves data from an object in a specified format
OleQueryBounds	Retrieves the bounding rectangle for an object
OleQueryClientVersion	Retrieves the version number of a client library
OleQueryName	Retrieves the name of an object
OleQueryProtocol	Determines whether an object supports a protocol
OleQuerySize	Retrieves the size of an object
OleQueryType	Determines if object is linked, embedded, or static
OleRelease	Releases an object from memory
OleSaveToStream	Saves an object to the stream
OleSetBounds	Sets the bounding rectangle for an object
OleSetColorScheme	Specifies the client's recommended object colors
OleSetData	Sends data in the specified format to the server
OleSetHostNames	Sets the client name and object name for server
OleSetTargetDevice	Specifies the target device for an object

Server Functions (Client) (3.1)

OleClose	Closes the specified open object
OleExecute	Sends DDE execute commands to a server
OleLockServer	Keeps an open server application in memory
OleQueryOpen	Determines whether an object is open
OleQueryReleaseError	Determines the status of a released operation
OleQueryReleaseMethod	Determines which operation released
OleQueryReleaseStatus	Determines whether an operation released
OleReconnect	Reconnects to an open linked object
OleRequestData	Retrieves data from a server in a specified format
OleUnlockServer	Releases a server locked with OleLockServer

Server Functions (Server) (3.1)

OleBlockServer	Queues incoming requests for the server
OleQueryServerVersion	Retrieves the version number of the server library
OleRegisterServer	Registers the specified server
OleRevokeObject	Revokes access to an object
OleRevokeServer	Revokes the specified server
OleUnblockServer	Processes requests from a queue

Alphabetized Windows functions (3.1)

_hread	Reads from a file
_hwrite	Writes to a file
_lclose	Closes an open file
_lcreat	Creates or opens a file
_llseek	Repositions the file pointer
_lopen	Opens a file
_lread	Reads from a file
_lwrite	Writes to a file
AbortDoc	Terminates a print job
AccessResource	Opens a resource file and locates a resource
AddAtom	Adds a string to the local atom table
AddFontResource	Adds a font to the font table
AdjustWindowRect	Computes the required size of a window rectangle
AdjustWindowRectEx	Computes the required size of a window rectangle
AllocDiskSpace	Creates a file to consume space on a disk partition.
AllocDStoCSAlias	Translates a data segment to a code segment
AllocFileHandles	Allocates up to 256 file handles
AllocGDIMem	Allocates all available memory in the **GDI** heap.
AllocMem	Allocates all available memory.
AllocResource	Allocates memory for a resource
AllocSelector	Allocates a new selector
AllocUserMem	Allocates all available memory in the User heap.
AnimatePalette	Replaces entries in a logical palette
AnsiLower	Converts a string to lower case
AnsiLowerBuff	Converts a string buffer to lower case
AnsiNext	Moves to the next character in a string
AnsiPrev	Move to the previous character in a string
AnsiToOem	Translates a Windows string to an OEM string
AnsiToOemBuff	Translates a Windows string to an OEM string
AnsiUpper	Converst a string to upper case
AnsiUpperBuff	Converts a string buffer to upper case
AnyPopup	Indicates if pop-up or overlapped window exists
AppendMenu	Appends a new item to a menu
Arc	Draws an arc
ArrangeIconicWindows	Arranges minimized child windows
BeginDeferWindowPos	Creates a window-position structure
BeginPaint	Prepares a window for painting
BitBlt	Copies a bitmap between device contexts
BringWindowToTop	Uncovers an overlapped window
BuildCommDCB	Translates a device definition string to a **DCB**
CallMsgFilter	Passes a message to a message-filter function
CallNextHookEx	Passes hook information down the hook chain
CallWindowProc	Passes a message to a window procedure
Catch	Captures the current execution environment
ChangeClipboardChain	Removes a window from the clipboard-viewer chain
ChangeMenu	Obsolete
CheckDlgButton	Changes a check mark by a dialog button
CheckMenuItem	Changes a check mark by a menu item
CheckRadioButton	Places a check mark by a radio button
ChildWindowFromPoint	Determines the window containing a point
ChooseColor	Creates a color-selection dialog box
ChooseFont	Creates a font-selection dialog box
Chord	Draws a chord
ClassFirst	Retrieves information about first class in class list

ClassNext	Retrieves information about next class in class list
ClearCommBreak	Restores character transmission
ClientToScreen	Converts client point to screen coordinates
ClipCursor	Confines the cursor to a specified rectangle
CloseClipboard	Closes the clipboard
CloseComm	Closes a communications device
CloseDriver	Closes an installable driver
CloseMetaFile	Closes metafile dc and gets handle
CloseSound	Obsolete
CloseWindow	Minimizes a window
CombineRgn	Creates a region by combining two regions
CommDlgExtendedError	Retrieves Error Data
CopyCursor	Copies a cursor
CopyIcon	Copies an icon
CopyLZFile	Copies a file and decompresss it if compressed
CopyMetaFile	Copies a metafile
CopyRect	Copies the dimensions of a rectangle
CountClipboardFormats	Returns the number of clipboard formats
CountVoiceNotes	Obsolete
CreateBitmap	Creates device-dependent memory bitmap
CreateBitmapIndirect	Creates bitmap using **BITMAP** structure
CreateBrushIndirect	Creates a brush with specified attributes
CreateCaret	Creates a new shape for the system caret
CreateCompatibleBitmap	Creates bitmap compatible with DC
CreateCompatibleDC	Creates a DC compatible with specified DC
CreateCursor	Creates a cursor with specified dimensions
CreateDC	Creates a device context
CreateDialog	Creates a modeless dialog box
CreateDialogIndirect	Creates modeless dialog box from memory template
CreateDialogIndirectParam	Creates modeless dialog box from memory template
CreateDialogParam	Creates a modeless dialog box
CreateDIBitmap	Creates bitmap handle from DIB spec
CreateDIBPatternBrush	Creates a pattern brush from a DIB
CreateDiscardableBitmap	Creates discardable bitmap
CreateEllipticRgn	Creates an elliptical region
CreateEllipticRgnIndirect	Creates an elliptical region
CreateFont	Creates a logical font
CreateFontIndirect	Creates a font using **LOGFONT** structure
CreateHatchBrush	Creates a hatched brush
CreateIC	Creates an information context
CreateIcon	Creates an icon with the specified dimensions
CreateMenu	Creates a menu
CreateMetaFile	Creates a metafile device context
CreatePalette	Creates a logical color palette
CreatePatternBrush	Creates a pattern brush from a bitmap
CreatePen	Creates a pen
CreatePenIndirect	Creates a pen using a **LOGPEN** structure
CreatePolygonRgn	Creates a polygonal region
CreatePolyPolygonRgn	Creates a region consisting of polygons
CreatePopupMenu	Creates a pop-up window
CreateRectRgn	Creates a rectangular region
CreateRectRgnIndirect	Creates a region using a **RECT** structure
CreateRoundRectRgn	Creates a rectangular region with round corners
CreateScalableFontResource	Creates resource file with font info
CreateSolidBrush	Creates a solid brush with a specified color
CreateWindow	Creates a window

CreateWindowEx	Creates a window
DdeAbandonTransaction	Abandons an asynchronous transaction
DdeAccessData	Accesses a DDE global memory object
DdeAddData	Adds data to a DDE global memory object
DdeClientTransaction	Begins a DDE data transaction
DdeCmpStringHandles	Compares two DDE string handles
DdeConnect	Establishes a conversation with a server
DdeConnectList	Establishes multiple DDE conversations
DdeCreateDataHandle	Creates a DDE data handle
DdeCreateStringHandle	Creates a DDE string handle
DdeDisconnect	Terminates a DDE conversation
DdeDisconnectList	Destroys a DDE conversation list
DdeEnableCallback	Enables or disables one or more DDE conversations
DdeFreeDataHandle	Frees a global memory object
DdeFreeStringHandle	Frees a DDE string handle
DdeGetData	Copies data from a global memory object to a buffer
DdeGetLastError	Returns an error code set by a DDEML function
DdeInitialize	Registers an application with the DDEML
DdeKeepStringHandle	Increments the usage count for a string handle
DdeNameService	Registers or unregisters a service name
DdePostAdvise	Prompts a server to send advise data to a client
DdeQueryConvInfo	Retrieves information about a DDE conversation
DdeQueryNextServer	Obtains the next handle in a conversation list
DdeQueryString	Copies string-handle text to a buffer
DdeReconnect	Reestablishes a conversation with a server
DdeSetUserHandle	Associates a user-defined handle with a transaction
DdeUnaccessData	Frees a DDE global memory object
DdeUninitialize	Frees an application's DDEML resources
DebugBreak	Causes a breakpoint exception
DebugOutput	sends messages to the debugging terminal
DefDlgProc	Provides default window message processing
DefDriverProc	Calls the default installable-driver procedure
DeferWindowPos	Updates a multiple window position structure
DefFrameProc	Default MDI frame window message processing
DefHookProc	Calls the next function in a hook-function chain
DefMDIChildProc	Default MDI child window message processing
DefScreenSaverProc	Calls default screen-saver window procedure
DefWindowProc	Calls the default window procedure
DeleteAtom	Decrements a local atom's reference count
DeleteDC	Deletes a device context
DeleteMenu	Deletes an item from a menu
DeleteMetaFile	Invalidates a metafile handle
DeleteObject	Deletes an object from memory
DestroyCaret	Destroys the current caret
DestroyCursor	Destroys a cursor
DestroyIcon	Destroys an icon
DestroyMenu	Destroys a menu
DestroyWindow	Destroys a window
DeviceCapabilities	Retrieves the capabilities of a device
DeviceMode	Displays dialog box for printing modes
DialogBox	Creates a modal dialog box
DialogBoxIndirect	Creates modal dialog box from template in memory
DialogBoxIndirectParam	Creates modal dialog box from template in memory
DialogBoxParam	Creates a modal dialog box
DirectedYield	Forces execution to continue at a specified task
DispatchMessage	Dispatches a message to a window

DlgChangePassword	Changes password for screen saver
DlgDirList	Fills a directory list box
DlgDirListComboBox	Fills a directory list box
DlgDirSelect	Retrieves a selection from a directory list box
DlgDirSelectComboBox	Retrieves a selction from a directory list box
DlgDirSelectComboBoxEx	Retrieves selection from dir. list box
DlgDirSelectEx	Retrieves a selection from a directory list box
DlgGetPassword	Retrieves password for screen saver
DlgInvalidPassword	Warns of invalid screen saver password
DOS3Call	Issues a DOS Int 21h function request
DPtoLP	Converts device points to logical points
DragAcceptFiles	Registers whether a windows accepts dropped files
DragFinish	Releases memory allocated for dropping files
DragQueryFile	Retrieves filename of dropped file
DragQueryPoint	Retrieves mouse position at file drop
DrawFocusRect	Draws a rectangle in the focus style
DrawIcon	Draws an icon in the specified device context
DrawMenuBar	Redraws the menu bar
DrawText	Draws formatted text in a rectangle
Ellipse	Draws an ellipse
EmptyClipboard	Empties the clipboard and frees data handles
EnableCommNotification	Enables/disables **WM_COMMNOTIFY** posting to window
EnableHardwareInput	Controls mouse and keyboard input queuing
EnableMenuItem	Enabls, disables, or grays a menu item
EnableScrollBar	Enables or disables scroll-bar arrows
EnableWindow	Sets the window-enable state
EndDeferWindowPos	Updates position and size of multiple windows
EndDialog	Hides a modal dialog box
EndDoc	Ends a print job
EndPage	Ends a page
EndPaint	Marks end of painting in the specified window
EnumChildWindows	Passes child-window handles to callback function
EnumClipboardFormats	Returns available clipboard formats
EnumFontFamilies	Retrieves fonts in a specified family
EnumFonts	Enumerates fonts on specified device
EnumMetaFile	Enumerates metafile records
EnumObjects	Enumerates pens and brushes in a device context
EnumProps	Passes property-list entries to callback
EnumTaskWindows	Passes task's window handles to callback
EnumWindows	Passes parent-window handles to a callback
EqualRect	Determines whether two rectangles are equal
EqualRgn	Compares two regions for equality
Escape	Allows access to device facilities
EscapeCommFunction	Passes an extended function to a device
ExcludeClipRect	Changes clipping region, excluding rectangle
ExcludeUpdateRgn	Excludes an updated region from clipping region
ExitWindows	Restarts or terminates Windows
ExitWindowsExec	Terminates Windows, runs MS-DOS app
ExtDeviceMode	Displays dialog box for printing modes
ExtFloodFill	Fills area with current brush
ExtractIcon	Retrieves handle of icon from executable file
ExtTextOut	Writes a character string in rectangular region
FatalAppExit	Terminates an application
FatalExit	Displays debug info., causes breakpoint exception
FillRect	Fills a rectangle with the specified brush
FillRgn	Fills a region with a brush

FindAtom	Retrieves a string atom from the local atom table
FindExecutable	Retrieves name and handle of program for a file
FindResource	Locates a resource in a resource file
FindText	Creates a find-text dialog box
FindWindow	Returns window handle for class and window name
FlashWindow	Flashes a window once
FloodFill	Fills area with current brush
FlushComm	Flushes a transmit or receive queue
FrameRect	Draws a window border with a specified brush
FrameRgn	Draws a border around a region
FreeAllGDIMem	Frees memory allocated by AllocGDIMem.
FreeAllMem	Frees memory allocated by AllocMem.
FreeAllUserMem	Frees memory allocated by AllocUserMem.
FreeLibrary	Unloads a library module instance
FreeModule	Unloads a module instance
FreeProcInstance	Frees a function instance
FreeResource	Unloads a resource instance
FreeSelector	Fress an allocated selector
GetActiveWindow	Retrieves the handle of the active window
GetAspectRatioFilter	Retrieves setting of aspect-ratio filter
GetAspectRatioFilterEx	Retrieves current aspect-ratio filter
GetAsyncKeyState	Determines key state
GetAtomHandle	Retrieves an atom handle
GetAtomName	Retrieves a local atom string
GetBitmapBits	Copies bitmap bits to a buffer
GetBitmapDimension	Retrieves width and height of bitmap
GetBitmapDimensionEx	Retrieves width and height of bitmap
GetBkColor	Retrieves the current background color
GetBkMode	Retrieves the background mode
GetBoundsRect	Returns current accumulated bounding rectangle
GetBrushOrg	Retrieves the origin of the current brush
GetBrushOrgEx	Retrieves the origin of the current brush
GetCapture	Returns the handle for the mouse-capture window
GetCaretBlinkTime	Returns the caret blink rate
GetCaretPos	Returns the current caret position
GetCharABCWidths	Retrieves widths of TrueType characters
GetCharWidth	Retrieves character widths
GetClassInfo	Returns window class information
GetClassLong	Returns window-class data
GetClassName	Returns window class name
GetClassWord	Returns window class memory word
GetClientRect	Returns window client area coordinates
GetClipboardData	Returns a handle to clipboard data
GetClipboardFormatName	Returns registered clipboard format name
GetClipboardOwner	Returns clipboard owner window handle
GetClipboardViewer	Returns first clipboard viewer window handle
GetClipBox	Retrieves rectangle for clipping region
GetClipCursor	Returns cursor-confining rectangle coordinates
GetCodeHandle	Determines the location of a function
GetCodeInfo	Retrieves code-segment information
GetCommError	Returns communications-device status
GetCommEventMask	Retrieves the device event mask
GetCommState	Reads communications device status
GetCurrentPDB	Returns the selector address of the current PDB
GetCurrentPosition	Retrieves current position
GetCurrentPositionEx	Retrieves position in logical units

GetCurrentTask	Returns current task handle
GetCurrentTime	Returns elapsed time since Windows started
GetCursor	Returns current cursor handle
GetCursorPos	Returns current cursor position
GetDC	Returns window device-context handle
GetDCEx	Retrieves the handle of a device context
GetDCOrg	Retrieves translation origin for device context
GetDesktopWindow	Returns desktop window handle
GetDeviceCaps	Retrieves device capabilities
GetDialogBaseUnits	Returns dialog base units
GetDIBits	Copies DIB bits into a buffer
GetDlgCtrlID	Returns child window ID
GetDlgItem	Returns handle of a dialog control
GetDlgItemInt	Translates dialog text into an integer
GetDlgItemText	Retrieves dialog control text
GetDOSEnvironment	Returns a far pointer to the current environment
GetDoubleClickTime	Returns mouse double click time
GetDriverInfo	Retrieves installable-driver data
GetDriverModuleHandle	Retrieves an installable-driver instance handle
GetDriveType	Determines drive type
GetExpandedName	Retrieves original filename for a compressed file
GetFileResource	Copies a resource into a buffer
GetFileResourceSize	Returns the size of a resource
GetFileTitle	Retrieves a filename
GetFileVersionInfo	Returns version information about a file
GetFileVersionInfoSize	Returns the size of a file's version information
GetFocus	Returns current focus window handle
GetFontData	Retrieves font metric data
GetFreeFileHandles	Returns the number of free file handles
GetFreeSpace	Returns number of free bytes in the global heap
GetFreeSystemResources	Returns percentage of free system resource space
GetGlyphOutline	Retrieves data for individual outline character
GetInputState	Returns mouse, keyboard and timer queue status
GetInstanceData	Copy previous instance data into current instance
GetKBCodePage	Returns the current code page
GetKerningPairs	Retrieves kerning pairs for current font
GetKeyboardState	Returns virtual-keyboard keys status
GetKeyboardType	Retrieves keyboard information
GetKeyNameText	Retrieves string representing the name of a key
GetKeyState	Returns specified virtual key state
GetLastActivePopup	Determines most recently active pop-up window
GetMapMode	Retrieves mapping mode
GetMenu	Returns menu handle for the specified window
GetMenuCheckMarkDimensions	Returns default check mark bitmap dimensions
GetMenuItemCount	Returns the number of items in a menu
GetMenuItemID	Returns a menu-item identifier
GetMenuState	Returns status flags for the specified menu item
GetMenuString	Copies a menu-itme label into a buffer
GetMessage	Retrieves a message from the message queue
GetMessageExtraInfo	Retrieves information about a hardware message
GetMessagePos	Returns cursor position for last message
GetMessageTime	Returns the time for the last message
GetMetaFile	Creates handle to a metafile
GetMetaFileBits	Creates memory block from metafile
GetModuleFileName	Returns the file name for a module handle
GetModuleHandle	Returns a module handle for a named module

GetModuleUsage	Returns the reference count for a module
GetNearestColor	Retrieves closest available color
GetNearestPaletteIndex	Retrieves nearest match for a color
GetNextDlgGroupItem	Returns handle of previous or next group control
GetNextDlgTabItem	Returns the next or previous **WS_TABSTOP** control
GetNextDriver	Enumerates installable-driver instances
GetNextWindow	Returns next or previous window-manager window
GetNumTasks	Returns the current number of tasks
GetObject	Retrieves infOrmation about an object
GetOpenClipboardWindow	Returns handle to window that opened clipboard
GetOpenFileName	Creates an open-filename dialog box
GetOutlineTextMetrics	Retrieves metrics for TrueType fonts
GetPaletteEntries	Retrieves range of palette entries
GetParent	Returns parent window handle
GetPixel	Retrieves **RGB** color of specified pixel
GetPolyFillMode	Retrieves the current polygon-filling mode
GetPriorityClipboardFormat	Returns first clipboard format
GetPrivateProfileInt	Retrieves integer value from .ini file
GetPrivateProfileString	Retrieves a string from an initialization file
GetProcAddress	Returns the address of an exported DLL function
GetProfileInt	Retrieves an integer value from WIN.INI
GetProfileString	Retrieves a string from WIN.INI
GetProp	Returns data handle from a window property list
GetQueueStatus	Determines queued message type
GetRasterizerCaps	Retrieves status of TrueType on system
GetRgnBox	Retrieves bounding rectangle for region
GetROP2	Retrieves the current drawing mode
GetSaveFileName	Creates a save-filename dialog box
GetScrollPos	Returns current scroll-bar thumb position
GetScrollRange	Returns minimum and maximum scroll-bar positions
GetSelectorBase	Retrieves the base address of a selector
GetSelectorLimit	Retreives the limit of a selector
GetStockObject	Retrieves handle of a stock pen, brush, or font
GetStretchBltMode	Retrieves the current bitmap-stretching mode
GetSubMenu	Returns pop-up menu handle
GetSysColor	Returns display-element color
GetSysModalWindow	Returns system-model window handle
GetSystemDebugState	Returns system-state information to a debugger
GetSystemDir	Returns the Windows system subdirectory
GetSystemDirectory	Returns the Windows system directory
GetSystemMenu	Provides access to the System menu
GetSystemMetrics	Retrieves the system metrics
GetSystemPaletteEntries	Retrieves entries from system palette
GetSystemPaletteUse	Determines use of entire system palette
GetTabbedTextExtent	Determines dimensions of tabbed string
GetTempDrive	Returns a disk drive letter for temporary files
GetTempFileName	Creates a temporary filename
GetTextAlign	Retrieves text-alignment flags
GetTextCharacterExtra	Retrieves intercharacter spacing
GetTextColor	Retrieves the current text color
GetTextExtent	Determines dimensions of a string
GetTextExtentPoint	Retrieves dimensions of string
GetTextFace	Retrieves typeface name of the current font
GetTextMetrics	Retrieves the metrics for the current font
GetThresholdEvent	Obsolete
GetThresholdStatus	Obsolete

GetTickCount	Returns amount of time Windows has been running
GetTimerResolution	Retrieves the timer resolution
GetTopWindow	Returns handle for top child of given window
GetUpdateRect	Returns window update region dimensions
GetUpdateRgn	Returns window update region
GetVersion	Returns the current Dos and Windows versions
GetViewportExt	Retrieves viewport extent
GetViewportExtEx	Retrieves viewport extent
GetViewportOrg	Retrieves viewport origin
GetViewportOrgEx	Retrieves viewport origin
GetWinDebugInfo	Queries current system-debugging information
GetWindow	Returns specified window handle
GetWindowDC	Returns window device context
GetWindowExt	Retrieves window extents
GetWindowExtEx	Retrieves window extents
GetWindowLong	Returns long value from extra window memory
GetWindowOrg	Retrieves window origin
GetWindowOrgEx	Retrieves window origin
GetWindowPlacement	Returns window show state and min/max position
GetWindowRect	Retrieves a window's coordinates
GetWindowsDir	Returns the Windows directory
GetWindowsDirectory	Returns the Windows directory
GetWindowTask	Returns the task associated with a window
GetWindowText	Copies window title-bar text to a buffer
GetWindowTextLength	Returns length of window title bar text
GetWindowWord	Returns a word value from extra window memory
GetWinFlags	Returns system configuration flags
GetWinMem32Version	Retrieves version of the 32-bit memory API
Global16PointerAlloc	Converts 16:32 pointer to 16:16
Global16PointerFree	Frees a 16:16 pointer alias
Global32Alloc	Allocates a USE32 memory object
Global32CodeAlias	Creates USE32 alias selector for 32-bit object
Global32CodeAliasFree	Frees a USE32 code-segment alias selector
Global32Free	Frees a USE32 memory object
Global32Realloc	Changes size of a USE32 memory object
GlobalAddAtom	Adds a string to the system atom table
GlobalAlloc	Allocates memory from the global heap
GlobalCompact	Generates free global memory by compacting
GlobalDeleteAtom	Decrements a global atom's reference count
GlobalDosAlloc	Allocates memory available to DOS in real mode
GlobalDosFree	Frees global memory allocated by GlobalDosAlloc
GlobalEntryHandle	Retrieves information about global memory object
GlobalEntryModule	Retrieves information about specific memory object
GlobalFindAtom	Retrieves string atom from the global atom table
GlobalFirst	Retrieves information about first global memory object
GlobalFix	Locks a global memory block in linear memory
GlobalFlags	Returns information about a global memory object
GlobalFree	Frees a global memory object
GlobalGetAtomName	Retrieves a global atom string
GlobalHandle	Returns a handle for a specified selector
GlobalHandleToSel	Converts a global handle to a selector
GlobalInfo	Retrieves information about the global heap
GlobalLock	Locks global memory object and returns a pointer
GlobalLRUNewest	Moves global memory block to newest LRU position
GlobalLRUOldest	Moves global memory block to oldest LRU position
GlobalNext	Retrieves information about next global memory object

GlobalNotify	Installs a notification procedure
GlobalPageLock	Increments global memory page-lock count
GlobalPageUnlock	Decrements global memory page-lock count
GlobalReAlloc	Changes size/attributes of global memory object
GlobalSize	Returns the size of a global memory object
GlobalUnfix	Unlocks a global-memory block in linear memory
GlobalUnlock	Unlocks a global memory object
GlobalUnWire	Should not be used
GlobalWire	Should not be used
GrayString	Draws gray text at the specified location
HelpMessageFilterHookFunction	Posts screen saver help message
HideCaret	Removes the caret from the screen
HiliteMenuItem	Changes highlight of top-level menu item
hmemcpy	Copies bytes
InflateRect	Changes rectangle dimensions
InitAtomTable	Sets the size of the local atom table
InSendMessage	Determines if a window is processing SendMessage
InsertMenu	Inserts a new item in a menu
InterruptRegister	Installs function to handle system interrupts
InterruptUnRegister	Removes function that processed system interrupts
IntersectClipRect	Creates clipping region from intersection
IntersectRect	Calculates a rectangle intersection
InvalidateRect	Adds a rectangle to the update region
InvalidateRgn	Adds a region to the update region
InvertRect	Inverts a rectangular region
InvertRgn	Inverts the colors in a region
IsBadCodePtr	Determines whether a code pointer is valid
IsBadHugeReadPtr	Determines if a huge read pointer is valid
IsBadHugeWritePtr	Determines if a huge write pointer is valid
IsBadReadPtr	Determines whether a read pointer is valid
IsBadStringPtr	Determines whether a string pointer is valid
IsBadWritePtr	Determines whether a write pointer is valid
IsCharAlpha	Determines if a character is alphabetical
IsCharAlphaNumeric	Determines is a character is alphanumeric
IsCharLower	Determines if a character is lower case
IsCharUpper	Determines if a character is upper case
IsChild	Determines if a window is a child
IsClipboardFormatAvailable	Determines if specified format data is available
IsDBCSLeadByte	Determines if a character is a DBCS lead byte
IsDialogMessage	Determines if a message is for a dialog box
IsDlgButtonChecked	Determines the state of a button control
IsGDIObject	Determines if handle is not **GDI** object
IsIconic	Determines if a window is minimized
IsMenu	Determines if a menu handle is valid
IsRectEmpty	Determines whether rectangle is empty
IsTask	Determines whether a task handle is valid
IsWindow	Determines if a window handle is valid
IsWindowEnabled	Determines if a window accepts user input
IsWindowVisible	Determines visibility state of a window
IsZoomed	Determines if a window is maximized
KillTimer	Removes a timer
LimitEmsPages	Obsolete
LineDDA	Computes successive points in a line
LineTo	Draws a line from the current position
LoadAccelerators	Loads an accelerator table
LoadBitmap	Loads a bitmap resource

LoadCursor	Loads a cursor resource
LoadIcon	Loads an icon resource
LoadLibrary	Returns a handle to a library module
LoadMenu	Loads a menu resource
LoadMenuIndirect	Obtains a menu handle for a menu template
LoadModule	Loads and executes a program
LoadResource	Returns a handle to a resource
LoadString	Loads a string resource
LocalAlloc	Allocate memory from the local heap
LocalCompact	Generates free local memory by compacting
LocalFirst	Retrieves information about first local memory object
LocalFlags	Returns local memory object information
LocalFree	Frees a local memory object
LocalHandle	Returns the handle of a local memory object
LocalInfo	Fills structure with information about local heap
LocalInit	Initializes a local heap
LocalLock	Locks a local memory object and returns a pointer
LocalNext	Retrieves information about next local memory object
LocalReAlloc	Changes local memory size or attributes
LocalShrink	Shrinks the specified local heap
LocalSize	Returns the size of a local memory object
LocalUnlock	Unlocks a local memory object
LockInput	Locks input to all tasks except the current one
LockResource	Returns the address of a resource
LockSegment	Locks a discardable memory segment
LockWindowUpdate	Disables or reenables drawing in a window
LogError	Identifies an error message
LogParamError	Identifies a parameter validation error
LPtoDP	Converts logical points to device points
lstrcat	Appends one string to another
lstrcmp	Compares two character strings
lstrcmpi	Compares two character strings
lstrcpy	Copies a string to a buffer
lstrlen	Returns the number of characters in a string
LZClose	Closes a file
LZCopy	Copies a file and expands it if compressed
LZDone	Frees buffers allocated by LZStart
LZInit	Initializes data structures needed for decompression
LZOpenFile	Opens a file (both compressed and uncompressed)
LZRead	Reads a specified number of bytes from a compressed file
LZSeek	Repositions pointer in file
LZStart	Allocates buffers for CopyLZFile function
MakeProcInstance	Returns the address of prolog code for a function
MapDialogRect	Maps dialog box units to pixels
MapVirtualKey	Translates a virual-key code or scan code
MapWindowPoints	Converts points to another coordinate system
MemManInfo	Retrieves information about the memory manager
MemoryRead	Reads memory from an arbitrary global heap object
MemoryWrite	Writes memory to an arbitrary global heap object
MessageBeep	Generates a beep
MessageBox	Creates a message-box window
ModifyMenu	Changes an existing menu item
ModuleFindHandle	Retrieves information about a module
ModuleFindName	Retrieves information about a module
ModuleFirst	Retrieves information about first module
ModuleNext	Retrieves information about next module

MoveTo	Moves the current position
MoveToEx	Moves the current position
MoveWindow	Changes the position and dimensions of a window
MulDiv	Multiplies two values and divides the result
NetBIOSCall	Issues a NETBIOS Interrupt 5Ch
NotifyRegister	Installs a notification callback function
NotifyUnRegister	Removes a notification callback function
OemKeyScan	Maps OEM ASCII to scan codes
OemToAnsi	Translates an OEM string to a Windows string
OemToAnsiBuff	Translates an OEM string to a Windows string
OffsetClipRgn	Moves a clipping region
OffsetRect	Moves a rectangle by an offset
OffsetRgn	Moves a region by a specified offset
OffsetViewportOrg	Moves viewport origin
OffsetViewportOrgEx	Moves viewport origin
OffsetWindowOrg	Moves window origin
OffsetWindowOrgEx	Moves window origin
OleActivate	Activates an object
OleBlockServer	Queues incoming requests for the server
OleClone	Makes a copy of an object
OleClose	Closes specified object
OleCopyFromLink	Makes an embedded copy of a linked object
OleCopyToClipboard	Puts the specified object on the clipboard
OleCreate	Creates an object of a specified class
OleCreateFromClip	Creates an object from the clipboard
OleCreateFromFile	Creates an object from a file
OleCreateFromTemplate	Creates an object from a template
OleCreateInvisible	Creates an object without displaying it
OleCreateLinkFromClip	Creates link to object from the clipboard
OleCreateLinkFromFile	Creates link to object in a file
OleDelete	Deletes an object
OleDraw	Draws an object into a device context
OleEnumFormats	Enumerates data formats for an object
OleEnumObjects	Enumerates objects in a document
OleEqual	Compares two objects for equality
OleExecute	Sends DDE execute commands to a server
OleGetData	Retrieves data for an object in a specified format
OleGetLinkUpdateOptions	Retrieves update options for an object
OleIsDcMeta	Identifies metafile device context
OleLoadFromStream	Loads an object from containing document
OleLockServer	Keeps server in memory
OleObjectConvert	Creates a new object using a specified protocol
OleQueryBounds	Retrieves bounding rectangle for object
OleQueryClientVersion	Retrieves version of client library
OleQueryCreateFromClip	Retrieves create data for clipboard object
OleQueryLinkFromClip	Retrieves link data for clipboard object
OleQueryName	Retrieves the name of an object
OleQueryOpen	Determines whether an object is open
OleQueryOutOfDate	Determines whether an object is out-of-date
OleQueryProtocol	Determines if an object supports a protocol
OleQueryReleaseError	Determines status of released operation
OleQueryReleaseMethod	Determines which operation released
OleQueryReleaseStatus	Determines whether an operation released
OleQueryServerVersion	Retrieves version of server library
OleQuerySize	Retrieves the size of an object
OleQueryType	Determines if object is linked, embedded, or static

OleReconnect	Reconnects to an open linked object
OleRegisterClientDoc	Registers a document with the library
OleRegisterServer	Registers the specified server
OleRegisterServerDoc	Registers document with server library
OleRelease	Releases an object from memory
OleRename	Informs library an object is renamed
OleRenameClientDoc	Informs library a document is renamed
OleRenameServerDoc	Informs library a document is renamed
OleRequestData	Retrieves data from a server in a specified format
OleRevertClientDoc	Informs library a doc reverted to saved state
OleRevertServerDoc	Informs library a doc is reset to saved state
OleRevokeClientDoc	Informs library a document is not open
OleRevokeObject	Revokes access to an object
OleRevokeServer	Revokes the specified server
OleRevokeServerDoc	Revokes the specified document
OleSavedClientDoc	Informs library a doc has been saved
OleSavedServerDoc	Informs library a doc has been saved
OleSaveToStream	Saves an object to the stream
OleSetBounds	Sets bounding rectangle for object
OleSetColorScheme	Specifies client's recommended object colors
OleSetData	Sends data in specified format to server
OleSetHostNames	Sets client name and object name for server
OleSetLinkUpdateOptions	Sets update options for an object
OleSetTargetDevice	Sets target device for an object
OleUnblockServer	Processes requests from queue
OleUnlockServer	Releases server locked with OleLockServer
OleUpdate	Updates an object
OpenClipboard	Opens the clipboard
OpenComm	Opens a communications device
OpenDriver	Opens an installable driver
OpenFile	Creates, opens, reopens or deletes a file
OpenIcon	Activates a minimized window
OpenSound	Obsolete
OutputDebugString	Sends a character string to the debugger
PaintRgn	Fills region with brush in device context
PatBlt	Creates a bitmap pattern
PeekMessage	Checks message queue
Pie	Draws a pie-shaped wedge
PlayMetaFile	Plays a metafile
PlayMetaFileRecord	Plays a metafile record
Polygon	Draws a polygon
Polyline	Draws line segments to connect specified points
PolyPolygon	Draws a series of polygons
PostAppMessage	Posts a message to an application
PostMessage	Places a message in a window's message queue
PostQuitMessage	Tells Windows that an application is terminating
PrestoChangoSelector	Generates code selector from data
PrintDlg	Creates a print-text dialog box
ProfClear	Discards all buffered Profiler samples
ProfFinish	Stops profile sampling and flushes profile buffer
ProfFlush	Flushes the Profiler sampling buffer to disk
ProfInsChk	Determines whether Profiler is installed
ProfSampRate	Sets the Profiler sampling rate
ProfSetup	Sets Profiler buffer size and sample quantity
ProfStart	Starts profile sampling
ProfStop	Stops profile sampling

PtInRect	Determines if a point is in a rectangle
PtInRegion	Queries whether a point is in a region
PtVisible	Queries whether point is within clipping region
QueryAbort	Queries whether to terminate a print job
QuerySendMessage	Determines if a message originated within a task
ReadComm	Reads from a communications device
RealizePalette	Maps entries from logical to system palette
Rectangle	Draws a rectangle
RectInRegion	Queries whether rectangle overlaps region
RectVisible	Queries whether rectangle is in clip region
RedrawWindow	Updates a client rectangle or region
RegCloseKey	Closes a key
RegCreateKey	Creates a key
RegDeleteKey	Deletes a key
RegEnumKey	Enumerates subkeys of specified key
RegisterClass	Registers a window class
RegisterClipboardFormat	Registers a new clipboard format
RegisterDialogClasses	Registers dialog classes for screen-savers
RegisterWindowMessage	Defines a new unique window message
RegOpenKey	Opens a key
RegQueryValue	Retrieves text string for specified key
RegSetValue	Associates a text string with a specified key
ReleaseCapture	Releases mouse capture
ReleaseDC	Frees a device context
RemoveFontResource	Removes font resource
RemoveMenu	Deletes a menu item and pop-up menu
RemoveProp	Removes a property-list entry
ReplaceText	Creates a replace-text dialog box
ReplyMessage	Replies to a SendMessage
ResetDC	Updates a device context
ResizePalette	Changes the size of a logical palette
RestoreDC	Restores device context
RoundRect	Draws a rectangle with rounded corners
SaveDC	Saves current state of device context
ScaleViewportExt	Scales viewport extents
ScaleViewportExtEx	Scales viewport extents
ScaleWindowExt	Scales window extents
ScaleWindowExtEx	Scales window extents
ScreenSaverConfigureDialog	Processes input to screensaver config. dialog
ScreenSaverProc	Processes input to a screen-saver window
ScreenToClient	Converts screen point to client coordinates
ScrollDC	Scrolls a rectangle horizontally and vertically
ScrollWindow	Scrolls a window's client area
ScrollWindowEx	Scrolls a window's client area
SelectClipRgn	Selects clipping region for device context
SelectObject	Selects object into a device context
SelectPalette	Selects a palette into a device context
SendDlgItemMessage	Sends a message to a dialog box control
SendDriverMessage	Sends a message to an installable driver
SendMessage	Sends a message to a window
SetAbortProc	Sets the abort function for a print job
SetActiveWindow	Makes a top-level window active
SetBitmapBits	Sets bitmap bits from array of bytes
SetBitmapDimension	Sets width and height of bitmap
SetBitmapDimensionEx	Sets width and height of bitmap
SetBkColor	Sets the current background color

SetBkMode	Sets the background mode
SetBoundsRect	Controls bounding-rectangle accumulation
SetBrushOrg	Sets the origin of the current brush
SetCapture	Sets the mouse capture to a window
SetCaretBlinkTime	Sets caret blink rate
SetCaretPos	Sets the caret position
SetClassLong	Sets a long value in extra class memory
SetClassWord	Sets a word value in extra class memory
SetClipboardData	Sets the data in the clipboard
SetClipboardViewer	Adds a window to the clipboard-viewer chain
SetCommBreak	Suspends character transmission
SetCommEventMask	Enables events in a device event mask
SetCommState	Sets communications-device state
SetCursor	Changes the mouse cursor
SetCursorPos	Sets mouse-cursor position in screen coordinates
SetDIBits	Sets the bits of a bitmap
SetDIBitsToDevice	Sets DIB bits to device
SetDlgItemInt	Converts an integer to a dialog text string
SetDlgItemText	Sets dialog title or item text
SetDoubleClickTime	Sets the mouse double-click time
SetErrorMode	Controls Interrupt 24h Error Handling
SetFocus	Sets the input focus to a window
SetHandleCount	Changes the number of available file handles
SetKeyboardState	Sets the keyboard state table
SetMapMode	Sets mapping mode
SetMapperFlags	Sets font-mapper flag
SetMenu	Sets the menu for a window
SetMenuItemBitmaps	Associates bitmaps with a menu item
SetMessageQueue	Creates a new message queue
SetMetaFileBits	Creates memory block from metafile
SetMetaFileBitsBetter	Creates memory block from metafile
SetPaletteEntries	Sets colors and flags for a color palette
SetParent	Changes a child's paren window
SetPixel	Sets pixel to specified color
SetPolyFillMode	Sets the polygon-filling mode
SetProp	Adds or changes a property-list entry
SetRect	Sets a rectangle's dimensions
SetRectEmpty	Creates an empty rectangle
SetRectRgn	Changes a region into specified rectangle
SetResourceHandler	Installs a load-resource callback function
SetROP2	Sets the current drawing mode
SetScrollPos	Sets scroll-bar thumb position
SetScrollRange	Sets minimum and maximum scroll-bar positions
SetSelectorBase	Sets the base and limit of a selector
SetSelectorLimit	Sets the limit of a selector
SetSoundNoise	Obsolete
SetStretchBltMode	Sets the bitmap-stretching mode
SetSwapAreaSize	Sets the amount of memory used for code segments
SetSysColors	Sets one or more system colors
SetSysModalWindow	Makes a window the system-modal window
SetSystemPaletteUse	Use of system palette static colors
SetTextAlign	Sets text-alignment flags
SetTextCharacterExtra	Sets intercharacter spacing
SetTextColor	Sets the foreground color of text
SetTextJustification	Sets alignment for text output
SetTimer	Installs a system timer

SetViewportExt	Sets viewport extents
SetViewportExtEx	Sets viewport extents
SetViewportOrg	Sets viewport origin
SetViewportOrgEx	Sets viewport origin
SetVoiceAccent	Obsolete
SetVoiceEnvelope	Obsolete
SetVoiceNote	Obsolete
SetVoiceQueueSize	Obsolete
SetVoiceSound	Obsolete
SetVoiceThreshold	Obsolete
SetWinDebugInfo	Sets current system-debugging information
SetWindowExt	Sets window extents
SetWindowExtEx	Sets window extents
SetWindowLong	Sets a long value in extra window memory
SetWindowOrg	Sets the window origin
SetWindowOrgEx	Sets the window origin
SetWindowPlacement	Sets window show state and min/max position
SetWindowPos	Sets a windows size, position, and order
SetWindowsHook	Installs a hook function
SetWindowsHookEx	Installs a hook function
SetWindowText	Sets text in a caption title or control window
SetWindowWord	Sets a word value in extra window memory
ShellExecute	Opens or prints specified file
ShowCaret	Shows (unhides) the caret
ShowCursor	Shows or hides the mouse cursor
ShowOwnedPopups	Shows or hides pop-up windows
ShowScrollBar	Shows or hides a scroll bar
ShowWindow	Sets window visibility state
SizeofResource	Returns the size of a resource
SpoolFile	Puts a file in the spooler queue
StackTraceCSIPFirst	Retrieves information about a stack frame
StackTraceFirst	Retrieves information about the first stack frame
StackTraceNext	Retrieves information about the next stack frame
StartDoc	Starts a print job
StartPage	Prepares printer driver to receive data
StartSound	Obsolete
StopSound	Obsolete
StretchBlt	Copies a bitmap, transforming if required
StretchDIBits	Moves DIB from source to destination rectangle
SubtractRect	Creates rect from difference of two rects
SwapMouseButton	Reverses the meaning of the mouse buttons
SwapRecording	Starts or stops memory swap recording
SwitchStackBack	Restores the current-task stack
SwitchStackTo	Changes the location of the stack
SyncAllVoices	Obsolete
SystemHeapInfo	Retrieves information about the **USER** heap
SystemParametersInfo	Queries or sets systemwide parameters
TabbedTextOut	Writes a tabbed character string
TaskFindHandle	Retrieves information about a task
TaskFirst	Retrieves information about first task in task queue
TaskGetCSIP	Returns the next CS:IP value of a task.
TaskNext	Retrieves information about next task in the task queue
TaskSetCSIP	Sets the CS:IP of a sleeping task.
TaskSwitch	Switches to a specific address within a new task
TerminateApp	Terminates an application
TextOut	Writes a character string at specified location

Throw	Restores the execution environment
TimerCount	Retrieves execution times
ToAscii	Translates virtual-key code to Windows character
TrackPopupMenu	Displays and tracks a pop-up menu
TranslateAccelerator	Processes menu command keyboard accelerators
TranslateMDISysAccel	Processes MDI keyboard accelerators
TranslateMessage	Translates virtual-key messages
TransmitCommChar	Places a character in the transmit queue
UnAllocDiskSpace	Deletes the file created by AllocDiskSpace.
UnAllocFileHandles	Frees file handles allocated by AllocFileHandles.
UngetCommChar	Puts a character back in the receive queue
UnhookWindowsHook	Removes a filter function
UnhookWindowsHookEx	Removes a function from the hook chain
UnionRect	Creates the union of two rectangles
UnlockSegment	Unlocks a discardable memory segment
UnrealizeObject	Resets brush origins and realizes palettes
UnregisterClass	Removes a window class
UpdateColors	Updates colors in client area
UpdateWindow	Updates a window's client area
ValidateCodeSegments	Test for memory overwrites
ValidateFreeSpaces	Checks free memory for valid contents
ValidateRect	Removes a rectangle from the update region
ValidateRgn	Removes a region from the update region
VerFindFile	Determines where to install a file
VerInstallFile	Installs a file
VerLanguageName	Converts a binary language identifier into a string
VerQueryValue	Returns version information about a block
VkKeyScan	Translates Windows character to virtual-key code
WaitMessage	Suspends an application and yields control
WaitSoundState	Obsolete
WindowFromPoint	Returns window containing a point
WinExec	Runs a program
WinHelp	Invokes Windows Help
WNetAddConnection	Adds network connections
WNetCancelConnection	Removes network connections
WNetGetConnection	Lists network connections
WriteComm	Writes to a communications device
WritePrivateProfileString	Writes a string to an initialization file
WriteProfileString	Writes a string to WIN.INI
wsprintf	Formats a string
wvsprintf	Formats a string
XTYP_ADVDATA	Passes advise data to a client
XTYP_ADVREQ	Prompts a server to send advise data to a client
XTYP_ADVSTART	Requests an advise loop
XTYP_ADVSTOP	Ends an advise loop
XTYP_CONNECT	Requests a DDE conversation
XTYP_CONNECT_CONFIRM	Confirms a DDE conversation
XTYP_DISCONNECT	Terminates a DDE conversation
XTYP_ERROR	Notifies a DDEML application of a critical error
XTYP_EXECUTE	Executes a server command
XTYP_MONITOR	Informs a DDE monitor application of a DDE event
XTYP_POKE	Sends unsolicited data to a server
XTYP_REGISTER	Registers a service name
XTYP_REQUEST	Requests data from a server
XTYP_UNREGISTER	Unregisters a service name
XTYP_WILDCONNECT	Requests multiple DDE conversation

XTYP_XACT_COMPLETE	Confirms completion of asynchronous transaction
Yield	Stops the current task

Message groups (3.1)

Button messages

BM_GETCHECK	Retrieves the button check state
BM_GETSTATE	Determines the state of a button or check box
BM_SETCHECK	Sets the button check state
BM_SETSTATE	Sets the highlighting state of a button
BM_SETSTYLE	Sets the style of a button

Clipboard messages

WM_ASKCBFORMATNAME	Retrieves the name of the clipboard format
WM_CHANGECBCHAIN	Notifies clipboard viewer of removal from chain
WM_COPY	Copies a selection to the clipboard
WM_CUT	Deletes a selection and copies it to the clipboard
WM_DESTROYCLIPBOARD	Notifies owner that the clipboard was emptied
WM_DRAWCLIPBOARD	Indicates the clipboard's contents have changed
WM_HSCROLLCLIPBOARD	Prompts owner to scroll clipboard contents
WM_PAINTCLIPBOARD	Prompts owner to display clipboard contents
WM_PASTE	Inserts clipboard data into an edit control
WM_RENDERALLFORMATS	Notifies owner to render all clipboard formats
WM_RENDERFORMAT	Notifies owner to render clipboard data
WM_SIZECLIPBOARD	Indicates a change in the chipboard's size
WM_VSCROLLCLIPBOARD	Prompts owner to scroll clipboard contents

Combo box messages

CB_ADDSTRING	Adds a string to the list box of a combo box
CB_DELETESTRING	Deletes list-box string in a combo box
CB_DIR	Adds file names to the list box of a combo box
CB_FINDSTRING	Finds a string in the list box of a combo box
CB_GETCOUNT	Gets the number of list-box items in a combo box
CB_GETCURSEL	Gets index of selected list-box item in combo box
CB_GETDROPPEDCONTROLRECT	Gets rectangle of combo-box drop-down list box
CB_GETDROPPEDSTATE	Determines if a combo box's list box is visible
CB_GETEDITSEL	Gets position of selection in edit control
CB_GETEXTENDEDUI	Determines if combo box has extended interface
CB_GETITEMDATA	Retrieves a value associated with an item
CB_GETITEMHEIGHT	Retrieves the height of items in a combo box
CB_GETLBTEXT	Gets a string from the list box of a combo box
CB_GETLBTEXTLEN	Gets length of a list-box string in a combo box
CB_INSERTSTRING	Inserts a string into the list box of a combo box
CB_LIMITTEXT	Limits amount of edit-control text in a combo box
CB_RESETCONTENT	Removes all items from list box of a combo box
CB_SELECTSTRING	Selects a string in the list box of a combo box
CB_SETCURSEL	Selects a string in the list box of a combo box
CB_SETEDITSEL	Sets the edit-control selection of a combo box
CB_SETEXTENDEDUI	Sets the default or extended user interface
CB_SETITEMDATA	Sets the value associated with an item
CB_SETITEMHEIGHT	Sets the height of items in a combo box
CB_SHOWDROPDOWN	Shows or hides the list box of a combo box

DDE messages

WM_DDE_ACK	Acknowledges the receipt of a DDE transaction
WM_DDE_ADVISE	Starts an advise loop with a DDE server
WM_DDE_DATA	Passes a data item to a DDE client
WM_DDE_EXECUTE	Passes a command to a DDE server
WM_DDE_INITIATE	Initiates a DDE conversation
WM_DDE_POKE	Send unsolicited data to a server
WM_DDE_REQUEST	Requests a data item from a DDE server
WM_DDE_TERMINATE	Terminates a DDE conversation
WM_DDE_UNADVISE	Ends a DDE advise loop

Edit-control messages

EM_CANUNDO	Determines if edit-control operation can be undone
EM_EMPTYUNDOBUFFER	Resets (clears) the edit-control undo flag
EM_FMTLINES	Sets soft line-break characters on or off
EM_GETFIRSTVISIBLELINE	Gets index of top line in an edit control
EM_GETHANDLE	Gets the handle of the memory for an MLE
EM_GETLINE	Retrieves a line from an MLE
EM_GETLINECOUNT	Retrieves number of lines in an MLE
EM_GETMODIFY	Checks whether edit-control contents have changed
EM_GETRECT	Gets the coordinates of an edit-control rectangle
EM_GETSEL	Gets position of current edit-contol selection
EM_LIMITTEXT	Limits amount of text in an edit control
EM_LINEFROMCHAR	Retrieves a line number from a character index
EM_LINEINDEX	Retrieves the character index of an MLE line
EM_LINELENGTH	Retrieves the length of a line in an MLE
EM_LINESCROLL	Scrolls text in an MLE
EM_REPLACESEL	Replaces current selection in an edit control
EM_SETHANDLE	Sets the memory handle for an MLE
EM_SETMODIFY	Sets or clears edit-control modification flag
EM_SETPASSWORDCHAR	Sets or removes edit-control password character
EM_SETREADONLY	Sets the read-only state of an edit control
EM_SETRECT	Sets the formatting rectangle of an MLE
EM_SETRECTNP	Sets the formatting rectangle of an MLE
EM_SETSEL	Selects text within an edit control
EM_SETTABSTOPS	Sets the tab stops in an MLE
EM_SETWORDBREAKPROC	Provides custom word breaks in edit controls
EM_UNDO	Undoes the last operation in an edit control

List box messages

LB_ADDSTRING	Adds a string to a list box
LB_DELETESTRING	Deletes a string in a list box
LB_DIR	Adds file names to a list box
LB_FINDSTRING	Finds a string in a list box
LB_GETCARETINDEX	Gets index of list-box item with focus rectangle
LB_GETCOUNT	Gets the number of items in a list box
LB_GETCURSEL	Gets index of selected item in a list box
LB_GETHORIZONTALEXTENT	Gets the horizontal extent of a list box
LB_GETITEMDATA	Retrieves value associated with a list-box item
LB_GETITEMHEIGHT	Retrieves the height of items in a list box
LB_GETITEMRECT	Retrieves the bounding rectangle for an item
LB_GETSEL	Retrieves the selection state of an item
LB_GETSELCOUNT	Retrieves a count of selected list-box items
LB_GETSELITEMS	Lists item numbers of selected list-box items
LB_GETTEXT	Gets a string from a list box
LB_GETTEXTLEN	Gets the length of a string in a list box
LB_GETTOPINDEX	Retrieves index of first visible list-box item
LB_INSERTSTRING	Inserts a string into a list box
LB_RESETCONTENT	Removes all items from a list box
LB_SELECTSTRING	Selects a string in a list box
LB_SELITEMRANGE	Selects consecutive items in a list box
LB_SETCARETINDEX	Sets the focus rectangle in a list box
LB_SETCOLUMNWIDTH	Sets the width of columns in a list box
LB_SETCURSEL	Selects a string in a list box
LB_SETHORIZONTALEXTENT	Sets the horizontal extent of a list box
LB_SETITEMDATA	Associates a value with a list-box item
LB_SETITEMHEIGHT	Sets the height of items in a list box
LB_SETSEL	Selects a string in a multi-selection list box
LB_SETTABSTOPS	Sets tab stops in a list box
LB_SETTOPINDEX	Ensures that a list-box item is visible

New 3.1 messages

CB_FINDSTRINGEXACT	Finds a string in the list box of a combo box
CB_GETDROPPEDCONTROLRECT	Gets rectangle of combo-box drop-down list box
CB_GETDROPPEDSTATE	Determines if a combo box's list box is visible
CB_GETEXTENDEDUI	Selects the default or extended user interface
CB_GETITEMHEIGHT	Retrieves the height of items in a combo box
CB_SETEXTENDEDUI	Sets the default or extended user interface
CB_SETITEMHEIGHT	Sets the height of items in a combo box
EM_GETFIRSTVISIBLELINE	Gets index of top line in an edit control
EM_GETPASSWORDCHAR	Retrieves edit-control password character
EM_GETWORDBREAKPROC	Retrieves edit-control wordwrap function
EM_SETREADONLY	Sets the read-only state of an edit control
EM_SETWORDBREAKPROC	Provides custom word breaks in edit controls
LB_FINDSTRINGEXACT	Finds a string in a list box
LB_GETCARETINDEX	Gets index of list-box item with focus rectangle
LB_GETITEMHEIGHT	Retrieves the height of items in a list box
LB_SETCARETINDEX	Sets the focus rectangle in a list box
LB_SETITEMHEIGHT	Sets the height of items in a list box
STM_GETICON	Gets icon handle associated with an icon control
STM_SETICON	Associates an icon handle with an icon control
WM_CHOOSEFONT_GETLOGFONT	Retrieves **LOGFONT** for Font Dialog
WM_COMMNOTIFY	Notifies a window about the status of its queues
WM_DROPFILES	Indicates that a file has been dropped
WM_PALETTEISCHANGING	Indicates that the palette is changing
WM_POWER	Indicates the system is entering suspended mode
WM_QUEUESYNC	Delimits CBT messages
WM_SYSTEMERROR	Indicates a system error has occurred
WM_WINDOWPOSCHANGED	Notifies window of size or position change
WM_WINDOWPOSCHANGING	Notifies window of new size or position

BM_GETCHECK (2.x)

```
BM_GETCHECK
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends a BM_GETCHECK message to retrieve the check state of a button.

Parameters

This message has no parameters.

Returns

The return value from a button created with the **BS_AUTOCHECKBOX**, **BS_AUTORADIOBUTTON**, BS_AUTO3STATE, **BS_CHECKBOX**, **BS_RADIOBUTTON**, or BS_3STATE style may be one of the following values:

Value	Meaning
0	Button state is unchecked.
1	Button state is checked.
2	Button state is indeterminate (applies only if the button has the BS_3STATE or BS_AUTO3STATE style).

If the button has any other style, the return value is 0.

Example

This example determines if the ID_MYCHECKBOX control is currently checked:

```
int checked;

checked = (int) SendDlgItemMessage(hwndDlg, ID_MYCHECKBOX,
    BM_GETCHECK, 0, 0);
```

See Also

BM_GETSTATE, **BM_SETCHECK**, **SendDlgItemMessage**

BM_GETSTATE (2.x)

```
BM_GETSTATE
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends a BM_GETSTATE message to retrieve the state of a button.

Parameters

This message has no parameters.

Returns

The return value specifies the current state of the button. You can use the following masks to extract information about the state:

Mask	Description
0x0003	Specifies the check state (radio buttons and check boxes only). A value of 0 indicates the button is unchecked. A value of 1 indicates the button is checked. A radio button is checked when it contains a dot; a check box is checked when it contains an X. A value of 2 indicates the check state is indeterminate (3-state check boxes only). The state of a 3-state check box is indeterminate when it is grayed.
0x0004	Specifies the highlight state. A nonzero value indicates that the button is highlighted. A button is highlighted when the user presses and holds the left mouse button. The highlighting is removed when the user releases the mouse button.
0x0008	Specifies the focus state. A nonzero value indicates that the button has the focus.

Example

This example determines whether a button currently has the focus:

```
#define BFFOCUS 0x0008

DWORD dwResult;

dwResult = SendDlgItemMessage(hdlg, ID_MYBUTTON, BM_GETSTATE, 0, 0);
if (dwResult & BFFOCUS)

    /* button has the focus */
```

See Also

BM_GETCHECK, **BM_SETSTATE**

BM_SETCHECK (2.x)

```
BM_SETCHECK
wParam = (WPARAM) fCheck; /* check state            */
lParam = 0L;              /* not used, must be zero */
```

An application sends a BM_SETCHECK message to set the check state of a button.

Parameter	Description
fCheck	Value of *wParam.* Specifies the check state. This parameter can be one of the following values:

Value	Meaning
0	Set the button state to unchecked.
1	Set the button state to checked.
2	Set the button state to indeterminate. This value can be used only if the button has the BS_3STATE or BS_AUTO3STATE style.

Returns
The return value is always zero.

Comments
The BM_SETCHECK message has no effect on push buttons.

Example
This example places a dot inside a radio button:

```
SendDlgItemMessage(hdlg, ID_MYRADIOBUTTON, BM_SETCHECK, TRUE, 0);
```

See Also
BM_GETCHECK, **BM_SETSTATE**

BM_SETSTATE (2.x)

```
BM_SETSTATE
wParam = (WPARAM) fState;   /* highlight state        */
lParam = 0L;                /* not used, must be zero */
```

An application sends a BM_SETSTATE message to set the highlight state of a button.

Parameter	Description
fState	Value of *wParam.* Specifies whether the button is to be highlighted. A nonzero value highlights the button. A zero value removes any highlighting.

Returns
The return value is always zero.

Comments
Highlighting affects the exterior of a button. It has no effect on the check state of a radio button or check box.

A button is automatically highlighted when the user presses and holds the left mouse button. The highlighting is removed when the user releases the mouse button.

Example
This example highlights and then removes highlighting from a push button, simulating the visual effect of a user clicking the button:

```
SendDlgItemMessage(hdlg, ID_MYPUSHBUTTON, BM_SETSTATE, TRUE, 0);

    /*
     * Perform some action; then remove the highlighting,
     * thereby returning it to its normal state.
     */

SendDlgItemMessage(hdlg, ID_MYPUSHBUTTON, BM_SETSTATE, FALSE, 0);
```

See Also
BM_GETSTATE, **BM_SETCHECK**

BM_SETSTYLE (2.x)

```
BM_SETSTYLE
wParam =  (WPARAM) LOWORD(dwStyle); /* style       */
lParam =  MAKELPARAM(fRedraw, 0);   /* redraw flag */
```

An application sends a BM_SETSTYLE message to change the style of a button.

Parameter	Description
dwStyle	Value of *wParam.* Specifies the button style. For a list of possible buttons styles, see the **Button styles** topic.
fRedraw	Value of the low-order word of *lParam.* Specifies whether the button is to be redrawn. A value of TRUE redraws the button. A value of FALSE does not redraw the button.

Returns

The return value is always zero.

Comments

Unlike **BM_SETCHECK** and **BM_SETSTATE**, BM_SETSTYLE does not have a corresponding message to retrieve the current style. Use the **GetWindowLong** function with the **GWL_STYLE** offset to retrieve the complete button style. The low word of the complete button style is the button-specific style.

An application should not attempt to change a button's type (for example, changing a radio button to a check box).

Example

This example sends a BM_SETSTYLE message to make a button become the default push button:

```
SendDlgItemMessage(hdlg, ID_MYPUSHBUTTON, BM_SETSTYLE,
    (WPARAM) BS_DEFPUSHBUTTON, TRUE);
```

See Also

GetWindowLong

CB_ADDSTRING (3.0)

```
CB_ADDSTRING
wParam = 0;                          /* not used, must be zero   */
lParam = (LPARAM) (LPCSTR) lpsz;     /* address of string to add */
```

An application sends a CB_ADDSTRING message to add a string to the list box of a combo box. If the combo box does not have the **CBS_SORT** style, the string is added to the end of the list. Otherwise, the string is inserted into the list and the list is sorted.

Parameter	Description
lpsz	Value of *lParam.* Points to the null-terminated string to be added. If the combo box was created with an owner-drawn style but without the **CBS_HASSTRINGS** style, the value of the *lpsz* parameter is stored rather than the string it would otherwise point to.

Returns

The return value is the zero-based index to the string in the list box of the combo box. The return value is CB_ERR if an error occurs; the return value is CB_ERRSPACE if insufficient space is available to store the new string.

Comments

If an owner-drawn combo box was created with the **CBS_SORT** style but not the **CBS_HASSTRINGS** style, the **WM_COMPAREITEM** message is sent one or more times to the owner of the combo box so that the new item can be properly placed in the list.

To insert a string into a specific location within the list, use the **CB_INSERTSTRING** message.

Example

This example adds the string "my string" to the list box of a combo box:

```
DWORD dwIndex;

dwIndex = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_ADDSTRING, 0, (LPARAM) ((LPSTR) "my string"));
```

See Also

CB_INSERTSTRING, **WM_COMPAREITEM**, **CB_DIR**

CB_DELETESTRING (3.0)

```
CB_DELETESTRING
wParam = (WPARAM) index;  /* item to delete         */
lParam = 0L;              /* not used, must be zero */
```

An application sends a CB_DELETESTRING message to delete a string in the list box of a combo box.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the string to delete.

Returns

The return value is a count of the strings remaining in the list. The return value is CB_ERR if the *index* parameter specifies an index greater than the number of items in the list.

Comments

If the combo box was created with an owner-drawn style but without the **CBS_HASSTRINGS** style, a **WM_DELETEITEM** message is sent to the owner of the combo box so that the application can free any additional data associated with the item.

Example

This example deletes the first string in a combo box:

```
DWORD dwRemaining;

dwRemaining = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_DELETESTRING, 0, 0);
```

See Also

WM_DELETEITEM, **CB_RESETCONTENT**

CB_DIR (3.0)

```
CB_DIR
wParam = (WPARAM) (UINT) uAttrs;          /* file attributes     */
lParam = (LPARAM) (LPCSTR) lpszFileSpec; /* address of filename */
```

An application sends a CB_DIR message to add a list of filenames to the list box of a combo box.

Parameter	Description
uAttrs	Value of *wParam.* Specifies the attributes of the files to be added to the list box. It can be any combination of the following values:

Value	Meaning
DDL_READWRITE	File can be read from or written to.
DDL_READONLY	File can be read from but not written to.
DDL_HIDDEN	File is hidden and does not appear in a directory listing.
DDL_SYSTEM	File is a system file.
DDL_DIRECTORY	The name pointed to by the *lpszFileSpec* parameter specifies a directory.
DDL_ARCHIVE	File has been archived.
DDL_DRIVES	All drives that match the name specified by the *lpszFileSpec* parameter are included. If the **DDL_DRIVES** flag is set, the **DDL_EXCLUSIVE** flag is set automatically. Therefore, to create a directory listing that includes drives and files, the developer must send this message twice: once with the DDL_DRIVES flag set and once with the flags for the rest of the list.
DDL_EXCLUSIVE	Exclusive flag. If the exclusive flag is set, only files of the specified type are listed. Otherwise, files of the specified type are listed in addition to files that do not match the specified type.

lpszFileSpec	Value of *lParam.* Points to the null-terminated string that specifies the filename to add to the list. If the filename contains any wildcards (for example, *.*), all files that match and have the attributes specified by the *uAttrs* parameter will be added to the list.

Returns

The return value is the zero-based index of the last filename added to the list. The return value is CB_ERR if an error occurs. The return value is CB_ERRSPACE if insufficient space is available to store the new strings.

Example

This example adds the names of all available drives to a combo box:

```
DWORD dwIndexLastItem;

dwIndexLastItem = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX, CB_DIR,
    0x4000 | 0x8000, (LPARAM) ((LPSTR) "*"));
```

See Also

DlgDirList, **DlgDirListComboBox**, **CB_ADDSTRING**, **CB_INSERTSTRING**

CB_FINDSTRING (3.0)

```
CB_FINDSTRING
wParam = (WPARAM) indexStart;        /* item before start of search */
lParam = (LPARAM) (LPCSTR) lpszFind; /* address of prefix string    */
```

An application sends a CB_FINDSTRING message to search the list box of a combo box for an item that begins with the characters in a specified string.

Parameter	Description
indexStart	Value of *wParam.* Specifies the zero-based index of the item before the first item to be searched. When the search reaches the bottom of the list box, it continues from the top of the list box back to the item specified by the *indexStart* parameter. If *indexStart* is -1, the entire list box is searched from the beginning.
lpszFind	Value of *lParam.* Points to the null-terminated string that contains the prefix to search for. The search is not case-sensitive, so this string can contain any combination of uppercase and lowercase letters.

Returns

The return value is the zero-based index of the matching item, or it is CB_ERR if the search was unsuccessful.

Comments

If the combo box was created with an owner-drawn style but without the **CBS_HASSTRINGS** style, the action taken by the CB_FINDSTRING message depends on whether the **CBS_SORT** style is used. If the CBS_SORT style is used, **WM_COMPAREITEM** messages are sent to the owner of the combo box to determine which item matches the specified string. Otherwise, CB_FINDSTRING attempts to match the doubleword value against the value of the *lpszFind* parameter.

Example

This example searches for the string "my string" in a combo box and copies it, if found, to the szBuf buffer:

```
char szBuf[20];
DWORD dwIndex;

dwIndex = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_FINDSTRING, 0, (LPARAM) ((LPSTR) "my string"));
if (dwIndex != CB_ERR)
    SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
        CB_GETLBTEXT, (WPARAM) dwIndex, (LPARAM) ((LPSTR) szBuf));
```

See Also

CB_FINDSTRINGEXACT, **CB_SELECTSTRING**, **WM_COMPAREITEM**

CB_FINDSTRINGEXACT (3.1)

```
CB_FINDSTRINGEXACT
wParam = (WPARAM) indexStart;        /* item before start of search */
lParam = (LPARAM) (LPCSTR) lpszFind; /* address of prefix string    */
```

An application sends a CB_FINDSTRINGEXACT message to find the first list box string (in a combo box) that matches the string specified in the *lpszFind* parameter.

Parameter	Description
indexStart	Value of *wParam.* Specifies the zero-based index of the item before the first item to be searched. When the search reaches the bottom of the list box, it continues from the top of the list box back to the item specified by the *indexStart* parameter. If *indexStart* is -1, the entire list box is searched from the beginning.
lpszFind	Value of *lParam.* Points to the null-terminated string to search for. This string can contain a complete filename, including the extension. The search is not case-sensitive, so this string can contain any combination of uppercase and lowercase letters.

Returns

The return value is the zero-based index of the matching item, or it is CB_ERR if the search was unsuccessful.

Comments

If the combo box was created with an owner-drawn style but without the **CBS_HASSTRINGS** style, the action taken by the CB_FINDSTRINGEXACT message depends on whether the **CBS_SORT** style is used. If the CBS_SORT style is used, **WM_COMPAREITEM** messages are sent to the owner of the combo box to determine which item matches the specified string. Otherwise, CB_FINDSTRINGEXACT attempts to match the doubleword value against the value of the *lpszFind* parameter.

Example

This example searches for the string "my string" in a combo box and copies it, if found, to the *szBuf* buffer:

```
char szBuf[20];
DWORD dwIndex;

dwIndex = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_FINDSTRINGEXACT, 0, (LPARAM) ((LPSTR) "my string"));
if (dwIndex != CB_ERR)
    SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
        CB_GETLBTEXT, (WPARAM) dwIndex, (LPARAM) ((LPSTR) szBuf));
```

See Also

CB_FINDSTRING, **CB_SELECTSTRING**, **WM_COMPAREITEM**

CB_GETCOUNT (3.0)

```
CB_GETCOUNT
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends a CB_GETCOUNT message to retrieve the number of items in the list box of a combo box.

Parameters

This message has no parameters.

Returns

The return value is the number of items in the list box.

Comments

The returned count is one greater than the index value of the last item (the index is zero-based).

Example

This example retrieves the number of items in a combo box:

```
WORD cListItems;

cListItems = (WORD) SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_GETCOUNT, 0, 0);
```

CB_GETCURSEL (3.0)

```
CB_GETCURSEL
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends a CB_GETCURSEL message to retrieve the index of the currently selected item, if any, in the list box of a combo box.

Parameters

This message has no parameters.

Returns

The return value is the zero-based index of the currently selected item, or it is CB_ERR if no item is selected.

Example

This example retrieves the index of the currently selected string in the list box of a combo box and then retrieves that string:

```
char szBuf[20];
DWORD dwIndex;

dwIndex = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX, CB_GETCURSEL, 0, 0);
if (dwIndex != CB_ERR)
    SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
        CB_GETLBTEXT, (WPARAM) dwIndex, (LPARAM) ((LPSTR) szBuf));
```

See Also

CB_SELECTSTRING, CB_SETCURSEL

CB_GETDROPPEDCONTROLRECT (3.1)

```
CB_GETDROPPEDCONTROLRECT
wParam = 0;                              /* not used, must be zero    */
lParam = (LPARAM) (RECT FAR*) lprc;      /* address of RECT structure */
```

An application sends a CB_GETDROPPEDCONTROLRECT message to retrieve the screen coordinates of the visible (dropped-down) list box of a combo box.

Parameter	Description
lprc	Value of *lParam.* Points to the **RECT** structure that is to receive the coordinates.

Returns

The return value is always CB_OKAY.

Example

This example retrieves the bounding rectangle of the list box of a combo box:

```
RECT rcl;

SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_GETDROPPEDCONTROLRECT, 0, (DWORD) ((LPRECT) &rcl));
```

CB_GETDROPPEDSTATE (3.1)

```
CB_GETDROPPEDSTATE
wParam = 0;     /* not used, must be zero */
lParam = 0L;    /* not used, must be zero */
```

An application sends a CB_GETDROPPEDSTATE message to determine whether the list box of a combo box is visible (dropped down).

Parameters

This message has no parameters.

Returns

The return value is nonzero if the list box is visible; otherwise, it is zero.

Example

This example determines whether the list box of a combo box is visible:

```
BOOL fDropped;

fDropped = (BOOL) SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_GETDROPPEDSTATE, 0, 0L);
```

See Also

CB_SHOWDROPDOWN

CB_GETEDITSEL (2.x)

```
CB_GETEDITSEL
wParam = 0;     /* not used, must be zero */
lParam = 0L;    /* not used, must be zero */
```

An application sends a CB_GETEDITSEL message to retrieve the starting and ending character positions of the current selection in the edit control of a combo box.

Parameters

This message has no parameters.

Returns

The return value is a doubleword value that contains the starting position in the low-order word and the position of the first nonselected character after the end of the selection in the high-order word.

Example

This example retrieves the selection positions of the edit control of a combo box, and converts them into starting and ending positions:

```
DWORD dwResult;
WORD wStart, wEnd;

dwResult = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
        CB_GETEDITSEL, 0, 0);
wStart = LOWORD(dwResult);
wEnd   = HIWORD(dwResult);
```

See Also

CB_SETEDITSEL

CB_GETEXTENDEDUI (3.1)

```
CB_GETEXTENDEDUI
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends a CB_GETEXTENDEDUI message to determine whether a combo box has the default user interface or the extended user interface.

Parameters

This message has no parameters.

Returns

The return value is nonzero if the combo box has the extended user interface; otherwise, it is zero.

Comments

The extended user interface differs from the default user interface in the following ways:

- Clicking the static control displays the list box (**CBS_DROPDOWNLIST** style only).
- Pressing the DOWN ARROW key displays the list box (F4 is disabled).
- Scrolling in the static control is disabled when the item list is not visible (arrow keys are disabled).

Example

This example determines whether a combo box has the extended user interface:

```
BOOL fExtended;

fExtended = (BOOL) SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_GETEXTENDEDUI, 0, 0L);
```

See Also

CB_SETEXTENDEDUI

CB_GETITEMDATA (3.0)

```
CB_GETITEMDATA
wParam = (WPARAM) index;  /* item index             */
lParam = 0L;              /* not used, must be zero */
```

An application sends a CB_GETITEMDATA message to a combo box to retrieve the application-supplied doubleword value associated with the specified item in the combo box. (This is the value in the *lParam* parameter of a **CB_SETITEMDATA** message.)

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the item.

Returns

The return value is the doubleword value associated with the item, or it is CB_ERR if an error occurs.

See Also

CB_SETITEMDATA

CB_GETITEMHEIGHT (3.1)

```
CB_GETITEMHEIGHT
wParam = (WPARAM) index;  /* item index             */
lParam = 0L;              /* not used, must be zero */
```

An application sends a CB_GETITEMHEIGHT message to retrieve the height of list items in a combo box.

Parameter	Description
index	Value of *wParam.* Specifies the component of the combo box whose height is to be retrieved. If the *index* parameter is -1, the height of the edit-control (or static-text) portion of the combo box is retrieved. If the combo box has the **CBS_OWNERDRAWVARIABLE** style, *index* specifies the zero-based index of the list item whose height is to be retrieved. Otherwise, *index* should be set to zero.

Returns

The return value is the height, in pixels, of the list items in a combo box. The return value is the height of the item specified by the *index* parameter if the combo box has the **CBS_OWNERDRAWVARIABLE** style. The return value is the height of the edit-control (or static-text) portion of the combo box if *index* is -1. The return value is CB_ERR if an error occurred.

Example

This example sends a CB_GETITEMHEIGHT message to retrieve the height of the list items in a combo box:

```
LRESULT lrHeight;

lrHeight = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_GETITEMHEIGHT, 0, 0L);
```

See Also

CB_SETITEMHEIGHT, **WM_MEASUREITEM**

CB_GETLBTEXT (3.0)

```
CB_GETLBTEXT
wParam = (WPARAM) index;                /* item index        */
lParam = (LPARAM) (LPCSTR) lpszBuffer;  /* address of buffer */
```

An application sends a CB_GETLBTEXT message to retrieve a string from the list box of a combo box.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the string to retrieve.
lpszBuffer	Value of *lParam.* Points to the buffer that receives the string. The buffer must have sufficient space for the string and a terminating null character. A **CB_GETLBTEXTLEN** message can be sent before the CB_GETLBTEXT message to retrieve the length, in bytes, of the string.

Returns

The return value is the length of the string, in bytes, excluding the terminating null character. If the *index* parameter does not specify a valid index, the return value is CB_ERR.

Comments

If the combo box was created with an owner-drawn style but without the **CBS_HASSTRINGS** style, the buffer pointed to by the *lpszBuffer* parameter of the message receives the doubleword value associated with the item.

Example

This example retrieves the length of the first item in the list box of a combo box, allocates sufficient memory for the string, and sends a CB_GETLBTEXT message to retrieve the string:

```
DWORD cbItemString;
PSTR psz;

cbItemString = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_GETLBTEXTLEN, 0, 0);
if (cbItemString != CB_ERR) {
    psz = (PSTR) LocalAlloc(LMEM_FIXED, (WORD) cbItemString);
    SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
        CB_GETLBTEXT, 0, (LPARAM) ((LPSTR) psz));
}
```

See Also

CB_GETLBTEXTLEN

CB_GETLBTEXTLEN (3.0)

```
CB_GETLBTEXTLEN
wParam = (WPARAM) index;  /* item index             */
lParam = 0L;              /* not used, must be zero */
```

An application sends a CB_GETLBTEXTLEN message to retrieve the length of a string in the list box of a combo box.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the string.

Returns

The return value is the length of the string, in bytes, excluding the terminating null character. If the *index* parameter does not specify a valid index, the return value is CB_ERR.

Example

This example retrieves the length of the first item in the list box of a combo box:

```
DWORD cbItemString;

cbItemString = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_GETLBTEXTLEN, 0, 0);
```

See Also

CB_GETLBTEXT

CB_INSERTSTRING (3.0)

```
CB_INSERTSTRING
wParam = (WPARAM) index;            /* item index                  */
lParam = (LPARAM) (LPCSTR) lpsz;    /* address of string to insert */
```

An application sends a CB_INSERTSTRING message to insert a string into the list box of a combo box. Unlike the **CB_ADDSTRING** message, the CB_INSERTSTRING message does not cause a list with the **CBS_SORT** style to be sorted.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the position at which to insert the string. If this parameter is -1, the string is added to the end of the list.
lpsz	Value of *lParam.* Points to the null-terminated string that is to be inserted. If the combo box was created with an owner-drawn style but without the **CBS_HASSTRINGS** style, the value of the *lpsz* parameter is stored rather than the string it would otherwise point to.

Returns

The return value is the index of the position at which the string was inserted. The return value is CB_ERR if an error occurs. The return value is CB_ERRSPACE if insufficient space is available to store the new string.

Example

This example inserts the string "my string" into the third position in the list box of a combo box:

```
SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_INSERTSTRING, 2, (LPARAM) ((LPSTR) "my string"));
```

See Also

CB_ADDSTRING, **CB_DIR**

CB_LIMITTEXT (3.0)

```
CB_LIMITTEXT
wParam = (WPARAM) cchLimit;    /* maximum number of characters */
lParam = 0L;                   /* not used, must be zero       */
```

An application sends a CB_LIMITTEXT message to limit the length of the text that the user may type in the edit control of a combo box.

Parameter	Description
cchLimit	Value of *wParam.* Specifies the length, in bytes, of the text the user can enter. If this parameter is zero, the text length is set to 65,535 bytes.

Returns

The return value is 1 if the message is successful. If this message is sent to a combo box with the style **CBS_DROPDOWNLIST**, the return value is CB_ERR.

Comments

If the combo box does not have the style **CBS_AUTOHSCROLL**, setting the text limit to be larger than the size of the edit control has no effect.

The CB_LIMITTEXT message limits only the text the user can enter. It has no effect on any text already in the edit control when the message is sent, nor does it affect the length of the text copied to the edit control when a string in the list box is selected.

Example

This example limits the text of the edit control of a combo box to five characters:

```
SendDlgItemMessage(hdlg, ID_MYCOMBOBOX, CB_LIMITTEXT, 5, 0);
```

CB_RESETCONTENT (3.0)

```
CB_RESETCONTENT
wParam = 0;     /* not used, must be zero */
lParam = 0L;    /* not used, must be zero */
```

An application sends a CB_RESETCONTENT message to remove all items from the list box and edit control of a combo box.

Parameters

This message has no parameters.

Returns

The return value is always CB_OKAY.

Comments

If the combo box was created with an owner-drawn style but without the **CBS_HASSTRINGS** style, the owner of the combo box receives a **WM_DELETEITEM** message for each item in the combo box.

Example

This example removes all items from the list box and edit control of a combo box:

```
SendDlgItemMessage(hdlg, ID_MYCOMBOBOX, CB_RESETCONTENT, 0, 0);
```

See Also

CB_DELETESTRING, **WM_DELETEITEM**

CB_SELECTSTRING (3.0)

```
CB_SELECTSTRING
wParam = (WPARAM) indexStart;          /* item before first selection */
lParam = (LPARAM) (LPCSTR) lpszSelect; /* address of prefix string    */
```

An application sends a CB_SELECTSTRING message to search the list box of a combo box for an item that begins with the characters in a specified string. If a matching item is found, the item is selected and copied to the edit control.

Parameter	Description
indexStart	Value of *wParam.* Specifies the zero-based index of the item before the first item to be searched. When the search reaches the bottom of the list box, it continues from the top of the list box back to the item specified by the *indexStart* parameter. If *indexStart* is -1, the entire list box is searched from the beginning.
lpszSelect	Value of *lParam.* Points to the null-terminated string that contains the prefix to search for. The search is not case-sensitive, so this string can contain any combination of uppercase and lowercase letters.

Returns

The return value is the index of the selected item if the string was found. The return value is CB_ERR and the current selection is not changed if the search was unsuccessful.

Comments

A string is selected only if its initial characters (from the starting point) match the characters in the prefix string.

If the combo box was created with an owner-drawn style but without the **CBS_HASSTRINGS** style, the action taken by the CB_SELECTSTRING message depends on whether the **CBS_SORT** style is used. If the CBS_SORT style is used, **WM_COMPAREITEM** messages are sent to the owner of the combo box to determine which item matches the specified string. Otherwise, CB_SELECTSTRING attempts to match the doubleword value against the value of the *lpszFind* parameter.

Example

This example searches the entire list box of a combo box for the string "my string" and, if the string is found, selects it:

```
DWORD dwIndexFoundString;

dwIndexFoundString = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_SELECTSTRING, -1, (LPARAM) ((LPSTR) "my string"));
```

See Also

CB_FINDSTRING, **CB_FINDSTRINGEXACT**, **CB_SETCURSEL**, **WM_COMPAREITEM**

CB_SETCURSEL (3.0)

```
CB_SETCURSEL
wParam = (WPARAM) index;  /* item index             */
lParam = 0L;              /* not used, must be zero */
```

An application sends a CB_SETCURSEL message to select a string in the list box of a combo box. If necessary, the list box scrolls the string into view (if the list box is visible). The text in the edit control of the combo box is changed to reflect the new selection. Any previous selection in the list box is removed.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the string to select. If the *index* parameter is -1, any current selection in the list box is removed and the edit control is cleared.

Returns

The return value is the index of the item selected if the message is successful. The return value is CB_ERR if the *index* parameter is greater than the number of items in the list or if *index* is set to -1 (which clears the selection).

Example

This example retrieves the number of items in the list box of a combo box and sends a CB_SETCURSEL message to select the last item in the list:

```
WORD cListItems;

cListItems = (WPARAM) SendDlgItemMessage(hdlg,
    ID_MYCOMBOBOX, CB_GETCOUNT, 0, 0);
SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_SETCURSEL,
    cListItems - 1,   /* zero-based index, so subtract one from total */
    0);
```

See Also

CB_GETCURSEL, **CB_SELECTSTRING**

CB_SETEDITSEL (3.0)

```
CB_SETEDITSEL
wParam = 0;                                  /* not used, must be zero  */
lParam = MAKELPARAM((ichStart), (ichEnd);  /* start and end positions */
```

An application sends a CB_SETEDITSEL message to select characters in the edit control of a combo box.

Parameter	Description
ichStart	Value of the low-order word of *lParam.* Specifies the starting position. If this parameter is set to -1, the selection, if any, is removed.
ichEnd	Value of the high-order word of *lParam.* Specifies the ending position. If this parameter is set to -1, all text from the starting position to the last character in the edit control is selected.

Returns

The return value is nonzero if the message is successful. It is CB_ERR if the message is sent to a combo box with the **CBS_DROPDOWNLIST** style.

Comments

The positions are zero-based. To select the first character of the edit control, you specify a starting position of zero. The ending position is for the character just after the last character to select. For example, to select the first four characters of the edit control, you would use a starting position of 0 and an ending position of 4.

Example

This example selects the first four characters of the edit control of a combo box:

```
SendDlgItemMessage(hdlg, ID_MYCOMBOBOX,
    CB_SETEDITSEL, 0, MAKELONG(0, 4));
```

See Also

CB_GETEDITSEL

CB_SETEXTENDEDUI (3.1)

```
CB_SETEXTENDEDUI
wParam = (WPARAM) (BOOL) fExtended;      /* extended UI flag       */
lParam = 0L;                             /* not used, must be zero */
```

An application sends a CB_SETEXTENDEDUI message to select either the default user interface or the extended user interface for a combo box that has the **CBS_DROPDOWN** or **CBS_DROPDOWNLIST** style.

Parameter	Description
fExtended	Value of *wParam.* Specifies whether the combo box should use the extended user interface or the default user interface. A value of TRUE selects the extended user interface; a value of FALSE selects the standard user interface.

Returns

The return value is CB_OKAY if the operation is successful, or it is CB_ERR if an error occurred.

Comments

The extended user interface differs from the default user interface in the following ways:

- Clicking the static control displays the list box (**CBS_DROPDOWNLIST** style only).
- Pressing the DOWN ARROW key displays the list box (F4 is disabled).
- Scrolling in the static control is disabled when the item list is not visible (the arrow keys are disabled).

Example

This example selects the extended user interface for a combo box:

```
SendDlgItemMessage(hdlg, ID_MYCOMBOBOX, CB_SETEXTENDEDUI,
    TRUE, 0L);
```

See Also

CB_GETEXTENDEDUI

CB_SETITEMDATA (3.0)

```
CB_SETITEMDATA
wParam = (WPARAM) index;            /* item index */
lParam = (LPARAM) (DWORD) dwData;   /* item data  */
```

An application sends a CB_SETITEMDATA message to set the doubleword value associated with the specified item in a combo box.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index to the item.
dwData	Value of *lParam.* Specifies the new value to be associated with the item.

Returns

The return value is CB_ERR if an error occurs.

See Also

CB_GETITEMDATA

CB_SETITEMHEIGHT (3.1)

```
CB_SETITEMHEIGHT
wParam = (WPARAM) index;        /* item index  */
lParam = (LPARAM) (int) height; /* item height */
```

An application sends a CB_SETITEMHEIGHT message to set the height of list items in a combo box or the height of the edit-control (or static-text) portion of a combo box.

Parameter	Description
index	Value of *wParam.* Specifies whether the height of list items or the height of the edit-control (or static-text) portion of the combo box is set. If the combo box has the **CBS_OWNERDRAWVARIABLE** style, the *index* parameter specifies the zero-based index of the list item whose height is to be set; otherwise, *index* must be zero and the height of all list items will be set. If *index* is -1, the height of the edit-control or static-text portion of the combo box is to be set.
height	Value of the low-order word of *lParam.* Specifies the height, in pixels, of the combo box component identified by *index.*

Returns

The return value is CB_ERR if the index or height is invalid.

Comments

The height of the edit-control (or static-text) portion of the combo box is set independently of the height of the list items. An application must ensure that the height of the edit-control (or static-text) portion isn't smaller than the height of a particular list box item.

Example

This example sends a CB_SETITEMHEIGHT message to set the height of list items in a combo box:

```
LPARAM lrHeight;

SendDlgItemMessage(hdlg, ID_MYCOMBOBOX, CB_SETITEMHEIGHT,
    0, lrHeight);
```

See Also

CB_GETITEMHEIGHT, **WM_MEASUREITEM**

CB_SHOWDROPDOWN (3.0)

```
CB_SHOWDROPDOWN
wParam = (WPARAM) (BOOL) fShow;      /* the show/hide flag     */
lParam = 0L;                         /* not used, must be zero */
```

An application sends a CB_SHOWDROPDOWN message to show or hide the list box of a combo box that has the **CBS_DROPDOWN** or **CBS_DROPDOWNLIST** style.

Parameter	Description
fShow	Value of *wParam.* Specifies whether the drop-down list box is to be shown or hidden. A value of TRUE shows the list box. A value of FALSE hides the list box.

Returns
The return value is always nonzero.

Comments
This message has no effect on a combo box created with the **CBS_SIMPLE** style.

Example
This example shows the list box of a combo box:

```
SendDlgItemMessage(hdlg, ID_MYCOMBOBOX, CB_SHOWDROPDOWN, TRUE, 0);
```

See Also
CB_GETDROPPEDSTATE

DM_GETDEFID

```
DM_GETDEFID
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends a DM_GETDEFID message to get the identifier of the default push button for a dialog box.

Parameters

This message has no parameters.

Returns

The return value is a doubleword value. If the default push button has an identifier value, the high-order word contains DC_HASDEFID and the low-order word contains the identifier value. The return value is zero if the default push button does not have an identifier value.

Example

This example gets the identifier of the default push button of a dialog box:

```
DWORD dwResult;
WORD idDefPushButton;

dwResult = SendMessage(hdlg, DM_GETDEFID, 0, 0);
if (HIWORD(dwResult) == DC_HASDEFID)
    idDefPushButton = LOWORD(dwResult);
```

See Also

DM_SETDEFID

DM_SETDEFID (2.x)

```
DM_SETDEFID
wIDPushBtn = wParam; /* identifier of new default push button */
```

An application sends a DM_SETDEFID message to change the identifier of the default push button for a dialog box.

Parameter	Description
wIDPushBtn	Value of *wParam.* Specifies the identifier of the push button that will become the default.

Returns

The return value is always nonzero.

See Also

DM_GETDEFID

EM_CANUNDO (2.x)

```
EM_CANUNDO
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an EM_CANUNDO message to determine whether an edit-control operation can be undone.

Parameters

This message has no parameters.

Returns

The return value is nonzero if the last edit operation can be undone, or it is zero if the last edit operation cannot be undone.

Example

This example sends an EM_CANUNDO message to determine whether the last edit-control operation can be undone and, if so, sends an **EM_UNDO** message to undo the last operation:

```
if (SendDlgItemMessage(hdlg, ID_MYEDITCONTROL, EM_CANUNDO, 0, 0))
    SendDlgItemMessage(hdlg, ID_MYEDITCONTROL, EM_UNDO, 0, 0);
```

See Also

EM_EMPTYUNDOBUFFER, **EM_UNDO**

EM_EMPTYUNDOBUFFER (3.0)

```
EM_EMPTYUNDOBUFFER
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an EM_EMPTYUNDOBUFFER message to reset (clear) the undo flag of an edit control. The undo flag is set whenever an operation within the edit control can be undone.

Parameters

This message has no parameters.

Returns
This message does not return a value.

Comments
The undo flag is automatically cleared whenever the edit control receives a **WM_SETTEXT** or **EM_SETHANDLE** message.

Example
This example resets the undo flag of an edit control:

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL, EM_EMPTYUNDOBUFFER, 0, 0);
```

See Also
EM_CANUNDO, **EM_UNDO**

EM_FMTLINES (2.x)

```
EM_FMTLINES
wParam = (WPARAM) (BOOL) fAddEOL;   /* line break flag        */
lParam = 0L;                        /* not used, must be zero */
```

An application sends an EM_FMTLINES message to set the inclusion of soft line break characters on or off within a multiline edit control. A soft line break consists of two carriage returns and a linefeed inserted at the end of a line that is broken because of wordwrapping.

This message is processed only by multiline edit controls.

Parameter	Description
fAddEOL	Value of *wParam.* Specifies whether soft line break characters are to be inserted. A value of TRUE inserts the characters; a value of FALSE removes them.

Returns

The return value is identical to the *fAddEOL* parameter.

Comments

This message affects only the buffer returned by the **EM_GETHANDLE** message and the text returned by the **WM_GETTEXT** message. It has no effect on the display of the text within the edit control.

A line that ends with a hard line break is not affected by the EM_FMTLINES message. A hard line break consists of one carriage return and a linefeed.

Example

This example sends an EM_FMTLINES message to turn off soft line breaks, then allocates a buffer for the text, and then retrieves the text by sending a **WM_GETTEXT** message:

```
WPARAM cbText;
HGLOBAL hmem;
LPSTR lpstr;

SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_FMTLINES, FALSE, 0);

cbText = (WPARAM) SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    WM_GETTEXTLENGTH, 0, 0);
cbText++;       /* make room for the terminating null character */
hmem = (HGLOBAL) GlobalAlloc(GMEM_MOVEABLE, (DWORD) cbText);
lpstr = GlobalLock(hmem);
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    WM_GETTEXT, cbText, (LPARAM) lpstr);
```

See Also

EM_GETWORDBREAKPROC, **EM_SETWORDBREAKPROC**

EM_GETFIRSTVISIBLELINE (3.1)

```
EM_GETFIRSTVISIBLELINE
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an EM_GETFIRSTVISIBLELINE message to determine the topmost visible line in an edit control.

Parameters

This message has no parameters.

Returns

The return value is the zero-based index of the topmost visible line. For single-line edit controls, the return value is zero.

Example

This example gets the index of the topmost visible line in an edit control:

```
int FirstVis;

FirstVis = (int) SendDlgItemMessage(hdlg, IDD_EDIT,
    EM_GETFIRSTVISIBLELINE, 0, 0L);
```

EM_GETHANDLE (2.x)

```
EM_GETHANDLE
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an EM_GETHANDLE message to retrieve a handle to the memory currently allocated for a multiline edit control. The handle is a local memory handle and can be used by any of the functions that take a local memory handle as a parameter.

This message is processed only by multiline edit controls.

Parameters

This message has no parameters.

Returns

The return value is a local memory handle identifying the buffer that holds the contents of the edit control. If an error occurs, such as sending the message to a single-line edit control, the return value is zero.

Comments

An application can send this message to a multiline edit control in a dialog box only if it created the dialog box with the **DS_LOCALEDIT** style flag set. If the DS_LOCALEDIT style is not set, the return value is still nonzero, but the return value will not be meaningful.

Example

This example sends an EM_GETHANDLE message to a multiline edit control and calls the **LocalSize** function to determine the current size of the edit control using the handle returned by the EM_GETHANDLE message:

```
HANDLE hmemMle;
WORD cbMle;

hmemMle = (HLOCAL) SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_GETHANDLE, 0, 0);
cbMle = LocalSize(hmemMle);
```

See Also

EM_SETHANDLE

EM_GETLINE (2.x)

```
EM_GETLINE
wParam = (WPARAM) line;          /* line number to retrieve    */
lParam = (LPARAM) (LPSTR) lpch; /* address of buffer for line */
```

An application sends an EM_GETLINE message to retrieve a line of text from an edit control.

Parameter	Description
line	Value of *wParam.* Specifies the line number of the line to retrieve from a multiline edit control. Line numbers are zero-based; a value of zero specifies the first line. This parameter is ignored by a single-line edit control.
lpch	Value of *lParam.* Points to the buffer that receives a copy of the line. The first word of the buffer specifies the maximum number of bytes that can be copied to the buffer.

Returns

The return value is the number of bytes actually copied. The return value is zero if the line number specified by the *line* parameter is greater than the number of lines in the edit control.

Comments

The copied line does not contain a terminating null character.

Example

This example sets the maximum size of the buffer, sends an EM_GETLINE message to get the first line of the multiline edit control, and adds a terminating null character to the end of the retrieved line:

```
unsigned char szBuf[128];
WORD cbText;

*(WORD *) szBuf = sizeof(szBuf) - 1; /* sets the buffer size   */
cbText = (WORD) SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_GETLINE,
    0,                           /* line number               */
    (DWORD) (LPSTR) szBuf);      /* buffer address            */
szBuf[cbText] = '\0';            /* terminating null character */
```

See Also

EM_LINELENGTH, **WM_GETTEXT**

EM_GETLINECOUNT (2.x)

```
EM_GETLINECOUNT
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an EM_GETLINECOUNT message to retrieve the number of lines in a multiline edit control.

This message is processed only by multiline edit controls.

Parameters

This message has no parameters.

Returns

The return value is an integer containing the number of lines in the multiline edit control. If no text is in the edit control, the return value is 1.

Example

This example sends an EM_GETLINECOUNT message to retrieve the number of lines in a multiline edit control and then sends an **EM_LINESCROLL** message to scroll the edit control so that the last line is displayed at the top of the edit control.

```
int cLines;

cLines = (int) SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_GETLINECOUNT, 0, 0);
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_LINESCROLL, 0, MAKELONG(cLines - 1, 0));
```

EM_GETMODIFY (2.x)

```
EM_GETMODIFY
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an EM_GETMODIFY message to determine whether the contents of an edit control have been modified.

Parameters

This message has no parameters.

Returns

The return value is nonzero if the edit-control contents have been modified, or it is zero if the contents have remained unchanged.

Comments

Windows maintains an internal flag indicating whether the contents of the edit control have been changed. This flag is cleared when the edit control is first created; or an **EM_SETMODIFY** message can be sent to clear the flag.

Example

This example sends an EM_GETMODIFY message to determine whether the edit control has been modified and, if it has, retrieves the current contents of the edit control and clears the modification flag by sending an **EM_SETMODIFY** message:

```
char szBuf[128];

if (SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
        EM_GETMODIFY, 0, 0)) {
    SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
        WM_GETTEXT, sizeof(szBuf), (LPARAM) ((LPSTR) szBuf));
    SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
        EM_SETMODIFY, FALSE, 0);
}
```

See Also

EM_SETMODIFY

EM_GETPASSWORDCHAR (3.1)

```
EM_GETPASSWORDCHAR
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an EM_GETPASSWORDCHAR message to retrieve the password character displayed in an edit control when the user enters text.

Parameters

This message has no parameters.

Returns

The return value specifies the character to be displayed in place of the character typed by the user. The return value is NULL if no password character exists.

Comments

If the edit control is created with the **ES_PASSWORD** style, the default password character is set to an asterisk (*).

See Also

EM_SETPASSWORDCHAR

EM_GETRECT (2.x)

```
EM_GETRECT
wParam = 0;                          /* not used, must be zero    */
lParam = (LPARAM) (RECT FAR*) lprc; /* address of RECT structure */
```

An application sends an EM_GETRECT message to retrieve the formatting rectangle of an edit control. The formatting rectangle is the limiting rectangle of the text. The limiting rectangle is independent of the size of the edit-control window.

Parameter	Description
lprc	Value of *lParam.* Points to the **RECT** structure that receives the formatting rectangle.

Returns
The return value is not a meaningful value.

Comments
The formatting rectangle of a multiline edit control can be modified by the **EM_SETRECT** and **EM_SETRECTNP** messages.

Example
This example sends an EM_GETRECT message to retrieve the formatting rectangle of an edit control:

```
RECT rcl;

SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_GETRECT, 0, (DWORD) ((LPRECT) &rcl));
```

See Also
EM_SETRECT, **EM_SETRECTNP**, **RECT**

EM_GETSEL (2.x)

```
EM_GETSEL
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an EM_GETSEL message to get the starting and ending character positions of the current selection in an edit control.

Parameters

This message has no parameters.

Returns

The return value is a doubleword value that contains the starting position in the low-order word and the position of the first nonselected character after the end of the selection in the high-order word.

Example

This example gets the selection positions of an edit control and converts them into starting and ending positions:

```
DWORD dwResult;
WORD wStart, wEnd;

dwResult = SendDlgItemMessage(hdlg, ID_MYCOMBOBOX, EM_GETSEL, 0, 0);
wStart = LOWORD(dwResult);
wEnd   = HIWORD(dwResult);
```

See Also

EM_REPLACESEL, **EM_SETSEL**

EM_GETWORDBREAKPROC (3.1)

```
EM_GETWORDBREAKPROC
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends the EM_GETWORDBREAKPROC message to an edit control to retrieve the current wordwrap function.

Parameters

This message has no parameters.

Returns

The return value specifies the procedure-instance address of the application-defined wordwrap function. The return value is NULL if no wordwrap function exists.

Comments

A wordwrap function scans a text buffer (which contains text to be sent to the display), looking for the first word that does not fit on the current display line. The wordwrap function places this word at the beginning of the next line on the display. A wordwrap function defines at what point Windows should break a line of text for multiline edit controls, usually at a space character that separates two words.

See Also

EM_FMTLINES, **EM_SETWORDBREAKPROC**, **MakeProcInstance**, **WordBreakProc**

EM_LIMITTEXT (2.x)

```
EM_LIMITTEXT
wParam = (WPARAM) cchMax;    /* text length            */
lParam = 0L;                 /* not used, must be zero */
```

An application sends an EM_LIMITTEXT message to limit the length of the text the user can enter into an edit control.

Parameter	Description
cchMax	Value of *wParam.* Specifies the length, in bytes, of the text the user can enter. If this parameter is zero, the text length is set to 65,535 bytes.

Returns

This message does not return a value.

Comments

The EM_LIMITTEXT message limits only the text the user can enter. It has no effect on any text already in the edit control when the message is sent, nor does it affect the length of text copied to the edit control by the **WM_SETTEXT** message.

If an application uses the **WM_SETTEXT** message to place more text into an edit control than is specified in the EM_LIMITTEXT message, the user can edit the entire contents of the edit control.

EM_LINEFROMCHAR (2.x)

```
EM_LINEFROMCHAR
wParam = (WPARAM) ich;     /* character index        */
lParam = 0L;               /* not used, must be zero */
```

An application sends an EM_LINEFROMCHAR message to retrieve the line number of the line that contains the specified character index. A character index is the number of characters from the beginning of the edit control.

This message is processed only by multiline edit controls.

Parameter	Description
ich	Value of *wParam.* Specifies the character index of the character contained in the line whose number is to be retrieved. If the *ich* parameter is -1, either the line number of the current line (the line containing the caret) is retrieved or, if there is a selection, the line number of the line containing the beginning of the selection is retrieved.

Returns

The return value is the zero-based line number of the line containing the character index specified by *ich.*

Example

This example sends an EM_LINEFROMCHAR message to retrieve the line number of the current line in a multiline edit control:

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_LINEFROMCHAR, -1, 0);
```

See Also

EM_LINEINDEX

EM_LINEINDEX (2.x)

```
EM_LINEINDEX
wParam = (WPARAM) line;    /* line number            */
lParam = 0L;               /* not used, must be zero */
```

An application sends an EM_LINEINDEX message to retrieve the character index of a line within a multiline edit control. The character index is the number of characters from the beginning of the edit control to the specified line.

This message is processed only by multiline edit controls.

Parameter	Description
line	Value of *wParam.* Specifies the zero-based line number. A value of -1 specifies the current line number (the line that contains the caret).

Returns

The return value is the character index of the line specified in the *line* parameter, or it is -1 if the specified line number is greater than the number of lines in the edit control.

Example

This example uses the **EM_GETLINECOUNT** message to retrieve the number of lines in an edit control and then uses EM_LINEINDEX to retrieve the character index for the last line in the edit control:

```
WPARAM cLines, index;

cLines = (WPARAM) SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_GETLINECOUNT, 0, 0);
index = (WPARAM) SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_LINEINDEX, cLines - 1, 0);
```

See Also

EM_LINEFROMCHAR

EM_LINELENGTH (2.x)

```
EM_LINELENGTH
wParam = (WPARAM) ich;     /* character index        */
lParam = 0L;               /* not used, must be zero */
```

An application sends an EM_LINELENGTH message to retrieve the length of a line in an edit control.

Parameter	Description
ich	Value of *wParam.* Specifies the character index of a character in the line whose length is to be retrieved when EM_LINELENGTH is sent to a multiline edit control. If this parameter is -1, the message returns the number of unselected characters on lines containing selected characters. For example, if the selection extended from the fourth character of one line through the eighth character from the end of the next line, the return value would be 10 (three characters on the first line and seven on the next). When EM_LINELENGTH is sent to a single-line edit control, this parameter is ignored.

Returns

The return value is the length, in bytes, of the line specified by the *ich* parameter when an EM_LINELENGTH message is sent to a multiline edit control. The return value is the length, in bytes, of the text in the edit control when an EM_LINELENGTH message is sent to a single-line edit control.

Comments

Use the **EM_LINEINDEX** message to retrieve a character index for a given line number within a multiline edit control.

Example

This example sends an **EM_LINEINDEX** message to retrieve the length of the first line in a multiline edit control (or the entire text of a single-line edit control):

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_LINELENGTH, 0, 0);
```

See Also

EM_GETLINE

EM_LINESCROLL (2.x)

```
EM_LINESCROLL
wParam = 0;                      /* not used, must be zero         */
lParam = MAKELPARAM(dv, dh);     /* lines and characters to scroll */
```

An application sends an EM_LINESCROLL message to scroll the text of a multiline edit control.

This message is processed only by multiline edit controls.

Parameter	Description
dv	Value of the low-order word of *lParam.* Specifies the number of lines to scroll vertically.
dh	Value of the high-order word of *lParam.* Specifies the number of character positions to scroll horizontally. This value is ignored if the edit control has either the **ES_RIGHT** or **ES_CENTER** style.

Returns

The return value is nonzero if the message is sent to a multiline edit control, or it is zero if the message is sent to a single-line edit control.

Comments

The edit control does not scroll vertically past the last line of text in the edit control. If the current line plus the number of lines specified by the *dv* parameter exceeds the total number of lines in the edit control, the value is adjusted so that the last line of the edit control is scrolled to the top of the edit-control window.

The EM_LINESCROLL message can be used to scroll horizontally past the last character of any line.

Example

This example sends an EM_LINESCROLL message to scroll the text in a multiline edit control vertically by five lines:

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_LINESCROLL, 0, MAKELONG(5, 0));
```

EM_REPLACESEL (2.x)

```
EM_REPLACESEL
wParam = 0;                                  /* not used, must be zero */
lParam = (LPARAM) (LPCSTR) lpszReplace;      /* address of new string  */
```

An application sends an EM_REPLACESEL message to replace the current selection in an edit control with the text specified by the *lpszReplace* parameter.

Parameter	Description
lpszReplace	Value of *lParam.* Points to a null-terminated string containing the replacement text.

Returns
This message does not return a value.

Comments
Use the EM_REPLACESEL message when you want to replace only a portion of the text in an edit control. If you want to replace all of the text, use the **WM_SETTEXT** message.

If there is no current selection, the replacement text is inserted at the current cursor location.

Example
This example sets the selection to the beginning of the edit control and inserts the string "C:\":

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_SETSEL, 0, MAKELONG(0, 0));
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_REPLACESEL, 0, (LPARAM) ((LPSTR) "C:\\"));
```

See Also
EM_GETSEL, **EM_SETSEL**

EM_SETHANDLE (2.x)

```
EM_SETHANDLE
wParam = (WPARAM) (HLOCAL) hloc; /* handle of local memory object */
lParam = 0L;                     /* not used, must be zero        */
```

An application sends an EM_SETHANDLE message to set the handle to the local memory that will be used by a multiline edit control.

This message is processed only by multiline edit controls.

Parameter	Description
hloc	Value of *wParam.* Identifies the local memory. This handle must have been created by a previous call to the **LocalAlloc** function using the **LMEM_MOVEABLE** flag. The memory should contain a null-terminated string, or the first byte of the allocated memory should be set to zero.

Returns

This message does not return a value.

Comments

Before an application sets a new memory handle, it should send an **EM_GETHANDLE** message to retrieve the handle to the current memory buffer and should free that memory by using the **LocalFree** function.

Sending an EM_SETHANDLE message clears the undo buffer (**EM_CANUNDO** returns zero) and the internal modification flag (**EM_GETMODIFY** returns zero). The edit-control window is redrawn.

An application can send this message to a multiline edit control in a dialog box only if it has created the dialog box with the **DS_LOCALEDIT** style flag set.

Example

This example frees the current memory for the edit control, allocates new memory, and reads up to BUF_SIZE bytes of a file into the allocated memory. It then sends an EM_SETHANDLE message to set the handle of the edit control to the new memory, effectively placing up to BUF_SIZE bytes of the file into the edit control.

```
#define BUF_SIZE 4 * 1024

HFILE hf;
OFSTRUCT of;
HLOCAL hlocOldMem, hlocNewMem;
PSTR pBuf;
int cbRead;

/* Get the handle to the old memory and free it. */

hlocOldMem = (HLOCAL) SendDlgItemMessage(hdlg,
    ID_MYEDITCONTROL, EM_GETHANDLE, 0, 0);
LocalFree(hlocOldMem);

/* Allocate new memory and read the file into it. */

hlocNewMem = LocalAlloc(LMEM_MOVEABLE, BUF_SIZE);
pBuf = LocalLock(hlocNewMem);
of.cBytes = sizeof(OFSTRUCT);
hf = OpenFile("test.txt", &of, OF_READ);
cbRead = _lread(hf, pBuf, BUF_SIZE);
pBuf[cbRead] = '\0';    /* add terminating null character */
```

```
_lclose(hf);

/* Adjust the buffer for the amount actually read in. */

LocalReAlloc(hlocNewMem, cbRead, 0);

/* Set the handle to the new buffer. */

LocalUnlock(hlocNewMem);
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_SETHANDLE, (WPARAM) hlocNewMem, 0);
```

See Also

EM_GETHANDLE, LocalAlloc, LocalFree

EM_SETMODIFY (2.x)

```
EM_SETMODIFY
wParam = (WPARAM) (UINT) fModified;     /* modification flag      */
lParam = 0L;                            /* not used, must be zero */
```

An application sends an EM_SETMODIFY message to set or clear the modification flag for an edit control. The modification flag indicates whether the text within the edit control has been modified. It is automatically set whenever the user changes the text. An **EM_GETMODIFY** message can be sent to retrieve the value of the modification flag.

Parameter	Description
fModified	Value of *wParam.* Specifies the new value for the modification flag. A value of TRUE indicates the text has been modified, and a value of FALSE indicates it has not been modified.

Returns

This message does not return a value.

Example

This example sends an EM_SETMODIFY message to clear the modification flag:

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL, EM_SETMODIFY, FALSE, 0);
```

See Also

EM_GETMODIFY

EM_SETPASSWORDCHAR (3.0)

```
EM_SETPASSWORDCHAR
wParam = (WPARAM) (UINT) ch;     /* character to display   */
lParam = 0L;                     /* not used, must be zero */
```

An application sends an EM_SETPASSWORDCHAR message to set or remove a password character displayed in an edit control when the user types text. When a password character is set, that character is displayed for each character the user types.

This message has no effect on a multiline edit control.

Parameter	Description
ch	Value of *wParam.* Specifies the character to be displayed in place of the character typed by the user. If the *ch* parameter is zero, the actual characters typed by the user are displayed.

Returns

The return value is nonzero if the message is sent to an edit control.

Comments

When the EM_SETPASSWORDCHAR message is received by an edit control, the edit control redraws all visible characters by using the character specified by the *ch* parameter.

If the edit control is created with the **ES_PASSWORD** style, the default password character is set to an asterisk (*). This style is removed if an EM_SETPASSWORDCHAR message is sent with the *wParam* parameter set to zero.

Example

This example sends an EM_SETPASSWORDCHAR message to set the password character of an edit control to a question mark:

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_SETPASSWORDCHAR, (WORD) '?', 0);
```

See Also

EM_GETPASSWORDCHAR

EM_SETREADONLY (3.1)

```
EM_SETREADONLY
wParam = (WPARAM) (BOOL) fReadOnly;      /* read-only flag          */
lParam = 0L;                             /* not used, must be zero */
```

An application sends an EM_SETREADONLY message to set the read-only state of an edit control.

Parameter	Description
fReadOnly	Value of *wParam.* Specifies whether to set or remove the read-only state of the edit control. A value of TRUE sets the state to read-only; a value of FALSE sets the state to read/write.

Returns

The return value is nonzero if the operation is successful, or it is zero if an error occurs.

Comments

When the state of an edit control is set to read-only, the user cannot change the text within the edit control.

EM_SETREADONLY does not have a corresponding message to retrieve the current style. Calling the **GetWindowLong** function with the **GWL_STYLE** offset retrieves the full control style.

Example

This example sets the state of an edit control to read-only:

```
SendDlgItemMessage(hdlg, IDD_EDIT, EM_SETREADONLY,
    TRUE, 0L);
```

See Also

GetWindowLong

EM_SETRECT (2.x)

```
EM_SETRECT
wParam = 0;                              /* not used, must be zero */
lParam = (LPARAM) (const RECT FAR*) lprc; /* address of RECT    */
```

An application sends an EM_SETRECT message to set the formatting rectangle of a multiline edit control. The formatting rectangle is the limiting rectangle of the text. The limiting rectangle is independent of the size of the edit-control window. When the edit control is first created, the formatting rectangle is the same as the client area of the edit-control window. By using the EM_SETRECT message, an application can make the formatting rectangle larger or smaller than the edit-control window.

This message is processed only by multiline edit controls.

Parameter	Description
lprc	Value of *lParam.* Points to a **RECT** structure that specifies the new dimensions of the rectangle.

Returns

This message does not return a value.

Comments

The EM_SETRECT message causes the text of the edit control to be redrawn. To change the size of the formatting rectangle without redrawing the text, use the **EM_SETRECTNP** message.

If the edit control does not have a horizontal scroll bar, and the formatting rectangle is set to be larger than the edit-control window, lines of text exceeding the width of the edit-control window (but smaller than the width of the formatting rectangle) are clipped instead of wrapped.

If the edit control contains a border, the formatting rectangle is reduced by the size of the border. If you are adjusting the rectangle returned by an **EM_GETRECT** message, you must remove the size of the border before using the rectangle with the EM_SETRECT message.

Example

This example retrieves the current formatting rectangle for a multiline edit control, removes the border width dimensions, and sets the right border to 32767 so that all text sent to the edit control is clipped rather than wrapped if it exceeds the width of the edit-control window. The example then sends an EM_SETRECT message to set the new formatting rectangle.

```
RECT rect;

SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_GETRECT, 0, (LPARAM) (RECT FAR*) &rect);
rect.left = 0;             /* remove border width  */
rect.right = 32767;        /* clip all lines       */
rect.bottom += rect.top;   /* remove border height */
rect.top = 0;              /* remove border height */
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_SETRECT, 0, (LPARAM) (RECT FAR*) &rect);
```

See Also

EM_GETRECT, **EM_SETRECTNP**, **RECT**

EM_SETRECTNP (2.x)

```
EM_SETRECTNP
wParam = 0;                          /* not used, must be zero    */
lParam = (LPARAM) (const RECT FAR*) lprc; /* address of RECT      */
```

An application sends an EM_SETRECTNP message to set the formatting rectangle of a multiline edit control. The formatting rectangle is the limiting rectangle of the text. The limiting rectangle is independent of the size of the edit-control window. When the edit control is first created, the formatting rectangle is the same as the client area of the edit-control window. By using the EM_SETRECTNP message, an application can make the formatting rectangle larger or smaller than the edit-control window.

The EM_SETRECTNP message is identical to the **EM_SETRECT** message, except that the edit-control window is not redrawn.

This message is processed only by multiline edit controls.

Parameter	Description
lprc	Value of *lParam.* Points to a **RECT** structure that specifies the new dimensions of the rectangle.

Returns

This message does not return a value.

See Also

EM_GETRECT, **EM_SETRECT**, **RECT**

EM_SETSEL (2.x)

```
EM_SETSEL
wParam = (WPARAM) (UINT) fScroll;          /* flag for caret scrolling */
lParam = MAKELPARAM(ichStart, ichEnd);     /* start and end positions  */
```

An application sends an EM_SETSEL message to select a range of characters in an edit control.

Parameter	Description
fScroll	Value of *wParam.* When this parameter is zero, the caret is scrolled into view. When this parameter is one, the caret is not scrolled into view.
ichStart	Value of the low-order word of *lParam.* Specifies the starting position.
ichEnd	Value of the high-order word of *lParam.* Specifies the ending position.

Returns

The return value is nonzero if the message is sent to an edit control.

Comments

If the *ichStart* parameter is 0 and the *ichEnd* parameter is -1, all the text in the edit control is selected. If *ichStart* is -1, any current selection is removed. The caret is placed at the end of the selection indicated by the greater of the two values *ichEnd* and *ichStart.*

Example

This example sends an EM_SETSEL message to select the entire contents of an edit control. It then sends a **WM_CUT** message to copy the contents of the edit control to the clipboard and then to delete the contents of the edit control.

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_SETSEL, 0, MAKELONG(0, -1));
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    WM_CUT, 0, 0);
```

See Also

EM_GETSEL, **EM_REPLACESEL**

Windows 3.1 changes

The meaning of the *wParam* parameter has changed. The *wParam* parameter specifies whether or not to scroll the caret.

EM_SETTABSTOPS (3.0)

```
EM_SETTABSTOPS
wParam = (WPARAM) cTabs;                        /* number of tab stops */
lParam = (LPARAM) (const int FAR*) lpTabs;      /* tab-stop array      */
```

An application sends an EM_SETTABSTOPS message to set the tab stops in a multiline edit control (MLE). When text is copied to an MLE, any tab character in the text causes space to be generated up to the next tab stop.

This message is processed only by MLEs.

Parameter	Description
cTabs	Value of *wParam.* Specifies the number of tab stops contained in the *lpTabs* parameter. If this parameter is 0, the *lpTabs* parameter is ignored and default tab stops are set at every 32 dialog box units. If this parameter is 1, tab stops are set at every *n* dialog box units, where *n* is the distance pointed to by the *lpTabs* parameter. If the *cTabs* parameter is greater than 1, *lpTabs* points to an array of tab stops.
lpTabs	Low and high-order words of *lParam.* Points to an array of unsigned integers specifying the tab stops, in dialog box units. If the *cTabs* parameter is 1, *lpTabs* points to an unsigned integer containing the distance between all tab stops, in dialog units.

Returns

The return value is nonzero if the tabs were set; otherwise, the return value is zero.

Comments

The EM_SETTABSTOPS message does not automatically redraw the edit-control window. If the application is changing the tab stops for text already in the edit control, it should call the **InvalidateRect** function to redraw the edit-control window.

Example

This example sends an EM_SETTABSTOPS message to set tab stops at every 64 dialog box units. It then calls **InvalidateRect** to redraw the edit-control window.

```
WORD wTabSpacing = 64;

SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_SETTABSTOPS, 1, (LPARAM) (int far*) &wTabSpacing);
InvalidateRect(GetDlgItem(hdlg, ID_MYEDITCONTROL),
    NULL, TRUE);
```

See Also

GetDialogBaseUnits

EM_SETWORDBREAKPROC (3.1)

```
EM_SETWORDBREAKPROC
wParam = 0;                                  /* not used, must be zero */
lParam = (LPARAM) (EDITWORDBREAKPROC) ewbprc; /* address of function */
```

An application sends the EM_SETWORDBREAKPROC message to an edit control to replace the default wordwrap function with an application-defined wordwrap function.

Parameter	Description
ewbprc	Value of *lParam.* Specifies the procedure-instance address of the application-defined wordwrap function. The **MakeProcInstance** function must be used to create the address. For more information, see the description of the **WordBreakProc** callback function.

Returns

This message does not return a value.

Comments

A wordwrap function scans a text buffer (which contains text to be sent to the display), looking for the first word that does not fit on the current display line. The wordwrap function places this word at the beginning of the next line on the display.

A wordwrap function defines the point at which Windows should break a line of text for multiline edit controls, usually at a space character that separates two words. Either a multiline or a single-line edit control might call this function when the user presses arrow keys in combination with the CTRL key to move the cursor to the next word or previous word. The default wordwrap function breaks a line of text at a space character. The application-defined function may define wordwrap to occur at a hyphen or a character other than the space character.

See Also

EM_FMTLINES, **EM_GETWORDBREAKPROC**, **MakeProcInstance**, **WordBreakProc**

EM_UNDO (2.x)

```
EM_UNDO
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an EM_UNDO message to undo the last edit-control operation.

Parameters

This message has no parameters.

Returns

The return value is always nonzero for a single-line edit control. For a multiline edit control, the return value is nonzero if the undo operation is successful or zero if the undo operation fails.

Comments

An undo operation can also be undone. For example, you can restore deleted text with the first EM_UNDO message and remove the text again with a second EM_UNDO message as long as there is no intervening edit-control operation.

Example

This example undoes the last edit-control operation:

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL, EM_UNDO, 0, 0);
```

See Also

EM_CANUNDO, **EM_EMPTYUNDOBUFFER**, **WM_UNDO**

LB_ADDSTRING (2.x)

```
LB_ADDSTRING
wParam = 0;                        /* not used, must be zero   */
lParam = (LPARAM) (LPCSTR) lpsz; /* address of string to add */
```

An application sends an LB_ADDSTRING message to add a string to a list box. If the list box does not have the **CBS_SORT** style, the string is added to the end of the list. Otherwise, the string is inserted into the list and the list is sorted.

Parameter	Description
lpsz	Value of *lParam.* Points to the null-terminated string that is to be added. If the list box was created with an owner-drawn style but without the **LBS_HASSTRINGS** style, the value of the *lpsz* parameter is stored rather than the string it would otherwise point to.

Returns

The return value is the zero-based index to the string in the list box. The return value is LB_ERR if an error occurs; the return value is LB_ERRSPACE if insufficient space is available to store the new string.

Comments

If an owner-drawn list box was created with the **LBS_SORT** style but not the **LBS_HASSTRINGS** style, the **WM_COMPAREITEM** message is sent one or more times to the owner of the list box so the new item can be properly placed in the list box.

Example

This example adds the string "my string" to a list box:

```
DWORD dwIndex;

dwIndex = SendDlgItemMessage(hdlg, ID_MYLISTBOX,
    LB_ADDSTRING, 0, (LPARAM) ((LPSTR) "my string"));
```

See Also

LB_DIR, **LB_INSERTSTRING**, **WM_COMPAREITEM**

LB_DELETESTRING (2.x)

```
LB_DELETESTRING
wParam = (WPARAM) index;     /* index of string to delete */
lParam = 0L;                 /* not used, must be zero    */
```

An application sends an LB_DELETESTRING message to delete a string in a list box.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the string to delete.

Returns

The return value is a count of the strings remaining in the list. The return value is LB_ERR if the *index* parameter specifies an index greater than the number of items in the list.

Comments

If the list box was created with an owner-drawn style but without the **LBS_HASSTRINGS** style, a **WM_DELETEITEM** message is sent to the owner of the list box so that the application can free any additional data associated with the item.

Example

This example deletes the first string in a list box:

```
DWORD dwRemaining;

dwRemaining = SendDlgItemMessage(hdlg, ID_MYLISTBOX,
    LB_DELETESTRING, 0, 0);
```

See Also

LB_RESETCONTENT, **WM_DELETEITEM**

LB_DIR (2.x)

```
LB_DIR
wParam = (WPARAM) (UINT) uAttrs;         /* file attributes           */
lParam = (LPARAM) (LPCSTR) lpszFileSpec; /* filename string's address */
```

An application sends an LB_DIR message to add a list of filenames to a list box.

Parameter	Description
uAttrs	Value of *wParam.* Specifies the attributes of the files to be added to the list box. It can be any combination of the following values:

Value	Meaning
DDL_READWRITE	File can be read from or written to.
DDL_READONLY	File can be read from but not written to.
DDL_HIDDEN	File is hidden and does not appear in a directory listing.
DDL_SYSTEM	File is a system file.
DDL_DIRECTORY	The name pointed to by the *lpszFileSpec* parameter specifies a directory.
DDL_ARCHIVE	File has been archived.
DDL_DRIVES	All drives that match the name specified by the *lpszFileSpec* parameter are included. If the **DDL_DRIVES** flag is set, the **DDL_EXCLUSIVE** flag is set automatically. Therefore, to create a directory listing that includes drives and files, the developer must send this message twice: once with the DDL_DRIVES flag set and once with the flags for the rest of the list.
DDL_EXCLUSIVE	Exclusive flag. If the exclusive flag is set, only files of the specified type are listed. Otherwise, files of the specified type are listed in addition to files that do not match the specified type.

lpszFileSpec	Value of *lParam.* Points to the null-terminated string that specifies the filename to add to the list. If the filename contains wildcards (for example, *.*), all files that match and have the attributes specified by the *uAttrs* parameter are added to the list.

Returns

The return value is the zero-based index of the last filename added to the list. The return value is LB_ERR if an error occurs; the return value is LB_ERRSPACE if insufficient space is available to store the new strings.

Example

This example adds the names of all available drives to a list box:

```
DWORD dwIndexLastItem;

dwIndexLastItem = SendDlgItemMessage(hdlg, ID_MYLISTBOX, LB_DIR,
    0x4000 | 0x8000, (LPARAM) ((LPSTR) "*"));
```

See Also

DlgDirList, **LB_ADDSTRING**, **LB_INSERTSTRING**

LB_FINDSTRING (3.0)

```
LB_FINDSTRING
wParam = (WPARAM) indexStart;        /* item before start of search */
lParam = (LPARAM) (LPCSTR) lpszFind; /* address of search string    */
```

An application sends an LB_FINDSTRING message to search a list box for an item that begins with the characters in a specified string.

Parameter	Description
indexStart	Value of *wParam.* Specifies the zero-based index of the item before the first item to be searched. When the search reaches the bottom of the list box, it continues from the top of the list box back to the item specified by the *indexStart* parameter. If *indexStart* is -1, the entire list box is searched from the beginning.
lpszFind	Value of *lParam.* Points to the null-terminated string that contains the prefix to search for. The search is not case-sensitive, so this string can contain any combination of uppercase and lowercase letters.

Returns

The return value is the index of the matching item, or it is LB_ERR if the search was unsuccessful.

Comments

If the combo box was created with an owner-drawn style but without the **CBS_HASSTRINGS** style, the action taken by the LB_FINDSTRING message depends on whether the **CBS_SORT** style is used. If the CBS_SORT style is used, **WM_COMPAREITEM** messages are sent to the owner of the combo box to determine which item matches the specified string. Otherwise, LB_FINDSTRING attempts to match the doubleword value against the value of the *lpszFind* parameter.

Example

This example searches for the string "my string" in a list box and copies it, if found, to the szBuf buffer:

```
char szBuf[20];
DWORD dwIndex;

dwIndex = SendDlgItemMessage(hdlg, ID_MYLISTBOX,
    LB_FINDSTRING, 0, (LPARAM) ((LPSTR) "my string"));
if (dwIndex != LB_ERR)
    SendDlgItemMessage(hdlg, ID_MYLISTBOX,
        LB_GETTEXT, (WPARAM) dwIndex, (LPARAM) ((LPSTR) szBuf));
```

See Also

LB_FINDSTRINGEXACT, **LB_SELECTSTRING**, **WM_COMPAREITEM**

LB_FINDSTRINGEXACT (3.1)

```
LB_FINDSTRINGEXACT
wParam = (WPARAM) indexStart;        /* item before start of search */
lParam = (LPARAM) (LPCSTR) lpszFind; /* address of search string    */
```

An application sends an LB_FINDSTRINGEXACT message to find the first list box string that matches the string specified in the *lpszFind* parameter.

Parameter	Description
indexStart	Value of *wParam.* Specifies the zero-based index of the item before the first item to be searched. When the search reaches the bottom of the list box, it continues from the top of the list box back to the item specified by the *indexStart* parameter. If *indexStart* is -1, the entire list box is searched from the beginning.
lpszFind	Value of *lParam.* Points to the null-terminated string to search for. This string can contain a complete filename, including the extension. The search is not case-sensitive, so the string can contain any combination of uppercase and lowercase letters.

Returns

The return value is the index of the matching item, or it is LB_ERR if the search was unsuccessful.

Comments

If the combo box was created with an owner-drawn style but without the **CBS_HASSTRINGS** style, the action taken by the LB_FINDSTRINGEXACT message depends on whether the **CBS_SORT** style is used. If the CBS_SORT style is used, **WM_COMPAREITEM** messages are sent to the owner of the combo box to determine which item matches the specified string. Otherwise, LB_FINDSTRINGEXACT attempts to match the doubleword value against the value of the *lpszFind* parameter.

Example

This example searches for the string "my string" in a list box and copies it, if found, to the *szBuf* buffer:

```
char szBuf[20];
DWORD dwIndex;

dwIndex = SendDlgItemMessage(hdlg, ID_MYLISTBOX,
    LB_FINDSTRINGEXACT, 0, (LPARAM) ((LPSTR) "my string"));
if (dwIndex != LB_ERR)
    SendDlgItemMessage(hdlg, ID_MYLISTBOX,
        LB_GETTEXT, (WPARAM) dwIndex, (LPARAM) ((LPSTR) szBuf));
```

See Also

LB_FINDSTRING, **LB_SELECTSTRING**, **WM_COMPAREITEM**

LB_GETCARETINDEX (3.1)

```
LB_GETCARETINDEX
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an LB_GETCARETINDEX message to determine the index of the item that has the focus rectangle in a multiple-selection list box. The item may or may not be selected.

Parameters

This message has no parameters.

Returns

The return value is the zero-based index of the item that has the focus rectangle in a list box. If the list box is a single-selection list box, the return value is the index of the item that is selected, if any.

Example

This example sends an LB_GETCARETINDEX message to retrieve the index of the item that has the focus rectangle in the list box:

```
LRESULT lrIndex;

lrIndex = SendDlgItemMessage(hdlg, ID_MYLISTBOX,
    LB_GETCARETINDEX, 0, 0L);
```

See Also

LB_SETCARETINDEX

LB_GETCOUNT (2.x)

```
LB_GETCOUNT
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an LB_GETCOUNT message to retrieve the number of items in a list box.

Parameters

This message has no parameters.

Returns

The return value is the number of items in the list box, or it is LB_ERR if an error occurs.

Comments

The returned count is one greater than the index value of the last item (the index is zero-based).

Example

This example retrieves the number of items in a list box:

```
DWORD cListItems;

cListItems = SendDlgItemMessage(hdlg, ID_MYLISTBOX, LB_GETCOUNT, 0, 0);
```

LB_GETCURSEL (2.x)

```
LB_GETCURSEL
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an LB_GETCURSEL message to retrieve the index of the currently selected item, if any, in a single-selection list box.

Parameters

This message has no parameters.

Returns

The return value is the zero-based index of the currently selected item. It is LB_ERR if no item is currently selected.

Comments

An application should use the **LB_GETCARETINDEX** to retrieve the index of the item that has the focus rectangle in a multiple-selection list box.

The LB_GETCURSEL message cannot be sent to a multiple-selection list box.

Example

This example retrieves the index of the currently selected string in a list box and then retrieves that string:

```
char szBuf[20];
DWORD dwIndex;

dwIndex = SendDlgItemMessage(hdlg, ID_MYLISTBOX, LB_GETCURSEL, 0, 0);
if (dwIndex != LB_ERR)
    SendDlgItemMessage(hdlg, ID_MYLISTBOX,
        LB_GETTEXT, (WPARAM) dwIndex, (LPARAM) ((LPSTR) szBuf));
```

See Also

LB_GETSEL, **LB_SETCURSEL**, **LB_SELECTSTRING**

LB_GETHORIZONTALEXTENT (3.0)

```
LB_GETHORIZONTALEXTENT
wParam = 0;     /* not used, must be zero */
lParam = 0L;    /* not used, must be zero */
```

An application sends the LB_GETHORIZONTALEXTENT message to retrieve from a list box the width, in pixels, by which the list box can be scrolled horizontally if the list box has a horizontal scroll bar.

Parameters

This message has no parameters.

Returns

The return value is the scrollable width of the list box, in pixels.

Comments

To respond to the LB_GETHORIZONTALEXTENT message, the list box must have been defined with the **WS_HSCROLL** style.

This message is not useful for multicolumn listboxes.

Example

This example gets the horizontal extent of a list box:

```
SendDlgItemMessage(hDlg, ID_MYLISTBOX,
    LB_GETHORIZONTALEXTENT, 0, 0L);
```

See Also

LB_SETHORIZONTALEXTENT

LB_GETITEMDATA (3.0)

```
LB_GETITEMDATA
wParam = (WPARAM) index;     /* item index              */
lParam = 0L;                 /* not used, must be zero */
```

An application sends the LB_GETITEMDATA message to retrieve the application-supplied doubleword value associated with the specified item in a list box. (This is the value of the *lParam* parameter of an **LB_SETITEMDATA** message.)

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the item.

Returns

The return value is the doubleword value associated with the item, or it is LB_ERR if an error occurs.

Example

This example retrieves the value associated with an item in a list box. The value is the handle of a global memory object.

```
HGLOBAL hglbData;
LPSTR   lpLBData;
HWND    hListBox;
WPARAM  nIndex;

if ((hglbData = (HGLOBAL) LOWORD(SendMessage(hListBox, LB_GETITEMDATA,
        nIndex, 0)))) {
    if ((lpLBData = GlobalLock(hglbData))) {
        .
        . /* Access or manipulate the data */
        .

        GlobalUnlock(hglbData);
    }
}
```

See Also

LB_SETITEMDATA

LB_GETITEMHEIGHT (3.1)

```
LB_GETITEMHEIGHT
wParam = (WPARAM) index;    /* item index             */
lParam = 0L;                /* not used, must be zero */
```

An application sends an LB_GETITEMHEIGHT message to determine the height of items in a list box.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the item in the list box. This parameter is used only if the list box has the **LBS_OWNERDRAWVARIABLE** style; otherwise, it should be set to zero.

Returns

The return value is the height, in pixels, of the items in the list box. The return value is the height of the item specified by the *index* parameter if the list box has the **LBS_OWNERDRAWVARIABLE** style. The return value is LB_ERR if an error occurs.

Example

This example sends an LB_GETITEMHEIGHT message to retrieve the height of the items in a list box:

```
LRESULT lrHeight;

lrHeight = SendDlgItemMessage(hdlg, ID_MYLISTBOX,
    LB_GETITEMHEIGHT, 0, 0L);
```

See Also

LB_GETITEMRECT, **LB_SETITEMHEIGHT**, **WM_MEASUREITEM**

LB_GETITEMRECT (3.0)

```
LB_GETITEMRECT
wParam = (WPARAM) index;            /* item index                */
lParam = (LPARAM) (RECT FAR*) lprc; /* address of RECT structure */
```

An application sends an LB_GETITEMRECT message to retrieve the dimensions of the rectangle that bounds an item as it is currently displayed in the list box window.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the item.
lprc	Value of *lParam.* Specifies a long pointer to a **RECT** structure that receives the client coordinates for the item in the list box.

Returns

The return value is LB_ERR if an error occurs.

See Also

LB_GETITEMHEIGHT, **LB_SETITEMHEIGHT**, **WM_MEASUREITEM**, **RECT**

LB_GETSEL (2.x)

```
LB_GETSEL
wParam = (WPARAM) index;     /* item index              */
lParam = 0L;                 /* not used, must be zero */
```

An application sends an LB_GETSEL message to retrieve the selection state of an item.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the item.

Returns

The return value is a positive number if an item is selected; otherwise, it is zero. The return value is LB_ERR if an error occurs.

See Also

LB_GETCURSEL, **LB_SELECTSTRING**, **LB_SELITEMRANGE**, **LB_SETSEL**

LB_GETSELCOUNT (3.0)

```
LB_GETSELCOUNT
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an LB_GETSELCOUNT message to retrieve the total number of selected items in a multiple-selection list box.

Parameters

This message has no parameters.

Returns

The return value is the count of selected items in a list box. The return value is LB_ERR if the list box is a single-selection list box.

See Also

LB_GETSELITEMS

LB_GETSELITEMS (3.0)

```
LB_GETSELITEMS
wParam = (WPARAM) cItems;              /* maximum number of items */
lParam = (LPARAM) (int FAR*) lpItems; /* address of buffer       */
```

An application sends an LB_GETSELITEMS message to fill a buffer with an array of integers that specify the item numbers of selected items in a multiple-selection list box.

Parameter	Description
cItems	Value of *wParam.* Specifies the maximum number of selected items whose item numbers are to be placed in the buffer.
lpItems	Value of *lParam.* Specifies a long pointer to a buffer large enough for the number of integers specified by the *cItems* parameter.

Returns

The return value is the actual number of items placed in the buffer. The return value is LB_ERR if the list box is a single-selection list box.

See Also

LB_GETSELCOUNT

LB_GETTEXT (2.x)

```
LB_GETTEXT
wParam = (WPARAM) index;                /* item index        */
lParam = (LPARAM) (LPCSTR) lpszBuffer; /* address of buffer */
```

An application sends an LB_GETTEXT message to retrieve a string from a list box.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the string to retrieve.
lpszBuffer	Value of *lParam.* Points to the buffer that receives the string. The buffer must have sufficient space for the string and a terminating null character. An **LB_GETTEXTLEN** message can be sent before the LB_GETTEXT message to retrieve the length, in bytes, of the string.

Returns

The return value is the length of the string, in bytes, excluding the terminating null character. The return value is LB_ERR if the *index* parameter does not specify a valid index.

Comments

If the list box was created with an owner-drawn style but without the **LBS_HASSTRINGS** style, the buffer pointed to by the *lpszBuffer* parameter receives the doubleword value associated with the item.

Example

This example retrieves the length of the first item in the list box, allocates sufficient memory for the string, and then sends an LB_GETTEXT message to retrieve the string:

```
DWORD cbItemString;
PSTR psz;

cbItemString = SendDlgItemMessage(hdlg, ID_MYLISTBOX,
    LB_GETTEXTLEN, 0, 0);
if (cbItemString != LB_ERR) {
    psz = (PSTR) LocalAlloc(LMEM_FIXED, (WORD) cbItemString);
    SendDlgItemMessage(hdlg, ID_MYLISTBOX,
        LB_GETTEXT, 0, (LPARAM) ((LPSTR) psz));
}
```

See Also

LB_GETTEXTLEN

LB_GETTEXTLEN (2.x)

```
LB_GETTEXTLEN
wParam = (WPARAM) index;     /* item index             */
lParam = 0L;                 /* not used, must be zero */
```

An application sends an LB_GETTEXTLEN message to retrieve the length of a string in a list box.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the string.

Returns

The return value is the length of the string, in bytes, excluding the terminating null character. The return value is LB_ERR if the *index* parameter does not specify a valid index.

Example

This example retrieves the length of the first item in the list box:

```
DWORD cbItemString;

cbItemString = SendDlgItemMessage(hdlg, ID_MYLISTBOX,
    LB_GETTEXTLEN, 0, 0);
```

See Also

LB_GETTEXT

LB_GETTOPINDEX (3.0)

```
LB_GETTOPINDEX
wParam = 0;     /* not used, must be zero */
lParam = 0L;    /* not used, must be zero */
```

An application sends an LB_GETTOPINDEX message to retrieve the index of the first visible item in a list box. Initially, the item with index 0 is at the top of the list box, but if the list box is scrolled, another item may be at the top.

Parameters

This message has no parameters.

Returns

The return value is the zero-based index of the first visible item in a list box.

See Also

LB_SETTOPINDEX

LB_INSERTSTRING (2.x)

```
LB_INSERTSTRING
wParam = (WPARAM) index;            /* item index                   */
lParam = (LPARAM) (LPCSTR) lpsz;    /* address of string to insert */
```

An application sends an LB_INSERTSTRING message to insert a string into a list box. Unlike the **LB_ADDSTRING** message, the LB_INSERTSTRING message does not cause a list with the **LBS_SORT** style to be sorted.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the position at which to insert the string. If this parameter is -1, the string is added to the end of the list.
lpsz	Value of *lParam.* Points to the null-terminated string that is to be inserted. If the list was created with an owner-drawn style but without the **LBS_HASSTRINGS** style, the value of the *lpsz* parameter is stored rather than the string it would otherwise point to.

Returns

The return value is the index of the position at which the string was inserted. The return value is LB_ERR if an error occurs. The return value is LB_ERRSPACE if insufficient space is available to store the new string.

Example

This example inserts the string "my string" into the third position of the list box:

```
SendDlgItemMessage(hdlg, ID_MYLISTBOX,
    LB_INSERTSTRING, 2, (LPARAM) ((LPSTR) "my string"));
```

See Also

LB_ADDSTRING, **LB_DIR**

LB_RESETCONTENT (2.x)

```
LB_RESETCONTENT
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an LB_RESETCONTENT message to remove all items from a list box.

Parameters

This message has no parameters.

Returns

This message does not return a value.

Comments

If the list box was created with an owner-drawn style but without the **LBS_HASSTRINGS** style, the owner of the list box receives a **WM_DELETEITEM** message for each item in the list box.

Example

This example removes all items from a list box:

```
SendDlgItemMessage(hdlg, ID_MYLISTBOX, LB_RESETCONTENT, 0, 0);
```

See Also

LB_DELETESTRING, **WM_DELETEITEM**

LB_SELECTSTRING (2.x)

```
LB_SELECTSTRING
wParam = (WPARAM) indexStart;        /* item before start of search */
lParam = (LPARAM) (LPCSTR) lpszFind; /* address of search string    */
```

An application sends an LB_SELECTSTRING message to search a list box for an item that begins with the characters in a specified string. If a matching item is found, the item is selected.

Parameter	Description
indexStart	Value of *wParam.* Specifies the zero-based index of the item before the first item to be searched. When the search reaches the bottom of the list box, it continues from the top of the list box back to the item specified by the *indexStart* parameter. If *indexStart* is -1, the entire list box is searched from the beginning.
lpszFind	Value of *lParam.* Points to the null-terminated string that contains the prefix to search for. The search is not case-sensitive, so this string can contain any combination of uppercase and lowercase letters.

Returns

The return value is the index of the selected item if the search was successful. The return value is LB_ERR if the search was unsuccessful and the current selection is not changed.

Comments

The list box is scrolled, if necessary, to bring the selected item into view.

An item is selected only if its initial characters (from the starting point) match the characters in the string specified by the *lpszFind* parameter.

If the combo box was created with an owner-drawn style but without the **CBS_HASSTRINGS** style, the action taken by the LB_SELECTSTRING message depends on whether the **CBS_SORT** style is used. If the CBS_SORT style is used, **WM_COMPAREITEM** messages are sent to the owner of the combo box to determine which item matches the specified string. Otherwise, LB_SELECTSTRING attempts to match the doubleword value against the value of the *lpszFind* parameter.

Example

This example searches the entire list box for an item that matches the string "my string" and, if the item is found, selects it:

```
DWORD dwIndexFoundString;

dwIndexFoundString = SendDlgItemMessage(hdlg, ID_MYLISTBOX,
    LB_SELECTSTRING, -1, (LPARAM) ((LPSTR) "my string"));
```

See Also

LB_FINDSTRING, **LB_FINDSTRINGEXACT**, **LB_SELITEMRANGE**, **LB_SETCURSEL**, **LB_SETSEL**, **WM_COMPAREITEM**

LB_SELITEMRANGE (3.0)

```
LB_SELITEMRANGE
wParam = (WPARAM) (BOOL) fSelect;   /* selection flag       */
lParam = MAKELPARAM(wFirst, wLast); /* first and last items */
```

An application sends an LB_SELITEMRANGE message to select one or more consecutive items in a multiple-selection list box.

Parameter	Description
fSelect	Value of *wParam.* Specifies how to set the selection. If the *fSelect* parameter is nonzero, the string is selected and highlighted; if *fSelect* is zero, the highlight is removed and the string is no longer selected.
wFirst	Value of the low-order word of *lParam.* Specifies the zero-based index of the first item to set.
wLast	Value of the high-order word of *lParam.* Specifies the zero-based index of the last item to set.

Returns
The return value is LB_ERR if an error occurs.

Comments
This message should be used only with multiple-selection list boxes.

See Also
LB_SELECTSTRING, **LB_SETSEL**

LB_SETCARETINDEX (3.1)

```
LB_SETCARETINDEX
wParam = (WPARAM) index;          /* item index               */
lParam = MAKELPARAM(fScroll, 0); /* flag for scrolling item */
```

An application sends an LB_SETCARETINDEX message to set the focus rectangle to the item at the specified index in a multiple-selection list box. If the item is not visible, it is scrolled into view.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the item to receive the focus rectangle in the list box.
fScroll	Value of *lParam.* If this value is zero, the item is scrolled until it is fully visible. If this value is nonzero, the item is scrolled until it is at least partially visible.

Returns

The return value is LB_ERR if an error occurs.

Example

This example sends an LB_SETCARETINDEX message to set the focus rectangle to an item in a list box:

```
WPARAM wIndex;

wIndex = 0;     /* set index to first item */

SendDlgItemMessage(hdlg, ID_MYLISTBOX, LB_SETCARETINDEX,
    wIndex, 0L);
```

See Also

LB_GETCARETINDEX

Windows 3.1 Changes

In previous versions of Windows, the *lParam* was not used.

LB_SETCOLUMNWIDTH (3.0)

```
LB_SETCOLUMNWIDTH
wParam = (WPARAM) cxColumn;      /* column width           */
lParam = 0L;                     /* not used, must be zero */
```

An application sends an LB_SETCOLUMNWIDTH message to a multiple-column list box (created with the **LBS_MULTICOLUMN** style) to set the width, in pixels, of all columns in the list box.

Parameter	Description
cxColumn	Value of *wParam.* Specifies the width, in pixels, of all columns.

Returns
This message does not return a value.

Example
This example sets the width of the columns in a multiple-column list box:

```
WPARAM wColWidth;

wColWidth = 100;    /* set column width to 100 pixels */

SendDlgItemMessage(hDlg, ID_MYLISTBOX, LB_SETCOLUMNWIDTH,
    wColWidth, 0L);
```

See Also
LB_SETHORIZONTALEXTENT

LB_SETCURSEL (2.x)

```
LB_SETCURSEL
wParam = (WPARAM) index;     /* item index             */
lParam = 0L;                 /* not used, must be zero */
```

An application sends an LB_SETCURSEL message to select a string and scroll it into view, if necessary. When the new string is selected, the list box removes the highlight from the previously selected string.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the string that is selected. If the *index* parameter is -1, the list box is set to have no selection.

Returns

The return value is LB_ERR if an error occurs. The return value will be LB_ERR even though no error has occurred if the *index* parameter is -1.

Comments

This message should be used only with single-selection list boxes. It cannot be used to set or remove a selection in a multiple-selection list box.

See Also

LB_GETCURSEL, **LB_SELECTSTRING**, **LB_SETSEL**

LB_SETHORIZONTALEXTENT (3.0)

```
LB_SETHORIZONTALEXTENT
wParam = (WPARAM) cxExtent; /* horizontal scroll width */
lParam = 0L;                /* not used, must be zero  */
```

An application sends the LB_SETHORIZONTALEXTENT message to set the width, in pixels, by which a list box can be scrolled horizontally. If the size of the list box is smaller than this value, the horizontal scroll bar horizontally scrolls items in the list box. If the size of the list box is equal to or greater than this value, the horizontal scroll bar is hidden.

Parameter	Description
cxExtent	Value of *wParam.* Specifies the number of pixels by which the list box can be scrolled.

Returns

This message does not return a value.

Comments

To respond to the LB_SETHORIZONTALEXTENT message, the list box must have been defined with the **WS_HSCROLL** style.

By default, the horizontal extent of a list box is zero. Windows does not display the scroll bar unless the horizontal extent is set to a value greater than the width, in pixels, of the client area of the list box.

This message is not useful for multicolumn listboxes. Multicolumn listboxes should instead use the **LB_SETCOLUMNWIDTH** message.

Example

This example sets the horizontal extent of a list box based on the width of the string about to be added to the list box. The horizontal extent is set if the string is wider than the widest string in the list box and is wider than the client area of the list box.

```
DWORD dwStringExt;
HDC hdcLB;
PSTR pszString;
TEXTMETRIC tm;
WORD wLongest;
WORD wLBWidth;

dwStringExt = GetTextExtent(hdcLB, (LPSTR) pszString,
    strlen(pszString)) + tm.tmAveCharWidth;

if ((LOWORD(dwStringExt) > wLongest) &&
        (LOWORD(dwStringExt) > wLBWidth)) {
    SendDlgItemMessage(hDlg, ID_MYLISTBOX, LB_SETHORIZONTALEXTENT,
        LOWORD(dwStringExt), 0L);
    wLongest = LOWORD(dwStringExt);
}

SendDlgItemMessage(hDlg, ID_MYLISTBOX, LB_ADDSTRING, 0,
    (LPARAM) ((LPCSTR) pszString));
```

See Also

LB_GETHORIZONTALEXTENT, **LB_SETCOLUMNWIDTH**

LB_SETITEMDATA (3.0)

```
LB_SETITEMDATA
wParam = (WPARAM) index;    /* item index                    */
lParam = (LPARAM) dwData;   /* value to associate with item */
```

An application sends the LB_SETITEMDATA message to set a doubleword value associated with the specified item in a list box.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the item.
dwData	Value of *lParam.* Specifies the value to be associated with the item.

Returns

The return value is LB_ERR if an error occurs.

Example

This example associates a handle of a 64-byte memory object with each item in a list box:

```
HGLOBAL hglbData;
LPSTR   lpLBData;
HWND    hListBox;
WPARAM  nIndex;

case WM_INITDIALOG:

    if ((hglbData = GlobalAlloc(GMEM_MOVEABLE, 64))) {
        if ((lpLBData = GlobalLock(hglbData))) {
            .
            . /* Store the data in the memory object. */
            .
            GlobalUnlock(hglbData);
        }
    }
    SendMessage(hListBox, LB_SETITEMDATA, nIndex,
        MAKELONG(hglbData, 0));
```

See Also

LB_GETITEMDATA

LB_SETITEMHEIGHT (3.1)

```
LB_SETITEMHEIGHT
wParam = (WPARAM) index;        /* item index */
lParam = MAKELPARAM(cyItem, 0); /* item height */
```

An application sends an LB_SETITEMHEIGHT message to set the height of items in a list box. If the list box has the **LBS_OWNERDRAWVARIABLE** style, this message sets the height of the item specified by the *wParam* parameter. Otherwise, this message sets the height of all items in the list box.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the item in the list box. This parameter is used only if the list box has the **LBS_OWNERDRAWVARIABLE** style; otherwise, it should be set to zero.
cyItem	Value of the low-order word of *lParam.* Specifies the height, in pixels, of the item.

Returns

The return value is LB_ERR if the index or height is invalid.

Example

This example sends an LB_SETITEMHEIGHT message to set the height of the items in a list box:

```
LPARAM lpmHeight;

SendDlgItemMessage(hdlg, ID_MYLISTBOX, LB_SETITEMHEIGHT,
    0, lpmHeight);
```

See Also

LB_GETITEMHEIGHT, **LB_GETITEMRECT**, **WM_MEASUREITEM**

LB_SETSEL (2.x)

```
LB_SETSEL
wParam = (WPARAM) (BOOL) fSelect;   /* selection flag */
lParam = MAKELPARAM(index, 0);      /* item index     */
```

An application sends an LB_SETSEL message to select a string in a multiple-selection list box.

Parameter	Description
fSelect	Value of *wParam.* Specifies how to set the selection. If the *fSelect* parameter is TRUE, the string is selected and highlighted; if *fSelect* is FALSE, the highlight is removed and the string is no longer selected.
index	Value of the low-order word of *lParam.* Specifies the zero-based index of the string to set. If the *index* parameter is -1, the selection is added to or removed from all strings, depending on the value of *fSelect.*

Returns

The return value is LB_ERR if an error occurs.

Comments

This message should be used only with multiple-selection list boxes.

See Also

LB_GETSEL, **LB_SETCURSEL**, **LB_SELECTSTRING**, **LB_SELITEMRANGE**

LB_SETTABSTOPS (3.0)

```
LB_SETTABSTOPS
wParam = (WPARAM) cTabs;              /* number of tab stops       */
lParam = (LPARAM) (int FAR*) lpTabs; /* address of tab-stop array */
```

An application sends an LB_SETTABSTOPS message to set the tab-stop positions in a list box.

Parameter	Description
cTabs	Value of *wParam.* Specifies the number of tab stops in the list box.
lpTabs	Value of *lParam.* Points to the first member of an array of integers containing the tab stops, in dialog box units. The tab stops must be sorted in increasing order; back tabs are not allowed.

Returns

The return value is nonzero if all the tabs were set; otherwise, the return value is zero.

Comments

To respond to the LB_SETTABSTOPS message, the list box must have been created with the **LBS_USETABSTOPS** style.

If the *cTabs* parameter is zero and the *lpTabs* parameter is NULL, the default tab stop is two dialog box units.

If *cTabs* is 1, the list box will have tab stops separated by the distance specified by *lpTabs.*

If *lpTabs* points to more than a single value, a tab stop will be set for each value in *lpTabs,* up to the number specified by *cTabs.*

A dialog box unit is a horizontal or vertical distance. One horizontal dialog box unit is equal to one-fourth of the current dialog box base width unit. The dialog box base units are computed based on the height and width of the current system font. The **GetDialogBaseUnits** function returns the current dialog box base units, in pixels.

LB_SETTOPINDEX (3.0)

```
LB_SETTOPINDEX
wParam = (WPARAM) index;        /* item index             */
lParam = 0L;                    /* not used, must be zero */
```

An application sends an LB_SETTOPINDEX message to ensure that a particular item in a list box is visible.

Parameter	Description
index	Value of *wParam.* Specifies the zero-based index of the item in the list box.

Returns

The return value is LB_ERR if an error occurs.

Comments

The system scrolls the list box so that either the specified item appears at the top of the list box or the maximum scroll range has been reached.

Example

This example searches for an item in a list box that matches the string "my string" and, if a match is found, ensures that the item is visible:

```
int iIndex;


iIndex = (int) SendMessage(hMyListbox, LB_FINDSTRING, -1,
    (LPARAM) (LPSTR) "my string");

if (iIndex != LB_ERR)
  SendMessage(hMyListbox, LB_SETTOPINDEX, (WPARAM) iIndex, 0);
```

See Also

LB_GETTOPINDEX

STM_GETICON (3.1)

```
STM_GETICON
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends an STM_GETICON message to retrieve the handle of the icon associated with an icon resource.

Parameters

This message has no parameters.

Returns

The return value is the icon handle if the operation is successful, or it is zero if the icon has no associated icon resource or if an error occurred.

Example

This example gets the handle of the icon associated with an icon resource:

```
HICON hicon;

hicon = (HICON) SendDlgItemMessage(hdlg, IDD_ICON,
    STM_GETICON, 0, 0L);
```

See Also

STM_SETICON

STM_SETICON (3.1)

```
STM_SETICON
wParam = (WPARAM) (HICON) hicon;     /* handle of the icon     */
lParam = 0L;                         /* not used, must be zero */
```

An application sends an STM_SETICON message to associate an icon with an icon resource.

Parameter	Description
hicon	Value of *wParam.* Identifies the icon to associate with the icon resource.

Returns

The return value is the handle of the icon that was previously associated with the icon resource, or it is zero if an error occurred.

Example

This example associates the system-defined question-mark icon with an icon resource:

```
HICON hicon, hiconOld;

hicon = LoadIcon(NULL, IDI_QUESTION);
hiconOld = (HICON) SendDlgItemMessage(hdlg, IDD_ICON,
    STM_SETICON, (WPARAM) hicon, 0);
```

See Also

STM_GETICON, **LoadIcon**

WM_ACTIVATE (2.x)

```
WM_ACTIVATE
fActive = wParam;                    /* activation flag */
fMinimized = (BOOL) HIWORD(lParam); /* minimized flag  */
hwnd = (HWND) LOWORD(lParam);        /* window handle   */
```

The WM_ACTIVATE message is sent when a window is being activated or deactivated. This message is sent first to the window procedure of the main window being deactivated and then to the window procedure of the main window being activated.

Parameter	Description
fActive	Value of *wParam.* Specifies whether the window is being activated or deactivated. It can be one of the following values:

Value	Description
WA_INACTIVE	The window is being deactivated.
WA_ACTIVE	The window is being activated through some method other than a mouse click (for example, by use of the keyboard interface to select the window).
WA_CLICKACTIVE	The window is being activated by a mouse click.

fMinimized	Value of the high-order word of *lParam.* Specifies the minimized state of the window being activated or deactivated. A nonzero value indicates the window is minimized.
hwnd	Value of the low-order word of *lParam.* Identifies the window being activated or deactivated. This handle can be NULL.

Returns
An application should return zero if it processes this message.

Comments
If the window is activated with a mouse click, it also receives a **WM_MOUSEACTIVATE** message.

Example
This example sets the input focus while processing the WM_ACTIVATE message:

```
case WM_ACTIVATE:

    if (wParam && !HIWORD(lParam))
        SetFocus(hwnd);
    break;
```

See Also
WM_MOUSEACTIVATE, **WM_NCACTIVATE**, **DefWindowProc**, **SetFocus**

WM_ACTIVATEAPP (2.x)

```
WM_ACTIVATEAPP
fActive = (BOOL) wParam;        /* the activation/deactivation flag */
htask = (HTASK) LOWORD(lParam); /* task handle                      */
```

The WM_ACTIVATEAPP message is sent when a window is about to be activated and that window belongs to a different task than the active window. The message is sent to all top-level windows of the task being activated and to all top-level windows of the task being deactivated.

Parameter	Description
fActive	Value of *wParam.* Specifies whether the window is being activated or deactivated. A nonzero value means the window is being activated. A zero value means the window is being deactivated.
htask	Value of the low-order word of *lParam.* Specifies a task handle. If the *fActive* parameter is nonzero, the handle identifies the task that owns the window being deactivated. If *fActive* is zero, the handle identifies the task that owns the window being activated.

Returns

An application should return zero if it processes this message.

See Also

WM_ACTIVATE

WM_ASKCBFORMATNAME (2.x)

```
WM_ASKCBFORMATNAME
wParam = (WPARAM) cbMax;            /* maximum bytes to copy  */
lParam = (LPARAM) lpszFormatName;   /* address of format name */
```

A clipboard viewer application sends a WM_ASKCBFORMATNAME message to the clipboard owner when the clipboard contains the data handle of the CF_OWNERDISPLAY format (that is, when the clipboard owner should display the clipboard contents).

Parameter	Description
cbMax	Value of *wParam.* Specifies the maximum number of bytes to copy.
lpszFormatName	Value of *lParam.* Points to the buffer where the copy of the format name is to be stored.

Returns

An application should return zero if it processes this message.

Comments

The clipboard owner should copy the name of the CF_OWNERDISPLAY format into the specified buffer, not exceeding the maximum number of bytes.

See Also

WM_PAINTCLIPBOARD

WM_CANCELMODE (2.x)

```
WM_CANCELMODE
```

The WM_CANCELMODE message is sent to inform a window to cancel any internal mode. This message is sent to the focus window when a dialog box or message box is displayed, giving the focus window the opportunity to cancel modes such as mouse capture.

Parameters

This message has no parameters.

Returns

An application should return zero if it processes this message.

Comments

The **DefWindowProc** function processes this message by calling the **ReleaseCapture** function. **DefWindowProc** does not cancel any other modes.

See Also

DefWindowProc, **ReleaseCapture**

WM_CHANGECBCHAIN (2.x)

```
WM_CHANGECBCHAIN
hwndRemoved = (HWND) wParam;        /* handle of removed window */
hwndNext = (HWND) LOWORD(lParam);   /* handle of next window    */
```

The WM_CHANGECBCHAIN message notifies the first window in the clipboard-viewer chain that a window is being removed from the chain.

Parameter	Description
hwndRemoved	Value of *wParam.* Identifies the window that is being removed from the clipboard-viewer chain.
hwndNext	Value of the low-order word of *lParam.* Identifies the window that follows the window being removed from the clipboard-viewer chain.

Returns

An application should return zero if it processes this message.

Comments

Each window that receives the WM_CHANGECBCHAIN message should call the **SendMessage** function to pass the message on to the next window in the clipboard-viewer chain. If the window being removed is the next window in the chain, the window specified by the *hwndNext* parameter becomes the next window and clipboard messages are passed on to it.

See Also

ChangeClipboardChain, **SendMessage**

WM_CHAR (2.x)

```
WM_CHAR
nVKey = wParam;               /* virtual-key code */
dwKeyData = (DWORD) lParam;   /* key data         */
```

The WM_CHAR message is sent when a **WM_KEYUP** message and a **WM_KEYDOWN** message are translated. The WM_CHAR message contains the value of the key being pressed or released.

Parameter	Description
nVKey	Value of *wParam.* Specifies the virtual-key code value of the key.
dwKeyData	Value of *lParam.* Specifies the repeat count, scan code, extended key, context code, previous key state, and key-transition state, as shown in the following table:

Bit	Description
0-15	Specifies the repeat count. The value is the number of times the keystroke is repeated as a result of the user holding down the key.
16-23	Specifies the scan code. The value depends on the original equipment manufacturer (OEM).
24	Specifies whether the key is an extended key, such as a function key or a key on the numeric keypad. The value is 1 if it is an extended key; otherwise, it is 0.
25-26	Not used.
27-28	Used internally by Windows.
29	Specifies the context code. The value is 1 if the ALT key is held down while the key is pressed; otherwise, the value is 0.
30	Specifies the previous key state. The value is 1 if the key is down before the message is sent, or it is 0 if the key is up.
31	Specifies the key-transition state. The value is 1 if the key is being released, or it is 0 if the key is being pressed.

Returns

An application should return zero if it processes this message.

Comments

Because there is not necessarily a one-to-one correspondence between keys pressed and character messages generated, the information in the high-order word of the *dwKeyData* parameter is usually not useful to applications. The information in the high-order word applies only to the most recent **WM_KEYUP** or **WM_KEYDOWN** message that precedes the posting of the character message.

For IBM Enhanced 101- and 102-key keyboards, enhanced keys are the right ALT key and the right CTRL key on the main section of the keyboard; the INS, DEL, HOME, END, PAGE UP, PAGE DOWN, and arrow keys in the clusters to the left of the numeric keypad; and the division (*/*) and ENTER keys on the numeric keypad. Some other keyboards may support the extended-key bit in the *dwKeyData* parameter.

See Also

WM_KEYDOWN, **WM_KEYUP**

WM_CHARTOITEM (3.0)

```
WM_CHARTOITEM
nKey = wParam;                          /* key value       */
hwndListBox = (HWND) LOWORD(lParam);    /* list box handle */
iCaretPos = HIWORD(lParam);             /* caret position  */
```

The WM_CHARTOITEM message is sent by a list box with the **LBS_WANTKEYBOARDINPUT** style to its owner in response to a **WM_CHAR** message.

Parameter	Description
nKey	Value of *wParam.* Specifies the value of the key the user pressed.
hwndListBox	Value of the low-order word of *lParam.* Identifies the list box.
iCaretPos	Value of the high-order word of *lParam.* Specifies the current caret position.

Returns

The return value specifies the action that the application performed in response to the message. A return value of -2 indicates that the application handled all aspects of selecting the item and requires no further action by the list box. A return value of -1 indicates that the list box should perform the default action in response to the keystroke. A return value of 0 or greater specifies the zero-based index of an item in the list box and indicates that the list box should perform the default action for the keystroke on the given item.

Comments

Only owner-drawn list boxes that do not have the **LBS_HASSTRINGS** style can receive this message.

See Also

WM_CHAR, **WM_VKEYTOITEM**

WM_CHILDACTIVATE (2.x)

`WM_CHILDACTIVATE`

The WM_CHILDACTIVATE message is sent to a multiple document interface (MDI) child window when the user clicks the window's title bar or when the window is activated, moved, or sized.

Parameters

This message has no parameters.

Returns

An application should return zero if it processes this message.

See Also

MoveWindow, **SetWindowPos**

WM_CHOOSEFONT_GETLOGFONT (3.1)

```
WM_CHOOSEFONT_GETLOGFONT
wParam = 0;                    /* not used, must be zero         */
lplf = (LPLOGFONT) lParam;     /* address of a LOGFONT structure */
```

An application sends a WM_CHOOSEFONT_GETLOGFONT message to the Font dialog box created by the **ChooseFont** function to retrieve the current **LOGFONT** structure.

Parameter	Description
lplf	Points to a **LOGFONT** structure that receives information about the current logical font.

Returns

This message does not return a value.

Comments

An application uses this message to retrieve the **LOGFONT** structure while the Font dialog box is open. When the user closes the dialog box, the **ChooseFont** function receives information about the **LOGFONT** structure.

See Also

WM_GETFONT, **ChooseFont**, **LOGFONT**

WM_CLEAR (2.x)

```
WM_CLEAR
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends a WM_CLEAR message to an edit control or combo box to delete (clear) the current selection, if any, in the edit control.

Parameters

This message has no parameters.

Returns

The return value is nonzero if this message is sent to an edit control or a combo box.

Comments

The deletion performed by the WM_CLEAR message can be undone by sending the edit control an **EM_UNDO** message.

To delete the current selection and place the deleted contents into the clipboard, use the **WM_CUT** message.

Example

This example sends an **EM_SETSEL** message to select the entire contents of an edit control. It then sends a WM_CLEAR message to delete the contents of the edit control.

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_SETSEL, 0, MAKELONG(0, -1));
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    WM_CLEAR, 0, 0);
```

See Also

EM_UNDO, **WM_COPY**, **WM_CUT**, **WM_PASTE**

WM_CLOSE (2.x)

```
WM_CLOSE
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

The WM_CLOSE message is sent as a signal that a window or an application should terminate. An application can prompt the user for confirmation prior to destroying the window by processing the WM_CLOSE message and calling the **DestroyWindow** function only if the user confirms the choice.

Parameters

This message has no parameters.

Returns

An application should return zero if it processes this message.

Example

This example processes a WM_CLOSE message and requests confirmation from the user before terminating the application:

```
case WM_CLOSE:
    if (MessageBox(hwnd, "Are you sure you want to exit?", "MyApp",
          MB_ICONQUESTION | MB_OKCANCEL) == IDOK)
        DestroyWindow(hwnd);
    return 0L;
```

See Also

DestroyWindow, **PostQuitMessage**, **WM_DESTROY**, **WM_QUERYENDSESSION**, **WM_QUIT**

WM_COMMAND (2.x)

```
WM_COMMAND
idItem = wParam;        /* control or menu item identifier      */
hwndCtl = (HWND) LOWORD(lParam); /* handle of control           */
wNotifyCode = HIWORD(lParam);    /* notification message        */
```

The WM_COMMAND message is sent to a window when the user selects an item from a menu, when a control sends a notification message to its parent window, or when an accelerator keystroke is translated.

Parameter	Description
idItem	Value of *wParam.* Specifies the identifier of the menu item or control.
hwndCtl	Value of the low-order word of *lParam.* Identifies the control sending the message if the message is from a control. Otherwise, this parameter is zero.
wNotifyCode	Value of the high-order word of *lParam.* Specifies the notification message if the message is from a control. If the message is from an accelerator, this parameter is 1. If the message is from a menu, this parameter is 0.

Returns
An application should return zero if it processes this message.

Comments
Accelerator keystrokes that are defined to select items from the System menu (sometimes referred to as the Control menu) are translated into **WM_SYSCOMMAND** messages.

If an accelerator keystroke that corresponds to a menu item occurs when the window that owns the menu is minimized, no WM_COMMAND message is sent. However, if an accelerator keystroke occurs that does not match any of the items on the window's menu or on the System menu, a WM_COMMAND message is sent even if the window is minimized.

Example
This example creates an Options dialog box in response to a WM_COMMAND message sent as a result of a menu selection:

```
FARPROC lpProc;

case WM_COMMAND:
    switch (wParam) {
        case IDM_OPTIONS:
            lpProc = MakeProcInstance(OptionsProc, hInstance);
            DialogBox(hInstance, "OptionsBox", hwnd, (DLGPROC) lpProc);
            FreeProcInstance(lpProc);
            break;
        .
        . /* Process other menu commands. */
        .
    }
    break;
```

See Also
WM_SYSCOMMAND

WM_COMMNOTIFY (3.1)

```
WM_COMMNOTIFY
idDevice = wParam;              /* communication-device ID  */
nNotifyStatus = LOWORD(lParam); /* notification-status flag */
```

The WM_COMMNOTIFY message is posted by a communication device driver whenever a COM port event occurs. The message indicates the status of a window's input or output queue.

Parameter	Description
idDevice	Value of *wParam.* Specifies the identifier of the communication device that is posting the notification message.
nNotifyStatus	Value of the low-order word of *lParam.* Specifies the notification status in the low-order word. The notification status may be one or more of the following flags:

Value	Meaning
CN_EVENT	Indicates that an event has occurred that was enabled in the event word of the communication device. This event was enabled by a call to the **SetCommEventMask** function. The application should call the **GetCommEventMask** function to determine which event occurred and to clear the event.
CN_RECEIVE	Indicates that at least *cbWriteNotify* bytes are in the input queue. The *cbWriteNotify* parameter is a parameter of the **EnableCommNotification** function.
CN_TRANSMIT	Indicates that fewer than *cbOutQueue* bytes are in the output queue waiting to be transmitted. The *cbOutQueue* parameter is a parameter of the **EnableCommNotification** function.

Returns

An application should return zero if it processes this message.

Comments

This message is sent only when the event word changes for the communication device. The application that sends WM_COMMNOTIFY must clear each event to be sure of receiving future notifications.

See Also

EnableCommNotification

WM_COMPACTING (3.0)

```
WM_COMPACTING
wCompactRatio = wParam;  /* compacting ratio */
```

The WM_COMPACTING message is sent to all top-level windows when Windows detects that more than 12.5 percent of system time over a 30- to 60-second interval is being spent compacting memory. This indicates that system memory is low.

Parameter	Description
wCompactRatio	Value of *wParam.* Specifies the ratio of central processing unit (CPU) time currently spent by Windows compacting memory to CPU time currently spent by Windows performing other operations. For example, 0x8000 represents 50 percent of CPU time spent compacting memory.

Returns

An application should return zero if it processes this message.

Comments

When an application receives this message, it should free as much memory as possible, taking into account the current level of activity of the application and the total number of applications running with Windows. The application can call the **GetNumTasks** function to determine how many applications are running.

See Also

GetNumTasks

WM_COMPAREITEM (3.0)

```
WM_COMPAREITEM
idCtl = wParam;                              /* control identifier */
lpcis = (const COMPAREITEMSTRUCT FAR*) lParam; /* structure     */
```

The WM_COMPAREITEM message determines the relative position of a new item in the sorted list of an owner-drawn combo box or list box. Whenever the application adds a new item, Windows sends this message to the owner of a combo box or list box created with the **CBS_SORT** or **LBS_SORT** style.

Parameter	Description
idCtl	Value of *wParam.* Specifies the identifier of the control that sent the WM_COMPAREITEM message.
lpcis	Value of *lParam.* Points to a **COMPAREITEMSTRUCT** data structure that contains the identifiers and application-supplied data for two items in the combo box or list box.

Returns

The return value indicates the relative position of the two items. It may be any of the following values:

Value	Meaning
-1	Item 1 precedes item 2 in the sorted order.
0	Item 1 and item 2 are equivalent in the sorted order.
1	Item 1 follows item 2 in the sorted order.

Comments

When the owner of an owner-drawn combo box or list box receives this message, the owner returns a value indicating which of the items specified in the **COMPAREITEMSTRUCT** structure should appear before the other. Typically, Windows sends this message several times until it determines the exact position for the new item.

See Also

COMPAREITEMSTRUCT

Windows 3.1 changes

The meaning of the *wParam* parameter has changed. The *wParam* parameter specifies the identifier of the control.

WM_COPY (2.x)

```
WM_COPY
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends a WM_COPY message to an edit control or combo box to copy the current selection to the clipboard in CF_TEXT format.

Parameters

This message has no parameters.

Returns

The return value is nonzero if this message is sent to an edit control or a combo box.

Example

This example sends an **EM_SETSEL** message to select the entire contents of an edit control. It then sends a WM_COPY message to copy the contents of the edit control to the clipboard.

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_SETSEL, 0, MAKELONG(0, -1));
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    WM_COPY, 0, 0);
```

See Also

WM_CLEAR, **WM_CUT**, **WM_PASTE**

WM_CREATE (2.x)

```
WM_CREATE
lpcs = (CREATESTRUCT FAR*) lParam;      /* structure address          */
```

The WM_CREATE message is sent when an application requests that a window be created by calling the **CreateWindowEx** or **CreateWindow** function. The window procedure for the new window receives this message after the window is created but before the window becomes visible. The message is sent to the window before the **CreateWindowEx** or **CreateWindow** function returns.

Parameter	Description
lpcs	Value of *lParam.* Points to a **CREATESTRUCT** data structure containing information about the window being created. The members of the **CREATESTRUCT** structure are identical to the parameters of the **CreateWindowEx** function.

Returns

If an application processes this message, it should return 0 to continue creation of the window. If the application returns -1, the window will be destroyed and the **CreateWindowEx** or **CreateWindow** function will return a NULL handle.

See Also

CreateWindow, **CreateWindowEx**, **WM_NCCREATE**, **CREATESTRUCT**

WM_CTLCOLOR (2.x)

```
WM_CTLCOLOR
hdcChild = (HDC) wParam;            /* child-window display context */
hwndChild = (HWND) LOWORD(lParam);  /* handle of child window       */
nCtlType = (int) HIWORD(lParam);    /* type of control              */
```

The WM_CTLCOLOR message is sent to the parent of a system-defined control class or a message box when the control or message box is about to be drawn. The following controls send this message:

Combo boxes
Edit controls
List boxes
Buttons
Static controls
Scroll bars

Parameter	Description
hdcChild	Value of *wParam.* Identifies the display context for the child window.
hwndChild	Value of the low-order word of *lParam.* Identifies the child window.
nCtlType	Value of the high-order word of *lParam.* Specifies the type of the control. This parameter can be one of the following values:

Value	Meaning
CTLCOLOR_BTN	Button
CTLCOLOR_DLG	Dialog box
CTLCOLOR_EDIT	Edit control
CTLCOLOR_LISTBOX	List box
CTLCOLOR_MSGBOX	Message box
CTLCOLOR_SCROLLBAR	Scroll bar
CTLCOLOR_STATIC	Static control

Returns

If an application processes the WM_CTLCOLOR message, it must return a handle to the brush that is to be used for painting the control background or it must return NULL.

Comments

The WM_CTLCOLOR message is sent to the parent window for all control types except dialog boxes. When the *nCtlType* parameter specifies CTLCOLOR_DLG, the message is sent to the dialog box procedure.

To change the text color, the application should call the **SetTextColor** function with the desired red, green, and blue (**RGB**) values.

To change the background color of a single-line edit control, the application must set the brush handle in both the CTLCOLOR_EDIT and CTLCOLOR_MSGBOX message codes, and the application must call the **SetBkColor** function in response to the CTLCOLOR_EDIT code.

The return value from this message has no effect on a button with the **BS_PUSHBUTTON** or **BS_DEFPUSHBUTTON** style.

To change the color of the list box for a drop-down combo box, applications should subclass the combo box and check for the WM_CTLCOLOR message with CTLCOLOR_LISTBOX in the *nCtlType* parameter. This procedure can return a handle to the brush that will be used to paint the background. In this case, the **SetBkColor** function must be used to set the background color for the text.

Example

This example creates a green brush and passes the handle of the brush to a single-line edit control in

response to a WM_CTLCOLOR message:

```
static HBRUSH hbrGreen;

switch(msg) {
    case WM_INITDIALOG:

        /* Create a green brush */

        hbrGreen = CreateSolidBrush(RGB(0, 255, 0));
        return TRUE;

    case WM_CTLCOLOR:
        switch(HIWORD(lParam)) {
            case CTLCOLOR_EDIT:

                /* Set text to white and background to green */

                SetTextColor((HDC) wParam, RGB(255, 255, 255));
                SetBkColor((HDC) wParam, RGB(0, 255, 0));
                return (LRESULT) hbrGreen;

            case CTLCOLOR_MSGBOX:

                /*
                 * For single-line edit controls, this code must be
                 * processed so that the background color of the format
                 * rectangle will also be painted with the new color.
                 */

                return (LRESULT) hbrGreen;
        }
        return (LRESULT) NULL;
}
```

See Also
SetBkColor

WM_CUT (2.x)

```
WM_CUT
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends a WM_CUT message to an edit control or combo box to delete (cut) the current selection, if any, in the edit control and copy the deleted text to the clipboard in CF_TEXT format.

Parameters

This message has no parameters.

Returns

The return value is nonzero if this message is sent to an edit control or a combo box.

Comments

An **EM_UNDO** message can be sent to the edit control to undo the deletion performed by the WM_CUT message.

To delete the current selection without placing the deleted text onto the clipboard, use the **WM_CLEAR** message.

Example

This example sends an **EM_SETSEL** message to select the entire contents of an edit control. It then sends a WM_CUT message to delete the contents of the edit control and to copy the deleted text to the clipboard.

```
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    EM_SETSEL, 0, MAKELONG(0, -1));
SendDlgItemMessage(hdlg, ID_MYEDITCONTROL,
    WM_CUT, 0, 0);
```

See Also

WM_CLEAR, **WM_COPY**, **WM_PASTE**

WM_DDE_ACK (2.x)

```
#include <dde.h>

WM_DDE_ACK
wParam = (WPARAM) hwnd;             /* handle of posting window      */
lParam = MAKELPARAM(wLow, wHigh);  /* depending on received message */
```

The WM_DDE_ACK message notifies an application of the receipt and processing of a **WM_DDE_INITIATE**, **WM_DDE_EXECUTE**, **WM_DDE_DATA**, **WM_DDE_ADVISE**, **WM_DDE_UNADVISE**, or **WM_DDE_POKE** message, and in some cases, of a **WM_DDE_REQUEST** message.

Parameter	Description
hwnd	Value of *wParam.* Specifies the handle of the window posting the message.
wLow	Value of the low-order word of *lParam.* Specifies data as follows, depending on the message to which the WM_DDE_ACK message is responding:

Message	Parameter	Description
WM_DDE_INITIATE	*aApplication*	An atom that contains the name of the replying application.
WM_DDE_EXECUTE and all other messages	*wStatus*	A series of flags that indicate the status of the response.

wHigh	Value of high-order word of *lParam.* Specifies data as follows, depending on the message to which the WM_DDE_ACK message is responding:

Message	Parameter	Description
WM_DDE_INITIATE	*aTopic*	An atom that contains the topic with which the replying server window is associated.
WM_DDE_EXECUTE	*hCommands*	A handle that identifies the data item containing the command string.
All other messages	*aItem*	An atom that specifies the data item for which the response is sent.

Returns

This message does not return a value.

Comments

The *wStatus* word consists of a **DDEACK** data structure.

Posting

Except in response to the **WM_DDE_INITIATE** message, the application posts the WM_DDE_ACK message by calling the **PostMessage** function, not the **SendMessage** function. When responding to WM_DDE_INITIATE, the application sends the WM_DDE_ACK message by calling **SendMessage**.

When acknowledging any message with an accompanying *aItem* atom, the application posting WM_DDE_ACK can either reuse the *aItem* atom that accompanied the original message or delete it and create a new one.

When acknowledging **WM_DDE_EXECUTE**, the application that posts WM_DDE_ACK should reuse the *hCommands* object that accompanied the original WM_DDE_EXECUTE message.

If an application has initiated the termination of a conversation by posting **WM_DDE_TERMINATE** and

is awaiting confirmation, the waiting application should not acknowledge (positively or negatively) any subsequent messages sent by the other application. The waiting application should delete any atoms or shared memory objects received in these intervening messages (but should not delete the atoms in response to the WM_DDE_ACK message).

Receiving

The application that receives WM_DDE_ACK should delete all atoms accompanying the message.

If the application receives WM_DDE_ACK in response to a message with an accompanying *hData* object, the application should delete the *hData* object.

If the application receives a negative WM_DDE_ACK message posted in reply to a **WM_DDE_ADVISE** message, the application should delete the *hOptions* object posted with the original WM_DDE_ADVISE message.

If the application receives a negative WM_DDE_ACK message posted in reply to a **WM_DDE_EXECUTE** message, the application should delete the *hCommands* object posted with the original WM_DDE_EXECUTE message.

See Also

DDEACK, **PostMessage**, **WM_DDE_ADVISE**, **WM_DDE_DATA**, **WM_DDE_EXECUTE**, **WM_DDE_INITIATE**, **WM_DDE_POKE**, **WM_DDE_REQUEST**, **WM_DDE_TERMINATE**, **WM_DDE_UNADVISE**, **DDEACK**

WM_DDE_ADVISE (2.x)

```
#include <dde.h>

WM_DDE_ADVISE
wParam = (WPARAM) hwnd;                /* handle of posting window   */
lParam = MAKELPARAM(hOptions, aItem); /* send options and data item */
```

A dynamic data exchange (DDE) client application posts the WM_DDE_ADVISE message to a DDE server application to request the server to supply an update for a data item whenever it changes.

Parameter	Description
hwnd	Value of *wParam.* Identifies the sending window.
hOptions	Value of the low-order word of *lParam.* Specifies a handle of a global memory object that specifies how the data is to be sent.
aItem	Value of the high-order word of *lParam.* Specifies the data item being requested.

Returns

This message does not return a value.

Comments

The global memory object identified by the *hOptions* parameter consists of a **DDEADVISE** data structure.

If an application supports more than one clipboard format for a single topic and item, it can post multiple WM_DDE_ADVISE messages for the topic and item, specifying a different clipboard format with each message.

Posting

The application posts the WM_DDE_ADVISE message by calling the **PostMessage** function, not the **SendMessage** function.

The application allocates *hOptions* by calling the **GlobalAlloc** function with the **GMEM_DDESHARE** option.

The application allocates *aItem* by calling the **GlobalAddAtom** function.

If the receiving (server) application responds with a negative **WM_DDE_ACK** message, the posting (client) application must delete the *hOptions* object.

Receiving

The application posts the **WM_DDE_ACK** message to respond positively or negatively. When posting WM_DDE_ACK, the application can reuse the *aItem* atom or delete it and create a new one. If the WM_DDE_ACK message is positive, the application should delete the *hOptions* object; otherwise, the application should not delete the object.

See Also

DDEADVISE, **GlobalAddAtom**, **GlobalAlloc**, **PostMessage**, **WM_DDE_DATA**, **WM_DDE_REQUEST**, **DDEADVISE**

WM_DDE_DATA (2.x)

```
#include <dde.h>

WM_DDE_DATA
wParam = (WPARAM) hwnd;              /* handle of posting window    */
lParam = MAKELPARAM(hData, aItem);  /* memory object and data item */
```

A dynamic data exchange (DDE) server application posts a WM_DDE_DATA message to a DDE client application to pass a data item to the client or to notify the client of the availability of a data item.

Parameter	Description
hwnd	Value of *wParam.* Specifies the handle of the window posting the message.
hData	Value of the low-order word of *lParam.* Identifies the global memory object containing the data and additional information. The handle should be set to NULL if the server is notifying the client that the data item value has changed during a warm link. A warm link is established when the client sends a **WM_DDE_ADVISE** message with the *fDeferUpd* bit set.
aItem	Value of the high-order word of *lParam.* Specifies the data item for which data or notification is sent.

Returns

This message does not return a value.

Comments

The global memory object identified by the *hData* parameter consists of a **DDEDATA** structure.

Posting

The application posts the WM_DDE_DATA message by calling the **PostMessage** function, not the **SendMessage** function.

The application allocates *hData* by calling the **GlobalAlloc** function with the **GMEM_DDESHARE** option.

The application allocates *aItem* by calling the **GlobalAddAtom** function.

If the receiving (client) application responds with a negative **WM_DDE_ACK** message, the posting (server) application must delete the *hData* object.

If the posting (server) application sets the **fRelease** member of the **DDEDATA** structure to FALSE, the posting application is responsible for deleting *hData* upon receipt of either a positive or negative acknowledgment.

The application should not set both the **fAckReq** and **fRelease** members of the **DDEDATA** structure to FALSE. If both members are set to FALSE, it is difficult for the posting (server) application to determine when to delete *hData.*

Receiving

If **fAckReq** is TRUE, the application posts the **WM_DDE_ACK** message to respond positively or negatively. When posting WM_DDE_ACK, the application can reuse the *aItem* atom or delete it and create a new one.

If **fAckReq** is FALSE, the application deletes the *aItem* atom.

If the posting (server) application specified *hData* as NULL, the receiving (client) application can request the server to send the actual data by posting a **WM_DDE_REQUEST** message.

After processing a WM_DDE_DATA message in which *hData* is not NULL, the application should delete *hData* unless either of the following conditions is true:

- The **fRelease** member is FALSE.
- The **fRelease** member is TRUE, but the receiving (client) application responds with a negative

WM_DDE_ACK message.

See Also
DDEDATA, **GlobalAddAtom**, **GlobalAlloc**, **PostMessage**, **WM_DDE_ACK**, **WM_DDE_ADVISE**, **WM_DDE_POKE**, **WM_DDE_REQUEST**

WM_DDE_EXECUTE (2.x)

```
#include <dde.h>

WM_DDE_EXECUTE
wParam = (WPARAM) hwnd;                    /* handle of posting window */
lParam = MAKELPARAM(reserved, hCommands); /* commands to execute      */
```

A dynamic data exchange (DDE) client application posts a WM_DDE_EXECUTE message to a DDE server application to send a string to the server to be processed as a series of commands. The server application is expected to post a **WM_DDE_ACK** message in response.

Parameter	Description
hwnd	Value of *wParam.* Identifies the sending window.
reserved	Value of the low-order word of *lParam.* Reserved; must be zero.
hCommands	Value of the high-order word of *lParam.* Identifies a global memory object containing the command(s) to be executed.

Returns
This message does not return a value.

Comments
The command string is a null-terminated string, consisting of one or more *opcode* strings enclosed in single brackets ([ ]) and separated by spaces.

Each *opcode* string has the following syntax. The *parameters* list is optional.

opcode parameters

The *opcode* is any application-defined single token. It cannot include spaces, commas, parentheses, or quotation marks.

The *parameters* list can contain any application-defined value or values. Multiple parameters are separated by commas, and the entire parameter list is enclosed in parentheses. Parameters cannot include commas or parentheses except inside a quoted string. If a bracket or parenthesis character is to appear in a quoted string, it must be doubled--for example, "((".

The following are valid command strings:

```
[connect][download(query1,results.txt)][disconnect]
[query("sales per employee for each district")]
[open("sample.xlm")][run("r1c1")]
```

Posting

The application posts the WM_DDE_EXECUTE message by calling the **PostMessage** function, not the **SendMessage** function.

The application allocates *hCommands* by calling the **GlobalAlloc** function with the **GMEM_DDESHARE** option.

When processing a **WM_DDE_ACK** message posted in reply to a WM_DDE_EXECUTE message, the application that posted the original WM_DDE_EXECUTE message must delete the *hCommands* object sent back in the WM_DDE_ACK message.

Receiving

The application posts the **WM_DDE_ACK** message to respond positively or negatively, reusing the *hCommands* object.

See Also
PostMessage, **WM_DDE_ACK**

WM_DDE_INITIATE (2.x)

```
#include <dde.h>

WM_DDE_INITIATE
wParam = (WPARAM) hwnd;                      /* sending window's handle */
lParam = MAKELPARAM(aApplication, aTopic); /* app. and topic atoms    */
```

A dynamic data exchange (DDE) client application sends a WM_DDE_INITIATE message to initiate a conversation with server applications responding to the specified application and topic names.

Upon receiving this message, all server applications with names that match the *aApplication* application and that support the *aTopic* topic are expected to acknowledge it (see the **WM_DDE_ACK** message).

Parameter	Description
hwnd	Value of *wParam.* Identifies the sending window.
aApplication	Value of the low-order word of *lParam.* Specifies the atom identifying the name of the application with which a conversation is requested. The application name cannot contain slash marks (/) or backslashes (\). These characters are reserved for future use in network implementations. If *aApplication* is NULL, a conversation with all applications is requested.
aTopic	Value of the high-order word of *lParam.* Specifies the atom identifying the the topic for which a conversation is requested. If the topic is NULL, a conversation for all available topics is requested.

Returns
This message does not return a value.

Comments
If *aApplication* is NULL, any application can respond. If *aTopic* is NULL, any topic is valid. Upon receiving a WM_DDE_INITIATE request with the *aTopic* parameter set to NULL, an application is expected to send a **WM_DDE_ACK** message for each of the topics it supports.

Sending

The application sends the WM_DDE_INITIATE message by calling the **SendMessage** function, not the **PostMessage** function. The application broadcasts the message to all windows by setting the first parameter of **SendMessage** to -1, as shown:

```
SendMessage(-1, WM_DDE_INITIATE, hwndClient, MAKELONG(aApp, aTopic));
```

If the application has already obtained the window handle of the desired server, it can send WM_DDE_INITIATE directly to the server window by passing the server's window handle as the first parameter of **SendMessage**.

The application allocates *aApplication* and *aTopic* by calling **GlobalAddAtom**.

When **SendMessage** returns, the application deletes the *aApplication* and *aTopic* atoms.

Receiving

To complete the initiation of a conversation, the application responds with one or more **WM_DDE_ACK** messages, where each message is for a separate topic. When sending a WM_DDE_ACK message, the application creates new *aApplication* and *aTopic* atoms; it should not reuse the atoms sent with the WM_DDE_INITIATE message.

See Also
GlobalAddAtom, **SendMessage**, **WM_DDE_ACK**

WM_DDE_POKE (2.x)

```
#include <dde.h>

WM_DDE_POKE
wParam = (WPARAM) hwnd;              /* handle of posting window */
lParam = MAKELPARAM(hData, aItem);  /* data handle and item     */
```

A dynamic data exchange (DDE) client application posts a WM_DDE_POKE message to a server application. A client uses this message to request the server to accept an unsolicited data item. The server is expected to reply with a **WM_DDE_ACK** message indicating whether it accepted the data item.

Parameter	Description
hwnd	Value of *wParam.* Specifies the handle of the window posting the message.
hData	Value of the low-order word of *lParam.* Identifies the data being posted. The handle identifies a global memory object that contains a **DDEPOKE** data structure.
aItem	Value of the high-order word of *lParam.* Specifies a global atom that identifies the data item being offered to the server.

Returns

This message does not return a value.

Comments

Posting

The posting (client) application should do the following:

- Use the **PostMessage** function to post the WM_DDE_POKE message.
- Use the **GlobalAlloc** function with the **GMEM_DDESHARE** option to allocate memory for the data.
- Use the **GlobalAddAtom** function to create the atom for the data item.
- Delete the global memory object if the server application responds with a negative **WM_DDE_ACK** message.
- Delete the global memory object if the client has set the **fRelease** member of the **DDEPOKE** structure to FALSE and the server responds with either a positive or negative WM_DDE_ACK.

Receiving

The receiving (server) application should do the following:

- Post the **WM_DDE_ACK** message to respond positively or negatively. When posting WM_DDE_ACK, reuse the data-item atom or delete it and create a new one.
- Delete the global memory object after processing WM_DDE_POKE unless either the **fRelease** flag was set to FALSE or the **fRelease** flag was set to TRUE but the server has responded with a negative **WM_DDE_ACK** message.

See Also

DDEPOKE, **GlobalAlloc**, **PostMessage**, **WM_DDE_ACK**, **WM_DDE_DATA**, **DDEPOKE**

WM_DDE_REQUEST (2.x)

```
#include <dde.h>

WM_DDE_REQUEST
wParam = (WPARAM) hwnd;                /* handle of posting window  */
lParam = MAKELPARAM(cfFormat, aItem); /* clipboard format and item */
```

A dynamic data exchange (DDE) client application posts a WM_DDE_REQUEST message to a DDE server application to request the value of a data item.

Parameter	Description
hwnd	Value of *wParam.* Identifies the sending window.
cfFormat	Value of the low-order word of *lParam.* Specifies a standard or registered clipboard format number.
aItem	Value of the high-order word of *lParam.* Specifies which data item is being requested from the server.

Returns
This message does not return a value.

Comments
Posting

The application posts the WM_DDE_REQUEST message by calling the **PostMessage** function, not the **SendMessage** function.

The application allocates *aItem* by calling the **GlobalAddAtom** function.

Receiving

If the receiving (server) application can satisfy the request, it responds with a **WM_DDE_DATA** message containing the requested data. Otherwise, it responds with a negative **WM_DDE_ACK** message.

When responding with either a **WM_DDE_DATA** or **WM_DDE_ACK** message, the application can reuse the *aItem* atom or delete it and create a new one.

See Also
GlobalAddAtom, **PostMessage**, **WM_DDE_ACK**

WM_DDE_TERMINATE (2.x)

```
#include <dde.h>

WM_DDE_TERMINATE
wParam = (WPARAM) hwnd; /* handle of posting window */
lParam = 0L;            /* not used, must be zero   */
```

A dynamic data exchange (DDE) application (client or server) posts a WM_DDE_TERMINATE message to terminate a conversation.

Parameter	Description
hwnd	Value of *wParam.* Identifies the sending window.

Returns

This message does not return a value.

Comments

Posting

The application posts the WM_DDE_TERMINATE message by calling the **PostMessage** function, not the **SendMessage** function.

While waiting for confirmation of the termination, the posting application should not acknowledge any other messages sent by the receiving application. If the posting application receives messages (other than WM_DDE_TERMINATE) from the receiving application, it should delete any atoms or shared memory objects accompanying the messages.

Receiving

The application responds by posting a WM_DDE_TERMINATE message.

See Also

PostMessage

WM_DDE_UNADVISE (2.x)

```
#include <dde.h>

WM_DDE_UNADVISE
wParam = (WPARAM) hwnd;                  /* handle of posting window   */
lParam = MAKELPARAM(cfFormat, aItem);    /* clipboard format and item  */
```

A dynamic data exchange (DDE) client application posts a WM_DDE_UNADVISE message to inform a server application that the specified item or a particular clipboard format for the item should no longer be updated. This terminates the warm or hot link for the specified item.

Parameter	Description
hwnd	Value of *wParam.* Identifies the sending window.
cfFormat	Value of the low-order word of *lParam.* Specifies the clipboard format of the item for which the update request is being retracted. When the *cfFormat* parameter is NULL, all active **WM_DDE_ADVISE** conversations for the item are to be terminated.
aItem	Value of the high-order word of *lParam.* Specifies the item for which the update request is being retracted. When *aItem* is NULL, all active **WM_DDE_ADVISE** conversations associated with the client are to be terminated.

Returns

This message does not return a value.

Comments

Posting

The application posts the WM_DDE_UNADVISE message by calling the **PostMessage** function, not the **SendMessage** function.

The application allocates *aItem* by calling the **GlobalAddAtom** function.

Receiving

The application posts the **WM_DDE_ACK** message to respond positively or negatively. When posting WM_DDE_ACK, the application can reuse the *aItem* atom or delete it and create a new one.

See Also

GlobalAddAtom, **PostMessage**, **WM_DDE_ACK**

WM_DEADCHAR (2.x)

```
WM_DEADCHAR
chDeadKey = wParam;          /* dead-key character */
dwKeyData = (DWORD) lParam;  /* key data           */
```

The WM_DEADCHAR message is sent when a **WM_KEYUP** message and a **WM_KEYDOWN** message are translated. It specifies the character value of a dead key. A dead key is a key, such as the umlaut (double-dot) character, that is combined with other characters to form a composite character. For example, the umlaut-O character consists of the dead key, umlaut, and the O key.

Parameter	Description
chDeadKey	Value of *wParam.* Specifies the dead-key character value.
dwKeyData	Value of *lParam.* Specifies the repeat count, scan code, extended key, context code, previous key state, and key-transition state, as shown in the following table:

Bit	Description
0-15	Specifies the repeat count. The value is the number of times the keystroke is repeated as a result of the user holding down the key.
16-23	Specifies the scan code. The value depends on the original equipment manufacturer (OEM).
24	Specifies whether the key is an extended key, such as a function key or a key on the numeric keypad. The value is 1 if it is an extended key; otherwise, it is 0.
25-26	Not used.
27-28	Used internally by Windows.
29	Specifies the context code. The value is 1 if the ALT key is held down while the key is pressed; otherwise, the value is 0.
30	Specifies the previous key state. The value is 1 if the key is down before the message is sent, or it is 0 if the key is up.
31	Specifies the key-transition state. The value is 1 if the key is being released, or it is 0 if the key is being pressed.

Returns

An application should return zero if it processes this message.

Comments

An application typically uses the WM_DEADCHAR message to give the user feedback about each key pressed. For example, an application can display the accent in the current character position without moving the caret.

Because there is not necessarily a one-to-one correspondence between keys pressed and character messages generated, the information in the high-order word of the *dwKeyData* parameter is usually not useful to applications. The information in the high-order word applies only to the most recent **WM_KEYUP** or **WM_KEYDOWN** message that precedes the posting of the character message.

For IBM Enhanced 101- and 102-key keyboards, enhanced keys are the right ALT key and the right CTRL key on the main section of the keyboard; the INS, DEL, HOME, END, PAGE UP, PAGE DOWN, and arrow keys in the clusters to the left of the numeric keypad; and the division (*/*) and ENTER keys on the numeric keypad. Some other keyboards may support the extended-key bit in the *dwKeyData* parameter.

See Also

WM_KEYDOWN

WM_DELETEITEM (3.0)

```
WM_DELETEITEM
idCtl = wParam;                              /* control identifier */
lpdis = (const DELETEITEMSTRUCT FAR*) lParam; /* structure      */
```

The WM_DELETEITEM message is sent to the owner of an owner-drawn list box or combo box when the list box or combo box is destroyed or when items are removed by the **LB_DELETESTRING**, **LB_RESETCONTENT**, **CB_DELETESTRING**, or **CB_RESETCONTENT** message.

Parameter	Description
idCtl	Value of *wParam.* Specifies the identifier of the control that sent the WM_DELETEITEM message.
lpdis	Value of *lParam.* Points to a **DELETEITEMSTRUCT** structure that contains information about the item deleted from the list box.

Returns

An application should return TRUE if it processes this message.

See Also

CB_DELETESTRING, **CB_RESETCONTENT**, **LB_DELETESTRING**, **LB_RESETCONTENT**, **DELETEITEMSTRUCT**

Windows 3.1 changes

The meaning of the *wParam* parameter has changed. The *wParam* parameter specifies the identifier of the control.

WM_DESTROY (2.x)

```
WM_DESTROY
```

The WM_DESTROY message is sent when a window is being destroyed. It is sent to the window procedure of the window being destroyed after the window is removed from the screen.

This message is sent first to the window being destroyed and then to the child windows as they are destroyed. During the processing of the WM_DESTROY message, it can be assumed that all child windows still exist.

Parameters

This message has no parameters.

Returns

An application should return zero if it processes this message.

Comments

If the window being destroyed is part of the clipboard-viewer chain (set by calling the **SetClipboardViewer** function), the window must remove itself from the clipboard-viewer chain by calling the **ChangeClipboardChain** function before returning from the WM_DESTROY message.

Example

This example processes the WM_DESTROY message by calling the **PostQuitMessage** function:

```
case WM_DESTROY:
    PostQuitMessage(0);
    return 0L;
```

See Also

ChangeClipboardChain, **DestroyWindow**, **PostQuitMessage**, **SetClipboardViewer**, **WM_CLOSE**

WM_DESTROYCLIPBOARD (2.x)

```
WM_DESTROYCLIPBOARD
```

The WM_DESTROYCLIPBOARD message is sent to the clipboard owner when the clipboard is emptied by a call to the **EmptyClipboard** function.

Parameters

This message has no parameters.

Returns
An application should return zero if it processes this message.

See Also
EmptyClipboard

WM_DEVMODECHANGE (2.x)

```
WM_DEVMODECHANGE
lpszDev = (LPCSTR) lParam;  /* address of device name */
```

The WM_DEVMODECHANGE message is sent to all top-level windows when the default device-mode settings have changed.

Parameter	Description
lpszDev	Value of *lParam.* Points to the device name specified in the Windows initialization file, WIN.INI.

Returns

An application should return zero if it processes this message.

Comments

Applications that receive this message may reinitialize their device-mode settings. Applications that use the **ExtDeviceMode** function to save and restore device settings typically do not process this message.

This message is not sent when the user changes the default printer from Control Panel. In this case, a **WM_WININICHANGE** message is generated.

See Also

ExtDeviceMode, **WM_WININICHANGE**

WM_DRAWCLIPBOARD (2.x)

```
WM_DRAWCLIPBOARD
```

The WM_DRAWCLIPBOARD message is sent to the first window in the clipboard-viewer chain when the contents of the clipboard change. Only applications that have joined the clipboard-viewer chain by calling the **SetClipboardViewer** function need to process this message.

Parameters

This message has no parameters.

Returns

An application should return zero if it processes this message.

Comments

Each window that receives the WM_DRAWCLIPBOARD message should call the **SendMessage** function to pass the message on to the next window in the clipboard-viewer chain. The handle of the next window is returned by the **SetClipboardViewer** function; the handle may be modified in response to a **WM_CHANGECBCHAIN** message.

See Also

SendMessage, **SetClipboardViewer**, **WM_CHANGECBCHAIN**

WM_DRAWITEM (3.0)

```
WM_DRAWITEM
idCtl = (int) wParam;                       /* control identifier */
lpdis = (const DRAWITEMSTRUCT FAR*) lParam;    /* structure     */
```

The WM_DRAWITEM message is sent to the owner of an owner-drawn button, combo box, list box, or menu when a visual aspect of the button, combo box, list box, or menu has changed.

Parameter	Description
idCtl	Value of *wParam.* Specifies the identifier of the control that sent the WM_DRAWITEM message. This parameter is zero if the message was sent by a menu.
lpdis	Value of *lParam.* Points to a **DRAWITEMSTRUCT** structure that contains information about the item to be drawn and the type of drawing required.

Returns

An application should return TRUE if it processes this message.

Comments

The **itemAction** member of the **DRAWITEMSTRUCT** structure defines the drawing operation that is to be performed. The data in this member allows the owner of the control to determine what drawing action is required.

Before returning from processing this message, an application should ensure that the device context identified by the *hDC* member of the **DRAWITEMSTRUCT** structure is in the default state.

Example

This example shows how to process the WM_DRAWITEM message:

```
LPDRAWITEMSTRUCT lpdis;

case WM_DRAWITEM:
    lpdis = (DRAWITEMSTRUCT FAR*) lParam;

    switch (lpdis->itemAction) {

        case ODA_DRAWENTIRE:
            .
            . /* Redraw the entire control or menu. */
            .
            return TRUE;

        case ODA_SELECT:
            .
            . /* Redraw to reflect current selection state. */
            .
            return TRUE;

        case ODA_FOCUS:
            .
            . /* Redraw to reflect current focus state. */
            .
            return TRUE;
    }
    break;
```

See Also

WM_COMPAREITEM, **WM_DELETEITEM**, **WM_INITDIALOG**, **WM_MEASUREITEM**,

DRAWITEMSTRUCT

Windows 3.1 changes

The meaning of the *wParam* parameter has changed. If a control sends the WM_DRAWITEM message, the *wParam* parameter specifies the identifier of the control. If a menu sends the message, *wParam* is zero.

WM_DROPFILES (3.1)

```
WM_DROPFILES
hDrop = (HANDLE) wParam;    /* handle of internal drop structure */
```

The WM_DROPFILES message is sent when the user releases the left mouse button over the window of an application that has registered itself as a recipient of dropped files.

Parameter	Description
hDrop	Value of *wParam.* Identifies an internal data structure describing the dropped files. This handle is valid only during the processing of the WM_DROPFILES message; if an application needs to use the data later, it must allocate memory and save the data. This handle is used by the **DragFinish**, **DragQueryFile**, and **DragQueryPoint** functions to retrieve information about the dropped files.

Returns

An application should return zero if it processes this message.

Comments

This message is posted, not sent.

See Also

DragAcceptFiles, **DragFinish**, **DragQueryFile**, **DragQueryPoint**

WM_ENABLE (2.x)

```
WM_ENABLE
fEnabled = (BOOL) wParam;     /* the enabled/disabled flag */
```

The WM_ENABLE message is sent when an application changes the enabled state of a window. It is sent to the window whose enabled state is changing. This message is sent before the **EnableWindow** function returns but after the enabled state (WS_DISABLE style bit) of the window has changed.

Parameter	Description
fEnabled	Value of *wParam.* Specifies whether the window has been enabled or disabled. This parameter is TRUE if the window has been enabled; it is FALSE if the window has been disabled.

Returns

An application should return zero if it processes this message.

See Also

EnableWindow

WM_ENDSESSION (2.x)

```
WM_ENDSESSION
fEndSession = (BOOL) wParam;     /* end-session flag */
```

The WM_ENDSESSION message is sent to an application that has returned a nonzero value in response to a **WM_QUERYENDSESSION** message. The WM_ENDSESSION message informs the application whether the session is actually ending.

Parameter	Description
fEndSession	Value of *wParam.* Specifies whether the session is being ended. It is TRUE if the session is being ended; otherwise, it is FALSE.

Returns

An application should return zero if it processes this message.

Comments

If the *fEndSession* parameter is TRUE, Windows can terminate any time after all applications have returned from processing this message. Therefore, an application should perform all tasks required for termination before returning from this message.

The application does not need to call the **DestroyWindow** or **PostQuitMessage** function when the session is ending.

See Also

DestroyWindow, **ExitWindows**, **PostQuitMessage**, **WM_QUERYENDSESSION**

WM_ENTERIDLE (2.x)

```
WM_ENTERIDLE
fwSource = wParam;                  /* idle-source flag               */
hwndDlg = (HWND) LOWORD(lParam);    /* handle of dialog box or window */
```

The WM_ENTERIDLE message informs an application's main window procedure that a modal dialog box or a menu is entering an idle state. A modal dialog box or menu enters an idle state when no messages are waiting in its queue after it has processed one or more previous messages.

Parameter	Description
fwSource	Value of *wParam.* Specifies whether the message is the result of a dialog box or a menu being displayed. This parameter can be one of the following values:
hwndDlg	Value of the low-order word of *lParam.* Identifies the dialog box (if *fwSource* is MSGF_DIALOGBOX) or the handle of the window containing the displayed menu (if *fwSource* is MSGF_MENU).

Value	Description
MSGF_DIALOGBOX	The system is idle because a dialog box is being displayed.
MSGF_MENU	The system is idle because a menu is being displayed.

Returns

An application should return zero if it processes this message.

Comments

The **DefWindowProc** function returns zero when it processes this message.

See Also

DefWindowProc

WM_ERASEBKGND (2.x)

```
WM_ERASEBKGND
hdc = (HDC) wParam; /* device-context handle */
```

The WM_ERASEBKGND message is sent when the window background needs to be erased (for example, when a window is resized). It is sent to prepare an invalidated region for painting.

Parameter	Description
hdc	Value of *wParam.* Identifies the device context.

Returns
An application should return nonzero if it erases the background; otherwise, it should return zero.

Comments
The **DefWindowProc** function erases the background by using the class background brush specified by the **hbrbackground** member of the **WNDCLASS** structure.

If the **hbrbackground** member is NULL, the application should process the WM_ERASEBKGND message and erase the background color. When processing the WM_ERASEBKGND message, the application must align the origin of the intended brush with the window coordinates by first calling the **UnrealizeObject** function for the brush and then selecting the brush.

An application should return nonzero in response to WM_ERASEBKGND if it processes the message and erases the background; this indicates that no futher erasing is required. If the app returns zero the window will remain marked as needing to be erased. (Typically, this means that the **fErase** member of the **PAINTSTRUCT** structure will be TRUE.)

Windows computes the background by using the MM_TEXT mapping mode. If the device context is using any other mapping mode, the area erased may not be within the visible part of the client area.

See Also
UnrealizeObject, **WM_ICONERASEBKGND**

WM_FONTCHANGE (2.x)

```
WM_FONTCHANGE
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends the WM_FONTCHANGE message to all top-level windows in the system after changing the pool of font resources.

Parameters

This message has no parameters.

Returns

An application should return zero if it processes this message.

Comments

An application that adds or removes fonts from the system (for example, by using the **AddFontResource** or **RemoveFontResource** function) should send this message to all top-level windows.

To send the WM_FONTCHANGE message to all top-level windows, an application can call the **SendMessage** function with the *hwnd* parameter set to HWND_BROADCAST.

See Also

AddFontResource, **RemoveFontResource**, **SendMessage**

WM_GETDLGCODE (2.x)

`WM_GETDLGCODE`

The WM_GETDLGCODE message is sent to the dialog box procedure associated with a control. Normally, Windows handles all arrow-key and TAB-key input to the control. By responding to the WM_GETDLGCODE message, an application can take control of a particular type of input and process the input itself.

Parameters

This message has no parameters.

Returns

The return value is any combination of the following values, indicating which type of input the application processes:

Value	Meaning
DLGC_BUTTON	Button (generic)
DLGC_DEFPUSHBUTTON	Default push button
DLGC_HASSETSEL	**EM_SETSEL** messages
DLGC_UNDEFPUSHBUTTON	No default push button processing. (An application can use this flag with DLGC_BUTTON to indicate that it processes button input but relies on the system for default push-button processing.)
DLGC_RADIOBUTTON	Radio button
DLGC_STATIC	Static control
DLGC_WANTALLKEYS	All keyboard input
DLGC_WANTARROWS	Arrow keys
DLGC_WANTCHARS	**WM_CHAR** messages
DLGC_WANTMESSAGE	All keyboard input (the application passes this message on to the control)
DLGC_WANTTAB	TAB key

Comments

Although the **DefWindowProc** function always returns zero in response to the WM_GETDLGCODE message, the window procedures for the predefined control classes return a code appropriate for each class.

The WM_GETDLGCODE message and the returned values are useful only with user-defined dialog box controls or standard controls modified by subclassing.

See Also

DefWindowProc

WM_GETFONT (3.0)

```
WM_GETFONT
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends a WM_GETFONT message to a control to retrieve the font with which the control is currently drawing its text.

Parameters

This message has no parameters.

Returns

The return value is the handle of the font used by the control, or it is NULL if the control is using the system font.

See Also

WM_SETFONT

WM_GETMINMAXINFO (2.x)

```
WM_GETMINMAXINFO
lpmmi = (MINMAXINFO FAR*) lParam; /* address of structure */
```

The WM_GETMINMAXINFO message is sent to a window whenever Windows needs the maximized position or dimensions of the window or needs the maximum or minimum tracking size of the window. The maximized size of a window is the size of the window when its borders are fully extended. The maximum tracking size of a window is the largest window size that can be achieved by using the borders to size the window. The minimum tracking size of a window is the smallest window size that can be achieved by using the borders to size the window.

Windows fills in a **MINMAXINFO** data structure, specifying default values for the various positions and dimensions. The application may change these values if it processes this message.

Parameter	Description
lpmmi	Value of *lParam.* Points to a **MINMAXINFO** data structure.

Returns

An application should return zero if it processes this message.

Example

This example processes a WM_GETMINMAXINFO message and sets the minimum tracking width of the window to 200 and the minimum tracking height of the window to 500:

```
MINMAXINFO FAR* lpmmi;

case WM_GETMINMAXINFO:
    lpmmi = (MINMAXINFO FAR*) lParam;
    lpmmi->ptMinTrackSize.x = 200;
    lpmmi->ptMinTrackSize.y = 500;

    break;
```

See Also

MINMAXINFO

WM_GETTEXT (2.x)

```
WM_GETTEXT
wParam = (WPARAM) cchTextMax;   /* number of bytes to copy    */
lParam = (LPARAM) lpszText;     /* address of buffer for text */
```

An application sends a WM_GETTEXT message to copy the text that corresponds to a window into a buffer provided by the caller.

Parameter	Description
cchTextMax	Value of *wParam.* Specifies the maximum number of bytes to be copied, including the terminating null character.
lpszText	Value of *lParam.* Points to the buffer that is to receive the text.

Returns

The return value is the number of bytes copied. It is CB_ERR if the message is sent to a combo box that has no edit control.

Comments

For an edit control, the text to be copied is the contents of the edit control. For a combo box, the text is the contents of the edit-control (or static-text) portion of the combo box. For a button, the text is the button name. For other windows, the text is the window title. To copy the text of an item in a list box, an application can use the **LB_GETTEXT** message.

When the WM_GETTEXT message is sent to a static control with the **SS_ICON** style, the handle of the icon will be returned in the first two bytes of the buffer pointed to by *lpszText.* This is true only if the **WM_SETTEXT** message has been used to set the icon.

Example

This example copies text from an edit control to a buffer:

```
HWND hwndMyEdit;
char szBuffer[32];

hwndMyEdit = GetDlgItem(hdlg, ID_MYEDITCONTROL);
SendMessage(hwndMyEdit, WM_GETTEXT, sizeof(szBuffer),
    (LPARAM) ((LPSTR) szBuffer));
```

See Also

LB_GETTEXT, **WM_GETTEXTLENGTH**, **WM_SETTEXT**

WM_GETTEXTLENGTH (2.x)

```
WM_GETTEXTLENGTH
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends a WM_GETTEXTLENGTH message to determine the length, in bytes, of the text associated with a window. The length does not include the terminating null character.

Parameters

This message has no parameters.

Returns

The return value is a word specifying the length, in bytes, of the text.

Comments

For an edit control, the text to be copied is the contents of the edit control. For a combo box, the text is the contents of the edit-control (or static-text) portion of the combo box. For a button, the text is the button name. For other windows, the text is the window title. To determine the length of an item in a list box, an application can use the **LB_GETTEXTLEN** message.

Example

This example enables the push button in a dialog box if the user has entered text in an edit control in the dialog box:

```
case ID_MYEDITCONTROL:
    if (HIWORD(lParam) == EN_CHANGE)
        EnableWindow(GetDlgItem(hdlg, IDOK),
            (BOOL) SendMessage((HWND) LOWORD(lParam),
            WM_GETTEXTLENGTH, 0, 0L));
    return TRUE;
```

See Also

LB_GETTEXTLEN, **WM_GETTEXT**

WM_HSCROLL (2.x)

```
WM_HSCROLL
wScrollCode = wParam;      /* scroll bar code                */
nPos = LOWORD(lParam);     /* current position of scroll box */
hwndCtl = (HWND) HIWORD(lParam); /* handle of the control    */
```

The WM_HSCROLL message is sent to a window when the user clicks the window's horizontal scroll bar.

Parameter	Description
wScrollCode	Value of *wParam.* Specifies a scroll bar code that indicates the user's scrolling request. This parameter can be one of the following values:

Value	Description
SB_BOTTOM	Scroll to bottom.
SB_ENDSCROLL	End scroll.
SB_LINEDOWN	Scroll one line down.
SB_LINEUP	Scroll one line up.
SB_PAGEDOWN	Scroll one page down.
SB_PAGEUP	Scroll one page up.
SB_THUMBPOSITION	Scroll to absolute position. The current position is specified by the *nPos* parameter.
SB_THUMBTRACK	Drag scroll box (thumb) to specified position. The current position is specified by the *nPos* parameter.
SB_TOP	Scroll to top.

nPos	Value of the low-order word of *lParam.* Specifies the current position of the scroll box if the *wScrollCode* parameter is SB_THUMBPOSITION or SB_THUMBTRACK; otherwise, the *nPos* parameter is not used.
hwndCtl	Value of the high-order word of *lParam.* Identifies the control if WM_HSCROLL is sent by a scroll bar. If WM_HSCROLL is sent as a result of the user clicking a pop-up window's scroll bar, the high-order word is not used.

Returns

An application should return zero if it processes this message.

Comments

The SB_THUMBTRACK scroll bar code typically is used by applications that give some feedback while the scroll box is being dragged.

If an application scrolls the contents of the window, it must also reset the position of the scroll box by using the **SetScrollPos** function.

See Also

SetScrollPos, **WM_VSCROLL**

WM_HSCROLLCLIPBOARD (2.x)

```
WM_HSCROLLCLIPBOARD
hwndCBViewer = (HWND) wParam;   /* handle of clipboard viewer */
wScrollCode = LOWORD(lParam);   /* scroll bar code            */
nPos = (int) HIWORD(lParam);    /* scroll box position        */
```

The WM_HSCROLLCLIPBOARD message is sent by the clipboard viewer to the clipboard owner when the clipboard data has the CF_OWNERDISPLAY format and an event occurs in the clipboard viewer's horizontal scroll bar. The owner should scroll the clipboard image, invalidate the appropriate section, and update the scroll bar values.

Parameter	Description
hwndCBViewer	Value of *wParam.* Identifies a clipboard-viewer window.
wScrollCode	Value of the low-order word of *lParam.* Specifies a scroll bar code. This parameter can be one of the following values:

Value	Description
SB_BOTTOM	Scroll to lower right.
SB_ENDSCROLL	End scroll.
SB_LINEDOWN	Scroll one line down.
SB_LINEUP	Scroll one line up.
SB_PAGEDOWN	Scroll one page down.
SB_PAGEUP	Scroll one page up.
SB_THUMBPOSITION	Scroll to absolute position.
SB_TOP	Scroll to upper left.

nPos	Value of the high-order word of *lParam.* Specifies the scroll box position if the scroll bar code is SB_THUMBPOSITION; otherwise, the high-order word of *lParam* is not used.

Returns
An application should return zero if it processes this message.

Comments
The clipboard owner should use the **InvalidateRect** function or repaint as needed. The scroll bar position should also be reset.

See Also
InvalidateRect, **WM_VSCROLLCLIPBOARD**

WM_ICONERASEBKGND (3.0)

```
WM_ICONERASEBKGND
hdc = (HDC) wParam;      /* device-context handle */
```

The WM_ICONERASEBKGND message is sent to a minimized (iconic) window when the background of the icon must be filled before painting the icon. A window receives this message only if a class icon is defined for the window; otherwise, **WM_ERASEBKGND** is sent.

Parameter	Description
hdc	Value of *wParam.* Identifies the device context of the icon.

Returns
An application should return zero if it processes this message.

Comments
The **DefWindowProc** function fills the icon background with the background brush of the parent window.

See Also
DefWindowProc, **WM_ERASEBKGND**

WM_INITDIALOG (2.x)

```
WM_INITDIALOG
hwndFocus = (HWND) wParam;  /* handle of control for focus */
dwData = lParam;            /* application-specific data   */
```

The WM_INITDIALOG message is sent to a dialog box procedure immediately before the dialog box is displayed.

Parameter	Description
hwndFocus	Value of *wParam.* Identifies the first control in the dialog box that can be given the input focus. Usually, this is the first control in the dialog box with the **WS_TABSTOP** style.
dwData	Value of *lParam.* Specifies application-specific data that was passed by the function used to create the dialog box if the dialog box was created by one of the following functions: **CreateDialogParam** **DialogBoxIndirectParam** **DialogBoxParam**

Returns

An application should return nonzero to set the input focus to the control identified by the *hwndFocus* parameter. An application should return zero if the dialog box procedure uses the **SetFocus** function to set the input focus to a different control in the dialog box.

Example

This example changes the font used by controls in a dialog box to a font that is not bold.

```
HFONT hfontDlg;
LOGFONT lFont;

case WM_INITDIALOG:

    /* Get dialog box font and create version that is not bold. */

    hfontDlg = (HFONT) NULL;
    if ((hfontDlg = (HFONT) SendMessage(hdlg, WM_GETFONT, 0, 0L))) {
        if (GetObject(hfontDlg, sizeof(LOGFONT), (LPSTR) &lFont)) {
            lFont.lfWeight = FW_NORMAL;
            if (hfontDlg = CreateFontIndirect((LPLOGFONT) &lFont)) {
                SendDlgItemMessage(hdlg, ID_CTRL1, WM_SETFONT,
                    (WPARAM) hfontDlg, 0);
                SendDlgItemMessage(hdlg, ID_CTRL2, WM_SETFONT,
                    (WPARAM) hfontDlg, 0);
                .
                . /* Set font for remaining controls. */
                .
            }
        }
    }
    return TRUE;
```

See Also

CreateDialogParam, **DialogBoxIndirectParam**, **DialogBoxParam**, **SetFocus**

WM_INITMENU (2.x)

```
WM_INITMENU
hmenuInit = (HMENU) wParam; /* handle of menu to initialize */
```

The WM_INITMENU message is sent when a menu is about to become active. It occurs when the user clicks an item on the menu bar or presses a menu key. This allows an application to modify the menu before it is displayed.

Parameter	Description
hmenuInit	Value of *wParam.* Identifies the menu to be initialized.

Returns

An application should return zero if it processes this message.

Comments

This message is sent only when a menu is first accessed; only one WM_INITMENU message is generated for each access. This means, for example, that moving the mouse across several menu items while holding down the button does not generate new messages. WM_INITMENU does not provide information about menu items.

See Also

WM_INITMENUPOPUP

WM_INITMENUPOPUP (2.x)

```
WM_INITMENUPOPUP
hmenuPopup = (HMENU) wParam;          /* handle of pop-up menu */
nIndex = (int) LOWORD(lParam);        /* index of pop-up menu  */
fSystemMenu = (BOOL) HIWORD(lParam); /* System-menu flag      */
```

The WM_INITMENUPOPUP message is sent when a pop-up menu is about to become active. This allows an application to modify the pop-up menu before it is displayed, without changing the entire menu.

Parameter	Description
hmenuPopup	Value of *wParam.* Identifies the pop-up menu.
nIndex	Value of the low-order word of *lParam.* Specifies the index of the pop-up menu in the main menu.
fSystemMenu	Value of the high-order word of *lParam.* Specifies a nonzero value if the pop-up menu is the System menu (sometimes referred to as the Control menu); otherwise, this parameter is zero.

Returns

An application should return zero if it processes this message.

Example

This example initializes the items in a pop-up menu:

```
int  cItems;
int  pos;
UINT id;

case WM_INITMENUPOPUP:
    cItems = GetMenuItemCount((HMENU) wParam);
    for (pos = 0; pos < cItems; pos++) {
        id = GetMenuItemID((HMENU) wParam, pos);
        .
        . /* Initialize menu items. */
        .
    }
    break;
```

See Also

WM_INITMENU

WM_KEYDOWN (2.x)

```
WM_KEYDOWN
wVkey = wParam;          /* virtual-key code */
dwKeyData = lParam;      /* key data         */
```

The WM_KEYDOWN message is sent when a nonsystem key is pressed. A nonsystem key is a key that is pressed when the ALT key is *not* pressed, or it is a key that is pressed when a window has the input focus.

Parameter	Description
wVkey	Value of *wParam.* Specifies the virtual-key code of the given key.
dwKeydata	Value of *lParam.* Specifies the repeat count, scan code, extended key, context code, previous key state, and key-transition state, as shown in the following table:

Bit	Description
0-15	Specifies the repeat count. The value is the number of times the keystroke is repeated as a result of the user holding down the key.
16-23	Specifies the scan code. The value depends on the original equipment manufacturer (OEM).
24	Specifies whether the key is an extended key, such as a function key or a key on the numeric keypad. The value is 1 if it is an extended key; otherwise, it is 0.
25-26	Not used.
27-28	Used internally by Windows.
29	Specifies the context code. The value is 1 if the ALT key is held down while the key is pressed; otherwise, the value is 0.
30	Specifies the previous key state. The value is 1 if the key is down before the message is sent, or it is 0 if the key is up.
31	Specifies the key-transition state. The value is 1 if the key is being released, or it is 0 if the key is being pressed.

For a WM_KEYDOWN message, the value of bit 29 (context code) is 0 and the value of bit 31 (key-transition state) is 0.

Returns

An application should return zero if it processes this message.

Comments

Because of the autorepeat feature, more than one WM_KEYDOWN message may occur before a **WM_KEYUP** message is sent. The previous key state (bit 30) can be used to determine whether the WM_KEYDOWN message indicates the first down transition or a repeated down transition.

For IBM Enhanced 101- and 102-key keyboards, enhanced keys are the right ALT key and the right CTRL key on the main section of the keyboard; the INS, DEL, HOME, END, PAGE UP, PAGE DOWN, and arrow keys in the clusters to the left of the numeric keypad; and the division (*/*) and ENTER key on the numeric keypad. Some other keyboards may support the extended-key bit in the *dwKeyData* parameter.

See Also

WM_CHAR, **WM_KEYUP**

WM_KEYUP (2.x)

```
WM_KEYUP
wVkey = wParam;          /* virtual-key code */
dwKeyData = lParam;      /* key data         */
```

The WM_KEYUP message is sent when a nonsystem key is released. A nonsystem key is a key that is pressed when the ALT key is *not* pressed, or it is a key that is pressed when a window has the input focus.

Parameter	Description
wVkey	Value of *wParam.* Specifies the virtual-key code of the given key.
dwKeyData	Value of *lParam.* Specifies the repeat count, scan code, extended key, context code, previous key state, and key-transition state, as shown in the following table:

Bit	Description
0-15	Specifies the repeat count. The value is the number of times the keystroke is repeated as a result of the user holding down the key.
16-23	Specifies the scan code. The value depends on the original equipment manufacturer (OEM).
24	Specifies whether the key is an extended key, such as a function key or a key on the numeric keypad. The value is 1 if it is an extended key; otherwise, it is 0.
25-26	Not used.
27-28	Used internally by Windows.
29	Specifies the context code. The value is 1 if the ALT key is held down while the key is pressed; otherwise, the value is 0.
30	Specifies the previous key state. The value is 1 if the key is down before the message is sent, or it is 0 if the key is up.
31	Specifies the key-transition state. The value is 1 if the key is being released, or it is 0 if the key is being pressed.

For a WM_KEYUP message, the value of bit 29 (context code) is 0 and the value of bit 31 (key-transition state) is 1.

Returns

An application should return zero if it processes this message.

Comments

For IBM Enhanced 101- and 102-key keyboards, enhanced keys are the right ALT key and the right CTRL key on the main section of the keyboard; the INS, DEL, HOME, END, PAGE UP, PAGE DOWN, and arrow keys in the clusters to the left of the numeric keypad; and the division (*/*) and ENTER keys on the numeric keypad. Some other keyboards may support the extended-key bit in the *dwKeyData* parameter.

See Also

WM_CHAR, **WM_KEYDOWN**

WM_KILLFOCUS (2.x)

```
WM_KILLFOCUS
hwndGetFocus = (HWND) lParam;   /* handle of window receiving focus */
```

The WM_KILLFOCUS message is sent immediately before a window loses the input focus.

Parameter	Description
hwndGetFocus	Value of *wParam.* Identifies the window that receives the input focus. (This parameter may be NULL.)

Returns
An application should return zero if it processes this message.

Comments
If an application is displaying a caret, the caret should be destroyed at this point.

See Also
SetFocus, **WM_SETFOCUS**

WM_LBUTTONDBLCLK (2.x)

```
WM_LBUTTONDBLCLK
fwKeys = wParam;          /* key flags                        */
xPos = LOWORD(lParam);    /* horizontal position of cursor */
yPos = HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_LBUTTONDBLCLK message is sent when the user double-clicks the left mouse button.

Parameter	Description
fwKeys	Value of *wParam.* Indicates whether various virtual keys are down. This parameter can be any combination of the following values:

Value	Description
MK_CONTROL	Set if CTRL key is down.
MK_LBUTTON	Set if left button is down.
MK_MBUTTON	Set if middle button is down.
MK_RBUTTON	Set if right button is down.
MK_SHIFT	Set if SHIFT key is down.

xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.

Returns

An application should return zero if it processes this message.

Comments

Only windows that have the **CS_DBLCLKS** class style can receive WM_LBUTTONDBLCLK messages. Windows generates a WM_LBUTTONDBLCLK message when the user presses, releases, and again presses the left mouse button within the system's double-click time limit. Double-clicking the left mouse button actually generates four messages: a **WM_LBUTTONDOWN** message, a **WM_LBUTTONUP** message, the WM_LBUTTONDBLCLK message, and another WM_LBUTTONUP message.

See Also

WM_LBUTTONDOWN, **WM_LBUTTONUP**

WM_LBUTTONDOWN (2.x)

```
WM_LBUTTONDOWN
fwKeys = wParam;          /* key flags                       */
xPos = LOWORD(lParam);    /* horizontal position of cursor */
yPos = HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_LBUTTONDOWN message is sent when the user presses the left mouse button.

Parameter	Description
fwKeys	Value of *wParam.* Specifies whether various virtual keys are down. This parameter can be any combination of the following values:

Value	Description
MK_CONTROL	Set if CTRL key is down.
MK_MBUTTON	Set if middle button is down.
MK_RBUTTON	Set if right button is down.
MK_SHIFT	Set if SHIFT key is down.

xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.

Returns
An application should return zero if it processes this message.

See Also
WM_LBUTTONDBLCLK, **WM_LBUTTONUP**

WM_LBUTTONUP (2.x)

```
WM_LBUTTONUP
fwKeys = wParam;          /* key flags                      */
xPos = LOWORD(lParam);    /* horizontal position of cursor */
yPos = HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_LBUTTONUP message is sent when the user releases the left mouse button.

Parameter	Description
fwKeys	Value of *wParam.* Indicates whether various virtual keys are down. This parameter can be any combination of the following values:

Value	Description
MK_CONTROL	Set if CTRL key is down.
MK_MBUTTON	Set if middle button is down.
MK_RBUTTON	Set if right button is down.
MK_SHIFT	Set if SHIFT key is down.

xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.

Returns
An application should return zero if it processes this message.

See Also
WM_LBUTTONDBLCLK, **WM_LBUTTONDOWN**

WM_MBUTTONDBLCLK (2.x)

```
WM_MBUTTONDBLCLK
fwKeys = wParam;          /* key flags                       */
xPos = LOWORD(lParam);    /* horizontal position of cursor */
yPos = HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_MBUTTONDBLCLK message is sent when the user double-clicks the middle mouse button.

Parameter	Description
fwKeys	Value of *wParam.* Indicates whether various virtual keys are down. This parameter can be any combination of the following values:

Value	Description
MK_CONTROL	Set if CTRL key is down.
MK_LBUTTON	Set if left button is down.
MK_MBUTTON	Set if middle button is down.
MK_RBUTTON	Set if right button is down.
MK_SHIFT	Set if SHIFT key is down.

xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.

Returns

An application should return zero if it processes this message.

Comments

Only windows that have the **CS_DBLCLKS** class style can receive WM_MBUTTONDBLCLK messages. Windows generates a WM_MBUTTONDBLCLK message when the user presses, releases, and again presses the middle mouse button within the system's double-click time limit. Double-clicking the middle mouse button actually generates four messages: a **WM_MBUTTONDOWN** message, a **WM_MBUTTONUP** message, the WM_MBUTTONDBLCLK message, and another WM_MBUTTONUP message.

See Also

WM_MBUTTONDOWN, **WM_MBUTTONUP**

WM_MBUTTONDOWN (2.x)

```
WM_MBUTTONDOWN
fwKeys = wParam;          /* key flags                      */
xPos = LOWORD(lParam);    /* horizontal position of cursor */
yPos = HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_MBUTTONDOWN message is sent when the user presses the middle mouse button.

Parameter	Description
fwKeys	Value of *wParam.* Indicates whether various virtual keys are down. This parameter can be any combination of the following values:

Value	Description
MK_CONTROL	Set if CTRL key is down.
MK_LBUTTON	Set if left button is down.
MK_RBUTTON	Set if right button is down.
MK_SHIFT	Set if SHIFT key is down.

xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.

Returns
An application should return zero if it processes this message.

See Also
WM_MBUTTONDBLCLK, **WM_MBUTTONUP**

WM_MBUTTONUP (2.x)

```
WM_MBUTTONUP
fwKeys = wParam;          /* key flags                       */
xPos = LOWORD(lParam);    /* horizontal position of cursor */
yPos = HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_MBUTTONUP message is sent when the user releases the middle mouse button.

Parameter	Description
fwKeys	Value of *wParam.* Indicates whether various virtual keys are down. This parameter can be any combination of the following values:

Value	Description
MK_CONTROL	Set if CTRL key is down.
MK_LBUTTON	Set if left button is down.
MK_RBUTTON	Set if right button is down.
MK_SHIFT	Set if SHIFT key is down.

xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.

Returns
An application should return zero if it processes this message.

See Also
WM_MBUTTONDBLCLK, **WM_MBUTTONDOWN**

WM_MDIACTIVATE (3.0)

```
WM_MDIACTIVATE
/* Message sent to MDI client */
wParam =  (WPARAM) (HWND) hwndChildAct; /* child to activate       */
lParam = 0L;                            /* not used, must be zero  */

/* Message received by MDI child */
wParam = (WPARAM) fActivate;            /* activation flag         */
hwndAct = (HWND) LOWORD(lParam);        /* child being activated   */
hwndDeact = (HWND) HIWORD(lParam);      /* child being deactivated */
```

An application sends the WM_MDIACTIVATE message to a multiple document interface (MDI) client window to instruct the client window to activate a different MDI child window. As the client window processes this message, it sends WM_MDIACTIVATE to the child window being deactivated and to the child window being activated.

Parameter	Description
In message sent to MDI client window:	
hwndChildAct	Value of *wParam.* Identifies the MDI child window to be activated.
In message received by MDI child window:	
fActivate	Value of *wParam.* Specifies whether to activate or deactivate the child window. If this parameter is TRUE, the child window is activated. If this parameter is FALSE, the child window is deactivated.
hwndAct	Value of the low-order word of *lParam.* Identifies the child window being activated.
hwndDeact	Value of the high-order word of *lParam.* Identifies the child window being deactivated.

Returns
An application should return zero if it processes this message.

Comments
An MDI child window is activated independently of the MDI frame window. When the frame window becomes active, the child window that was last activated with the WM_MDIACTIVATE message receives the **WM_NCACTIVATE** message to draw an active window frame and title bar; it does not receive another WM_MDIACTIVATE message.

See Also
WM_MDIGETACTIVE, **WM_NCACTIVATE**, **WM_MDINEXT**

WM_MDICASCADE (3.0)

```
WM_MDICASCADE
fnCascade = wParam;      /* cascade flag */
```

The WM_MDICASCADE message is sent to a multiple document interface (MDI) client window to arrange all its child windows in a cascade format.

Parameter	Description
fnCascade	Value of *wParam.* Specifies a cascade flag. Currently, only the following flag may be specified:

Value	Meaning
MDITILE_SKIPDISABLED	Prevents disabled MDI child windows from being cascaded.

Returns

An application should return zero if it processes this message.

See Also

WM_MDIICONARRANGE, **WM_MDITILE**

Windows 3.1 changes

The following cascade flag has been added:

Value	Meaning
MDITILE_SKIPDISABLED	Prevents disabled MDI child windows from being cascaded.

WM_MDICREATE (3.0)

```
WM_MDICREATE
wParam = 0;                                  /* not used, must be zero */
lParam = (LPARAM) (MDICREATESTRUCT FAR*) lpmcs; /* structure address  */
```

An application sends the WM_MDICREATE message to a multiple document interface (MDI) client window to create a child window.

Parameter	Description
lpmcs	Value of *lParam.* Points to an **MDICREATESTRUCT** structure.

Returns

The return value is the handle of the new window in the low-order word and zero in the high-order word.

Comments

The window is created with the style bits **WS_CHILD**, **WS_CLIPSIBLINGS**, **WS_CLIPCHILDREN**, **WS_SYSMENU**, **WS_CAPTION**, **WS_THICKFRAME**, **WS_MINIMIZEBOX**, and **WS_MAXIMIZEBOX**, plus additional style bits specified in the **MDICREATESTRUCT** structure to which *lpmcs* points. Windows adds the title of the new child window to the window menu of the frame window. An application should create all child windows of the client window with this message.

CreateWindow will override the default style bits if the MDIS_ALLCHILDSTYLES style is set when creating the MDI client window.

If a client window receives any message that changes the activation of child windows while the currently active MDI child window is maximized, Windows restores the currently active child window and maximizes the newly activated child window.

When the MDI child window is created, Windows sends the **WM_CREATE** message to the window. The *lpmcs* parameter of the WM_CREATE message contains a pointer to a **CREATESTRUCT** structure. The **lpCreateParams** member of the **CREATESTRUCT** structure contains a pointer to the **MDICREATESTRUCT** structure passed with the WM_MDICREATE message that created the MDI child window.

An application should not send a second WM_MDICREATE message while a WM_MDICREATE message is still being processed. For example, it should not send a WM_MDICREATE message while an MDI child window is processing its **WM_CREATE** message.

See Also

WM_MDIDESTROY, **CREATESTRUCT**, **MDICREATESTRUCT**

WM_MDIDESTROY (3.0)

```
WM_MDIDESTROY
hwndChild = (HWND) wParam;  /* handle of child to destroy */
```

An application sends the WM_MDIDESTROY message to a multiple document interface (MDI) client window to close an MDI child window.

Parameter	Description
hwndChild	Value of *wParam.* Identifies the child window to destroy.

Returns

An application should return zero if it processes this message.

Comments

This message removes the title of the child window from the frame window and deactivates the child window. An application should close all MDI child windows with this message.

If a client window receives any message that changes the activation of child windows while the currently active MDI child window is maximized, Windows restores the currently active child window and maximizes the newly activated child window.

See Also

WM_MDICREATE

WM_MDIGETACTIVE (3.0)

```
WM_MDIGETACTIVE
```

The WM_MDIGETACTIVE message retrieves the multiple document interface (MDI) child window that is active, along with a flag indicating whether the child window is maximized.

Parameters

This message has no parameters.

Returns

The return value is the handle of the active MDI child window in its low-order word. If the window is maximized, the high-order word is 1; otherwise, the high-order word is 0.

See Also

WM_MDIACTIVATE

WM_MDIICONARRANGE (3.0)

```
WM_MDIICONARRANGE
```

The WM_MDIICONARRANGE message is sent to a multiple document interface (MDI) client window to arrange all minimized document child windows. It does not affect child windows that are not minimized.

Parameters

This message has no parameters.

Returns
An application should return zero if it processes this message.

See Also
WM_MDICASCADE, **WM_MDITILE**

WM_MDIMAXIMIZE (3.0)

```
WM_MDIMAXIMIZE
hwndMaximize = (HWND) wParam;   /* handle of child to maximize */
```

The WM_MDIMAXIMIZE message causes a multiple document interface (MDI) client window to maximize an MDI child window. When a child window is maximized, Windows resizes it to make its client area fill the client window. Windows places the child window's System menu (sometimes referred to as the Control menu) in the frame's menu bar so that the user can restore or minimize the child window; Windows adds the title of the child window to the frame window's menu of child windows.

Parameter	Description
hwndMaximize	Value of *wParam.* Identifies the child window to maximize.

Returns

An application should return zero if it processes this message.

Comments

If an MDI client window receives any message that changes the activation of its child windows while the currently active MDI child window is maximized, Windows restores the currently active child window and maximizes the newly activated child window.

WM_MDINEXT (3.0)

```
WM_MDINEXT
wParam = (WPARAM) hwndChild; /* handle of child window        */
lParam = (LPARAM) fNext;     /* next or previous child window */
```

An application sends the WM_MDINEXT message to a multiple document interface (MDI) client window to activate the child window immediately behind the currently active child window and place the currently active child window behind all other child windows.

Parameter	Description
hwndChild	Value of *wParam.* Specifies the handle of the child window.
fNext	Value of *lParam.* If this parameter is zero, the message specifies that the next MDI child window should be activated. If this parameter is nonzero, the message specifies that the previous MDI child window should be activated.

Returns

An application should return zero if it processes this message.

Comments

If an MDI client window receives any message that changes the activation of its child windows while the currently active MDI child window is maximized, Windows restores the currently active child window and maximizes the newly activated child window.

See Also

WM_MDIACTIVATE, **WM_MDIGETACTIVE**

WM_MDIRESTORE (3.0)

```
WM_MDIRESTORE
wParam = (WPARAM) wIDChild;  /* handle of child window */
```

An application sends the WM_MDIRESTORE message to a multiple document interface (MDI) client window to restore an MDI child window from maximized or minimized size.

Parameter	Description
wIDChild	Value of *wParam.* Specifies the handle of the child window.

Returns

An application should return zero if it processes this message.

See Also

WM_MDIMAXIMIZE

WM_MDISETMENU (3.0)

```
WM_MDISETMENU
wParam = (WPARAM) (BOOL) fRefresh;              /* refresh flag */
lParam = MAKELPARAM(hmenuFrame, hmenuWindow);  /* new menus    */
```

An application sends a WM_MDISETMENU message to replace the menu of a multiple document interface (MDI) frame window, the Window pop-up menu, or both.

Parameter	Description
fRefresh	Value of *wParam.* Specifies whether to refresh the current menus or specify new menus. It is TRUE if the menus should just be refreshed. It is FALSE if, instead, the *hmenuFrame* and *hmenuWindow* parameters should be used to specify new menus for the window.
hmenuFrame	Value of the low-order word of *lParam.* Identifies the new frame-window menu. If this parameter is zero, the frame-window menu is not changed.
hmenuWindow	Value of the high-order word of *lParam.* Identifies the new Window pop-up menu. If this parameter is zero, the Window pop-up menu is not changed.

Returns

The return value is the handle of the frame-window menu replaced by this message.

Comments

After sending this message, an application must call the **DrawMenuBar** function to update the menu bar.

If this message replaces the Window pop-up menu, MDI child-window menu items are removed from the previous Window menu and added to the new Window pop-up menu.

If an MDI child window is maximized and this message replaces the MDI frame-window menu, the System menu (sometimes referred to as the Control menu) and restore controls are removed from the previous frame-window menu and added to the new menu.

See Also

DrawMenuBar

Windows 3.1 changes

The *wParam* parameter specifies whether or not to refresh the same menus. It is nonzero if the menus should just be refreshed. It is zero if, instead, the *lParam* parameter should be used to specify new menus for the window.

The previous release of the documentation stated that *wParam* was not used.

WM_MDITILE (3.0)

```
WM_MDITILE
fTile = wParam;      /* tiling flag */
```

The WM_MDITILE message is sent to a multiple document interface (MDI) client window to arrange all its child windows in a tiled format.

Parameter	Description
fTile	Value of *wParam.* Specifies a tiling flag. This parameter can be one of the following flags:

Value	Meaning
MDITILE_HORIZONTAL	Tiles MDI child windows so that they are wide rather than tall.
MDITILE_SKIPDISABLED	Prevents disabled MDI child windows from being tiled.
MDITILE_VERTICAL	Tiles MDI child windows so that they are tall rather than wide.

Returns
An application should return zero if it processes this message.

See Also
WM_MDICASCADE, **WM_MDIICONARRANGE**

Windows 3.1 changes

The following tiling flags have been added:

Value	Meaning
MDITILE_HORIZONTAL	Tiles MDI child windows horizontally (one window appears beside another).
MDITILE_SKIPDISABLED	Prevents disabled MDI child windows from being tiled.
MDITILE_VERTICAL	Tiles MDI child windows vertically (one window appears above another).

WM_MEASUREITEM (3.0)

```
WM_MEASUREITEM
nIDCtl = (int) wParam;                        /* control identifier   */
lpmisCtl = (MEASUREITEMSTRUCT FAR*) lParam; /* address of structure */
```

The WM_MEASUREITEM message is sent to the owner of an owner-drawn button, combo box, list box, or menu item when the control is created. When the owner receives the message, the owner fills in the **MEASUREITEMSTRUCT** structure pointed to by the *lpmisCtl* message parameter and returns; this informs Windows of the dimensions of the control. If a list box or combo box is created with the **LBS_OWNERDRAWVARIABLE** or **CBS_OWNERDRAWVARIABLE** style, this message is sent to the owner for each item in the control; otherwise, this message is sent once.

Parameter	Description
nIDCtl	Value of *wParam.* Specifies the identifier of the control that sent the WM_MEASUREITEM message. This parameter is 0 if the message was sent by a menu. This parameter is -1 when the system is requesting the dimensions of an edit control in an owner-drawn combo box.
lpmisCtl	Value of *lParam.* Points to a **MEASUREITEMSTRUCT** structure that contains the dimensions of the owner-drawn control.

Returns

An application should return TRUE if it processes this message.

Comments

Windows sends the WM_MEASUREITEM message to the owner of a combo box or list box created with the OWNERDRAWFIXED style before sending WM_INITDIALOG. As a result, when the owner receives this message, Windows has not yet determined the height and width of the font used in the control; function calls and calculations requiring these values should occur in the main function of the application or library.

See Also

WM_COMPAREITEM, **WM_DELETEITEM**, **WM_DRAWITEM**, **WM_INITDIALOG**, **MEASUREITEMSTRUCT**

Windows 3.1 changes

The meaning of the *wParam* parameter has changed. If a control sends the WM_MEASUREITEM message, the *wParam* parameter specifies the identifier of the control. If a menu sends the message, *wParam* is zero.

WM_MENUCHAR (2.x)

```
WM_MENUCHAR
chUser = wParam;                    /* ASCII character    */
fMenu = LOWORD(lParam);             /* menu flag          */
hmenu = (HMENU) HIWORD(lParam);     /* handle of the menu */
```

The WM_MENUCHAR message is sent when the user presses the key corresponding to a menu mnemonic character that doesn't match any of the predefined mnemonics in the current menu. It is sent to the window that owns the menu.

Parameter	Description
chUser	Value of *wParam.* Specifies the ASCII character that corresponds to the key the user pressed.
fMenu	Value of the low-order word of *lParam.* Specifies the type of the selected menu. This parameter can be one of the following values:
hmenu	Value of the high-order word of *lParam.* Identifies the selected menu.

Value	Meaning
MF_POPUP	The menu is a pop-up menu.
MF_SYSMENU	The menu is a System menu (sometimes referred to as a Control menu).

Returns

The return value is one of the following command code values in the high-order word:

Value	Description
0	Informs Windows that it should discard the character corresponding to the key the user pressed, and creates a short beep on the system speaker.
1	Informs Windows that it should close the current menu.
2	Informs Windows that the low-order word of the return value contains the item number for a specific item. This item is selected by Windows.

The low-order word is ignored if the high-order word contains 0 or 1. An application should process this message when an accelerator key has been used to select a bitmap placed in a menu.

Comments

The WM_MENUCHAR message is generated when the user presses ALT and any key, even if the key does not correspond to a mnemonic character. In this case, the *hmenu* parameter contains the window handle of the menu.

WM_MENUSELECT (2.x)

```
WM_MENUSELECT
wIDItem = wParam;               /* item identifier or menu handle */
fwMenu = LOWORD(lParam);        /* menu flags                     */
hmenu = (HMENU) HIWORD(lParam); /* handle of the menu             */
```

The WM_MENUSELECT message is sent to the window associated with a menu when the user selects a menu item.

Parameter	Description
wIDItem	Value of *wParam.* Specifies the menu-item identifier if the selected item is a menu item. If the selected item contains a pop-up menu, *wIDItem* contains the handle of the pop-up menu.
fwMenu	Low word of *lParam.* Specifies one or more menu flags. This parameter can be a combination of the following values:

Flag	Description
MF_BITMAP	Item is a bitmap.
MF_CHECKED	Item is checked.
MF_DISABLED	Item is disabled.
MF_GRAYED	Item is grayed.
MF_MOUSESELECT	Item was selected with a mouse.
MF_OWNERDRAW	Item is an owner-drawn item.
MF_POPUP	Item contains a pop-up menu.
MF_SEPARATOR	Item is a menu-item separator.
MF_SYSMENU	Item is contained in the System menu (sometimes referred to as the Control menu). The *hmenu* parameter identifies the System menu associated with the message.

hmenu	High word of *lParam.* If the *fwMenu* parameter contains the MF_SYSMENU flag, this parameter specifies the menu handle of the System menu.

Returns

An application should return zero if it processes this message.

Comments

If the *fwMenu* parameter contains -1 and the *hmenu* parameter contains 0, Windows has closed the menu. This occurs both when the menu is closed because the user pressed ESC or clicked outside the menu and when the user has selected a menu item.

WM_MOUSEACTIVATE (2.x)

```
WM_MOUSEACTIVATE
hwndTopLevel = (HWND) wParam;    /* handle of top-level parent */
wHitTestCode = LOWORD(lParam);   /* hit-test code              */
wMsg = HIWORD(lParam);           /* mouse-message identifier   */
```

The WM_MOUSEACTIVATE message is sent when the cursor is in an inactive window and the user presses a mouse button. The parent window receives this message only if the child window passes it to the **DefWindowProc** function.

Parameter	Description
hwndTopLevel	Value of *wParam.* Identifies the top-level parent window of the window being activated.
wHitTestCode	Value of the low-order word of *lParam.* Specifies the hit-test area code. A hit test is a test that determines the location of the cursor.
wMsg	Value of the high-order word of *lParam.* Specifies the identifier of the mouse message.

Returns

The return value specifies whether the window should be activated and whether the mouse event should be discarded. It must be one of the following values:

Value	Meaning
MA_ACTIVATE	Activate the window.
MA_NOACTIVATE	Do not activate the window.
MA_ACTIVATEANDEAT	Activate the window and discard the mouse event.
MA_NOACTIVATEANDEAT	Do not activate the window; discard the mouse event.

Comments

If the child window passes the message to the **DefWindowProc** function, **DefWindowProc** passes this message to a window's parent window before any processing occurs. If the parent window returns a nonzero value, processing is halted.

See Also

DefWindowProc

Windows 3.1 changes

The following returns were added:

Value	Meaning
MA_ACTIVATE	Activate the window.
MA_NOACTIVATE	Do not activate the window.
MA_ACTIVATEANDEAT	Activate the window and discard the mouse event.
MA_NOACTIVATEANDEAT	Do not activate the window and discard the mouse event.

WM_MOUSEMOVE (2.x)

```
WM_MOUSEMOVE
fwKeys = wParam;          /* key flags                       */
xPos = LOWORD(lParam);    /* horizontal position of cursor */
yPos = HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_MOUSEMOVE message is sent to a window when the mouse cursor moves. If the mouse is not captured, the message goes to the window beneath the cursor. Otherwise, the message goes to the window that has captured the mouse.

Parameter	Description
fwKeys	Value of *wParam.* Indicates whether various virtual keys are down. This parameter can be any combination of the following values:

Value	Description
MK_CONTROL	Set if CTRL key is down.
MK_LBUTTON	Set if left button is down.
MK_MBUTTON	Set if middle button is down.
MK_RBUTTON	Set if right button is down.
MK_SHIFT	Set if SHIFT key is down.

xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, as a screen coordinate.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, as a screen coordinate.

Returns

An application should return zero if it processes this message.

Comments

The **MAKEPOINT** macro can be used to convert the *lParam* parameter to a **POINT** structure.

See Also

SetCapture, **WM_NCHITTEST**, **MAKEPOINT**, **POINT**

WM_MOVE (2.x)

```
WM_MOVE
xPos = (int) LOWORD(lParam);    /* horizontal position */
yPos = (int) HIWORD(lParam);    /* vertical position   */
```

The WM_MOVE message is sent after a window has been moved.

Parameter	Description
xPos	Value of the low-order word of *lParam.* Specifies the new x-coordinate of the upper-left corner of the client area of the window.
yPos	Value of the high-order word of *lParam.* Specifies the new y-coordinate of the upper-left corner of the client area of the window.

Returns

An application should return zero if it processes this message.

Comments

The *xPos* and *yPos* parameters are given in screen coordinates for overlapped and pop-up windows and in parent-client coordinates for child windows.

An application can use the **MAKEPOINT** macro to convert the *lParam* parameter to a **POINT** data structure.

See Also

MAKEPOINT, **POINT**

WM_NCACTIVATE (2.x)

```
WM_NCACTIVATE
fActive = (BOOL) wParam;    /* the active/inactive flag */
```

The WM_NCACTIVATE message is sent to a window when its nonclient area needs to be changed to indicate an active or inactive state.

Parameter	Description
fActive	Value of *wParam.* Specifies when a title bar or icon needs to be changed to indicate an active or inactive state. The *fActive* parameter is TRUE if an active title bar or icon is to be drawn. It is FALSE for an inactive title bar or icon.

Returns

When the *fActive* parameter is FALSE, an application should return TRUE to indicate that Windows should proceed with the default processing or FALSE to prevent the caption bar or icon from being deactivated. When *fActive* is TRUE, the return value is ignored.

Comments

The **DefWindowProc** function draws the title bar and title bar text in their active colors when the *fActive* parameter is TRUE and in their inactive colors when *fActive* is FALSE.

See Also

DefWindowProc

WM_NCCALCSIZE (2.x)

```
WM_NCCALCSIZE
fCalcValidRects = (BOOL) wParam;            /* valid-area flag  */
lpncsp = (NCCALCSIZE_PARAMS FAR*) lParam;   /* address of data  */
```

The WM_NCCALCSIZE message is sent when the size and position of a window's client area needs to be calculated. By processing this message, an application can control the contents of the window's client area when the size or position of the window changes.

Parameter	Description
fCalcValidRects	Value of *wParam.* Specifies whether the application should specify which part of the client area contains valid information. Windows will copy the valid information to the specified area within the new client area. If this parameter is TRUE, the application should specify which part of the client area is valid.
lpncsp	Value of *lParam.* Points to an **NCCALCSIZE_PARAMS** data structure that contains information an application can use to calculate the new size and position of the client rectangle. Regardless of the value of *fCalcValidRects,* the first rectangle in the array specified by the **rgrc** member contains the coordinates of the window. For a child window, the coordinates are relative to the parent window's client area. For top-level windows, the coordinates are screen coordinates. An application should process WM_NCCALCSIZE by modifying the **rgrc[0]** rectangle to reflect the size and position of the client area. The **rgrc[1]** and **rgrc[2]** rectangles are valid only if *fCalcValidRects* is TRUE. In this case, the **rgrc[1]** rectangle contains the coordinates of the window before it was moved or resized. The **rgrc[2]** rectangle contains the coordinates of the window's client area before the window was moved. All coordinates are relative to the parent window or screen.

Returns

An application should return zero if *fCalcValidRects* is FALSE.

An application can return zero or a valid combination of the following values if *fCalcValidRects* is TRUE:

Value Meaning

WVR_ALIGNTOP, WVR_ALIGNLEFT, WVR_ALIGNBOTTOM, WVR_ALIGNRIGHT
: These values, used in combination, specify that the client area of the window is to be preserved and aligned appropriately relative to the new location of the client window. For example, to align the client area to the lower-left, return WVR_ALIGNLEFT | WVR_ALIGNTOP.

WVR_HREDRAW, WVR_VREDRAW
: These values, used in combination with any other values, cause the window to be completely redrawn if the client rectangle changed size horizontally or vertically. These values are similar to the **CS_HREDRAW** and **CS_VREDRAW** class styles.

WVR_REDRAW
: This value causes the entire window to be redrawn. It is a combination of WVR_HREDRAW and WVR_VREDRAW.

WVR_VALIDRECTS
: This value indicates that, upon return from WM_NCCALCSIZE, the **rgrc[1]** and **rgrc[2]** rectangles contain valid source and destination area rectangles, respectively. Windows combines these rectangles to calculate the area of the window that can be preserved. Windows copies any part of the window image that is within the source rectangle and clips the image to the destination rectangle. Both rectangles are in parent-relative or screen-relative coordinates.

  This return value allows an application to implement more elaborate client-area preservation strategies, such as centering or preserving a subset of the client area.

If *fCalcValidRects* is TRUE and an application returns zero, the old client area is preserved and is aligned with the upper-left corner of the new client area.

Comments

Redrawing of the window may occur, depending on whether **CS_HREDRAW** or **CS_VREDRAW** was specified. This is the default, backward-compatible **DefWindowProc** processing of this message (in addition to the usual client rectangle calculation described in the preceding table).

See Also

DefWindowProc, **MoveWindow**, **SetWindowPos**, **NCCALCSIZE_PARAMS**, **RECT**

WM_NCCREATE (2.x)

```
WM_NCCREATE
lpcs = (CREATESTRUCT FAR*) lParam;  /* address of initialization data */
```

The WM_NCCREATE message is sent prior to the **WM_CREATE** message when a window is first created.

Parameter	Description
lpcs	Value of *lParam.* Points to the **CREATESTRUCT** data structure for the window.

Returns

The return value is nonzero if the nonclient area is created. It is zero if an error occurs; in this case, the **CreateWindow** or **CreateWindowEx** function will return NULL.

Comments

Scroll bars are initialized (the scroll bar position and range are set), and the window text is set. Memory used internally to create and maintain the window is allocated.

See Also

CreateWindow, **WM_CREATE**, **CREATESTRUCT**

WM_NCDESTROY (2.x)

```
WM_NCDESTROY
```

The WM_NCDESTROY message informs a window that its nonclient area is being destroyed. The **DestroyWindow** function sends the WM_NCDESTROY message to the window following the **WM_DESTROY** message. WM_NCDESTROY is used to free the allocated memory object associated with the window.

Parameters

This message has no parameters.

Returns

An application should return zero if it processes this message.

Comments

This message frees any memory internally allocated for the window.

See Also

DestroyWindow, **WM_NCCREATE**

WM_NCHITTEST (2.x)

```
WM_NCHITTEST
xPos = (int) LOWORD(lParam);    /* horizontal position of cursor */
yPos = (int) HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_NCHITTEST message is sent to the window that contains the cursor or to the window that used the **SetCapture** function to capture the mouse input. It is sent every time the mouse is moved.

Parameter	Description
xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, in screen coordinates.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, in screen coordinates.

Returns

The return value of the **DefWindowProc** function is one of the following values indicating the position of the cursor:

Value	Meaning
HTBORDER	In the border of a window that does not have a sizing border
HTBOTTOM	In the lower horizontal border of a window
HTBOTTOMLEFT	In the lower-left corner of a window border
HTBOTTOMRIGHT	In the lower-right corner of a window border
HTCAPTION	In a title bar area
HTCLIENT	In a client area
HTERROR	On the screen background or on a dividing line between windows (same as HTNOWHERE except that the **DefWindowProc** function produces a system beep to indicate an error)
HTGROWBOX	In a size box (same as HTSIZE)
HTHSCROLL	In the horizontal scroll bar
HTLEFT	In the left border of a window
HTMAXBUTTON	In a Maximize button
HTMENU	In a menu area
HTMINBUTTON	In a Minimize button
HTNOWHERE	On the screen background or on a dividing line between windows
HTREDUCE	In a Minimize button
HTRIGHT	In the right border of a window
HTSIZE	In a size box (same as HTGROWBOX)
HTSYSMENU	In a System menu (sometimes referred to as a Control menu) or in a close button in a child window
HTTOP	In the upper horizontal border of a window
HTTOPLEFT	In the upper-left corner of a window border
HTTOPRIGHT	In the upper-right corner of a window border
HTTRANSPARENT	In a window currently covered by another window
HTVSCROLL	In the vertical scroll bar
HTZOOM	In a Maximize button

Comments

The **MAKEPOINT** macro can be used to convert the *lParam* parameter to a **POINT** structure.

Example

This example shows a portion of a subclass procedure that detects mouse messages in a static window:

```
LONG lRetVal;

case WM_NCHITTEST:
    lRetVal = DefWindowProc(hwnd, msg, wParam, lParam);
    if (lRetVal == HTTRANSPARENT) {
        .
        . /* Process mouse events in static window. */
        .
    }
    break;

default:
    CallWindowProc(lpStaticProc, hwnd, msg, wParam, lParam);
```

See Also

DefWindowProc, **GetCapture**, **MAKEPOINT**, **POINT**

Windows 3.1 changes

The following hit-test code was previously undocumented:

Value	Meaning
HTBORDER	In the border of a window that does not have a sizing border.

WM_NCLBUTTONDBLCLK (2.x)

```
WM_NCLBUTTONDBLCLK
nHittest = wParam;        /* hit-test code              */
xCursor = LOWORD(lParam); /* cursor horizontal position */
yCursor = HIWORD(lParam); /* cursor vertical position   */
```

The WM_NCLBUTTONDBLCLK message is sent when the user double-clicks the left mouse button while the cursor is within a nonclient area of the window.

Parameter	Description
nHittest	Value of *wParam.* Specifies the code returned by WM_NCHITTEST. For more information, see the description of the **WM_NCHITTEST** message.
xCursor	Value of the low-order word of *lParam.* Specifies the horizontal position of the cursor, in screen coordinates.
yCursor	Value of the high-order word of *lParam.* Specifies the vertical position of the cursor, in screen coordinates.

Returns

An application should return zero if it processes this message.

Comments

If appropriate, **WM_SYSCOMMAND** messages are sent.

See Also

WM_NCHITTEST, **WM_SYSCOMMAND**, **POINT**

WM_NCLBUTTONDOWN (2.x)

```
WM_NCLBUTTONDOWN
wHitTestCode = wParam;    /* hit-test code              */
xPos = LOWORD(lParam);    /* horizontal cursor position */
yPos = HIWORD(lParam);    /* vertical cursor position   */
```

The WM_NCLBUTTONDOWN message is sent to a window when the user presses the left mouse button while the cursor is within a nonclient area of the window.

Parameter	Description
wHitTestCode	Value of *wParam.* Specifies the code returned by WM_NCHITTEST. For more information, see the description of the **WM_NCHITTEST** message.
xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, in screen coordinates.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, in screen coordinates.

Returns

An application should return zero if it processes this message.

Comments

If appropriate, **WM_SYSCOMMAND** messages are sent.

See Also

WM_NCHITTEST, **WM_NCLBUTTONDBLCLK**, **WM_NCLBUTTONUP**, **WM_SYSCOMMAND**, **POINT**

WM_NCLBUTTONUP (2.x)

```
WM_NCLBUTTONUP
wHitTestCode = wParam;    /* hit-test code              */
xPos = LOWORD(lParam);    /* horizontal cursor position */
yPos = HIWORD(lParam);    /* vertical cursor position   */
```

The WM_NCLBUTTONUP message is sent to a window when the user releases the left mouse button while the cursor is within a nonclient area of the window.

Parameter	Description
wHitTestCode	Value of *wParam.* Specifies the code returned by WM_NCHITTEST. For more information, see the description of the **WM_NCHITTEST** message.
xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, in screen coordinates.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, in screen coordinates.

Returns

An application should return zero if it processes this message.

Comments

If appropriate, **WM_SYSCOMMAND** messages are sent.

See Also

WM_NCHITTEST, **WM_NCLBUTTONDOWN**, WM_NCLBUTTONUP, **WM_SYSCOMMAND**

WM_NCMBUTTONDBLCLK (2.x)

```
WM_NCMBUTTONDBLCLK
wHitTestCode = wParam;    /* hit-test code              */
xPos = LOWORD(lParam);    /* horizontal cursor position */
yPos = HIWORD(lParam);    /* vertical cursor position   */
```

The **WM_NCRBUTTONDOWN** message is sent to a window when the user double-clicks the middle mouse button while the cursor is within a nonclient area of the window.

Parameter	Description
wHitTestCode	Value of *wParam.* Specifies the code returned by WM_NCHITTEST. For more information, see the description of the **WM_NCHITTEST** message.
xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, as a screen coordinate.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, as a screen coordinate.

Returns

An application should return zero if it processes this message.

See Also

WM_NCHITTEST, **WM_NCMBUTTONDOWN**, **WM_NCMBUTTONUP**, **POINT**

WM_NCMBUTTONDOWN (2.x)

```
WM_NCMBUTTONDOWN
wHitTestCode = wParam;    /* hit-test code              */
xPos = LOWORD(lParam);    /* horizontal cursor position */
yPos = HIWORD(lParam);    /* vertical cursor position   */
```

The WM_NCMBUTTONDOWN message is sent to a window when the user presses the middle mouse button while the cursor is within a nonclient area of the window.

Parameter	Description
wHitTestCode	Value of *wParam.* Specifies the code returned by WM_NCHITTEST. For more information, see the description of the **WM_NCHITTEST** message.
xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, as a screen coordinate.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, as a screen coordinate.

Returns

An application should return zero if it processes this message.

See Also

WM_NCHITTEST, **WM_NCMBUTTONDBLCLK**, **WM_NCMBUTTONUP**

WM_NCMBUTTONUP (2.x)

```
WM_NCMBUTTONUP
wHitTestCode = wParam;    /* hit-test code              */
xPos = LOWORD(lParam);    /* horizontal cursor position */
yPos = HIWORD(lParam);    /* vertical cursor position   */
```

The WM_NCMBUTTONUP message is sent to a window when the user releases the left mouse button while the cursor is within a nonclient area of the window.

Parameter	Description
wHitTestCode	Value of *wParam.* Specifies the code returned by WM_NCHITTEST. For more information, see the description of the **WM_NCHITTEST** message.
xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, as a screen coordinate.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, as a screen coordinate.

Returns

An application should return zero if it processes this message.

See Also

WM_NCHITTEST, **WM_NCMBUTTONDBLCLK**, **WM_NCMBUTTONDOWN**

WM_NCMOUSEMOVE (2.x)

```
WM_NCMOUSEMOVE
wHitTestCode = wParam;    /* hit-test code              */
xPos = LOWORD(lParam);    /* horizontal cursor position */
yPos = HIWORD(lParam);    /* vertical cursor position   */
```

The WM_NCMOUSEMOVE message is sent to a window when the cursor is moved within a nonclient area of the window.

Parameter	Description
wHitTestCode	Value of *wParam.* Specifies the code returned by WM_NCHITTEST. For more information, see the description of the **WM_NCHITTEST** message.
xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, as a screen coordinate.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, as a screen coordinate.

Returns
An application should return zero if it processes this message.

Comments
If appropriate, **WM_SYSCOMMAND** messages are sent.

See Also
WM_NCHITTEST, **WM_SYSCOMMAND**, **POINT**

WM_NCPAINT (2.x)

`WM_NCPAINT`

The WM_NCPAINT message is sent to a window when its frame needs painting.

Parameters

This message has no parameters.

Returns
An application should return zero if it processes this message.

Comments
The **DefWindowProc** function paints the window frame.

An application can intercept this message and paint its own custom window frame. The clipping region for a window is always rectangular, even if the shape of the frame is altered.

See Also
DefWindowProc

WM_NCRBUTTONDBLCLK (2.x)

```
WM_NCRBUTTONDBLCLK
wHitTestCode = wParam;    /* hit-test code              */
xPos = LOWORD(lParam);    /* horizontal cursor position */
yPos = HIWORD(lParam);    /* vertical cursor position   */
```

The WM_NCRBUTTONDBLCLK message is sent to a window when the user double-clicks the right mouse button while the cursor is within a nonclient area of the window.

Parameter	Description
wHitTestCode	Value of *wParam.* Specifies the code returned by WM_NCHITTEST. For more information, see the description of the **WM_NCHITTEST** message.
xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, as a screen coordinate.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, as a screen coordinate.

Returns

An application should return zero if it processes this message.

See Also

WM_NCHITTEST, **WM_NCRBUTTONDOWN**, **WM_NCRBUTTONUP**, **POINT**

WM_NCRBUTTONDOWN (2.x)

```
WM_NCRBUTTONDOWN
wHitTestCode = wParam;    /* hit-test code              */
xPos = LOWORD(lParam);    /* horizontal cursor position */
yPos = HIWORD(lParam);    /* vertical cursor position   */
```

The WM_NCRBUTTONDOWN message is sent to a window when the user presses the right mouse button while the cursor is within a nonclient area of the window.

Parameter	Description
wHitTestCode	Value of *wParam.* Specifies the code returned by WM_NCHITTEST. For more information, see the description of the **WM_NCHITTEST** message.
xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, as a screen coordinate.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, as a screen coordinate.

Returns

An application should return zero if it processes this message.

See Also

WM_NCHITTEST, **WM_NCRBUTTONDBLCLK**, **WM_NCRBUTTONUP**, **POINT**

WM_NCRBUTTONUP (2.x)

```
WM_NCRBUTTONUP
wHitTestCode = wParam;    /* hit-test code              */
xPos = LOWORD(lParam);    /* horizontal cursor position */
yPos = HIWORD(lParam);    /* vertical cursor position   */
```

The WM_NCRBUTTONUP message is sent to a window when the user releases the right mouse button while the cursor is within a nonclient area of the window.

Parameter	Description
wHitTestCode	Value of *wParam.* Specifies the code returned by WM_NCHITTEST. For more information, see the description of the **WM_NCHITTEST** message.
xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, as a screen coordinate.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, as a screen coordinate.

Returns

An application should return zero if it processes this message.

See Also

WM_NCHITTEST, **WM_NCRBUTTONDBLCLK**, **WM_NCRBUTTONDOWN**, **POINT**

WM_NEXTDLGCTL (2.x)

```
WM_NEXTDLGCTL
wCtlFocus = wParam;               /* identifies control for focus */
fHandle = (BOOL) LOWORD(lParam);  /* wParam handle flag           */
```

An application sends the WM_NEXTDLGCTL message to a dialog box procedure to set the focus to a different control in a dialog box.

Parameter	Description
wCtlFocus	Value of *wParam.* If the *fHandle* parameter is nonzero, the *wCtlFocus* parameter is the handle of the control that receives the focus. If *fHandle* is zero, *wCtlFocus* is a flag that indicates whether the next or previous control with the **WS_TABSTOP** style receives the focus. If *wCtlFocus* is zero, the next control receives the focus; otherwise, the previous control with the WS_TABSTOP style receives the focus.
fHandle	Low-order word of *lParam.* Indicates how Windows uses the *wParam* parameter. If *fHandle* is nonzero, *wParam* is a handle associated with the control that receives the focus; otherwise, *wParam* is a flag that indicates whether the next or previous control with the **WS_TABSTOP** style receives the focus.

Returns

An application should return zero if it processes this message.

Comments

The effect of this message differs from that of the **SetFocus** function because WM_NEXTDLGCTL modifies the border around the default button.

Do not use the **SendMessage** function to send a WM_NEXTDLGCTL message if your application will concurrently process other messages that set the control focus. In this case, use the **PostMessage** function instead.

See Also

PostMessage, **SendMessage**, **SetFocus**

WM_PAINT (2.x)

```
WM_PAINT
```

The WM_PAINT message is sent when Windows or an application makes a request to repaint a portion of an application's window. The message is sent when the **UpdateWindow** or **RedrawWindow** function is called or by the **DispatchMessage** function when the application obtains a WM_PAINT message by using the **GetMessage** or **PeekMessage** function.

Parameters

This message has no parameters.

Returns

An application should return zero if it processes this message.

Comments

The **DispatchMessage** function sends this message when there are no other messages in the application's message queue.

A window may receive internal paint messages as a result of calling the **RedrawWindow** function with the **RDW_INTERNALPAINT** flag set. In this case, the window may not have an update region. An application should call the **GetUpdateRect** function to determine whether the window has an update region. If **GetUpdateRect** returns zero, the application should not call the **BeginPaint** and **EndPaint** functions.

It is an application's responsibility to check for any necessary internal repainting or updating by looking at its internal data structures for each WM_PAINT message, because a WM_PAINT message may have been caused by both an invalid area and a call to the **RedrawWindow** function with the **RDW_INTERNALPAINT** flag set.

An internal WM_PAINT message is sent only once by Windows. After an internal WM_PAINT message is returned from the **GetMessage** or **PeekMessage** function or is sent to a window by the **UpdateWindow** function, no further WM_PAINT messages will be sent or posted until the window is invalidated or until the **RedrawWindow** function is called again with the **RDW_INTERNALPAINT** flag set.

See Also

BeginPaint, **DispatchMessage**, **EndPaint**, **GetMessage**, **PeekMessage**, **RedrawWindow**, **UpdateWindow**

Windows 3.1 changes

A window that may receive internal paint messages as a result of calling the **RedrawWindow** function with the **RDW_INTERNALPAINT** flag set. In this case, the window may not have an update region. An application should call the **GetUpdateRect** function to determine whether the window has an update region. If **GetUpdateRect** returns zero, the application should not call the **BeginPaint** and **EndPaint** functions.

It is an application's responsibility to check for any necessary internal repainting or updating by looking at its internal data structures for each WM_PAINT message, since a WM_PAINT message may have been caused by both an invalid area and a call to the **RedrawWindow** function with the **RDW_INTERNALPAINT** flag set.

Internal WM_PAINT messages are only sent once by Windows. After an internal WM_PAINT message is returned from the **GetMessage** or **PeekMessage** function, or sent to a window by the **UpdateWindow** function, no further WM_PAINT messages will be sent or posted until the window is invalidated or until the **RedrawWindow** function is called again with the **RDW_INTERNALPAINT** flag set.

WM_PAINTCLIPBOARD (2.x)

```
WM_PAINTCLIPBOARD
hwndViewer = (HWND) wParam;              /* handle of viewer     */
pps = (PAINTSTRUCT FAR*) LOWORD(lParam); /* points to paint data */
```

The WM_PAINTCLIPBOARD message is sent by a clipboard viewer to the clipboard owner when the owner has placed data on the clipboard in the CF_OWNERDISPLAY format and the clipboard viewer's client area needs repainting.

Parameter	Description
hwndViewer	Value of *wParam.* Specifies a handle to the clipboard viewer window.
pps	Value of the low-order word of *lParam.* Points to a **PAINTSTRUCT** data structure that defines which part of the client area to paint.

Returns

An application should return zero if it processes this message.

Comments

To determine whether the entire client area or just a portion of it needs repainting, the clipboard owner must compare the dimensions of the drawing area given in the **rcPaint** member of the **PAINTSTRUCT** structure to the dimensions given in the most recent **WM_SIZECLIPBOARD** message.

An application must use the **GlobalLock** function to lock the memory that contains the **PAINTSTRUCT** data structure. The application should unlock that memory by using the **GlobalUnlock** function before it yields or returns control.

See Also

GlobalLock, **GlobalUnlock**, **WM_SIZECLIPBOARD**, **PAINTSTRUCT**

WM_PALETTECHANGED (3.0)

```
WM_PALETTECHANGED
hwndPalChg = (HWND) wParam; /* handle of window that changed palette */
```

The WM_PALETTECHANGED message is sent to all top-level and overlapped windows after the window with the input focus has realized its logical palette, thereby changing the system palette. This message allows a window without the input focus that uses a color palette to realize its logical palette and update its client area.

Parameter	Description
hwndPalChg	Value of *wParam.* Specifies the handle of the window that caused the system palette to change.

Returns

An application should return zero if it processes this message.

Comments

This message is sent to all top-level and overlapped windows, including the one that changed the system palette and caused this message to be sent. If any child windows use a color palette, this message must be passed on to them.

To avoid an infinite loop, a window that receives this message should not realize its palette unless it determines that *wParam* does not contain its own window handle.

Example

This example shows how an application selects and realizes its logical palette:

```
HDC hdc;
HPALETTE hpalApp, hpalT;
UINT i;

/*
 * If this application changed the palette, ignore the message.
 */

case WM_PALETTECHANGED:
    if ((HWND) wParam == hwnd)
        return 0;

/* Otherwise, fall through to WM_QUERYNEWPALETTE. */

case WM_QUERYNEWPALETTE:

    /*
     * If realizing the palette causes the palette to change,
     * redraw completely.
     */

    hdc = GetDC(hwnd);
    hpalT = SelectPalette (hdc, hpalApp, FALSE);

    i = RealizePalette(hdc); /* i == entries that changed  */

    SelectPalette (hdc, hpalT, FALSE);
    ReleaseDC(hwnd, hdc);
```

```
    /* If any palette entries changed, repaint the window. */

    if (i > 0)
        InvalidateRect(hwnd, NULL, TRUE);

    return i;
```

See Also

WM_PALETTEISCHANGING, **WM_QUERYNEWPALETTE**, **RealizePalette**

WM_PALETTEISCHANGING (3.1)

```
WM_PALETTEISCHANGING
hwndRealize = (HWND) wParam; /* handle of window to realize palette */
```

The WM_PALETTEISCHANGING message informs applications that an application is going to realize its logical palette.

Parameter	Description
hwndRealize	Value of *wParam.* Specifies the handle of the window that is going to realize its logical palette.

Returns

An application should return zero if it processes this message.

See Also

WM_PALETTECHANGED, **WM_QUERYNEWPALETTE**

WM_PARENTNOTIFY (3.0)

```
WM_PARENTNOTIFY
fwEvent = wParam;          /* event flags                        */
wValue1 = LOWORD(lParam); /* child handle/cursor x-coordinate */
wValue2 = HIWORD(lParam); /* child ID/cursor y-coordinate     */
```

The WM_PARENTNOTIFY message is sent to the parent of a child window when the child window is created or destroyed or when the user clicks a mouse button while the cursor is over the child window. When the child window is being created, the system sends WM_PARENTNOTIFY just before the **CreateWindow** or **CreateWindowEx** function that creates the window returns. When the child window is being destroyed, the system sends the message before any processing to destroy the window takes place.

Parameter	Description
fwEvent	Value of *wParam.* Specifies the event for which the parent is being notified. It can be any of the following values:

Value	Description
WM_CREATE	The child window is being created.
WM_DESTROY	The child window is being destroyed.
WM_LBUTTONDOWN	The user has placed the mouse cursor over the child window and clicked the left mouse button.
WM_MBUTTONDOWN	The user has placed the mouse cursor over the child window and clicked the middle mouse button.
WM_RBUTTONDOWN	The user has placed the mouse cursor over the child window and clicked the right mouse button.

wValue1	Value of the low-order word of *lParam.* If the *fwEvent* parameter is **WM_CREATE** or **WM_DESTROY**, the *wValue1* parameter specifies the handle of the child window. Otherwise, *wValue1* specifies the x-coordinate of the cursor.
wValue2	Value of the high-order word of *lParam.* If *fwEvent* is **WM_CREATE** or **WM_DESTROY**, the *wValue2* parameter specifies the identifier of the child window. Otherwise, *wValue2* specifies the y-coordinate of the cursor.

Returns

An application should return zero if it processes this message.

Comments

This message is also sent to all ancestor windows of the child window, including the top-level window.

All child windows except those that have the **WS_EX_NOPARENTNOTIFY** send this message to their parent windows. By default, child windows in a dialog box have the WS_EX_NOPARENTNOTIFY style unless the **CreateWindowEx** function was called to create the child window without this style.

See Also

CreateWindow, **CreateWindowEx**, **WM_CREATE**, **WM_DESTROY**, **WM_LBUTTONDOWN**, **WM_MBUTTONDOWN**, **WM_RBUTTONDOWN**

WM_PASTE (2.x)

```
WM_PASTE
wParam = 0;      /* not used, must be zero */
lParam = 0L;     /* not used, must be zero */
```

An application sends the WM_PASTE message to an edit control or combo box to insert the data from the clipboard into the edit control at the current cursor position. Data is inserted only if the clipboard contains data in CF_TEXT format.

Parameters

This message has no parameters.

Returns

The return value is nonzero if this message is sent to an edit control or a combo box.

Example

This example pastes data from the clipboard to an edit control:

```
SendDlgItemMessage(hdlg, IDD_MYEDITCONTROL, WM_PASTE, 0, 0L);
```

See Also

WM_CLEAR, **WM_COPY**, **WM_CUT**

WM_POWER (3.1)

```
WM_POWER
fwPowerEvt = wParam;     /* power-event notification message */
```

The WM_POWER message is sent when the system, typically a battery-powered personal computer, is about to enter the suspended mode.

Parameter	Description
fwPowerEvt	Value of *wParam.* Specifies a power-event notification message. This parameter may be one of the following values:

Value	Meaning
PWR_SUSPENDREQUEST	Indicates that the system is about to enter the suspended mode.
PWR_SUSPENDRESUME	Indicates that the system is resuming operation after entering the suspended mode normally--that is, the system sent a PWR_SUSPENDREQUEST notification message to the application before the system was suspended. An application should perform any necessary recovery actions.
PWR_CRITICALRESUME	Indicates that the system is resuming operation after entering the suspended mode without first sending a PWR_SUSPENDREQUEST notification message to the application. An application should perform any necessary recovery actions.

Returns

The value an application should return depends on the value of the *wParam* parameter, as follows:

Value of *wParam*	Return Value
PWR_SUSPENDREQUEST	PWR_FAIL to prevent the system from entering the suspended state; otherwise PWR_OK
PWR_SUSPENDRESUME	0
PWR_CRITICALRESUME	0

Comments

This message is sent only to an application that is running on a system that conforms to the advanced power management (APM) basic input-and-output system (BIOS) specification. The message is sent by the power-management driver to each window returned by the **EnumWindows** function.

The suspended mode is the state in which the greatest amount of power savings occurs, but all operational data and parameters are preserved. Random-access memory (RAM) contents are preserved, but many devices are likely to be turned off.

See Also

EnumWindows

WM_QUERYDRAGICON (3.0)

```
WM_QUERYDRAGICON
```

The WM_QUERYDRAGICON message is sent to a minimized (iconic) window that does not have an icon defined for its class. The system sends this message whenever it needs to display an icon for the window.

Parameters

This message has no parameters.

Returns

An application should return a doubleword value that contains a cursor or icon handle in the low-order word. The cursor or icon must be compatible with the display driver's resolution. If the application returns NULL, the system displays the default cursor. The default return value is NULL.

Comments

If an application returns the handle of an icon or cursor, the system converts it to black-and-white.

The application can call the **LoadCursor** or **LoadIcon** function to load a cursor or icon from the resources in its executable file and to obtain this handle.

Example

This example returns an icon handle in response to the WM_QUERYDRAGICON message. The icon is loaded from the resources in the application's executable file.

```
static HICON hIcon;

switch(msg) {
    case WM_CREATE:

        /* Load icon resource. */

        hIcon = LoadIcon(hInstance, (LPCSTR) "MyIcon");
        .
        . /* Initialize other variables. */
        .

        return 0L;

    case WM_QUERYDRAGICON:

        /* Icon is about to be dragged. Return handle to custom icon. */

        return (hIcon);

    .
    . /* Process other messages. */
    .

}
```

See Also

LoadCursor, **LoadIcon**

WM_QUERYENDSESSION (2.x)

```
WM_QUERYENDSESSION
```

The WM_QUERYENDSESSION message is sent when the user chooses to end the Windows session, or when an application calls the **ExitWindows** function. If any application returns zero, the Windows session is not ended. Windows stops sending WM_QUERYENDSESSION messages as soon as one application returns zero and sends **WM_ENDSESSION** messages, with the *wParam* parameter set to FALSE, to any applications that have already returned nonzero.

Parameters

This message has no parameters.

Returns

An application should return nonzero if it can conveniently terminate; otherwise, it should return zero.

Comments

The **DefWindowProc** function returns nonzero when it processes this message.

See Also

DefWindowProc, **ExitWindows**, **WM_ENDSESSION**

WM_QUERYNEWPALETTE (3.0)

WM_QUERYNEWPALETTE

The WM_QUERYNEWPALETTE message informs an application that it is about to receive the input focus, giving the application an opportunity to realize its logical palette when it receives the focus.

Parameters

This message has no parameters.

Returns

An application should return nonzero if it realizes its logical palette; otherwise, it should return zero.

Example

This example shows how an application selects and realizes its logical palette:

```
HDC hdc;
HPALETTE hpalApp, hpalT;
UINT i;

/*
 * If this application changed the palette, ignore the message.
 */

case WM_PALETTECHANGED:
    if ((HWND) wParam == hwnd)
        return 0;

/* Otherwise, fall through to WM_QUERYNEWPALETTE. */

case WM_QUERYNEWPALETTE:

    /*
     * If realizing the palette causes the palette to change,
     * redraw completely.
     */

    hdc = GetDC(hwnd);
    hpalT = SelectPalette (hdc, hpalApp, FALSE);

    i = RealizePalette(hdc); /* i == entries that changed  */

    SelectPalette (hdc, hpalT, FALSE);
    ReleaseDC(hwnd, hdc);


    /* If any palette entries changed, repaint the window. */

    if (i > 0)
        InvalidateRect(hwnd, NULL, TRUE);

    return i;
```

See Also

WM_PALETTECHANGED, **WM_PALETTEISCHANGING**

WM_QUERYOPEN (2.x)

```
WM_QUERYOPEN
```

The WM_QUERYOPEN message is sent to a minimized window when the user requests that the window be restored to its preminimized size and position.

Parameters

This message has no parameters.

Returns

An application that processes this message should return a nonzero value if the icon can be opened or zero to prevent the icon from opened.

Comments

While processing this message, the application should not perform any action that would cause an activation or focus change (for example, creating a dialog box).

The **DefWindowProc** function returns nonzero when it processes this message.

See Also

DefWindowProc

WM_QUEUESYNC (3.1)

```
WM_QUEUESYNC
```

The WM_QUEUESYNC message is sent by a computer-based training (CBT) application to separate user-input messages from other messages sent through the journal playback hook (**WH_JOURNALPLAYBACK**).

Parameters

This message has no parameters.

Returns

A CBT application should return zero if it processes this message.

Comments

Whenever a CBT application uses the journal playback hook, the first and last messages rendered are WM_QUEUESYNC. This allows the CBT application to intercept and examine user-initiated messages without doing so for events that it sends.

WM_QUIT (2.x)

```
WM_QUIT
wExit = wParam; /* exit code */
```

The WM_QUIT message indicates a request to terminate an application and is generated when the application calls the **PostQuitMessage** function. It causes the **GetMessage** function to return zero.

Parameter	Description
wExit	Value of *wParam.* Specifies the exit code given in the **PostQuitMessage** function.

Returns

This message does not have a return value, because it causes the message loop to terminate before the message is sent to the application's window procedure.

See Also

GetMessage, **PostQuitMessage**

WM_RBUTTONDBLCLK (2.x)

```
WM_RBUTTONDBLCLK
fwKeys = wParam;          /* key flags                       */
xPos = LOWORD(lParam);    /* horizontal position of cursor */
yPos = HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_RBUTTONDBLCLK message is sent when the user double-clicks the right mouse button.

Parameter	Description
fwKeys	Value of *wParam.* Indicates whether various virtual keys are down. This parameter can be any combination of the following values:

Value	Description
MK_CONTROL	Set if CTRL key is down.
MK_LBUTTON	Set if left button is down.
MK_MBUTTON	Set if middle button is down.
MK_RBUTTON	Set if right button is down.
MK_SHIFT	Set if SHIFT key is down.

xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.

Returns

An application should return zero if it processes this message.

Comments

Only windows that have the **CS_DBLCLKS** class style can receive WM_RBUTTONDBLCLK messages. Windows generates a WM_RBUTTONDBLCLK message when the user presses, releases, and again presses the right mouse button within the system's double-click time limit. Double-clicking the right mouse button actually generates four messages: a **WM_RBUTTONDOWN** message, a **WM_RBUTTONUP** message, the WM_RBUTTONDBLCLK message, and another WM_RBUTTONUP message.

See Also

WM_RBUTTONDOWN, **WM_RBUTTONUP**

WM_RBUTTONDOWN (2.x)

```
WM_RBUTTONDOWN
fwKeys = wParam;          /* key flags                      */
xPos = LOWORD(lParam);    /* horizontal position of cursor */
yPos = HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_RBUTTONDOWN message is sent when the user presses the right mouse button.

Parameter	Description
fwKeys	Indicates whether various virtual keys are down. This parameter can be any combination of the following values:

Value	Description
MK_CONTROL	Set if CTRL key is down.
MK_LBUTTON	Set if left mouse button is down.
MK_MBUTTON	Set if middle mouse button is down.
MK_SHIFT	Set if SHIFT key is down.

xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.

Returns
An application should return zero if it processes this message.

See Also
WM_RBUTTONDBLCLK, **WM_RBUTTONUP**

WM_RBUTTONUP (2.x)

```
WM_RBUTTONUP
fwKeys = wParam;          /* key flags                      */
xPos = LOWORD(lParam);    /* horizontal position of cursor */
yPos = HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_RBUTTONUP message is sent when the user releases the right mouse button.

Parameter	Description
fwKeys	Value of *wParam.* Indicates whether various virtual keys are down. This parameter can be any combination of the following values:

Value	Description
MK_CONTROL	Set if CTRL key is down.
MK_LBUTTON	Set if left mouse button is down.
MK_MBUTTON	Set if middle mouse button is down.
MK_SHIFT	Set if SHIFT key is down.

xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor. The coordinate is relative to the upper-left corner of the window.

Returns
An application should return zero if it processes this message.

See Also
WM_RBUTTONDBLCLK, **WM_RBUTTONDOWN**

WM_RENDERALLFORMATS (2.x)

WM_RENDERALLFORMATS

The WM_RENDERALLFORMATS message is sent to the clipboard owner when the owner application is being destroyed.

Parameters

This message has no parameters.

Returns

An application should return zero if it processes this message.

Comments

The clipboard owner should render the data in all the formats it is capable of generating and pass a data handle for each format to the clipboard by calling the **SetClipboardData** function. This ensures that the clipboard contains valid data even though the application that rendered the data is destroyed. The application should call the **OpenClipboard** function before calling **SetClipboardData** and should call the **CloseClipboard** function afterward.

Example

In this example, the application sends a **WM_RENDERFORMAT** message to itself for each clipboard format that the application supports:

```
case WM_RENDERALLFORMATS:
    OpenClipboard(hwnd);
    SendMessage(hwnd, WM_RENDERFORMAT, CF_DIB, 0L);
    SendMessage(hwnd, WM_RENDERFORMAT, CF_BITMAP, 0L);
    CloseClipboard();
    break;
```

See Also

CloseClipboard, **OpenClipboard**, **SetClipboardData**, **WM_RENDERFORMAT**

WM_RENDERFORMAT (2.x)

```
WM_RENDERFORMAT
uFmt = (UINT) wParam;    /* clipboard data format */
```

The WM_RENDERFORMAT message is sent to the clipboard owner when a particular format with delayed rendering needs to be rendered. The receiver should render the data in that format and pass it to the clipboard by calling the **SetClipboardData** function.

Parameter	Description
uFmt	Specifies the data format. It can be any one of the formats described with the **SetClipboardData** function.

Returns

An application should return zero if it processes this message.

Comments

The application should not call the **OpenClipboard** and **CloseClipboard** functions while processing this message.

Example

This example uses an application-defined function to render clipboard data. The function returns a data handle that is passed to the clipboard by the **SetClipboardData** function.

```
HANDLE hData;

case WM_RENDERFORMAT:
    if (hData = RenderFormat(wParam))
        SetClipboardData(wParam, hData);
    break;
```

See Also

CloseClipboard, **OpenClipboard**, **SetClipboardData**, **WM_RENDERALLFORMATS**

WM_SETCURSOR (2.x)

```
WM_SETCURSOR
hwndCursor = (HWND) wParam;    /* handle of window with cursor */
nHittest = LOWORD(lParam);     /* hit-test code                */
wMouseMsg = HIWORD(lParam);    /* mouse-message number         */
```

The WM_SETCURSOR message is sent to a window if mouse input is not captured and the mouse causes cursor movement within the window.

Parameter	Description
hwndCursor	Value of *wParam.* Specifies a handle to the window that contains the cursor.
nHittest	Value of the low-order word of *lParam.* Specifies the hit-test area code.
wMouseMsg	Value of the high-order word of *lParam.* Specifies the number of the mouse message.

Returns

An application should return TRUE to halt further processing or zero to continue.

Comments

If the *nHittest* parameter is HTERROR and the *wMouseMsg* parameter is a mouse button–down message, the **MessageBeep** function is called.

The **DefWindowProc** function passes the WM_SETCURSOR message to a parent window before processing. If the parent window returns TRUE, further processing is halted. Passing the message to a window's parent window gives the parent window control over the cursor's setting in a child window. The **DefWindowProc** function also uses this message to set the cursor to a pointer if it is not in the client area or to the registered-class cursor if it is in the client area.

For a standard dialog box to set the cursor for one of its child window controls, it must force the **DefDlgProc** function to return TRUE in response to the WM_SETCURSOR message. (**DefDlgProc** provides default processing for the standard dialog box class.) When **DefDlgProc** returns TRUE, the dialog procedure retains control over the cursor. When the dialog procedure processes the WM_SETCURSOR message, it can return TRUE by using the **SetWindowLong** function and the **DWL_MSGRESULT** offset, as shown in the following example:

```
SetWindowLong(hwndDlg, DWL_MSGRESULT, MAKELONG(TRUE, 0));
```

See Also

DefWindowProc, **MessageBeep**, **SetWindowLong**

WM_SETFOCUS (2.x)

```
WM_SETFOCUS
hwnd = (HWND) wParam;    /* handle of window losing focus */
```

The WM_SETFOCUS message is sent after a window gains the input focus.

Parameter	Description
hwnd	Value of *wParam.* Contains the handle of the window that loses the input focus. (This parameter may be NULL.)

Returns

An application should return zero if it processes this message.

Comments

To display a caret, an application should call the appropriate caret functions at this point.

WM_SETFONT (3.0)

```
WM_SETFONT
wParam = (WPARAM) hfont;                        /* handle of the font */
lParam = (LPARAM) MAKELONG((WORD) fRedraw, 0); /* redraw flag        */
```

An application sends the WM_SETFONT message to specify the font that a control is to use when drawing text.

Parameter	Description
hfont	Value of *wParam.* Specifies the handle of the font. If this parameter is NULL, the control will use the default system font to draw text.
fRedraw	Value of the low-order word of *lParam.* Specifies whether the control should be redrawn immediately upon setting the font. Setting the *fRedraw* parameter to TRUE causes the control to redraw itself.

Returns

An application should return zero if it processes this message.

Comments

The WM_SETFONT message applies to all controls, not just those in dialog boxes.

The best time for the owner of a dialog box to set the font of the control is when it receives the **WM_INITDIALOG** message. The application should call the **DeleteObject** function to delete the font when it is no longer needed--for example, after the control is destroyed.

The size of the control is not changed as a result of receiving this message. To prevent Windows from clipping text that does not fit within the boundaries of the control, the application should correct the size of the control window before changing the font.

Before Windows creates a dialog box with the DS_SETFONT style, Windows sends the WM_SETFONT message to the dialog box window before creating the controls. An application creates a dialog box with the DS_SETFONT style by calling any of the following functions:

- **CreateDialogIndirect**
- **CreateDialogIndirectParam**
- **DialogBoxIndirect**
- **DialogBoxIndirectParam**

The **DialogBoxHeader** structure that the application passes to these functions must have the DS_SETFONT style set and must contain the **wPointSize** and **szFaceName** members that define the font the dialog box will use to draw text.

For more information about the **DialogBoxHeader** structure, see the **Resource Format Overview**.

Example

This example changes the font used by controls in a dialog box to a font that is not bold.

```
HFONT hfontDlg;
LOGFONT lFont;

case WM_INITDIALOG:

    /* Get dialog box font and create version that is not bold. */

    hfontDlg = (HFONT) NULL;
    if ((hfontDlg = (HFONT) SendMessage(hdlg, WM_GETFONT, 0, 0L))) {
        if (GetObject(hfontDlg, sizeof(LOGFONT), (LPSTR) &lFont)) {
            lFont.lfWeight = FW_NORMAL;
```

```
            if (hfontDlg = CreateFontIndirect((LPLOGFONT) &lFont)) {
                SendDlgItemMessage(hdlg, ID_CTRL1, WM_SETFONT,
                    (WPARAM) hfontDlg, 0);
                SendDlgItemMessage(hdlg, ID_CTRL2, WM_SETFONT,
                    (WPARAM) hfontDlg, 0);
                .
                . /* Set font for remaining controls. */
                .
            }
        }
    }
    return TRUE;
```

See Also

CreateDialogIndirect, **CreateDialogIndirectParam**, **DeleteObject**, **DialogBoxIndirect**, **DialogBoxIndirectParam**, **WM_INITDIALOG**, **WM_SETFONT**

WM_SETREDRAW (2.x)

```
WM_SETREDRAW
wParam = (WPARAM) fRedraw;    /* state of redraw flag   */
lParam = 0L;                  /* not used, must be zero */
```

An application sends a WM_SETREDRAW message to a window to allow changes in that window to be redrawn or to prevent changes in that window from being redrawn.

Parameter	Description
fRedraw	Value of *wParam.* Specifies the state of the redraw flag. If this parameter is nonzero, the redraw flag is set. If this parameter is zero, the flag is cleared.

Returns

An application should return zero if it processes this message.

Comments

This message sets or clears the redraw flag. If the redraw flag is cleared, the contents of the specified window will not be updated after each change, and the window will not be repainted until the redraw flag is set. For example, an application that needs to add several items to a list box can clear the redraw flag, add the items, and then set the redraw flag. Finally, the application can call the **InvalidateRect** function to cause the list box to be repainted.

WM_SETTEXT (2.x)

```
WM_SETTEXT
wParam = 0;                          /* not used, must be zero        */
lParam = (LPARAM) (LPCSTR) pszText; /* address of window-text string */
```

An application sends a WM_SETTEXT message to set the text of a window.

Parameter	Description
pszText	Value of *lParam.* Points to a null-terminated string that is the window text.

Returns

The return value is LB_ERRSPACE (for a list box) or CB_ERRSPACE (for a combo box) if insufficient space is available to set the text in the edit control. It is CB_ERR if this message is sent to a combo box without an edit control.

Comments

For an edit control, the text to be set is the contents of the edit control. For a combo box, the text is the contents of the edit-control (or static-text) portion of the combo box. For a button, the text is the button name. For other windows, the text is the window title.

This message does not change the current selection in the list box of a combo box. An application should use the **CB_SELECTSTRING** message to select the item in the list box that matches the text in the edit control.

See Also

WM_GETTEXT

WM_SHOWWINDOW (2.x)

```
WM_SHOWWINDOW
fShow = (BOOL) wParam;              /* show/hide flag */
fnStatus = LOWORD(lParam);     /* status flag    */
```

The WM_SHOWWINDOW message is sent to a window when it is about to be hidden or shown. A window is hidden or shown when the **ShowWindow** function is called; when an overlapped window is maximized or restored; or when an overlapped or pop-up window is minimized or displayed on the screen. When an overlapped window is minimized, all pop-up windows associated with that window are hidden.

Parameter	Description
fShow	Value of *wParam.* Specifies whether a window is being shown. It is TRUE if the window is being shown; it is FALSE if the window is being hidden.
fnStatus	Value of the low-order word of *lParam.* Specifies the status of the window being shown. The *fnStatus* parameter is zero if the message is sent because of a **ShowWindow** function call; otherwise, *fnStatus* is one of the following values:

Value	Description
SW_PARENTCLOSING	Parent window is being minimized, or a pop-up window is being hidden.
SW_PARENTOPENING	Parent window is opening (being displayed) or a pop-up window is being shown.

Returns

An application should return zero if it processes this message.

Comments

The **DefWindowProc** function hides or shows the window as specified by the message.

The WM_SHOWWINDOW message is not sent under the following circumstances:

- When a main window is created with the **WS_MAXIMIZE** or **WS_MINIMIZE** style
- When the SW_SHOWNORMAL flag is specified in the call to the **ShowWindow** function

See Also

DefWindowProc, **ShowWindow**

WM_SIZE (2.x)

```
WM_SIZE
fwSizeType = wParam;      /* sizing-type flag      */
nWidth = LOWORD(lParam);  /* width of client area  */
nHeight = HIWORD(lParam); /* height of client area */
```

The WM_SIZE message is sent to a window after its size has changed.

Parameter	Description
fwSizeType	Value of *wParam.* Specifies the type of resizing requested. This parameter can be one of the following values:

Value	Description
SIZE_MAXIMIZED	Window has been maximized.
SIZE_MINIMIZED	Window has been minimized.
SIZE_RESTORED	Window has been resized, but neither SIZE_MINIMIZED nor SIZE_MAXIMIZED applies.
SIZE_MAXHIDE	Message is sent to all pop-up windows when some other window is maximized.
SIZE_MAXSHOW	Message is sent to all pop-up windows when some other window has been restored to its former size.

nWidth	Value of the low-order word of *lParam.* Specifies the new width of the client area.
nHeight	Value of the high-order word of *lParam.* Specifies the new height of the client area.

Returns

An application should return zero if it processes this message.

Comments

If the **SetScrollPos** or **MoveWindow** function is called for a child window as a result of the WM_SIZE message, the *fRepaint* parameter should be nonzero to cause the window to be repainted.

See Also

MoveWindow, **SetScrollPos**

WM_SIZECLIPBOARD (2.x)

```
WM_SIZECLIPBOARD
hwndViewer = (HWND) wParam;      /* handle of clipboard viewer */
hglb = (HGLOBAL) LOWORD(lParam); /* handle of global object    */
```

The WM_SIZECLIPBOARD message is sent by the clipboard viewer to the clipboard owner when the clipboard contains data with the CF_OWNERDISPLAY attribute and the size of the client area of the clipboard-viewer window has changed.

Parameter	Description
hwndViewer	Value of *wParam.* Identifies the clipboard-application window.
hglb	Value of the low-order word of *lParam.* Identifies a global memory object that contains a **RECT** data structure. The structure specifies the area that the clipboard owner should paint.

Returns

An application should return zero if it processes this message.

Comments

A WM_SIZECLIPBOARD message is sent with a null rectangle (0,0,0,0) as the new size when the clipboard application is about to be destroyed or minimized. This permits the clipboard owner to free its display resources.

An application must use the **GlobalLock** function to lock the memory that contains the **RECT** data structure. The application should unlock that memory by using the **GlobalUnlock** function before it yields or returns control.

See Also

GlobalLock, **GlobalUnlock**, **SetClipboardData**, **SetClipboardViewer**, **RECT**

WM_SPOOLERSTATUS (3.0)

```
WM_SPOOLERSTATUS
fwJobStatus = wParam;       /* job-status flag          */
cJobsLeft = LOWORD(lParam); /* number of jobs remaining */
```

The WM_SPOOLERSTATUS message is sent from Print Manager whenever a job is added to or removed from the Print Manager queue.

Parameter	Description
fwJobStatus	Value of *wParam.* Specifies the SP_JOBSTATUS flag.
cJobsLeft	Value of the low-order word of *lParam.* Specifies the number of jobs remaining in the Print Manager queue.

Returns

An application should return zero if it processes this message.

Comments

This message is for informational purposes only.

WM_SYSCHAR (2.x)

```
WM_SYSCHAR
wKeyCode = wParam;       /* ASCII key code */
dwKeyData = lParam;      /* key data       */
```

The WM_SYSCHAR message is sent to the window with the input focus when a **WM_SYSKEYUP** and a **WM_SYSKEYDOWN** message are translated. It specifies the virtual-key code of the System-menu key. (The System menu is sometimes referred to as the Control menu.)

Parameter	Description
wKeyCode	Value of *wParam.* Specifies the ASCII-character key code of a System-menu key.
dwKeyData	Value of *lParam.* Specifies the repeat count, scan code, extended key, context code, previous key state, and key-transition state, as shown in the following table:

Bit	Description
0-15	Specifies the repeat count. The value is the number of times the keystroke is repeated as a result of the user holding down the key.
16-23	Specifies the scan code. The value depends on the original equipment manufacturer (OEM).
24	Specifies whether the key is an extended key, such as a function key or a key on the numeric keypad. The value is 1 if it is an extended key; otherwise, it is 0.
25-26	Not used.
27-28	Used internally by Windows.
29	Specifies the context code. The value is 1 if the ALT key is held down while the key is pressed; otherwise, the value is 0.
30	Specifies the previous key state. The value is 1 if the key is down before the message is sent, or it is 0 if the key is up.
31	Specifies the key-transition state. The value is 1 if the key is being released, or it is 0 if the key is being pressed.

Returns

An application should return zero if it processes this message.

Comments

When the context code is zero, the message can be passed to the **TranslateAccelerator** function, which will handle it as though it were a normal key message instead of a System-menu key message. This allows accelerator keys to be used with the active window even if the active window does not have the input focus.

For IBM Enhanced 101- and 102-key keyboards, enhanced keys are the right ALT key and the right CTRL key on the main section of the keyboard; the INS, DEL, HOME, END, PAGE UP, PAGE DOWN, and arrow keys in the clusters to the left of the numeric keypad; and the division (*/*) and ENTER keys on the numeric keypad. Some other keyboards may support the extended-key bit in the *lParam* parameter.

See Also

TranslateAccelerator, **WM_SYSKEYDOWN**, **WM_SYSKEYUP**

WM_SYSCOLORCHANGE (2.x)

`WM_SYSCOLORCHANGE`

The WM_SYSCOLORCHANGE message is sent to all top-level windows when a change is made in the system color setting.

Parameters

This message has no parameters.

Returns

An application should return zero if it processes this message.

Comments

Windows sends a **WM_PAINT** message to any window that is affected by a system color change.

Applications that have brushes that use the existing system colors should delete those brushes and re-create them by using the new system colors.

See Also

SetSysColors, **WM_PAINT**

WM_SYSCOMMAND (2.x)

```
WM_SYSCOMMAND
wCmdType = wParam;        /* command value                 */
xPos = LOWORD(lParam);    /* horizontal position of cursor */
yPos = HIWORD(lParam);    /* vertical position of cursor   */
```

The WM_SYSCOMMAND message is sent when the user selects a command from the System menu (sometimes referred to as the Control menu) or when the user selects the Maximize button or the Minimize button.

Parameter	Description
wCmdType	Value of *wParam.* Specifies the type of system command requested. This parameter can be one of the following values:

Value	Meaning
SC_CLOSE	Close the window.
SC_HOTKEY	Activate the window associated with the application-specified hot key. The low-order word of *lParam* identifies the window to activate.
SC_HSCROLL	Scroll horizontally.
SC_KEYMENU	Retrieve a menu through a keystroke.
SC_MAXIMIZE (or SC_ZOOM)	Maximize the window.
SC_MINIMIZE (or SC_ICON)	Minimize the window.
SC_MOUSEMENU	Retrieve a menu through a mouse click.
SC_MOVE	Move the window.
SC_NEXTWINDOW	Move to the next window.
SC_PREVWINDOW	Move to the previous window.
SC_RESTORE	Restore window to normal position and size.
SC_SCREENSAVE	Execute the screen-saver application specified in the [boot] section of the SYSTEM.INI file.
SC_SIZE	Size the window.
SC_TASKLIST	Execute or activate the Windows Task Manager application.
SC_VSCROLL	Scroll vertically.

xPos	Value of the low-order word of *lParam.* Specifies the x-coordinate of the cursor, if a System-menu command is chosen with the mouse. Otherwise, this parameter is not used.
yPos	Value of the high-order word of *lParam.* Specifies the y-coordinate of the cursor, if a System-menu command is chosen with the mouse. Otherwise, this parameter is not used.

Returns

An application should return zero if it processes this message.

Comments

The **DefWindowProc** function carries out the System-menu request for the predefined actions specified in the preceding table.

In WM_SYSCOMMAND messages, the four low-order bits of the *wCmdType* parameter are used internally by Windows. When an application tests the value of *wCmdType,* it must combine the value 0xFFF0 with the *wCmdType* value by using the bitwise AND operator to obtain the correct result.

The menu items in a System menu can be modified by using the **GetSystemMenu**, **AppendMenu**,

InsertMenu, and **ModifyMenu** functions. Applications that modify the System menu must process WM_SYSCOMMAND messages. Any WM_SYSCOMMAND messages not handled by the application must be passed to the **DefWindowProc** function. Any command values added by an application must be processed by the application and cannot be passed to **DefWindowProc**.

An application can carry out any system command at any time by passing a WM_SYSCOMMAND message to the **DefWindowProc** function.

Accelerator keystrokes that are defined to select items from the System menu are translated into WM_SYSCOMMAND messages; all other accelerator key strokes are translated into **WM_COMMAND** messages.

See Also

AppendMenu, **DefWindowProc**, **GetSystemMenu**, **InsertMenu**, **ModifyMenu**, **WM_COMMAND**

Windows 3.1 changes

The following system-commmand values have been added:

Value	Meaning
SC_HOTKEY	Activate the window associated with the application-specified hot key. The low-order word of *lParam* identifies the window to activate.
SC_SCREENSAVE	Executes the screen-save application specified in the Desktop section of Control Panel.

WM_SYSDEADCHAR (2.x)

```
WM_SYSDEADCHAR
wDeadKey = wParam;              /* dead-key character */
cRepeat = (int) LOWORD(lParam); /* repeat count       */
cAutoRepeat = HIWORD(lParam);   /* auto-repeat count  */
```

The WM_SYSDEADCHAR message is sent to the window with the input focus when **WM_SYSKEYUP** and **WM_SYSKEYDOWN** messages are translated. It specifies the character value of a dead key.

Parameter	Description
wDeadKey	Value of *wParam.* Specifies the dead-key character value.
cRepeat	Value of the low-order word of *lParam.* Specifies the repeat count.
cAutoRepeat	Value of the high-order word of *lParam.* Specifies the auto-repeat count.

Returns
An application should return zero if it processes this message.

See Also
WM_SYSKEYDOWN, **WM_SYSKEYUP**

WM_SYSKEYDOWN (2.x)

```
WM_SYSKEYDOWN
wVkey = wParam;          /* virtual-key code */
dwKeyData = lParam;      /* key data         */
```

The WM_SYSKEYDOWN message is sent to the window with the input focus when the user holds down the ALT key and then presses another key. If no window currently has the input focus, the WM_SYSKEYDOWN message is sent to the active window. The window that receives the message can distinguish between these two contexts by checking the context code in the *dwKeyData* parameter.

Parameter	Description
wVkey	Value of *wParam.* Specifies the virtual-key code of the key being pressed.
dwKeyData	Value of *lParam.* Specifies the repeat count, scan code, extended key, context code, previous key state, and key-transition state, as shown in the following table:

Bit	Description
0-15	Specifies the repeat count. The value is the number of times the keystroke is repeated as a result of the user holding down the key.
16-23	Specifies the scan code. The value depends on the original equipment manufacturer (OEM).
24	Specifies whether the key is an extended key, such as a function key or a key on the numeric keypad. The value is 1 if it is an extended key; otherwise, it is 0.
25-26	Not used.
27-28	Used internally by Windows.
29	Specifies the context code. The value is 1 if the ALT key is held down while the key is pressed; otherwise, the value is 0.
30	Specifies the previous key state. The value is 1 if the key is down before the message is sent, or it is 0 if the key is up.
31	Specifies the key-transition state. The value is 1 if the key is being released, or it is 0 if the key is being pressed.

For WM_SYSKEYDOWN messages, the value of bit 29 (context code) is 1 if the ALT key is down while the key is pressed; it is 0 if the message is sent to the active window because no window has the input focus. The value of bit 31 (key-transition state) is 0.

Returns

An application should return zero if it processes this message.

Comments

When the context code is zero, the message can be passed to the **TranslateAccelerator** function, which will handle it as though it were a normal key message instead of a system-key message. This allows accelerator keys to be used with the active window even if the active window does not have the input focus.

Because of the autorepeat feature, more than one WM_SYSKEYDOWN message may occur before a **WM_SYSKEYUP** message is sent. The previous key state (bit 30) can be used to determine whether the WM_SYSKEYDOWN message indicates the first down transition or a repeated down transition.

For IBM Enhanced 101- and 102-key keyboards, enhanced keys are the right ALT key and the right CTRL key on the main section of the keyboard; the INS, DEL, HOME, END, PAGE UP, PAGE DOWN, and arrow keys in the clusters to the left of the numeric keypad; and the division (/) and ENTER keys on the numeric keypad. Some other keyboards may support the extended-key bit in the *lParam* parameter.

See Also

TranslateAccelerator, **WM_SYSKEYUP**

WM_SYSKEYUP (2.x)

```
WM_SYSKEYUP
wVkey = wParam;          /* virtual-key code */
dwKeyData = lParam;      /* key data         */
```

The WM_SYSKEYUP message is sent to the window with the input focus when the user releases a key that was pressed while the ALT key was held down. If no window currently has the input focus, the WM_SYSKEYUP message is sent to the active window. The window that receives the message can distinguish between these two contexts by checking the context code in the *lParam* parameter.

Parameter	Description
wVkey	Value of *wParam.* Specifies the virtual-key code of the key being pressed.
dwKeyData	Value of *lParam.* Specifies the repeat count, scan code, extended key, context code, previous key state, and key-transition state, as shown in the following table:

Bit	Description
0-15	Specifies the repeat count. The value is the number of times the keystroke is repeated as a result of the user holding down the key.
16-23	Specifies the scan code. The value depends on the original equipment manufacturer (OEM).
24	Specifies whether the key is an extended key, such as a function key or a key on the numeric keypad. The value is 1 if it is an extended key; otherwise, it is 0.
25-26	Not used.
27-28	Used internally by Windows.
29	Specifies the context code. The value is 1 if the ALT key is held down while the key is pressed; otherwise, the value is 0.
30	Specifies the previous key state. The value is 1 if the key is down before the message is sent, or it is 0 if the key is up.
31	Specifies the key-transition state. The value is 1 if the key is being released, or it is 0 if the key is being pressed.

For WM_SYSKEYUP messages, the value of bit 29 (context code) is 1 if the ALT key is down while the key is pressed; it is 0 if the message is sent to the active window because no window has the input focus. The value of bit 31 (key-transition state) is 1.

Returns

An application should return zero if it processes this message.

Comments

When the context code is zero, the message can be passed to the **TranslateAccelerator** function, which will handle it as though it were a normal key message instead of a system-key message. This allows accelerator keys to be used with the active window even if the active window does not have the input focus.

For IBM Enhanced 101- and 102-key keyboards, enhanced keys are the right ALT key and the right CTRL key on the main section of the keyboard; the INS, DEL, HOME, END, PAGE UP, PAGE DOWN, and arrow keys in the clusters to the left of the numeric keypad; and the division (/) and ENTER keys on the numeric keypad. Some other keyboards may support the extended-key bit in the *lParam* parameter.

For non-U.S. Enhanced 102-key keyboards, the right ALT key is handled as the CTRL+ALT key combination. The following list shows the messages that result when the user presses and releases this key, in the sequence they occur:

1 WM_KEYDOWN VK_CONTROL

2 WM_KEYDOWN VK_MENU
3 WM_KEYUP VK_CONTROL
4 WM_SYSKEYUP VK_MENU

See Also
TranslateAccelerator, **WM_SYSKEYDOWN**

WM_SYSTEMERROR (3.1)

```
WM_SYSTEMERROR
wErrSpec = wParam;  /* specifies when error occurred */
```

The WM_SYSTEMERROR message is sent when the Windows kernel encounters an error but cannot display the system-error message box.

Parameter	Description
wErrSpec	Value of *wParam.* Specifies when the error occurred. Currently, the only valid value is 1, indicating that the error occurred when a task or library was terminating.

Returns

An application should return zero if it processes this message.

Comments

A shell application should process this message, displaying a message box that indicates an error has occurred.

WM_TIMECHANGE (2.x)

```
WM_TIMECHANGE
wParam = 0;     /* not use, must be zero */
lParam = 0L;    /* not use, must be zero */
```

An application sends the WM_TIMECHANGE message to all top-level windows after changing the system time.

Parameters

This message has no parameters.

Returns

An application should return zero if it processes this message.

Comments

Any application that changes the system time should send this message to all top-level windows. To send the WM_TIMECHANGE message to all top-level windows, an application can use the **SendMessage** function with the *hwnd* parameter set to HWND_BROADCAST.

See Also

SendMessage

WM_TIMER (2.x)

```
WM_TIMER
wTimerID = wParam;                    /* timer identifier              */
tmprc = (TIMERPROC FAR*) lParam;      /* address of timer callback     */
```

The WM_TIMER message is posted to the installing application's message queue or sent to the appropriate **TimerProc** callback function after each interval specified in the **SetTimer** function used to install a timer.

Parameter	Description
wTimerID	Value of *wParam.* Specifies the identifier of the timer.
tmprc	Value of *lParam.* Points to a callback function that was passed to the **SetTimer** function when the timer was installed. If the *tmprc* parameter is not NULL, the system passes the WM_TIMER message to the specified callback function rather than posting the message to the application's message queue.

Returns

An application should return zero if it processes this message.

Comments

The **DispatchMessage** function sends this message when no other messages are in the application's message queue.

Example

This example uses the WM_TIMER message to create a blinking effect for a line of text:

```
DWORD dwXYVal;
WORD wXVal, wYVal;
char szMessage[16];

case WM_TIMER:
    hdc = GetDC(hwnd);
    dwXYVal = GetTextExtent(hdc, (LPCSTR) szMessage,
        lstrlen(szMessage));
    wXVal = LOWORD(dwXYVal);
    wYVal = HIWORD(dwXYVal);
    PatBlt(hdc, 10, 10, (int) wXVal, (int) wYVal, PATINVERT);
    ReleaseDC(hwnd, hdc);
    ValidateRect(hwnd, NULL);
    break;
```

See Also

SetTimer, **TimerProc**

WM_UNDO (2.x)

```
WM_UNDO
```

An application sends the WM_UNDO message to an edit control to undo the last operation. When this message is sent to an edit control, the previously deleted text is restored or the previously added text is deleted.

Parameters

This message has no parameters.

Returns

The return value is nonzero if the operation is successful, or it is zero if an error occurs.

See Also

WM_CLEAR, **WM_COPY**, **WM_CUT**, **WM_PASTE**

WM_USER (2.x)

```
WM_USER
```

WM_USER is a constant used by applications to help define private messages.

Comments
The WM_USER constant is used to distinguish between message values that are reserved for use by Windows and values that can be used by an application to send messages within a private window class. There are four ranges of message numbers:

Range	Meaning
0 through WM_USER - 1	Messages reserved for use by Windows.
WM_USER through 0x7FFF	Integer messages for use by private window classes.
0x8000 through 0xBFFF	Messages reserved for use by Windows.
0xC000 through 0xFFFF	String messages for use by applications.

Message numbers in the first range (0 through WM_USER - 1) are defined by Windows. Values in this range that are not explicitly defined are reserved for future use by Windows. This topic describes messages in this range.

Message numbers in the second range (WM_USER through 0x7FFF) can be defined and used by an application to send messages within a private window class. These values cannot be used to define messages that are meaningful throughout an application, because some predefined window classes already define values in this range. For example, such predefined control classes as BUTTON, EDIT, **LISTBOX**, and **COMBOBOX** may use these values. Messages in this range should not be sent to other applications unless the applications have been designed to exchange messages and to attach the same meaning to the message numbers.

Message numbers in the third range (0x8000 through 0xBFFF) are reserved for future use by Windows.

Message numbers in the fourth range (0xC000 through 0xFFFF) are defined at run time when an application calls the **RegisterWindowMessage** function to obtain a message number for a string. All applications that register the same string can use the associated message number for exchanging messages. The actual message number, however, is not a constant and cannot be assumed to be the same in different Windows sessions.

See Also
RegisterWindowMessage

WM_VKEYTOITEM (3.0)

```
WM_VKEYTOITEM
wVkey = wParam;                     /* virtual-key code       */
hwndLB = (HWND) LOWORD(lParam);     /* handle of the list box */
nCaretPos = HIWORD(lParam);         /* caret position         */
```

The WM_VKEYTOITEM message is sent by a list box with the **LBS_WANTKEYBOARDINPUT** style to its owner in response to a **WM_KEYDOWN** message.

Parameter	Description
wVkey	Value of *wParam.* Specifies the virtual-key code of the key that the user pressed.
hwndLB	Value of the low-order word of *lParam.* Identifies the list box.
nCaretPos	Value of the high-order word of *lParam.* Specifies the current position of the caret.

Returns

The return value specifies the action that the application performed in response to the message. A return value of -2 indicates that the application handled all aspects of selecting the item and requires no further action by the list box. A return value of -1 indicates that the list box should perform the default action in response to the keystroke. A return value of 0 or greater specifies the zero-based index of an item in the list box and indicates that the list box should perform the default action for the keystroke on the given item.

Comments

Only list boxes that have the **LBS_HASSTRINGS** style can receive this message.

See Also

WM_CHARTOITEM, **WM_KEYDOWN**

WM_VSCROLL (2.x)

```
WM_VSCROLL
wScrollCode = wParam;      /* scroll bar code             */
nPos = LOWORD(lParam);     /* current scroll box position */
hwndCtl = (HWND) HIWORD(lParam); /* handle of the control */
```

The WM_VSCROLL message is sent to a window when the user clicks the window's vertical scroll bar.

Parameter	Description
wScrollCode	Value of *wParam.* Specifies a scroll bar code that indicates the user's scrolling request. This parameter can be one of the following values:

Value	Description
SB_BOTTOM	Scroll to bottom.
SB_ENDSCROLL	End scroll.
SB_LINEDOWN	Scroll one line down.
SB_LINEUP	Scroll one line up.
SB_PAGEDOWN	Scroll one page down.
SB_PAGEUP	Scroll one page up.
SB_THUMBPOSITION	Scroll to absolute position. The current position is specified by the *nPos* parameter.
SB_THUMBTRACK	Drag scroll box (thumb) to specified position. The current position is specified by the *nPos* parameter.
SB_TOP	Scroll to top.

nPos	Value of the low-order word of *lParam.* Specifies the current position of the scroll box if *wScrollCode* is SB_THUMBPOSITION or SB_THUMBTRACK; otherwise, this parameter is not used.
hwndCtl	Value of the high-order word of *lParam.* Identifies the control if WM_VSCROLL is sent by a scroll bar. If WM_VSCROLL is sent as a result of the user clicking a pop-up window's scroll bar, the high-order word is not used.

Returns

An application should return zero if it processes this message.

Comments

The SB_THUMBTRACK message typically is used by applications that give some feedback while the scroll box is being dragged.

If an application scrolls the contents of the window, it must also reset the position of the scroll box by using the **SetScrollPos** function.

See Also

SetScrollPos, **WM_HSCROLL**

WM_VSCROLLCLIPBOARD (2.x)

```
WM_VSCROLLCLIPBOARD
hwndViewer = (HWND) wParam;      /* handle of clipboard viewer */
wScrollCode = LOWORD(lParam);    /* scroll bar code            */
wThumbPos = HIWORD(lParam);      /* scroll box position        */
```

The **WM_HSCROLLCLIPBOARD** message is sent by the clipboard viewer to the clipboard owner when the clipboard data has the CF_OWNERDISPLAY format and there is an event in the clipboard viewer's vertical scroll bar. The owner should scroll the clipboard image, invalidate the appropriate section, and update the scroll bar values.

Parameter	Description
hwndViewer	Value of *wParam.* Specifies a handle to a clipboard-viewer window.
wScrollCode	Value of the low-order word of *lParam.* Specifies one of the following scroll bar values:

Value	Description
SB_BOTTOM	Scroll to lower right.
SB_ENDSCROLL	End scroll.
SB_LINEDOWN	Scroll one line down.
SB_LINEUP	Scroll one line up.
SB_PAGEDOWN	Scroll one page down.
SB_PAGEUP	Scroll one page up.
SB_THUMBPOSITION	Scroll to absolute position.
SB_TOP	Scroll to upper left.

wThumbPos	Value of the high-order word of *lParam.* Specifies the scroll box position if the scroll bar code is SB_THUMBPOSITION; otherwise, the high-order word is not used.

Returns

An application should return zero if it processes this message.

Comments

The clipboard owner should use the **InvalidateRect** function or repaint the window as needed. The scroll bar position should also be reset.

See Also

InvalidateRect, **WM_HSCROLLCLIPBOARD**

WM_WINDOWPOSCHANGED (3.1)

```
WM_WINDOWPOSCHANGED
pwp = (const WINDOWPOS FAR*) lParam;    /* structure address          */
```

The WM_WINDOWPOSCHANGED message is sent to a window whose size, position, or z-order has changed as a result of a call to **SetWindowPos** or another window-management function.

Parameter	Description
pwp	Value of *lParam.* Points to a **WINDOWPOS** data structure that contains information about the window's new size and position.

Returns

An application should return zero if it processes this message.

Comments

The **DefWindowProc** function, when it processes the WM_WINDOWPOSCHANGED message, sends the **WM_SIZE** and **WM_MOVE** messages to the window. These messages are not sent if an application handles the WM_WINDOWPOSCHANGED message without calling **DefWindowProc**. It is more efficient to perform any move or size change processing during the WM_WINDOWPOSCHANGED message without calling **DefWindowProc**.

See Also

WM_MOVE, **WM_SIZE**, **WM_WINDOWPOSCHANGING**, **EndDeferWindowPos**, **SetWindowPos**

WM_WINDOWPOSCHANGING (3.1)

```
WM_WINDOWPOSCHANGING
pwp = (WINDOWPOS FAR*) lParam;  /* address of WINDOWPOS structure */
```

The WM_WINDOWPOSCHANGING message is sent to a window whose size, position, or z-order is about to change as a result of a call to **SetWindowPos** or another window-management function.

Parameter	Description
pwp	Value of *lParam.* Points to a **WINDOWPOS** data structure that contains information about the window's new size and position.

Returns

An application should return zero if it processes this message.

Comments

During this message, modifying any of the values in the **WINDOWPOS** structure affects the new size, position, or z-order. An application can prevent changes to the window by setting or clearing the appropriate bits in the **flags** member of the **WINDOWPOS** structure.

For a window with the **WS_OVERLAPPED** or **WS_THICKFRAME** style, the **DefWindowProc** function handles a WM_WINDOWPOSCHANGING message by sending a **WM_GETMINMAXINFO** message to the window. This is done to validate the new size and position of the window and to enforce the **CS_BYTEALIGNCLIENT** and CS_BYTEALIGN client styles. An application can override this functionality by not passing the WM_WINDOWPOSCHANGING message to the **DefWindowProc** function.

See Also

WM_WINDOWPOSCHANGED, **EndDeferWindowPos**, **SetWindowPos**

WM_WININICHANGE (2.x)

```
WM_WININICHANGE
wParam = 0;                              /* not used, must be zero */
lParam = (LPARAM) (LPCSTR) pszSection; /* address of string     */
```

An application sends the WM_WININICHANGE message to all top-level windows after making a change to the Windows initialization file, WIN.INI. The **SystemParametersInfo** function sends the WM_WININICHANGE message after an application uses the function to change a setting in the WIN.INI file.

Parameter	Description
pszSection	Value of *lParam.* Points to a string that specifies the name of the section that has changed (the string does not include the square brackets that enclose the section name).

Returns

An application should return zero if it processes this message.

Comments

To send the WM_WININICHANGE message to all top-level windows, an application can use the **SendMessage** function with the *hwnd* parameter set to HWND_BROADCAST.

If an application changes many different sections in WIN.INI at the same time, the application should send the WM_WININICHANGE message once with the *pszSection* parameter set to NULL. Otherwise, an application should send a separate WM_WININICHANGE message for each change it makes to WIN.INI.

If an application receives a WM_WININICHANGE message with the *pszSection* parameter set to NULL, the application should check all sections in WIN.INI that affect the application.

See Also

SendMessage, **SystemParametersInfo**

Messages (3.1)

BM_GETCHECK	Retrieves the check state of a button
BM_GETSTATE	Retrieves the state of a button
BM_SETCHECK	Sets the check state of a button
BM_SETSTATE	Sets the highlight state of a button
BM_SETSTYLE	Changes the style of a button
CB_ADDSTRING	Adds a string to the list box of a combo box
CB_DELETESTRING	Deletes a string in the list box of a combo box
CB_DIR	Adds filenames to the list box of a combo box
CB_FINDSTRING	Finds exact string in the list box of a combo box
CB_FINDSTRINGEXACT	Finds prefix string in the list box of a combo box
CB_GETCOUNT	Gets the number of list-box items in a combo box
CB_GETCURSEL	Gets index of selected list-box item in combo box
CB_GETDROPPEDCONTROLRECT	Gets rectangle of drop-down list box in combo box
CB_GETDROPPEDSTATE	Determines if list box of combo box is visible
CB_GETEDITSEL	Gets position of a selection in an edit control
CB_GETEXTENDEDUI	Determines if combo box has extended interface
CB_GETITEMDATA	Retrieves value associated with combo-box item
CB_GETITEMHEIGHT	Retrieves the height of list items in a combo box
CB_GETLBTEXT	Gets string from the list box of a combo box
CB_GETLBTEXTLEN	Gets length of string in list-box of combo box
CB_INSERTSTRING	Inserts a string into the list box of a combo box
CB_LIMITTEXT	Limits amount of edit-control text in a combo box
CB_RESETCONTENT	Removes all items from the list box of a combo box
CB_SELECTSTRING	Selects matching string in list box of combo box
CB_SETCURSEL	Selects indexed string in list box of combo box
CB_SETEDITSEL	Selects characters in edit control of combo box
CB_SETEXTENDEDUI	Sets the default or extended user interface
CB_SETITEMDATA	Associates a value with combo-box item
CB_SETITEMHEIGHT	Sets the height of list items in a combo box
CB_SHOWDROPDOWN	Shows or hides the list box of a combo box
DM_GETDEFID	Gets the identifier of the default push button
DM_SETDEFID	Sets the default push button of a dialog box
EM_CANUNDO	Determines if edit-control operation can be undone
EM_EMPTYUNDOBUFFER	Resets (clears) undo flag of edit control
EM_FMTLINES	Sets soft line break characters on or off
EM_GETFIRSTVISIBLELINE	Determines topmost line in an edit control
EM_GETHANDLE	Gets handle of memory for multiline edit control
EM_GETLINE	Retrieves line from multiline edit control
EM_GETLINECOUNT	Retrieves number of lines in an MLE
EM_GETMODIFY	Checks whether edit-control contents have changed
EM_GETPASSWORDCHAR	Retrieves edit-control password character
EM_GETRECT	Retrieves coordinates of edit-control rectangle
EM_GETSEL	Gets position of current edit-control selection
EM_GETWORDBREAKPROC	Retrieves the edit-control wordwrap function
EM_LIMITTEXT	Limits the amount of text in an edit control
EM_LINEFROMCHAR	Retrieves a line number from a character index
EM_LINEINDEX	Retrieves character index of edit-control line
EM_LINELENGTH	Retrieves length of line in edit control
EM_LINESCROLL	Scrolls text of a multiline edit control
EM_REPLACESEL	Replaces the current selection in an edit control
EM_SETHANDLE	Sets memory handle for multiline edit control
EM_SETMODIFY	Sets or clears edit-control modification flag
EM_SETPASSWORDCHAR	Sets or removes edit-control password character
EM_SETREADONLY	Sets the read-only state of an edit control
EM_SETRECT	Sets the formatting rectangle of an edit control

EM_SETRECTNP	Sets the formatting rectangle of an edit control
EM_SETSEL	Selects text in a multiline edit control
EM_SETTABSTOPS	Sets tab stops in multiline edit control
EM_SETWORDBREAKPROC	Provides custom word breaks in an edit control
EM_UNDO	Undoes the last edit-control operation
LB_ADDSTRING	Adds a string to a list box
LB_DELETESTRING	Deletes a string in a list box
LB_DIR	Adds a list of filenames to a list box
LB_FINDSTRING	Finds a prefix string in a list box
LB_FINDSTRINGEXACT	Finds an exact string in a list box
LB_GETCARETINDEX	Gets index of list-box item with focus rectangle
LB_GETCOUNT	Retrieves the number of items in a list box
LB_GETCURSEL	Retrieves index of selected item in a list box
LB_GETHORIZONTALEXTENT	Retrieves the horizontal extent of a list box
LB_GETITEMDATA	Retrieves the value associated with list-box item
LB_GETITEMHEIGHT	Determines the height of items in a list box
LB_GETITEMRECT	Retrieves the bounding rectangle for an item
LB_GETSEL	Retrieves the selection state of an item
LB_GETSELCOUNT	Retrieves the count of selected list-box items
LB_GETSELITEMS	Lists item numbers of selected list-box items
LB_GETTEXT	Retrieves a string from a list box
LB_GETTEXTLEN	Retrieves the length of a string in a list box
LB_GETTOPINDEX	Retrieves index of first visible list-box item
LB_INSERTSTRING	Inserts a string into a list box
LB_RESETCONTENT	Removes all items from a list box
LB_SELECTSTRING	Selects a matching string in a list box
LB_SELITEMRANGE	Selects consecutive items in a list box
LB_SETCARETINDEX	Sets the focus rectangle in a list box
LB_SETCOLUMNWIDTH	Sets the width of columns in a list box
LB_SETCURSEL	Selects an indexed string in a list box
LB_SETHORIZONTALEXTENT	Sets the horizontal extent of a list box
LB_SETITEMDATA	Associates a value with a list-box item
LB_SETITEMHEIGHT	Sets the height of items in a list box
LB_SETSEL	Selects a string in a multiple-selection list box
LB_SETTABSTOPS	Sets tab stops in a list box
LB_SETTOPINDEX	Ensures that a list-box item is visible
STM_GETICON	Gets icon handle associated with icon resource
STM_SETICON	Associates icon handle with icon resource
WM_ACTIVATE	Indicates a change in the activation state
WM_ACTIVATEAPP	Notifies applications when a new task is activated
WM_ASKCBFORMATNAME	Retrieves the name of the clipboard format
WM_CANCELMODE	Notifies a window to cancel internal modes
WM_CHANGECBCHAIN	Notifies clipboard viewer of removal from chain
WM_CHAR	Passes keyboard events to focus window
WM_CHARTOITEM	Provides list-box keystrokes to owner window
WM_CHILDACTIVATE	Notifies a child window of activation
WM_CHOOSEFONT_GETLOGFONT	Retrieves **LOGFONT** structure for Font dialog box
WM_CLEAR	Clears an edit control or combo box
WM_CLOSE	Signals a window or application to terminate
WM_COMMAND	Specifies a command message
WM_COMMNOTIFY	Notifies a window about the status of its queues
WM_COMPACTING	Indicates a low memory condition
WM_COMPAREITEM	Determines position of combo-box or list-box item
WM_COPY	Copies a selection to the clipboard
WM_CREATE	Indicates that a window is being created
WM_CTLCOLOR	Indicates that a control is about to be drawn

WM_CUT	Deletes a selection and copies it to the clipboard
WM_DDE_ACK	Acknowledges the receipt of a DDE transaction
WM_DDE_ADVISE	Starts an advise loop with a DDE server
WM_DDE_DATA	Passes a data item to a DDE client
WM_DDE_EXECUTE	Passes a command to a DDE server
WM_DDE_INITIATE	Initiates a DDE conversation
WM_DDE_POKE	Sends an unsolicited data item to a server
WM_DDE_REQUEST	Requests value of a data item from a DDE server
WM_DDE_TERMINATE	Terminates a DDE conversation
WM_DDE_UNADVISE	Ends a DDE advise loop
WM_DEADCHAR	Indicates when a dead key is pressed
WM_DELETEITEM	Indicates owner-drawn item or control is altered
WM_DESTROY	Indicates window is about to be destroyed
WM_DESTROYCLIPBOARD	Notifies owner when clipboard is emptied
WM_DEVMODECHANGE	Indicates when device-mode settings are changed
WM_DRAWCLIPBOARD	Indicates when clipboard contents are changed
WM_DRAWITEM	Indicates when owner-drawn control or menu changes
WM_DROPFILES	Indicates when a file is dropped
WM_ENABLE	Indicates when enable state of window is changing
WM_ENDSESSION	Indicates whether the Windows session is ending
WM_ENTERIDLE	Indicates a modal dialog box or menu is idle
WM_ERASEBKGND	Indicates when background of window needs erasing
WM_FONTCHANGE	Indicates a change in the font-resource pool
WM_GETDLGCODE	Allows processing of control input
WM_GETFONT	Retrieves the font that a control is using
WM_GETMINMAXINFO	Retrieves minimum and maximum sizing information
WM_GETTEXT	Copies the text that corresponds to a window
WM_GETTEXTLENGTH	Determines length of text associated with a window
WM_HSCROLL	Indicates a click in a horizontal scroll bar
WM_HSCROLLCLIPBOARD	Prompts owner to scroll clipboard contents
WM_ICONERASEBKGND	Notifies minimized window to fill icon background
WM_INITDIALOG	Initializes a dialog box
WM_INITMENU	Indicates when a menu is about to become active
WM_INITMENUPOPUP	Indicates when a pop-up menu is being created
WM_KEYDOWN	Indicates when a nonsystem key is pressed
WM_KEYUP	Indicates when a nonsystem key is released
WM_KILLFOCUS	Indicates window is about to lose input focus
WM_LBUTTONDBLCLK	Indicates double-click of left mouse button
WM_LBUTTONDOWN	Indicates when left mouse button is pressed
WM_LBUTTONUP	Indicates when left mouse button is released
WM_MBUTTONDBLCLK	Indicates double-click of middle mouse button
WM_MBUTTONDOWN	Indicates when middle mouse button is pressed
WM_MBUTTONUP	Indicates when middle mouse button is released
WM_MDIACTIVATE	Activates a new MDI child window
WM_MDICASCADE	Arranges MDI child windows in a cascade format
WM_MDICREATE	Prompts an MDI client to create a child window
WM_MDIDESTROY	Closes an MDI child window
WM_MDIGETACTIVE	Retrieves data about the active MDI child window
WM_MDIICONARRANGE	Arranges minimized MDI child windows
WM_MDIMAXIMIZE	Maximizes an MDI child window
WM_MDINEXT	Activates the next MDI child window
WM_MDIRESTORE	Prompts an MDI client to restore a child window
WM_MDISETMENU	Replaces the menu of a MDI frame window
WM_MDITILE	Arranges MDI child windows in a tiled format
WM_MEASUREITEM	Requests dimensions of owner-drawn control
WM_MENUCHAR	Indicates when unknown menu mnemonic is pressed

WM_MENUSELECT	Indicates when a menu item is selected
WM_MOUSEACTIVATE	Indicates a mouse click in an inactive window
WM_MOUSEMOVE	Indicates mouse-cursor movement
WM_MOVE	Indicates the position of a window has changed
WM_NCACTIVATE	Changes the active state of a nonclient area
WM_NCCALCSIZE	Calculates the size of a window's client area
WM_NCCREATE	Indicates a nonclient area is being created
WM_NCDESTROY	Indicates when nonclient area is being destroyed
WM_NCHITTEST	Indicates mouse-cursor movement
WM_NCLBUTTONDBLCLK	Indicates non-client left button double-click
WM_NCLBUTTONDOWN	Indicates left button pressed in nonclient area
WM_NCLBUTTONUP	Indicates left button released in nonclient area
WM_NCMBUTTONDBLCLK	Indicates middle button nonclient double-click
WM_NCMBUTTONDOWN	Indicates middle button pressed in nonclient area
WM_NCMBUTTONUP	Indicates middle button released in nonclient area
WM_NCMOUSEMOVE	Indicates mouse-cursor movement in nonclient area
WM_NCPAINT	Indicates a window's frame needs painting
WM_NCRBUTTONDBLCLK	Indicates right button nonclient double-click
WM_NCRBUTTONDOWN	Indicates right button pressed in nonclient area
WM_NCRBUTTONUP	Indicates right button released in nonclient area
WM_NEXTDLGCTL	Sets the focus to a different dialog box control
WM_PAINT	Indicates a window frame needs painting
WM_PAINTCLIPBOARD	Paints the specified portion of the window
WM_PALETTECHANGED	Indicates focus-window has realized its palette
WM_PALETTEISCHANGING	Informs windows about change to palette
WM_PARENTNOTIFY	Notifies parent of child-window activity
WM_PASTE	Inserts clipboard data into an edit control
WM_POWER	Indicates the system is entering suspended mode
WM_QUERYDRAGICON	Requests a cursor handle for a minimized window
WM_QUERYENDSESSION	Requests that the Windows session be ended
WM_QUERYNEWPALETTE	Allows a window to realize its logical palette
WM_QUERYOPEN	Requests that a minimized window be restored
WM_QUEUESYNC	Delimits CBT messages
WM_QUIT	Requests that an application be terminated
WM_RBUTTONDBLCLK	Indicates a double-click of right mouse button
WM_RBUTTONDOWN	Indicates when the right mouse button is pressed
WM_RBUTTONUP	Indicates when the right mouse button is released
WM_RENDERALLFORMATS	Notifies owner to render all clipboard formats
WM_RENDERFORMAT	Notifies owner to render particular clipboard data
WM_SETCURSOR	Displays the appropriate mouse cursor shape
WM_SETFOCUS	Indicates when a window has gained input focus
WM_SETFONT	Sets the font for a control
WM_SETREDRAW	Allows or prevents redrawing in a window
WM_SETTEXT	Sets the text of a window
WM_SHOWWINDOW	Indicates a window is about to be hidden or shown
WM_SIZE	Indicates a change in window size
WM_SIZECLIPBOARD	Indicates a change in clipboard size
WM_SPOOLERSTATUS	Indicates when a print job is added or removed
WM_SYSCHAR	Indicates when a System-menu key is pressed
WM_SYSCOLORCHANGE	Indicates when a system color setting is changed
WM_SYSCOMMAND	Indicates when a System-command is requested
WM_SYSDEADCHAR	Indicates when a system dead key is pressed
WM_SYSKEYDOWN	Indicates that ALT plus another key was pressed
WM_SYSKEYUP	Indicates that ALT plus another key was released
WM_SYSTEMERROR	Indicates that a system error has occurred
WM_TIMECHANGE	Indicates that the system time has been set

WM_TIMER	Indicates timeout interval for a timer has elapsed
WM_UNDO	Undoes the last operation in an edit control
WM_USER	Indicates a range of message values
WM_VKEYTOITEM	Provides list-box keystrokes to owner window
WM_VSCROLL	Indicates a click in a vertical scroll bar
WM_VSCROLLCLIPBOARD	Prompts the owner to scroll clipboard contents
WM_WINDOWPOSCHANGED	Notifies a window of a size or position change
WM_WINDOWPOSCHANGING	Notifies a window of a new size or position
WM_WININICHANGE	Notifies applications of change to WIN.INI

BN_CLICKED (2.x)

BN_CLICKED

The BN_CLICKED notification message is sent to the parent window when the user clicks a button. Unlike the other button-notification messages, this message is intended for applications written for any version of Windows.

Parameter	Description
wParam	Specifies the control identifier.
lParam	Contains a handle that identifies the button control in its low-order word and the BN_CLICKED notification code in its high-order word.

See Also

DRAWITEMSTRUCT, **WM_DRAWITEM**

BN_DISABLE (2.x)

BN_DISABLE

The BN_DISABLE notification message is sent when a button is disabled. This notification is provided for compatibility with applications written prior to Windows version 3.0. New applications should use the **BS_OWNERDRAW** button style and the **DRAWITEMSTRUCT** structure for this task.

See Also
DRAWITEMSTRUCT, **WM_DRAWITEM**

BN_DOUBLECLICKED (2.x)

BN_DOUBLECLICKED

The BN_DOUBLECLICKED notification message is sent when the user double clicks a button. This notification is provided for compatibility with applications written prior to Windows version 3.0. New applications should use the **BS_OWNERDRAW** button style and the **DRAWITEMSTRUCT** structure for this task.

See Also
DRAWITEMSTRUCT, **WM_DRAWITEM**

BN_HILITE (2.x)

BN_HILITE

The BN_HILITE notification message is sent when the user highlights a button. This notification is provided for compatibility with applications written prior to Windows version 3.0. New applications should use the **BS_OWNERDRAW** button style and the **DRAWITEMSTRUCT** structure for this task.

See Also
DRAWITEMSTRUCT, **WM_DRAWITEM**

BN_PAINT (2.x)

BN_PAINT

The BN_PAINT notification message is sent when a button should be painted. This notification is provided for compatibility with applications written prior to Windows version 3.0. New applications should use the **BS_OWNERDRAW** button style and the **DRAWITEMSTRUCT** structure for this task.

See Also
DRAWITEMSTRUCT, **WM_DRAWITEM**

BN_UNHILITE (2.x)

BN_UNHILITE

The BN_UNHILITE notification message is sent when the highlight should be removed from a button. This notification is provided for compatibility with applications written prior to Windows version 3.0. New applications should use the **BS_OWNERDRAW** button style and the **DRAWITEMSTRUCT** structure for this task.

See Also
DRAWITEMSTRUCT, **WM_DRAWITEM**

CBN_CLOSEUP (3.1)

CBN_CLOSEUP

The CBN_CLOSEUP notification message is sent when the list box of a combo box is hidden. The control's parent window receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the combo box.
lParam	Specifies the handle of the combo box in the low-order word, and specifies the CBN_CLOSEUP notification message in the high-order word.

Comments

This notification message is not sent to a combo box that has the **CBS_SIMPLE** style.

The order in which notifications will be sent cannot be predicted. In particular, a **CBN_SELCHANGE** notification may occur either before or after a CBN_CLOSEUP notification.

See Also

CBN_DROPDOWN, **CBN_SELCHANGE**, **WM_COMMAND**

CBN_DBLCLK (3.0)

CBN_DBLCLK

The CBN_DBLCLK notification message is sent when the user double-clicks a string in the list box of a combo box. The control's parent window receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the combo box.
lParam	Specifies the handle of the combo box in the low-order word and the CBN_DBLCLK notification message in the high-order word.

Comments

This notification message can occur only for a combo box with the **CBS_SIMPLE** style. For a combo box with the **CBS_DROPDOWN** or **CBS_DROPDOWNLIST** style, a double-click cannot occur because a single click hides the list box.

See Also

CBN_SELCHANGE, **WM_COMMAND**

CBN_DROPDOWN (3.0)

CBN_DROPDOWN

The CBN_DROPDOWN notification message is sent when the list box of a combo box is about to be dropped down (made visible). The parent window of the combo box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the combo box.
lParam	Specifies the handle of the combo box in the low-order word, and specifies the CBN_DROPDOWN notification message in the high-order word.

Comments

This notification message can occur only for a combo box with the **CBS_DROPDOWN** or **CBS_DROPDOWNLIST** style.

See Also

CBN_CLOSEUP, **WM_COMMAND**

CBN_EDITCHANGE (3.0)

CBN_EDITCHANGE

The CBN_EDITCHANGE notification message is sent after the user has taken an action that may have altered the text in the edit-control portion of a combo box. Unlike the **CBN_EDITUPDATE** notification message, this notification message is sent after Windows updates the screen. The parent window of the combo box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the combo box.
lParam	Specifies the handle of the combo box in the low-order word, and specifies the CBN_EDITCHANGE notification message in the high-order word.

Comments

This message does not occur if the combo box has the **CBS_DROPDOWNLIST** style.

See Also

CBN_EDITUPDATE, **WM_COMMAND**

CBN_EDITUPDATE (3.0)

CBN_EDITUPDATE

The CBN_EDITUPDATE notification message is sent when the edit-control portion of a combo box is about to display altered text. This notification is sent after the control has formatted the text, but before it displays the text. The parent window of the combo box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the combo box.
lParam	Specifies the handle of the combo box in the low-order word, and specifies the CBN_EDITUPDATE notification message in the high-order word.

Comments

This message does not occur if the combo box has the **CBS_DROPDOWNLIST** style.

See Also

CBN_EDITCHANGE, **WM_COMMAND**

CBN_ERRSPACE (3.0)

CBN_ERRSPACE

The CBN_ERRSPACE notification message is sent when a combo box cannot allocate enough memory to meet a specific request. The parent window of the combo box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the combo box.
lParam	Specifies the handle of the combo box in the low-order word, and specifies the CBN_ERRSPACE notification message in the high-order word.

See Also
WM_COMMAND

CBN_KILLFOCUS (3.0)

CBN_KILLFOCUS

The CBN_KILLFOCUS notification message is sent when a combo box loses the input focus. The parent window of the combo box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the combo box.
lParam	Specifies the handle of the combo box in the low-order word, and specifies the CBN_KILLFOCUS notification message in the high-order word.

See Also

CBN_SETFOCUS, **WM_COMMAND**

CBN_SELCHANGE (3.0)

CBN_SELCHANGE

The CBN_SELCHANGE notification message is sent when the selection in the list box of a combo box is about to be changed as a result of the user either clicking in the list box or changing the selection by using the arrow keys. The parent window of the combo box receives this code through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the combo box.
lParam	Specifies the handle of the combo box in the low-order word, and specifies the CBN_SELCHANGE notification message in the high-order word.

See Also

CBN_DBLCLK, **CB_SETCURSEL**, **WM_COMMAND**

CBN_SELENDCANCEL (3.1)

CBN_SELENDCANCEL

The CBN_SELENDCANCEL notification message is sent when the user clicks an item and then clicks another window or control to hide the list box of a combo box. This notification message is sent before the **CBN_CLOSEUP** notification message to indicate that the user's selection should be ignored.

Parameter	Description
wParam	Specifies the identifier of the combo box.
lParam	Specifies the handle of the combo box in the low-order word, and specifies the CBN_SELENDCANCEL notification message in the high-order word.

Comments

The CBN_SELENDCANCEL or **CBN_SELENDOK** notification message is sent even if the **CBN_CLOSEUP** notification message is not sent (as in the case of a combo box with the **CBS_SIMPLE** style).

See Also

CBN_SELENDOK, **WM_COMMAND**

CBN_SELENDOK (3.1)

CBN_SELENDOK

The CBN_SELENDOK notification message is sent when the user selects an item and then either presses the ENTER key or clicks the DOWN ARROW key to hide the list box of a combo box. This notification message is sent before the **CBN_CLOSEUP** notification message to indicate that the user's selection should be considered valid.

Parameter	Description
wParam	Specifies the identifier of the combo box.
lParam	Specifies the handle of the combo box in the low-order word, and specifies the CBN_SELENDOK notification message in the high-order word.

Comments

The CBN_SELENDOK or **CBN_SELENDCANCEL** notification message is sent even if the **CBN_CLOSEUP** notification message is not sent (as in the case of a combo box with the **CBS_SIMPLE** style).

See Also

CBN_SELENDCANCEL, **WM_COMMAND**

CBN_SETFOCUS (3.0)

CBN_SETFOCUS

The CBN_SETFOCUS notification message is sent when a combo box receives the input focus. The parent window of the combo box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the combo box.
lParam	Specifies the handle of the combo box in the low-order word, and specifies the CBN_SETFOCUS notification message in the high-order word.

See Also

CBN_KILLFOCUS, **WM_COMMAND**

EN_CHANGE (2.x)

EN_CHANGE

The EN_CHANGE notification message is sent when the user has taken an action that may have altered text in an edit control. Unlike the **EN_UPDATE** notification message, this notification message is sent after Windows updates the display. The control's parent window receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the edit control.
lParam	Specifies the handle of the edit control in the low-order word, and specifies the EN_CHANGE notification message in the high-order word.

See Also

EN_UPDATE, **WM_COMMAND**

EN_ERRSPACE (2.x)

EN_ERRSPACE

The EN_ERRSPACE notification message is sent when an edit control cannot allocate enough memory to meet a specific request. The control's parent window receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the edit control.
lParam	Specifies the handle of the edit control in the low-order word, and specifies the EN_ERRSPACE notification message in the high-order word.

See Also
WM_COMMAND

EN_HSCROLL (2.x)

EN_HSCROLL

The EN_HSCROLL notification message is sent when the user clicks an edit control's horizontal scroll bar. The control's parent window receives this notification message through a **WM_COMMAND** message. The parent window is notified before the screen is updated.

Parameter	Description
wParam	Specifies the identifier of the edit control.
lParam	Specifies the handle of the edit control in the low-order word, and specifies the EN_HSCROLL notification message in the high-order word.

See Also

EN_VSCROLL, **WM_COMMAND**

EN_KILLFOCUS (2.x)

EN_KILLFOCUS

The EN_KILLFOCUS notification message is sent when an edit control loses the input focus. The control's parent window receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the edit control.
lParam	Specifies the handle of the edit control in the low-order word, and specifies the EN_KILLFOCUS notification message in the high-order word.

See Also
EN_SETFOCUS, **WM_COMMAND**

EN_MAXTEXT (3.0)

EN_MAXTEXT

The EN_MAXTEXT notification message is sent when the current insertion has exceeded the specified number of characters for the edit control. The insertion has been truncated.

This message is also sent when an edit control does not have the **ES_AUTOHSCROLL** style and the number of characters to be inserted would exceed the width of the edit control.

This message is also sent when an edit control does not have the **ES_AUTOVSCROLL** style and the total number of lines resulting from a text insertion would exceed the height of the edit control.

The control's parent window receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the edit control.
lParam	Specifies the handle of the edit control in the low-order word, and specifies the EN_MAXTEXT notification message in the high-order word.

See Also
EM_LIMITTEXT, **WM_COMMAND**

EN_SETFOCUS (2.x)

EN_SETFOCUS

The EN_SETFOCUS notification message is sent when an edit control receives the input focus. The control's parent window receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the edit control.
lParam	Specifies the handle of the edit control in the low-order word, and specifies the EN_SETFOCUS notification message in the high-order word.

See Also
EN_KILLFOCUS, **WM_COMMAND**

EN_UPDATE (2.x)

EN_UPDATE

The EN_UPDATE notification message is sent when an edit control is about to display altered text. This notification is sent after the control has formatted the text but before it screens the text. This makes it possible to alter the window size, if necessary. The control's parent window receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the edit control.
lParam	Specifies the handle of the edit control in the low-order word, and specifies the EN_UPDATE notification message in the high-order word.

See Also

EN_CHANGE, **WM_COMMAND**

EN_VSCROLL (2.x)

EN_VSCROLL

The EN_VSCROLL notification message is sent when the user clicks an edit control's vertical scroll bar. The control's parent window receives this notification message through a **WM_COMMAND** message. The parent window is notified before the screen is updated.

Parameter	Description
wParam	Specifies the identifier of the edit control.
lParam	Specifies the handle of the edit control in the low-order word, and specifies the EN_VSCROLL notification message in the high-order word.

See Also

EN_HSCROLL, **WM_COMMAND**

LBN_DBLCLK (2.x)

LBN_DBLCLK

The LBN_DBLCLK notification message is sent when the user double-clicks a string in a list box. The parent window of the list box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the list box.
lParam	Specifies the handle of the list box in the low-order word, and specifies the LBN_DBLCLK notification message in the high-order word.

Comments

Only a list box that has **LBS_NOTIFY** style will send this notification message.

See Also

LBN_SELCHANGE, **WM_COMMAND**

LBN_ERRSPACE (2.x)

LBN_ERRSPACE

The LBN_ERRSPACE notification message is sent when a list box cannot allocate enough memory to meet a specific request. The parent window of the list box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the list box.
lParam	Specifies the handle of the list box in the low-order word, and specifies the LBN_ERRSPACE notification message in the high-order word.

See Also
WM_COMMAND

LBN_KILLFOCUS (3.0)

LBN_KILLFOCUS

The LBN_KILLFOCUS notification message is sent when a list box loses the input focus. The parent window of the list box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the list box.
lParam	Specifies the handle of the list box in the low-order word, and specifies the LBN_KILLFOCUS notification message in the high-order word.

See Also

LBN_SETFOCUS, **WM_COMMAND**

LBN_SELCANCEL (3.1)

LBN_SELCANCEL

The LBN_SELCANCEL notification message is sent when the user cancels the selection in a list box. The parent window of the list box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the list box.
lParam	Specifies the handle of the list box in the low-order word, and specifies the LBN_SELCANCEL notification message in the high-order word.

Comments

This notification applies only to a list box that has the **LBS_NOTIFY** style.

See Also

LBN_DBLCLK, **LBN_SELCHANGE**, **LB_SETCURSEL**, **WM_COMMAND**

LBN_SELCHANGE (2.x)

LBN_SELCHANGE

The LBN_SELCHANGE notification message is sent when the selection in a list box is about to change. The parent window of the list box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the list box.
lParam	Specifies the handle of the list box in the low-order word, and specifies the LBN_SELCHANGE notification message in the high-order word.

Comments

This notification is not sent if the selection is changed by the **LB_SETCURSEL** message.

This notification applies only to a list box that has the **LBS_NOTIFY** style.

The LBN_SELCHANGE notification is sent for a multiple-selection list box whenever the user presses an arrow key, even if the selection does not change.

See Also

LBN_DBLCLK, **LBN_SELCANCEL**, **LB_SETCURSEL**, **WM_COMMAND**

LBN_SETFOCUS (3.0)

LBN_SETFOCUS

The LBN_SETFOCUS notification message is sent when a list box receives the input focus. The parent window of the list box receives this notification message through a **WM_COMMAND** message.

Parameter	Description
wParam	Specifies the identifier of the list box.
lParam	Specifies the handle of the list box in the low-order word, and specifies the LBN_SETFOCUS notification message in the high-order word.

See Also

LBN_KILLFOCUS, **WM_COMMAND**

Notification messages (3.1)

BN_CLICKED	Indicates the user clicked a button
BN_DISABLE	Indicates a button is disabled
BN_DOUBLECLICKED	Indicates the user double-clicked a button
BN_HILITE	Indicates the user highlighted a button
BN_PAINT	Indicates the button should be painted
BN_UNHILITE	Indicates the highlight should be removed
CBN_CLOSEUP	Indicates the list box of a combo box has closed
CBN_DBLCLK	Indicates the user double-clicked a string
CBN_DROPDOWN	Indicates the list box of a combo box is dropping down
CBN_EDITCHANGE	Indicates the user has changed text in the edit control
CBN_EDITUPDATE	Indicates altered text is about to be displayed
CBN_ERRSPACE	Indicates the combo box is out of memory
CBN_KILLFOCUS	Indicates the combo box is losing the input focus
CBN_SELCHANGE	Indicates a new combo box list item is selected
CBN_SELENDCANCEL	Indicates the user's selection should be cancelled
CBN_SELENDOK	Indicates the user's selection is valid
CBN_SETFOCUS	Indicates the combo box is receiving the input focus
EN_CHANGE	Indicates the display is updated after text changes
EN_ERRSPACE	Indicates the edit control is out of memory
EN_HSCROLL	Indicates the user clicked the scroll bar
EN_KILLFOCUS	Indicates the edit control is losing the input focus
EN_MAXTEXT	Indicates the insertion is truncated
EN_SETFOCUS	Indicates the edit-control is receiving the input focus
EN_UPDATE	Indicates edit-control is about to display altered text
EN_VSCROLL	Indicates the user clicked the vertical scroll bar
LBN_DBLCLK	Indicates that the user double-clicked a string
LBN_ERRSPACE	Indicates the list box is out of memory
LBN_KILLFOCUS	Indicates the list box is losing the input focus
LBN_SELCANCEL	Indicates the selection is cancelled
LBN_SELCHANGE	Indicates the selection is about to change
LBN_SETFOCUS	Indicates the list box is receiving the input focus

OleActivate (3.1)

#include ole.h

OLESTATUS OleActivate(*lpObject, verb, fShow, fTakeFocus, hwnd, lprcBound***)**

```
LPOLEOBJECT lpObject;          /* address of object to activate          */
UINT verb;                     /* operation to perform                   */
BOOL fShow;                    /* whether to show window                 */
BOOL fTakeFocus;               /* whether server gets focus              */
HWND hwnd;                     /* window handle of destination document */
const RECT FAR* lprcBound;     /* bounding rectangle for object display  */
```

The **OleActivate** function opens an object for an operation. Typically, the object is edited or played.

Parameter	Description
lpObject	Points to the object to activate.
verb	Specifies which operation to perform (0 = the primary verb, 1 = the secondary verb, and so on).
fShow	Specifies whether the window is to be shown. If the window is to be shown, this value is TRUE; otherwise, it is FALSE.
fTakeFocus	Specifies whether the server should get the focus. If the server should get the focus, this value is TRUE; otherwise, it is FALSE. This parameter is relevant only if the *fShow* parameter is TRUE.
hwnd	Identifies the window of the document containing the object.
lprcBound	Points to a **RECT** structure containing the coordinates of the bounding rectangle in which the destination document displays the object. The mapping mode of the device context determines the units for these coordinates.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_OBJECT
OLE_WAIT_FOR_RELEASE

Comments

Typically, a server is launched in a separate window; editing then occurs asynchronously. The client is notified of changes to the object through the callback function.

A client application might set the *fShow* parameter to FALSE if a server needed to remain active without being visible on the display. (In this case, the application would also use the **OleSetData** function.)

Client applications typically specify the primary verb when the user double-clicks an object. The server can take any action in response to the specified verb. If the server supports only one action, it takes that action no matter which value is passed in the *verb* parameter.

In future releases of the object linking and embedding (**OLE**) protocol, the *hwnd* and *lprcBound* parameters will be used to help determine the placement of the server's editing window.

See Also

OleQueryOpen, **OleSetData**, **RECT**

OleBlockServer (3.1)

#include ole.h

OLESTATUS OleBlockServer(*lhSrvr***)**

LHSERVER *lhSrvr;* /* handle of server */

The **OleBlockServer** function causes requests to the server to be queued until the server calls the **OleUnblockServer** function.

Parameter	Description
lhSrvr	Identifies the server for which requests are to be queued.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be OLE_ERROR_HANDLE.

Comments

The server must call the **OleUnblockServer** function after calling the **OleBlockServer** function.

A server application can use the **OleBlockServer** and **OleUnblockServer** functions to control when the server library processes requests from client applications. Because only messages from the client to the server are blocked, a blocked server can continue to send messages to client applications.

A server application receives a handle when it calls the **OleRegisterServer** function.

See Also

OleRegisterServer, **OleUnblockServer**

OleClone (3.1)

#include ole.h

OLESTATUS OleClone(*lpObject, lpClient, lhClientDoc, lpszObjname, lplpObject***)**

```
LPOLEOBJECT lpObject;          /* address of object to copy          */
LPOLECLIENT lpClient;          /* address of OLECLIENT for new object */
LHCLIENTDOC lhClientDoc;       /* long handle of client document     */
LPCSTR lpszObjname;            /* address of string for object name  */
LPOLEOBJECT FAR* lplpObject;   /* address of pointer to new object   */
```

The **OleClone** function makes a copy of an object. The copy is identical to the source object, but it is not connected to the server.

Parameter	Description
lpObject	Points to the object to copy.
lpClient	Points to an **OLECLIENT** structure for the new object.
lhClientDoc	Identifies the client document in which the object is to be created.
lpszObjname	Points to a null-terminated string specifying the client's name for the object. This name must be unique with respect to the names of any other objects in the document and cannot contain a slash mark (/).
lplpObject	Points to a variable where the library will store the long pointer to the new object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_HANDLE
OLE_ERROR_OBJECT
OLE_WAIT_FOR_RELEASE

Comments

Client applications often use the **OleClone** function to support the Undo command.

A client application can supply a new **OLECLIENT** structure for the cloned object, if required.

See Also

OleEqual, **OLECLIENT**

OleClose (3.1)

#include ole.h

OLESTATUS OleClose(*lpObject***)**

LPOLEOBJECT *lpObject;* /* address of object to close */

The **OleClose** function closes the specified open object. Closing an object terminates the connection with the server application.

Parameter	**Description**
lpObject	Points to the object to close.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_OBJECT
OLE_WAIT_FOR_RELEASE

See Also

OleActivate, **OleDelete**, **OleReconnect**

OleCopyFromLink (3.1)

#include ole.h

OLESTATUS OleCopyFromLink(*lpObject, lpszProtocol, lpClient, lhClientDoc, lpszObjname, lplpObject***)**

```
LPOLEOBJECT lpObject;          /* address of object to embed        */
LPCSTR lpszProtocol;           /* address of protocol name          */
LPOLECLIENT lpClient;          /* address of client structure       */
LHCLIENTDOC lhClientDoc;       /* long handle of client document    */
LPCSTR lpszObjname;            /* address of string for object name */
LPOLEOBJECT FAR* lplpObject;   /* address of pointer to new object  */
```

The **OleCopyFromLink** function makes an embedded copy of a linked object.

Parameter	Description
lpObject	Points to the linked object that is to be embedded.
lpszProtocol	Points to a null-terminated string specifying the name of the protocol required for the new embedded object. Currently, this value can be StdFileEditing (the name of the object linking and embedding protocol).
lpClient	Points to an **OLECLIENT** structure for the new object.
lhClientDoc	Identifies the client document in which the object is to be created.
lpszObjname	Points to a null-terminated string specifying the client's name for the object.
lplpObject	Points to a variable where the library will store the long pointer to the new object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_HANDLE
OLE_ERROR_NAME
OLE_ERROR_OBJECT
OLE_ERROR_PROTOCOL
OLE_WAIT_FOR_RELEASE

Comments

Making an embedded copy of a linked object may involve starting the server application.

See Also

OleObjectConvert

OleCopyToClipboard (3.1)

#include ole.h

OLESTATUS OleCopyToClipboard(*lpObject***)**

LPOLEOBJECT *lpObject;* /* address of object */

The **OleCopyToClipboard** function puts the specified object on the clipboard.

Parameter	Description
lpObject	Points to the object to copy to the clipboard.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be OLE_ERROR_OBJECT.

Comments

A client application typically calls the **OleCopyToClipboard** function when a user chooses the Copy or Cut command from the Edit menu.

The client application should open and empty the clipboard, call the **OleCopyToClipboard** function, and close the clipboard.

OleCreate (3.1)

#include ole.h

OLESTATUS OleCreate(*lpszProtocol, lpClient, lpszClass, lhClientDoc, lpszObjname, lplpObject, renderopt, cfFormat***)**

```
LPCSTR lpszProtocol;              /* address of string for protocol name */
LPOLECLIENT lpClient;             /* address of client structure         */
LPCSTR lpszClass;                 /* address of string for classname     */
LHCLIENTDOC lhClientDoc;          /* long handle of client document      */
LPCSTR lpszObjname;               /* address of string for object name   */
LPOLEOBJECT FAR* lplpObject;      /* address of pointer to object        */
OLEOPT_RENDER renderopt;          /* rendering options                   */
OLECLIPFORMAT cfFormat;           /* clipboard format                    */
```

The **OleCreate** function creates an embedded object of a specified class. The server is opened to perform the initial editing.

Parameter	Description
lpszProtocol	Points to a null-terminated string specifying the name of the protocol required for the new embedded object. Currently, this value can be StdFileEditing (the name of the object linking and embedding protocol).
lpClient	Points to an **OLECLIENT** structure for the new object.
lpszClass	Points to a null-terminated string specifying the registered name of the class of the object to be created.
lhClientDoc	Identifies the client document in which the object is to be created.
lpszObjname	Points to a null-terminated string specifying the client's name for the object. This name must be unique with respect to the names of any other objects in the document and cannot contain a slash mark (*/*).
lplpObject	Points to a variable where the library will store the long pointer to the new object.
renderopt	Specifies the client's preference for presentation data for the object. This parameter can be one of the following values:

Value	Meaning
olerender_draw	The client calls the **OleDraw** function, and the library obtains and manages presentation data.
olerender_format	The client calls the **OleGetData** function to retrieve data in a specific format. The library obtains and manages the data in the requested format, as specified by the *cfFormat* parameter.
olerender_none	The client library does not obtain any presentation data and does not draw the object.

Returns

cfFormat Specifies the clipboard format when the *renderopt* parameter is **olerender_format**. This clipboard format is used in a subsequent call to **OleGetData**. If this clipboard format is CF_METAFILEPICT, CF_DIB, or CF_BITMAP, the library manages the data and draws the object. The library does not support drawing for any other formats. The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_HANDLE
OLE_ERROR_NAME
OLE_ERROR_PROTOCOL
OLE_WAIT_FOR_RELEASE

Comments

The **olerender_none** rendering option is typically used to support hyperlinks. With this option, the client does not call **OleDraw** and calls **OleGetData** only for ObjectLink, OwnerLink, and Native formats.

The **olerender_format** rendering option allows a client to compute data (instead of painting it), use an unusual data format, or modify a standard data format. With this option, the client does not call **OleDraw**. The client calls **OleGetData** to retrieve data in the specified format.

The **olerender_draw** rendering option is the most typical option. It is the easiest rendering option for the client to implement (the client simply calls **OleDraw**), and it allows the most flexibility. An object handler can exploit this flexibility to store no presentation data, a private presentation data format, or several different formats that it can choose among dynamically. Future implementations of object linking and embedding (**OLE**) may also exploit the flexibility that is inherent in this option.

See Also
OleCreateFromClip, **OleCreateFromTemplate**, **OleDraw**, **OleGetData**

OleCreateFromClip (3.1)

#include ole.h

OLESTATUS OleCreateFromClip(*lpszProtocol, lpClient, lhClientDoc, lpszObjname, lplpObject, renderopt, cfFormat***)**

```
LPCSTR lpszProtocol;              /* address of string for protocol name */
LPOLECLIENT lpClient;             /* address of client structure         */
LHCLIENTDOC lhClientDoc;          /* long handle of client document      */
LPCSTR lpszObjname;               /* address of string for object name   */
LPOLEOBJECT FAR* lplpObject;      /* address of pointer to object        */
OLEOPT_RENDER renderopt;          /* rendering options                   */
OLECLIPFORMAT cfFormat;           /* clipboard format                    */
```

The **OleCreateFromClip** function creates an object from the clipboard.

Parameter	Description
lpszProtocol	Points to a null-terminated string specifying the name of the protocol required for the new embedded object. Currently, this value can be StdFileEditing (the name of the object linking and embedding protocol) or Static (for uneditable pictures only).
lpClient	Points to an **OLECLIENT** structure allocated and initialized by the client application. This pointer is used to locate the callback function and is passed in callback notifications.
lhClientDoc	Identifies the client document in which the object is being created.
lpszObjname	Points to a null-terminated string specifying the client's name for the object. This name must be unique with respect to the names of any other objects in the document and cannot contain a slash mark (*/*).
lplpObject	Points to a variable where the library will store the long pointer to the new object.
renderopt	Specifies the client's preference for presentation data for the object. This parameter can be one of the following values:

Value	Meaning
olerender_draw	The client calls the **OleDraw** function, and the library obtains and manages presentation data.
olerender_format	The client calls the **OleGetData** function to retrieve data in a specific format. The library obtains and manages the data in the requested format, as specified by the *cfFormat* parameter.
olerender_none	The client library does not obtain any presentation data and does not draw the object.

cfFormat	Specifies the clipboard format when the *renderopt* parameter is **olerender_format**. This clipboard format is used in a subsequent call to **OleGetData**. If this clipboard format is CF_METAFILEPICT, CF_DIB, or CF_BITMAP, the library manages the data and draws the object. The library does not support drawing for any other formats.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_CLIP
OLE_ERROR_FORMAT
OLE_ERROR_HANDLE
OLE_ERROR_NAME
OLE_ERROR_OPTION
OLE_ERROR_PROTOCOL
OLE_WAIT_FOR_RELEASE

Comments

The client application should open and empty the clipboard, call the **OleCreateFromClip** function, and close the clipboard.

The **olerender_none** rendering option is typically used to support hyperlinks. With this option, the client does not call **OleDraw** and calls **OleGetData** only for ObjectLink, OwnerLink, and Native formats.

The **olerender_format** rendering option allows a client to compute data (instead of painting it), use an unusual data format, or modify a standard data format. With this option, the client does not call **OleDraw**. The client calls **OleGetData** to retrieve data in the specified format.

The **olerender_draw** rendering option is the most typical option. It is the easiest rendering option for the client to implement (the client simply calls **OleDraw**), and it allows the most flexibility. An object handler can exploit this flexibility to store no presentation data, a private presentation data format, or several different formats that it can choose among dynamically. Future implementations of object linking and embedding (**OLE**) may also exploit the flexibility that is inherent in this option.

See Also

OleCreate, **OleCreateFromTemplate**, **OleDraw**, **OleGetData**, **OleQueryCreateFromClip**

OleCreateFromFile (3.1)

#include ole.h

OLESTATUS OleCreateFromFile(*lpszProtocol, lpClient, lpszClass, lpszFile, lhClientDoc, lpszObjname, lplpObject, renderopt, cfFormat***)**

```
LPCSTR lpszProtocol;          /* address of string for protocol name */
LPOLECLIENT lpClient;         /* address of client structure         */
LPCSTR lpszClass;             /* address of string for class name    */
LPCSTR lpszFile;              /* address of string for filename      */
LHCLIENTDOC lhClientDoc;      /* long handle of client document      */
LPCSTR lpszObjname;           /* address of string for object name   */
LPOLEOBJECT FAR* lplpObject;  /* address of pointer to object        */
OLEOPT_RENDER renderopt;      /* rendering options                   */
OLECLIPFORMAT cfFormat;       /* clipboard format                    */
```

The **OleCreateFromFile** function creates an embedded object from the contents of a named file.

Parameter	Description
lpszProtocol	Points to a null-terminated string specifying the name of the protocol required for the new embedded object. Currently, this value can be StdFileEditing (the name of the object linking and embedding protocol).
lpClient	Points to an **OLECLIENT** structure allocated and initialized by the client application. This pointer is used to locate the callback function and is passed in callback notifications.
lpszClass	Points to a null-terminated string specifying the name of the class for the new object. If this value is NULL, the library uses the extension of the filename pointed to by the *lpszFile* parameter to find the class name for the object.
lpszFile	Points to a null-terminated string specifying the name of the file containing the object.
lhClientDoc	Identifies the client document in which the object is being created.
lpszObjname	Points to a null-terminated string specifying the client's name for the object. This name must be unique with respect to the names of any other objects in the document and cannot contain a slash mark (/).
lplpObject	Points to a variable where the library will store the long pointer to the new object.
renderopt	Specifies the client's preference for presentation data for the object. This parameter can be one of the following values:

Value	Meaning
olerender_draw	The client calls the **OleDraw** function, and the library obtains and manages presentation data.
olerender_format	The client calls the **OleGetData** function to retrieve data in a specific format. The library obtains and manages the data in the requested format, as specified by the *cfFormat* parameter.
olerender_none	The client library does not obtain any presentation data and does not draw the object.

cfFormat	Specifies the clipboard format when the *renderopt* parameter is **olerender_format**. This clipboard format is used in a subsequent call to **OleGetData**. If this clipboard format is CF_METAFILEPICT, CF_DIB, or CF_BITMAP, the library manages the data and draws the object. The library does not support drawing for any other formats.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_CLASS
OLE_ERROR_HANDLE
OLE_ERROR_MEMORY
OLE_ERROR_NAME
OLE_ERROR_PROTOCOL
OLE_WAIT_FOR_RELEASE

Comments

When a client application calls the **OleCreateFromFile** function, the server is started to render the Native and presentation data and then is closed. (If the server and document are already open, this function simply retrieves the information, without closing the server.) The server does not show the object to the user for editing.

The **olerender_none** rendering option is typically used to support hyperlinks. With this option, the client does not call **OleDraw** and calls **OleGetData** only for ObjectLink, OwnerLink, and Native formats.

The **olerender_format** rendering option allows a client to compute data (instead of painting it), use an unusual data format, or modify a standard data format. With this option, the client does not call **OleDraw**. The client calls **OleGetData** to retrieve data in the specified format.

The **olerender_draw** rendering option is the most typical option. It is the easiest rendering option for the client to implement (the client simply calls **OleDraw**), and it allows the most flexibility. An object handler can exploit this flexibility to store no presentation data, a private presentation data format, or several different formats that it can choose among dynamically. Future implementations of object linking and embedding (**OLE**) may also exploit the flexibility that is inherent in this option.

If a client application accepts files dropped from File Manager, it should respond to the **WM_DROPFILES** message by calling **OleCreateFromFile** and specifying Packager for the *lpszClass* parameter to indicate Microsoft Windows Object Packager.

See Also

OleCreate, **OleCreateFromTemplate**, **OleDraw**, **OleGetData**

OleCreateFromTemplate (3.1)

#include ole.h

OLESTATUS OleCreateFromTemplate(*lpszProtocol, lpClient, lpszTemplate, lhClientDoc, lpszObjname, lplpObject, renderopt, cfFormat***)**

```
LPCSTR lpszProtocol;          /* address of string for protocol name */
LPOLECLIENT lpClient;         /* address of client structure         */
LPCSTR lpszTemplate;          /* address of string for path of file  */
LHCLIENTDOC lhClientDoc;      /* long handle of client document      */
LPCSTR lpszObjname;           /* address of string for object name   */
LPOLEOBJECT FAR* lplpObject;  /* address of pointer to object        */
OLEOPT_RENDER renderopt;      /* rendering options                   */
OLECLIPFORMAT cfFormat;       /* clipboard format                    */
```

The **OleCreateFromTemplate** function creates an object by using another object as a template. The server is opened to perform the initial editing.

Parameter	Description
lpszProtocol	Points to a null-terminated string specifying the name of the protocol required for the new embedded object. Currently, this value can be StdFileEditing (the name of the object linking and embedding protocol).
lpClient	Points to an **OLECLIENT** structure for the new object.
lpszTemplate	Points to a null-terminated string specifying the path of the file to be used as a template for the new object. The server is opened for editing and loads the initial state of the new object from the named template file.
lhClientDoc	Identifies the client document in which the object is being created.
lpszObjname	Points to a null-terminated string specifying the client's name for the object. This name must be unique with respect to the names of any other objects in the document and cannot contain a slash mark (/).
lplpObject	Points to a variable where the library will store the long pointer to the new object.
renderopt	Specifies the client's preference for presentation data for the object. This parameter can be one of the following values:

Value	Meaning
olerender_draw	The client calls the **OleDraw** function, and the library obtains and manages presentation data.
olerender_format	The client calls the **OleGetData** function to retrieve data in a specific format. The library obtains and manages the data in the requested format, as specified by the *cfFormat* parameter.
olerender_none	The client library does not obtain any presentation data and does not draw the object.

cfFormat	Specifies the clipboard format when the *renderopt* parameter is **olerender_format**. This clipboard format is used in a subsequent call to the **OleGetData** function. If this clipboard format is CF_METAFILEPICT, CF_DIB, or CF_BITMAP, the library manages the data and draws the object. The library does not support drawing for any other formats.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_CLASS
OLE_ERROR_HANDLE
OLE_ERROR_MEMORY

OLE_ERROR_NAME
OLE_ERROR_PROTOCOL
OLE_WAIT_FOR_RELEASE

Comments

The client library uses the filename extension of the file specified in the *lpszTemplate* parameter to identify the server for the object. The association between the extension and the server is stored in the registration database.

The **olerender_none** rendering option is typically used to support hyperlinks. With this option, the client does not call **OleDraw** and calls **OleGetData** only for ObjectLink, OwnerLink, and Native formats.

The **olerender_format** rendering option allows a client to compute data (instead of painting it), use an unusual data format, or modify a standard data format. With this option, the client does not call **OleDraw**. The client calls **OleGetData** to retrieve data in the specified format.

The **olerender_draw** rendering option is the most typical option. It is the easiest rendering option for the client to implement (the client simply calls **OleDraw**), and it allows the most flexibility. An object handler can exploit this flexibility to store no presentation data, a private presentation data format, or several different formats that it can choose among dynamically. Future implementations of object linking and embedding (**OLE**) may also exploit the flexibility that is inherent in this option.

See Also

OleCreate, **OleCreateFromClip**, **OleDraw**, **OleGetData**, **OleObjectConvert**

OleCreateInvisible (3.1)

#include ole.h

OLESTATUS OleCreateInvisible(*lpszProtocol, lpClient, lpszClass, lhClientDoc, lpszObjname, lplpObject, renderopt, cfFormat, fActivate***)**

```
LPCSTR lpszProtocol;          /* address of string for protocol name */
LPOLECLIENT lpClient;         /* address of client structure         */
LPCSTR lpszClass;             /* address of string for classname     */
LHCLIENTDOC lhClientDoc;      /* long handle of client document      */
LPCSTR lpszObjname;           /* address of string for object name   */
LPOLEOBJECT FAR* lplpObject;  /* address of pointer to object        */
OLEOPT_RENDER renderopt;      /* rendering options                   */
OLECLIPFORMAT cfFormat;       /* clipboard format                    */
BOOL fActivate;               /* server activation flag              */
```

The **OleCreateInvisible** function creates an object without displaying the server application to the user. The function either starts the server to create the object or creates a blank object of the specified class and format without starting the server.

Parameter	Description
lpszProtocol	Points to a null-terminated string specifying the name of the protocol required for the new embedded object. Currently, this value can be StdFileEditing (the name of the object linking and embedding protocol) or Static (for uneditable pictures only).
lpClient	Points to an **OLECLIENT** structure allocated and initialized by the client application. This pointer is used to locate the callback function and is passed in callback notifications.
lpszClass	Points to a null-terminated string specifying the registered name of the class of the object to be created.
lhClientDoc	Identifies the client document in which the object is being created.
lpszObjname	Points to a null-terminated string specifying the client's name for the object. This name must be unique with respect to the names of any other objects in the document and cannot contain a slash mark (/).
lplpObject	Points to a variable where the library will store the long pointer to the new object.
renderopt	Specifies the client's preference for presentation data for the object. This parameter can be one of the following values:

Value	Meaning
olerender_draw	The client calls the **OleDraw** function, and the library obtains and manages presentation data.
olerender_format	The client calls the **OleGetData** function to retrieve data in a specific format. The library obtains and manages the data in the requested format, as specified by the *cfFormat* parameter.
olerender_none	The client library does not obtain any presentation data and does not draw the object.

cfFormat	Specifies the clipboard format when the *renderopt* parameter is **olerender_format**. This clipboard format is used in a subsequent call to **OleGetData**. If this clipboard format is CF_METAFILEPICT, CF_DIB, or CF_BITMAP, the library manages the data and draws the object. The library does not support drawing for any other formats.
fActivate	Specifies whether to start the server for the object. If this parameter is TRUE the server is started (but not shown). If this parameter is FALSE, the server is not started and the function creates a blank object of the specified class and format.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_HANDLE
OLE_ERROR_NAME
OLE_ERROR_PROTOCOL

Comments

An application can avoid redrawing an object repeatedly by calling the **OleCreateInvisible** function before using such functions as **OleSetBounds**, **OleSetColorScheme**, and **OleSetTargetDevice** to set up the object. After setting up the object, the application can either call the **OleActivate** function to display the object or call the **OleUpdate** and **OleClose** functions to update the object without displaying it.

See Also

OleActivate, **OleClose**, **OleSetBounds**, **OleSetColorScheme**, **OleSetTargetDevice**, **OleUpdate**

OleCreateLinkFromClip (3.1)

#include ole.h

OLESTATUS OleCreateLinkFromClip(*lpszProtocol, lpClient, lhClientDoc, lpszObjname, lplpObject, renderopt, cfFormat***)**

```
LPCSTR lpszProtocol;              /* address of string for protocol name */
LPOLECLIENT lpClient;             /* address of client structure         */
LHCLIENTDOC lhClientDoc;          /* long handle of client document      */
LPCSTR lpszObjname;               /* address of string for object name   */
LPOLEOBJECT FAR* lplpObject;      /* address of pointer to object        */
OLEOPT_RENDER renderopt;          /* rendering options                   */
OLECLIPFORMAT cfFormat;           /* clipboard format                    */
```

The **OleCreateLinkFromClip** function typically creates a link to an object from the clipboard.

Parameter	Description
lpszProtocol	Points to a null-terminated string specifying the name of the required protocol. Currently, this value can be StdFileEditing (the name of the object linking and embedding protocol).
lpClient	Points to an **OLECLIENT** structure allocated and initialized by the client application. This pointer is used to locate the callback function and is passed in callback notifications.
lhClientDoc	Identifies the client document in which the object is being created.
lpszObjname	Points to a null-terminated string specifying the client's name for the object. This name must be unique with respect to the names of any other objects in the document and cannot contain a slash mark (*/*).
lplpObject	Points to a variable where the library will store the long pointer to the new object.
renderopt	Specifies the client's preference for presentation data for the object. This parameter can be one of the following values:

Value	Meaning
olerender_draw	The client calls the **OleDraw** function, and the library obtains and manages presentation data.
olerender_format	The client calls the **OleGetData** function to retrieve data in a specific format. The library obtains and manages the data in the requested format, as specified by the *cfFormat* parameter.
olerender_none	The client library does not obtain any presentation data and does not draw the object.

cfFormat	Specifies the clipboard format when the *renderopt* parameter is **olerender_format**. This clipboard format is used in a subsequent call to **OleGetData**. If this clipboard format is CF_METAFILEPICT, CF_DIB, or CF_BITMAP, the library manages the data and draws the object. The library does not support drawing for any other formats.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_CLIP
OLE_ERROR_FORMAT
OLE_ERROR_HANDLE
OLE_ERROR_NAME
OLE_ERROR_PROTOCOL
OLE_WAIT_FOR_RELEASE

Comments

The **olerender_none** rendering option is typically used to support hyperlinks. With this option, the client does not call the **OleDraw** function and calls **OleGetData** only for ObjectLink, OwnerLink, and Native formats.

The **olerender_format** rendering option allows a client to compute data (instead of painting it), use an unusual data format, or modify a standard data format. With this option, the client does not call **OleDraw**. The client calls **OleGetData** to retrieve data in the specified format.

The **olerender_draw** rendering option is the most typical option. It is the easiest rendering option for the client to implement (the client simply calls **OleDraw**), and it allows the most flexibility. An object handler can exploit this flexibility to store no presentation data, a private presentation data format, or several different formats that it can choose among dynamically. Future implementations of object linking and embedding (**OLE**) may also exploit the flexibility that is inherent in this option.

See Also

OleCreate, **OleCreateFromTemplate**, **OleDraw**, **OleGetData**, **OleQueryLinkFromClip**

OleCreateLinkFromFile (3.1)

#include ole.h

OLESTATUS OleCreateLinkFromFile(*lpszProtocol, lpClient, lpszClass, lpszFile, lpszItem, lhClientDoc, lpszObjname, lplpObject, renderopt, cfFormat***)**

```
LPCSTR lpszProtocol;              /* address of string for protocol name  */
LPOLECLIENT lpClient;             /* address of client structure          */
LPCSTR lpszClass;                 /* string for class name                */
LPCSTR lpszFile;                  /* address of string for filename       */
LPCSTR lpszItem;                  /* address of string for doc. part to link */
LHCLIENTDOC lhClientDoc;          /* long handle of client document       */
LPCSTR lpszObjname;               /* address of string for object name    */
LPOLEOBJECT FAR* lplpObject;      /* address of pointer to new object     */
OLEOPT_RENDER renderopt;          /* rendering options                    */
OLECLIPFORMAT cfFormat;           /* clipboard format                     */
```

The **OleCreateLinkFromFile** function creates a linked object from a file that contains an object. If necessary, the library starts the server to render the presentation data, but the object is not shown in the server for editing.

Parameter	Description
lpszProtocol	Points to a null-terminated string specifying the name of the required protocol. Currently, this value can be StdFileEditing (the name of the object linking and embedding protocol).
lpClient	Points to an **OLECLIENT** structure allocated and initialized by the client application. This pointer is used to locate the callback function and is passed in callback notifications.
lpszClass	Points to a null-terminated string specifying the name of the class for the new object. If this value is NULL, the library uses the extension of the filename pointed to by the *lpszFile* parameter to find the class name for the object.
lpszFile	Points to a null-terminated string specifying the name of the file containing the object.
lpszItem	Points to a null-terminated string identifying the part of the document to link to. If this value is NULL, the link is to the entire document.
lhClientDoc	Identifies the client document in which the object is being created.
lpszObjname	Points to a null-terminated string specifying the client's name for the object. This name must be unique with respect to the names of any other objects in the document and cannot contain a slash mark (/).
lplpObject	Points to a variable where the library will store the long pointer to the new object.
renderopt	Specifies the client's preference for presentation data for the object. This parameter can be one of the following values:

Value	Meaning
olerender_draw	The client calls the **OleDraw** function, and the library obtains and manages presentation data.
olerender_format	The client calls the **OleGetData** function to retrieve data in a specific format. The library obtains and manages the data in the requested format, as specified by the *cfFormat* parameter.
olerender_none	The client library does not obtain any presentation data and does not draw the object.

cfFormat	Specifies the clipboard format when the *renderopt* parameter is **olerender_format**. This clipboard format is used in a subsequent call to **OleGetData**. If this clipboard format is CF_METAFILEPICT, CF_DIB, or CF_BITMAP, the library manages the data

and draws the object. The library does not support drawing for any other formats.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_CLASS
OLE_ERROR_HANDLE
OLE_ERROR_MEMORY
OLE_ERROR_NAME
OLE_ERROR_PROTOCOL
OLE_WAIT_FOR_RELEASE

Comments

The **olerender_none** rendering option is typically used to support hyperlinks. With this option, the client does not call **OleDraw** and calls **OleGetData** only for ObjectLink, OwnerLink, and Native formats.

The **olerender_format** rendering option allows a client to compute data (instead of painting it), use an unusual data format, or modify a standard data format. With this option, the client does not call **OleDraw**. The client calls **OleGetData** to retrieve data in the specified format.

The **olerender_draw** rendering option is the most typical option. It is the easiest rendering option for the client to implement (the client simply calls **OleDraw**), and it allows the most flexibility. An object handler can exploit this flexibility to store no presentation data, a private presentation data format, or several different formats that it can choose among dynamically. Future implementations of object linking and embedding (**OLE**) may also exploit the flexibility that is inherent in this option.

See Also

OleCreate, **OleCreateFromFile**, **OleCreateFromTemplate**, **OleDraw**, **OleGetData**

OleDelete (3.1)

#include ole.h

OLESTATUS OleDelete(*lpObject***)**

LPOLEOBJECT *lpObject;* /* address of object to delete */

The **OleDelete** function deletes an object and frees memory that was associated with that object. If the object was open, it is closed.

Parameter	**Description**
lpObject	Points to the object to delete.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_OBJECT
OLE_WAIT_FOR_RELEASE

Comments

An application uses the **OleDelete** function when the object is no longer part of the client document.

The **OleDelete** function, unlike **OleRelease**, indicates that the object has been permanently removed.

See Also

OleClose, **OleRelease**

OleDraw (3.1)

#include ole.h

OLESTATUS OleDraw(*lpObject, hdc, lprcBounds, lprcWBounds, hdcFormat***)**

```
LPOLEOBJECT lpObject;                 /* address of object to draw              */
HDC hdc;                              /* handle of DC for drawing object        */
const RECT FAR* lprcBounds;           /* bounding rectangle for drawing object  */
const RECT FAR* lprcWBounds;          /* bounding rectangle for metafile DC     */
HDC hdcFormat;                        /* handle of DC for formatting object     */
```

The **OleDraw** function draws a specified object into a bounding rectangle in a device context.

Parameter	Description
lpObject	Points to the object to draw.
hdc	Identifies the device context in which to draw the object.
lprcBounds	Points to a **RECT** structure defining the bounding rectangle, in logical units for the device context specified by the *hdc* parameter, in which to draw the object.
lprcWBounds	Points to a **RECT** structure defining the bounding rectangle if the *hdc* parameter specifies a metafile. The **left** and **top** members of the **RECT** structure should specify the window origin, and the **right** and **bottom** members should specify the window extents.
hdcFormat	Identifies a device context describing the target device for which to format the object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_ABORT
OLE_ERROR_BLANK
OLE_ERROR_DRAW
OLE_ERROR_MEMORY
OLE_ERROR_OBJECT

Comments

This function returns OLE_ERROR_ABORT if the callback function returns FALSE during drawing.

When the *hdc* parameter specifies a metafile device context, the rectangle specified by the *lprcWBounds* parameter contains the rectangle specified by the *lprcBounds* parameter. If *hdc* does not specify a metafile device context, the *lprcWBounds* parameter is ignored.

The library may use an object handler to render the object, and this object handler may need information about the target device. Therefore, the device-context handle specified by the *hdcFormat* parameter is required. The *lprcBounds* parameter identifies the rectangle on the device context (relative to its current mapping mode) that the object should be mapped onto. This may involve scaling the picture and can be used by client applications to impose a view scaling between the displayed view and the final printed image.

An object handler should format an object as if it were to be drawn at the size specified by a call to the **OleSetBounds** function for the device context specified by the *hdcFormat* parameter. Often this formatting will already have been done by the server application; in this case, the library simply renders the presentation data with suitable scaling for the required bounding rectangle. If cropping or banding is required, the device context in which the object is drawn may include a clipping region smaller than the specified bounding rectangle.

See Also

OleSetBounds

OleEnumFormats (3.1)

#include ole.h

OLECLIPFORMAT OleEnumFormats(*lpObject, cfFormat***)**

LPOLEOBJECT *lpObject;* /* address of object to query */
OLECLIPFORMAT *cfFormat;* /* format from previous function call */

The **OleEnumFormats** function enumerates the data formats that describe a specified object.

Parameter	Description
lpObject	Points to the object to be queried.
cfFormat	Specifies the format returned by the last call to the **OleEnumFormats** function. For the first call to this function, this parameter is zero.

Returns

The return value is the next available format if any further formats are available. Otherwise, the return value is NULL.

Comments

When an application specifies NULL for the *cfFormat* parameter, the **OleEnumFormats** function returns the first available format. Whenever an application specifies a format that was returned by a previous call to **OleEnumFormats**, the function returns the next available format, in sequence. When no more formats are available, the function returns NULL.

See Also

OleGetData

OleEnumObjects (3.1)

#include ole.h

OLESTATUS OleEnumObjects(*lhDoc, lplpObject***)**

LHCLIENTDOC *lhDoc;* /* document handle */
LPOLEOBJECT FAR* *lplpObject;* /* address of pointer to object */

The **OleEnumObjects** function enumerates the objects in a specified document.

Parameter	Description
lhDoc	Identifies the document for which the objects are enumerated.
lplpObject	Points to an object in the document when the function returns. For the first call to this function, this parameter should point to a NULL object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_HANDLE
OLE_ERROR_OBJECT

Comments

When an application specifies a NULL object for the *lplpObject* parameter, the **OleEnumObjects** function returns the first object in the document. Whenever an application specifies an object that was returned by a previous call to **OleEnumObjects**, the function returns the next object, in sequence. When there are no more objects in the document, the *lplpObject* parameter points to a NULL object.

Only objects that have been loaded and not released are enumerated by this function.

See Also

OleDelete, **OleRelease**

OleEqual (3.1)

#include ole.h

OLESTATUS OleEqual(*lpObject1, lpObject2***)**

LPOLEOBJECT *lpObject1;* /* address of first object to compare */
LPOLEOBJECT *lpObject2;* /* address of second object to compare */

The **OleEqual** function compares two objects for equality.

Parameter	Description
lpObject1	Points to the first object to test for equality.
lpObject2	Points to the second object to test for equality.

Returns

The return value is OLE_OK if the specified objects are equal. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_OBJECT
OLE_ERROR_NOT_EQUAL

Comments

Embedded objects are equal if their class, item, and native data are identical. Linked objects are equal if their class, document, and item are identical.

See Also

OleClone, **OleQueryOutOfDate**

OleExecute (3.1)

#include ole.h

OLESTATUS OleExecute(*lpObject, hglbCmds, reserved***)**

```
LPOLEOBJECT lpObject;     /* address of object receiving DDE commands */
HGLOBAL hglbCmds;         /* handle of memory with commands           */
UINT reserved;            /* reserved                                 */
```

The **OleExecute** function sends dynamic data exchange (DDE) execute commands to the server for the specified object.

Parameter	Description
lpObject	Points to an object identifying the server to which DDE execute commands are sent.
hglbCmds	Identifies the memory containing one or more DDE execute commands.
reserved	Reserved; must be zero.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_COMMAND
OLE_ERROR_MEMORY
OLE_ERROR_NOT_OPEN
OLE_ERROR_OBJECT
OLE_ERROR_PROTOCOL
OLE_ERROR_STATIC
OLE_WAIT_FOR_RELEASE

Comments

The client application should call the **OleQueryProtocol** function, specifying StdExecute, before calling the **OleExecute** function. The **OleQueryProtocol** function succeeds if the server for an object supports the **OleExecute** function.

See Also

OleQueryProtocol

OleGetData (3.1)

#include ole.h

OLESTATUS OleGetData(*lpObject, cfFormat, lphData***)**

```
LPOLEOBJECT lpObject;          /* address of object to query          */
OLECLIPFORMAT cfFormat;        /* format for retrieved data           */
HANDLE FAR* lphData;           /* address of memory to contain data   */
```

The **OleGetData** function retrieves data in the requested format from the specified object and supplies the handle of a memory or graphics device interface (GDI) object containing the data.

Parameter	Description
lpObject	Points to the object from which data is retrieved.
cfFormat	Specifies the format in which data is returned. This parameter can be one of the predefined clipboard formats or the value returned by the **RegisterClipboardFormat** function.
lphData	Points to the handle of a memory object that contains the data when the function returns.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_BLANK
OLE_ERROR_FORMAT
OLE_ERROR_OBJECT
OLE_WARN_DELETE_DATA

Comments

If the **OleGetData** function returns OLE_WARN_DELETE_DATA, the client application owns the data and should free the memory associated with the data when the client has finished using it. For other return values, the client should not free the memory or modify the data, because the data is controlled by the client library. If the application needs the data for long-term use, it should copy the data.

The **OleGetData** function typically returns OLE_WARN_DELETE_DATA if an object handler generates data for an object that the client library cannot interpret. In this case, the client application is responsible for controlling that data.

When the **OleGetData** function specifies CF_METAFILE or CF_BITMAP, the *lphData* parameter points to a GDI object, not a memory object, when the function returns. **OleGetData** supplies the handle of a memory object for all other formats.

See Also

OleEnumFormats, **OleSetData**, **RegisterClipboardFormat**

OleGetLinkUpdateOptions (3.1)

#include ole.h

OLESTATUS OleGetLinkUpdateOptions(*lpObject, lpUpdateOpt***)**

LPOLEOBJECT *lpObject;* /* address of object to query */
OLEOPT_UPDATE FAR* *lpUpdateOpt;* /* address of update options */

The **OleGetLinkUpdateOptions** function retrieves the link-update options for the presentation of a specified object.

Parameter	Description
lpObject	Points to the object to query.
lpUpdateOpt	Points to a variable in which the function stores the current value of the link-update option for the specified object. The link-update option setting may be one of the following values:

Value	Meaning
oleupdate_always	Update the linked object whenever possible. This option supports the Automatic link-update radio button in the Links dialog box.
oleupdate_oncall	Update the linked object only on request from the client application. This option supports the Manual link-update radio button in the Links dialog box.
oleupdate_onsave	Update the linked object when the source document is saved by the server.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_OBJECT
OLE_ERROR_STATIC

See Also

OleSetLinkUpdateOptions

OleIsDcMeta (3.1)

#include ole.h

BOOL OleIsDcMeta(*hdc***)**

HDC *hdc;* /* device-context handle */

The **OleIsDcMeta** function determines whether the specified device context is a metafile device context.

Parameter	Description
hdc	Identifies the device context to query.

Returns

The return value is a positive value if the device context is a metafile device context. Otherwise, it is NULL.

OleLoadFromStream (3.1)

#include ole.h

OLESTATUS OleLoadFromStream(*lpStream, lpszProtocol, lpClient, lhClientDoc, lpszObjname, lplpObject***)**

```
LPOLESTREAM lpStream;          /* address of stream for object        */
LPCSTR lpszProtocol;           /* address of string for protocol name */
LPOLECLIENT lpClient;          /* address of client structure         */
LHCLIENTDOC lhClientDoc;       /* long handle of client document      */
LPCSTR lpszObjname;            /* address of string for object name   */
LPOLEOBJECT FAR* lplpObject;   /* address of pointer to object        */
```

The **OleLoadFromStream** function loads an object from the containing document.

Parameter	Description
lpStream	Points to an **OLESTREAM** structure that was allocated and initialized by the client application. The library calls the **Get** function in the **OLESTREAMVTBL** structure to obtain the data for the object.
lpszProtocol	Points to a null-terminated string specifying the name of the required protocol. Currently, this value can be StdFileEditing (the name of the object linking and embedding protocol) or Static (for uneditable pictures only).
lpClient	Points to an **OLECLIENT** structure allocated and initialized by the client application. This pointer is used to locate the callback function and is passed in callback notifications.
lhClientDoc	Identifies the client document in which the object is being created.
lpszObjname	Points to a null-terminated string specifying the client's name for the object.
lplpObject	Points to a variable in which the library stores a pointer to the loaded object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_HANDLE
OLE_ERROR_NAME
OLE_ERROR_PROTOCOL
OLE_ERROR_STREAM
OLE_WAIT_FOR_RELEASE

Comments

To load an object, the client application needs only the location of that object in a file. A client typically loads an object only when the object is needed (for example, when it must be displayed).

If an object cannot be loaded when the *lpszProtocol* parameter specifies StdFileEditing, the application can call the **OleLoadFromStream** function again, specifying Static.

If the object is linked and the server and document are open, the library automatically makes the link between the client and server applications when an application calls **OleLoadFromStream**.

See Also

OleQuerySize, **OleSaveToStream**

OleLockServer (3.1)

#include ole.h

OLESTATUS OleLockServer(*lpObject, lphServer***)**

LPOLEOBJECT *lpObject;* /* address of object */
LHSERVER FAR* *lphServer;* /* address of handle of server */

The **OleLockServer** function is called by a client application to keep an open server application in memory. Keeping the server application in memory allows the client library to use the server application to open objects quickly.

Parameter	Description
lpObject	Points to an object the client library uses to identify the open server application to keep in memory. When the server has been locked, this object can be deleted.
lphServer	Points to the handle of the server application when the function returns.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_COMM
OLE_ERROR_LAUNCH
OLE_ERROR_OBJECT

Comments

A client calls **OleLockServer** to speed the opening of objects when the same server is used for a number of different objects. Before the client terminates, it must call the **OleUnlockServer** function to release the server from memory.

When **OleLockServer** is called more than once for a given server, even by different client applications, the server's lock count is increased. Each call to **OleUnlockServer** decrements the lock count. The server remains locked until the lock count is zero. If the object identified by the *lpObject* parameter is deleted before calling the **OleUnlockServer** function, **OleUnlockServer** must still be called to decrement the lock count.

If necessary, a server can terminate even though a client has called the **OleLockServer** function.

See Also

OleUnlockServer

OleObjectConvert (3.1)

#include ole.h

OLESTATUS OleObjectConvert(*lpObject, lpszProtocol, lpClient, lhClientDoc, lpszObjname, lplpObject***)**

```
LPOLEOBJECT lpObject;          /* address of object to convert          */
LPCSTR lpszProtocol;           /* address of string for protocol name */
LPOLECLIENT lpClient;          /* address of client for new object      */
LHCLIENTDOC lhClientDoc;       /* long handle of client document        */
LPCSTR lpszObjname;            /* address of string for object name     */
LPOLEOBJECT FAR* lplpObject;   /* address of pointer to new object      */
```

The **OleObjectConvert** function creates a new object that supports a specified protocol by converting an existing object. This function neither deletes nor replaces the original object.

Parameter	Description
lpObject	Points to the object to convert.
lpszProtocol	Points to a null-terminated string specifying the name of the required protocol. Currently this value can be Static (for uneditable pictures only).
lpClient	Points to an **OLECLIENT** structure for the new object.
lhClientDoc	Identifies the client document in which the object is being created.
lpszObjname	Points to a null-terminated string specifying the client's name for the object. This name must be unique with respect to the names of any other objects in the document and cannot contain a slash mark (/).
lplpObject	Points to a variable in which the library stores a pointer to the new object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_HANDLE
OLE_ERROR_NAME
OLE_ERROR_OBJECT
OLE_ERROR_STATIC

Comments

The only conversion currently supported is that of changing a linked or embedded object to a static object.

See Also

OleClone

OleQueryBounds (3.1)

#include ole.h

OLESTATUS OleQueryBounds(*lpObject, lpBounds***)**

LPOLEOBJECT *lpObject;* /* address of object to query */
RECT FAR* *lpBounds;* /* address of structure for bounding rectangle */

The **OleQueryBounds** function retrieves the extents of the bounding rectangle on the target device for the specified object. The coordinates are in MM_HIMETRIC units.

Parameter	Description
lpObject	Points to the object to query.
lpBounds	Points to a **RECT** structure for the extents of the bounding rectangle. The members of the **RECT** structure have the following meanings:

Member	Meaning
rect.left	0
rect.top	0
rect.right	x-extent
rect.bottom	y-extent

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_BLANK
OLE_ERROR_MEMORY
OLE_ERROR_OBJECT

See Also

OleSetBounds, **SetMapMode**, **RECT**

OleQueryClientVersion (3.1)

#include ole.h

DWORD OleQueryClientVersion(void)

The **OleQueryClientVersion** function retrieves the version number of the client library.

Returns
The return value is a doubleword value. The major version number is in the low-order byte of the low-order word, and the minor version number is in the high-order byte of the low-order word. The high-order word is reserved.

See Also
OleQueryServerVersion

OleQueryCreateFromClip (3.1)

#include ole.h

OLESTATUS OleQueryCreateFromClip(*lpszProtocol, renderopt, cfFormat***)**

```
LPCSTR lpszProtocol;        /* address of string for protocol name */
OLEOPT_RENDER renderopt;    /* rendering options                   */
OLECLIPFORMAT cfFormat;     /* format for clipboard data           */
```

The **OleQueryCreateFromClip** function checks whether the object on the clipboard supports the specified protocol and rendering options.

Parameter	Description
lpszProtocol	Points to a null-terminated string specifying the name of the protocol needed by the client. Currently, this value can be StdFileEditing (the name of the object linking and embedding protocol) or Static (for uneditable pictures only).
renderopt	Specifies the client's preference for presentation data for the object. This parameter can be one of the following values:

Value	Meaning
olerender_draw	The client calls the **OleDraw** function, and the library obtains and manages presentation data.
olerender_format	The library obtains and manages the data in the requested format, as specified by the *cfFormat* parameter.
olerender_none	The client library does not obtain any presentation data and does not draw the object.

cfFormat	Specifies the clipboard format. This parameter is used only when the *renderopt* parameter is **olerender_format**. If the clipboard format is CF_METAFILEPICT, CF_DIB, or CF_BITMAP, the library manages the data and draws the object. The library does not support drawing for any other formats.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_FORMAT
OLE_ERROR_PROTOCOL

Comments

The **OleQueryCreateFromClip** function is typically used to check whether to enable a Paste command.

The **olerender_none** rendering option is typically used to support hyperlinks. With this option, the client does not call **OleDraw** and calls the **OleGetData** function only for ObjectLink, OwnerLink, and Native formats.

The **olerender_format** rendering option allows a client to compute data (instead of painting it), use an unusual data format, or modify a standard data format. With this option the client does not call **OleDraw**. The client calls **OleGetData** to retrieve data in the specified format.

The **olerender_draw** rendering option is the most typical option. It is the easiest rendering option for the client to implement (the client simply calls **OleDraw**), and it allows the most flexibility. An object handler can exploit this flexibility to store no presentation data, a private presentation data format, or several different formats that it can choose among dynamically. Future implementations of object linking and embedding (**OLE**) may also exploit the flexibility that is inherent in this option.

See Also

OleCreateFromClip, **OleDraw**, **OleGetData**

OleQueryLinkFromClip (3.1)

#include ole.h

OLESTATUS OleQueryLinkFromClip(*lpszProtocol, renderopt, cfFormat***)**

```
LPCSTR lpszProtocol;        /* address of string for protocol name */
OLEOPT_RENDER renderopt;    /* rendering options                   */
OLECLIPFORMAT cfFormat;     /* format for clipboard data           */
```

The **OleQueryLinkFromClip** function checks whether a client application can use the data on the clipboard to produce a linked object that supports the specified protocol and rendering options.

Parameter	Description
lpszProtocol	Points to a null-terminated string specifying the name of the protocol needed by the client. Currently this value can be StdFileEditing (the name of the object linking and embedding protocol).
renderopt	Specifies the client's preference for presentation data for the object. This parameter can be one of the following values:

Value	Meaning
olerender_draw	The client calls the **OleDraw** function, and the library obtains and manages presentation data.
olerender_format	The library obtains and manages the data in the requested format, as specified by the *cfFormat* parameter.
olerender_none	The client library does not obtain any presentation data and does not draw the object.

cfFormat	Specifies the clipboard format. This parameter is used only when the *renderopt* parameter is **olerender_format**. If this clipboard format is CF_METAFILEPICT, CF_DIB, or CF_BITMAP, the library manages the data and draws the object. The library does not support drawing for any other formats.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_FORMAT
OLE_ERROR_PROTOCOL

Comments

The **OleQueryLinkFromClip** function is typically used to check whether to enable a Paste Link command.

The **olerender_none** rendering option is typically used to support hyperlinks. With this option, the client does not call **OleDraw** and calls the **OleGetData** function only for ObjectLink, OwnerLink, and Native formats.

The **olerender_format** rendering option allows a client to compute data (instead of painting it), use an unusual data format, or modify a standard data format. With this option, the client does not call **OleDraw**. The client calls **OleGetData** to retrieve data in the specified format.

The **olerender_draw** rendering option is the most typical option. It is the easiest rendering option for the client to implement (the client simply calls **OleDraw**), and it allows the most flexibility. An object handler can exploit this flexibility to store no presentation data, a private presentation data format, or several different formats that it can choose among dynamically. Future implementations of object linking and embedding (**OLE**) may also exploit the flexibility that is inherent in this option.

See Also

OleCreateLinkFromClip, **OleDraw**, **OleGetData**

OleQueryName (3.1)

#include ole.h

OLESTATUS OleQueryName(*lpObject, lpszObject, lpwBuffSize***)**

```
LPOLEOBJECT lpObject;       /* address of object                  */
LPSTR lpszObject;           /* address of string for object name  */
UINT FAR* lpwBuffSize;      /* address of word for size of buffer */
```

The **OleQueryName** function retrieves the name of a specified object.

Parameter	Description
lpObject	Points to the object whose name is being queried.
lpszObject	Points to a character array that contains a null-terminated string. When the function returns, this string specifies the name of the object.
lpwBuffSize	Points to a variable containing the size, in bytes, of the buffer pointed to by the *lpszObject* parameter. When the function returns, this value is the number of bytes copied to the buffer.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be OLE_ERROR_OBJECT.

See Also

OleRename

OleQueryOpen (3.1)

#include ole.h

OLESTATUS OleQueryOpen(*lpObject***)**

LPOLEOBJECT *lpObject;* /* address of object to query */

The **OleQueryOpen** function checks whether the specified object is open.

Parameter	Description
lpObject	Points to the object to query.

Returns

The return value is OLE_OK if the object is open. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_COMM
OLE_ERROR_OBJECT
OLE_ERROR_STATIC

See Also

OleActivate

OleQueryOutOfDate (3.1)

#include ole.h

OLESTATUS OleQueryOutOfDate(*lpObject***)**

LPOLEOBJECT *lpObject;* /* address of object to query */

The **OleQueryOutOfDate** function checks whether an object is out-of-date.

Parameter	Description
lpObject	Points to the object to query.

Returns

The return value is OLE_OK if the object is up-to-date. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_OBJECT
OLE_ERROR_OUTOFDATE

Comments

The **OleQueryOutOfDate** function has not been implemented for the current version of object linking and embedding (**OLE**). For linked objects, **OleQueryOutOfDate** always returns OLE_OK.

A linked object might be out-of-date if the document that is the source for the link has been updated. An embedded object that contains links to other objects might also be out-of-date.

See Also

OleEqual, **OleUpdate**

OleQueryProtocol (3.1)

#include ole.h

void FAR* OleQueryProtocol(*lpobj, lpszProtocol***)**

LPOLEOBJECT *lpobj;* /* address of object to query */
LPCSTR *lpszProtocol;* /* address of string for protocol to query */

The **OleQueryProtocol** function checks whether an object supports a specified protocol.

Parameter	Description
lpobj	Points to the object to query.
lpszProtocol	Points to a null-terminated string specifying the name of the requested protocol. This value can be StdFileEditing or StdExecute.

Returns

The return value is a void pointer to an **OLEOBJECT** structure if the function is successful, or it is NULL if the object does not support the requested protocol. The library can return OLE_WAIT_FOR_RELEASE when an application calls this function.

Comments

The **OleQueryProtocol** function queries whether the specified protocol is supported and returns a modified object pointer that allows access to the function table for the protocol. This modified object pointer points to a structure that has the same form as the **OLEOBJECT** structure; the new structure also points to a table of functions and may contain additional state information. The new pointer does not point to a different object--if the object is deleted, secondary pointers become invalid. If a protocol includes delete functions, calling a delete function invalidates all pointers to that object.

A client application typically calls **OleQueryProtocol**, specifying StdExecute for the *lpszProtocol* parameter, before calling the **OleExecute** function. This allows the client application to check whether the server for an object supports dynamic data exchange (DDE) execute commands.

See Also

OleExecute

OleQueryReleaseError (3.1)

#include ole.h

OLESTATUS OleQueryReleaseError(*lpobj***)**

LPOLEOBJECT *lpobj;* /* address of object to query */

The **OleQueryReleaseError** function checks the error value for an asynchronous operation on an object.

Parameter	Description
lpobj	Points to an object for which the error value is to be queried.

Returns

The return value, if the function is successful, is either OLE_OK if the asynchronous operation completed successfully or the error value for that operation. If the pointer passed in the *lpobj* parameter is invalid, the function returns OLE_ERROR_OBJECT.

Comments

A client application receives the OLE_RELEASE notification when an asynchronous operation has terminated. The client should then call **OleQueryReleaseError** to check whether the operation has terminated successfully or with an error value.

See Also

OleQueryReleaseMethod, **OleQueryReleaseStatus**

OleQueryReleaseMethod (3.1)

#include ole.h

OLE_RELEASE_METHOD OleQueryReleaseMethod(*lpobj***)**

LPOLEOBJECT *lpobj;* /* address of object to query */

The **OleQueryReleaseMethod** function finds out the operation that finished for the specified object.

Parameter	Description
lpobj	Points to an object for which the operation is to be queried.

Returns

The return value indicates the server operation (method) that finished. It can be one of the following values:

Value	Server operation
OLE_ACTIVATE	Activate
OLE_CLOSE	Close
OLE_COPYFROMLNK	CopyFromLink (autoreconnect)
OLE_CREATE	Create
OLE_CREATEFROMFILE	CreateFromFile
OLE_CREATEFROMTEMPLATE	CreateFromTemplate
OLE_CREATEINVISIBLE	CreateInvisible
OLE_CREATELINKFROMFILE	CreateLinkFromFile
OLE_DELETE	Object Delete
OLE_EMBPASTE	Paste and Update
OLE_LNKPASTE	PasteLink (autoreconnect)
OLE_LOADFROMSTREAM	LoadFromStream (autoreconnect)
OLE_NONE	No operation active
OLE_OTHER	Other miscellaneous asynchronous operations
OLE_RECONNECT	Reconnect
OLE_REQUESTDATA	OleRequestData
OLE_RUN	Run
OLE_SERVERUNLAUNCH	Server is stopping
OLE_SETDATA	OleSetData
OLE_SETUPDATEOPTIONS	Setting update options
OLE_SHOW	Show
OLE_UPDATE	Update

If the pointer passed in the *lpobj* parameter is invalid, the function returns OLE_ERROR_OBJECT.

Comments

A client application receives the OLE_RELEASE notification when an asynchronous operation has ended. The client can then call **OleQueryReleaseMethod** to check which operation caused the library to send the OLE_RELEASE notification. The client calls **OleQueryReleaseError** to determine whether the operation terminated successfully or with an error value.

See Also

OleQueryReleaseError, **OleQueryReleaseStatus**

OleQueryReleaseStatus (3.1)

#include ole.h

OLESTATUS OleQueryReleaseStatus(*lpobj***)**

LPOLEOBJECT *lpobj;* /* address of object to query */

The **OleQueryReleaseStatus** function determines whether an operation has finished for the specified object.

Parameter	Description
lpobj	Points to an object for which the operation is queried.

Returns

The return value, if the function is successful, is either OLE_BUSY if an operation is in progress or OLE_OK. If the pointer passed in the *lpobj* parameter is invalid, the function returns OLE_ERROR_OBJECT.

See Also

OleQueryReleaseError, **OleQueryReleaseMethod**

OleQueryServerVersion (3.1)

#include ole.h

DWORD OleQueryServerVersion(void)

The **OleQueryServerVersion** function retrieves the version number of the server library.

Returns
The return value is a doubleword value. The major version number is in the low-order byte of the low-order word, and the minor version number is in the high-order byte of the low-order word. The high-order word is reserved.

See Also
OleQueryClientVersion, **HIBYTE**, **LOBYTE**

OleQuerySize (3.1)

#include ole.h

OLESTATUS OleQuerySize(*lpObject, pdwSize***)**

LPOLEOBJECT *lpObject;* /* address of object to query */
DWORD FAR* *pdwSize;* /* address of size of object */

The **OleQuerySize** function retrieves the size of the specified object.

Parameter	Description
lpObject	Points to the object to query.
pdwSize	Points to a variable for the size of the object. This variable contains the size of the object when the function returns.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_BLANK
OLE_ERROR_MEMORY
OLE_ERROR_OBJECT

See Also

OleLoadFromStream

OleQueryType (3.1)

#include ole.h

OLESTATUS OleQueryType(*lpObject, lpType***)**

LPOLEOBJECT *lpObject;* /* address of object to query */
LONG FAR* *lpType;* /* address of type of object */

The **OleQueryType** function checks whether a specified object is embedded, linked, or static.

Parameter	Description
lpObject	Points to the object for which the type is to be queried.
lpType	Points to a long variable that contains the type of the object when the function returns. This parameter can be one of the following values:

Value	Meaning
OT_EMBEDDED	Object is embedded.
OT_LINK	Object is a link.
OT_STATIC	Object is a static picture.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_GENERIC
OLE_ERROR_OBJECT

See Also

OleEnumFormats

OleReconnect (3.1)

#include ole.h

OLESTATUS OleReconnect(*lpObject***)**

LPOLEOBJECT *lpObject;* /* address of object to reconnect to */

The **OleReconnect** function reestablishes a link to an open linked object. If the specified object is not open, this function does not open it.

Parameter	Description
lpObject	Points to the object to reconnect to.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_NOT_LINK
OLE_ERROR_OBJECT
OLE_ERROR_STATIC
OLE_WAIT_FOR_RELEASE

Comments

A client application can use **OleReconnect** to keep the presentation for a linked object up-to-date.

See Also

OleActivate, **OleClose**, **OleUpdate**

OleRegisterClientDoc (3.1)

#include ole.h

OLESTATUS OleRegisterClientDoc(*lpszClass, lpszDoc, reserved, lplhDoc***)**

```
LPCSTR lpszClass;                /* address of string for class name      */
LPCSTR lpszDoc;                  /* address of string for document name   */
LONG reserved;                   /* reserved                              */
LHCLIENTDOC FAR* lplhDoc;        /* address of handle of document         */
```

The **OleRegisterClientDoc** function registers an open client document with the library and returns the handle of that document.

Parameter	Description
lpszClass	Points to a null-terminated string specifying the class of the client document.
lpszDoc	Points to a null-terminated string specifying the location of the client document. (This value should be a fully qualified path.)
reserved	Reserved. Must be zero.
lplhDoc	Points to the handle of the client document when the function returns. This handle is used to identify the document in other document-management functions.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_ALREADY_REGISTERED
OLE_ERROR_MEMORY
OLE_ERROR_NAME

Comments

When a document being copied onto the clipboard exists only because the client application is copying Native data that contains objects, the name specified in the *lpszDoc* parameter must be Clipboard.

Client applications should register open documents with the library and notify the library when a document is renamed, closed, saved, or restored to a changed state.

See Also

OleRenameClientDoc, **OleRevertClientDoc**, **OleRevokeClientDoc**, **OleSavedClientDoc**

OleRegisterServerDoc (3.1)

#include ole.h

OLESTATUS OleRegisterServerDoc(*lhsrvr, lpszDocName, lpdoc, lplhdoc***)**

```
LHSERVER lhsrvr;                /* server handle                    */
LPCSTR lpszDocName;             /* address of string for document name */
LPOLESERVERDOC lpdoc;           /* address of OLESERVERDOC structure */
LHSERVERDOC FAR* lplhdoc;       /* handle of registered document    */
```

The **OleRegisterServerDoc** function registers a document with the server library in case other client applications have links to it. A server application uses this function when the server is started with the **/Embedding** *filename* option or when it creates or opens a document that is not requested by the library.

Parameter	Description
lhsrvr	Identifies the server. Server applications obtain this handle by calling the **OleRegisterServer** function.
lpszDocName	Points to a null-terminated string specifying the permanent name for the document. This parameter should be a fully qualified path.
lpdoc	Points to an **OLESERVERDOC** structure allocated and initialized by the server application.
lplhdoc	Points to a handle that will identify the document. This parameter points to the handle when the function returns.

Returns

If the function is successful, the return value is OLE_OK. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_ADDRESS
OLE_ERROR_HANDLE
OLE_ERROR_MEMORY

Comments

If the document was created or opened in response to a request from the server library, the server should not register the document by using **OleRegisterServerDoc**. Instead, the server should return a pointer to the **OLESERVERDOC** structure through the parameter to the relevant function.

See Also

OleRegisterServer, **OleRevokeServerDoc**

OleRegisterServer (3.1)

#include ole.h

OLESTATUS OleRegisterServer(*lpszClass, lpsrvr, lplhserver, hinst, srvruse***)**

```
LPCSTR lpszClass;          /* address of string for class name      */
LPOLESERVER lpsrvr;        /* address of OLESERVER structure        */
LHSERVER FAR* lplhserver;  /* address of server handle              */
HINSTANCE hinst;           /* instance handle                       */
OLE_SERVER_USE srvruse;    /* single or multiple instances          */
```

The **OleRegisterServer** function registers the specified server, class name, and instance with the server library.

Parameter	Description
lpszClass	Points to a null-terminated string specifying the class name being registered.
lpsrvr	Points to an **OLESERVER** structure allocated and initialized by the server application.
lplhserver	Points to a variable of type **LHSERVER** in which the library stores the handle of the server. This handle is used in such functions as **OleRegisterServerDoc** and **OleRevokeServer**.
hinst	Identifies the instance of the server application. This handle is used to ensure that clients connect to the correct instance of a server application.
srvruse	Specifies whether the server uses a single instance or multiple instances to support multiple objects. This value must be either OLE_SERVER_SINGLE or OLE_SERVER_MULTI.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_CLASS
OLE_ERROR_MEMORY
OLE_ERROR_PROTECT_ONLY

Comments

When the server application starts, it creates an **OLESERVER** structure and calls the **OleRegisterServer** function. Servers that support several class names can allocate a structure for each or reuse the same structure. The class name is passed to server-application functions that are called through the library, so that servers supporting more than one class can check which class is being requested.

The *srvruse* parameter is used when the libraries open an object. When OLE_SERVER_MULTI is specified for this parameter and all current instances are already editing an object, a new instance of the server is started. Servers that support the multiple document interface (MDI) typically specify OLE_SERVER_SINGLE.

See Also

OleRegisterServerDoc, **OleRevokeServer**

OleRelease (3.1)

#include ole.h

OLESTATUS OleRelease(*lpObject***)**

LPOLEOBJECT *lpObject;* /* address of object to release */

The **OleRelease** function releases an object from memory and closes it if it was open. This function does not indicate that the object has been deleted from the client document.

Parameter	**Description**
lpObject	Points to the object to release.

Returns

If the function is successful, the return value is OLE_OK. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_OBJECT
OLE_WAIT_FOR_RELEASE

Comments

The **OleRelease** function should be called for all objects when closing the client document.

See Also

OleDelete

OleRename (3.1)

#include ole.h

OLESTATUS OleRename(*lpObject, lpszNewname***)**

LPOLEOBJECT *lpObject;* /* address of object being renamed */
LPCSTR *lpszNewname;* /* address of string for new object name */

The **OleRename** function renames an object.

Parameter	Description
lpObject	Points to the object that is being renamed.
lpszNewname	Points to a null-terminated string specifying the new name of the object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be OLE_ERROR_OBJECT.

Comments

Object names need not be seen by the user. They must be unique within the containing document and must be preserved when the document is saved.

See Also

OleQueryName

OleRenameClientDoc (3.1)

#include ole.h

OLESTATUS OleRenameClientDoc(*lhClientDoc, lpszNewDocname***)**

LHCLIENTDOC *lhClientDoc;* /* handle of client document */
LPCSTR *lpszNewDocname;* /* address of string for new document name */

The **OleRenameClientDoc** function informs the client library that a document has been renamed. A client application calls this function when a document name has changed--for example, when the user chooses the Save or Save As command from the File menu.

Parameter	Description
lhClientDoc	Identifies the document that has been renamed.
lpszNewDocname	Points to a null-terminated string specifying the new name of the document.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be OLE_ERROR_HANDLE.

Comments

Client applications should register open documents with the library and notify the library when a document is renamed, closed, saved, or restored to a changed state.

See Also

OleRegisterClientDoc, **OleRevertClientDoc**, **OleRevokeClientDoc**, **OleSavedClientDoc**

OleRenameServerDoc (3.1)

#include ole.h

OLESTATUS OleRenameServerDoc(*lhDoc, lpszDocName***)**

LHSERVERDOC *lhDoc;* /* handle of document */
LPCSTR *lpszDocName;* /* address of string for path and filename */

The **OleRenameServerDoc** function informs the server library that a document has been renamed.

Parameter	Description
lhDoc	Identifies the document that has been renamed.
lpszDocName	Points to a null-terminated string specifying the new name of the document. This parameter is typically a fully qualified path.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_HANDLE
OLE_ERROR_MEMORY

Comments

The **OleRenameServerDoc** function has the same effect as sending the OLE_RENAMED notification to the client application's callback function. The server application calls this function when it renames a document to which the active links need to be reconnected or when the user chooses the Save As command from the File menu while working with an embedded object.

Server applications should register open documents with the server library and notify the library when a document is renamed, closed, saved, or restored to a changed state.

See Also

OleRegisterServerDoc, **OleRevertServerDoc**, **OleRevokeServerDoc**, **OleSavedServerDoc**

OleRequestData (3.1)

#include ole.h

OLESTATUS OleRequestData(*lpObject, cfFormat***)**

LPOLEOBJECT *lpObject;* /* address of object to query */
OLECLIPFORMAT *cfFormat;* /* format for retrieved data */

The **OleRequestData** function requests the library to retrieve data in a specified format from a server.

Parameter	Description
lpObject	Points to the object that is associated with the server from which data is to be retrieved.
cfFormat	Specifies the format in which data is to be returned. This parameter can be one of the predefined clipboard formats or the value returned by the **RegisterClipboardFormat** function.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_NOT_OPEN
OLE_ERROR_OBJECT
OLE_ERROR_STATIC
OLE_WAIT_FOR_RELEASE

Comments

The client application should be connected to the server application when the client calls the **OleRequestData** function. When the client receives the OLE_RELEASE notification, it can retrieve the data from the object by using the **OleGetData** function or query the data by using such functions as **OleQueryBounds**.

If the requested data format is the same as the presentation data for the object, the library manages the data and updates the presentation.

The **OleRequestData** function returns OLE_WAIT_FOR_RELEASE if the server is busy. In this case, the application should continue to dispatch messages until it receives a callback notification with the OLE_RELEASE argument.

See Also

OleEnumFormats, **OleGetData**, **OleSetData**, **RegisterClipboardFormat**

OleRevertClientDoc (3.1)

#include ole.h

OLESTATUS OleRevertClientDoc(*lhClientDoc***)**

LHCLIENTDOC *lhClientDoc;* /* handle of client document */

The **OleRevertClientDoc** function informs the library that a document has been restored to a previously saved condition.

Parameter	Description
lhClientDoc	Identifies the document that has been restored to its saved state.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be OLE_ERROR_HANDLE.

Comments

A client application should call the **OleRevertClientDoc** function when it reloads a document without saving changes to the document.

Client applications should register open documents with the library and notify the library when a document is renamed, closed, saved, or restored to a saved state.

See Also

OleRegisterClientDoc, **OleRenameClientDoc**, **OleRevokeClientDoc**, **OleSavedClientDoc**

OleRevertServerDoc (3.1)

#include ole.h

OLESTATUS OleRevertServerDoc(*lhDoc***)**

LHSERVERDOC *lhDoc;* /* handle of document */

The **OleRevertServerDoc** function informs the server library that the server has restored a document to its saved state without closing it.

Parameter	Description
lhDoc	Identifies the document that has been restored to its saved state.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be OLE_ERROR_HANDLE.

Comments

Server applications should register open documents with the server library and notify the library when a document is renamed, closed, saved, or restored to a saved state.

See Also

OleRegisterServerDoc, **OleRenameServerDoc**, **OleRevokeServerDoc**, **OleSavedServerDoc**

OleRevokeClientDoc (3.1)

#include ole.h

OLESTATUS OleRevokeClientDoc(*lhClientDoc***)**

LHCLIENTDOC *lhClientDoc;* /* handle of client document */

The **OleRevokeClientDoc** function informs the client library that a document is no longer open.

Parameter	Description
lhClientDoc	Identifies the document that is no longer open. This handle is invalid following the call to **OleRevokeClientDoc**.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_HANDLE
OLE_ERROR_NOT_EMPTY

Comments

The client application should delete all the objects in a document before calling **OleRevokeClientDoc**.

Client applications should register open documents with the library and notify the library when a document is renamed, closed, saved, or restored to a changed state.

See Also

OleRegisterClientDoc, **OleRenameClientDoc**, **OleRevertClientDoc**, **OleSavedClientDoc**

OleRevokeServerDoc (3.1)

#include ole.h

OLESTATUS OleRevokeServerDoc(*lhdoc***)**

LHSERVERDOC *lhdoc;* /* document handle */

The **OleRevokeServerDoc** function revokes the specified document. A server application calls this function when a registered document is being closed or otherwise made unavailable to client applications.

Parameter	Description
lhdoc	Identifies the document to revoke. This handle was returned by a call to the **OleRegisterServerDoc** function or was associated with a document by using one of the server-supplied functions that create documents.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_HANDLE
OLE_WAIT_FOR_RELEASE

Comments

If this function returns OLE_WAIT_FOR_RELEASE, the server application should not free the **OLESERVERDOC** structure or exit until the library calls the server's **Release** function.

See Also

OleRegisterServerDoc, **OleRevokeObject**, **OleRevokeServer**, **OLESERVERDOC**

OleRevokeObject (3.1)

#include ole.h

OLESTATUS OleRevokeObject(*lpClient***)**

LPOLECLIENT *lpClient;* /* address of OLECLIENT structure */

The **OleRevokeObject** function revokes access to an object. A server application typically calls this function when the user destroys an object.

Parameter	**Description**
lpClient	Points to the **OLECLIENT** structure associated with the object being revoked.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

See Also

OleRevokeServer, **OleRevokeServerDoc**

OleRevokeServer (3.1)

#include ole.h

OLESTATUS OleRevokeServer(*lhServer***)**

LHSERVER *lhServer;* /* server handle */

The **OleRevokeServer** function is called by a server application to close any registered documents.

Parameter	Description
lhServer	Identifies the server to revoke. A server application obtains this handle in a call to the **OleRegisterServer** function.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_HANDLE
OLE_WAIT_FOR_RELEASE

Comments

The **OleRevokeServer** function returns OLE_WAIT_FOR_RELEASE if communications between clients and the server are in the process of terminating. In this case, the server application should continue to send and dispatch messages until the library calls the server's **Release** function.

See Also

OleRegisterServer, **OleRevokeObject**, **OleRevokeServerDoc**

OleSavedClientDoc (3.1)

#include ole.h

OLESTATUS OleSavedClientDoc(*lhClientDoc***)**

LHCLIENTDOC *lhClientDoc;* /* handle of client document */

The **OleSavedClientDoc** function informs the client library that a document has been saved.

Parameter	Description
lhClientDoc	Identifies the document that has been saved.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be OLE_ERROR_HANDLE.

Comments

Client applications should register open documents with the client library and notify the library when a document is renamed, closed, saved, or restored to a saved state.

See Also

OleRegisterClientDoc, **OleRenameClientDoc**, **OleRevertClientDoc**, **OleRevokeClientDoc**

OleSavedServerDoc (3.1)

#include ole.h

OLESTATUS OleSavedServerDoc(*lhDoc***)**

LHSERVERDOC *lhDoc;* /* handle of document */

The **OleSavedServerDoc** function informs the server library that a document has been saved.

Parameter	Description
lhDoc	Identifies the document that has been saved.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_CANT_UPDATE_CLIENT
OLE_ERROR_HANDLE

Comments

The **OleSavedServerDoc** function has the same effect as sending the OLE_SAVED notification to the client application's callback function. The server application calls this function when saving a document or when updating an embedded object without closing the document.

When a server application receives the OLE_ERROR_CANT_UPDATE_CLIENT error value, it should display a message box indicating that the user cannot update the document until the server terminates.

Server applications should register open documents with the server library and notify the library when a document is renamed, closed, saved, or restored to a saved state.

See Also

OleRegisterServerDoc, **OleRenameServerDoc**, **OleRevertServerDoc**, **OleRevokeServerDoc**

OleSaveToStream (3.1)

#include ole.h

OLESTATUS OleSaveToStream(*lpObject, lpStream***)**

LPOLEOBJECT *lpObject;* /* address of object to save */
LPOLESTREAM *lpStream;* /* address of OLESTREAM structure */

The **OleSaveToStream** function saves an object to the stream.

Parameter	Description
lpObject	Points to the object to be saved to the stream.
lpStream	Points to an **OLESTREAM** structure allocated and initialized by the client application. The library calls the **Put** function in the **OLESTREAM** structure to store the data from the object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_BLANK
OLE_ERROR_MEMORY
OLE_ERROR_OBJECT
OLE_ERROR_STREAM

Comments

An application can use the **OleQuerySize** function to find the number of bytes to allocate for the object.

See Also

OleLoadFromStream, **OleQuerySize**

OleSetBounds (3.1)

#include ole.h

OLESTATUS OleSetBounds(*lpObject, lprcBound***)**

LPOLEOBJECT *lpObject;* /* address of object */
RECT FAR* *lprcBound;* /* address of structure for bounding rectangle */

The **OleSetBounds** function sets the coordinates of the bounding rectangle for the specified object on the target device.

Parameter	Description
lpObject	Points to the object for which the bounding rectangle is set.
lprcBound	Points to a **RECT** structure containing the coordinates of the bounding rectangle. The coordinates are specified in MM_HIMETRIC units. Neither the width nor height of an object should exceed 32,767 MM_HIMETRIC units.

Returns
The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_MEMORY
OLE_ERROR_OBJECT
OLE_WAIT_FOR_RELEASE

The **OleSetBounds** function returns OLE_ERROR_OBJECT when it is called for a linked object.

Comments
The **OleSetBounds** function is ignored for linked objects, because the size of a linked object is determined by the source document for the link.

A client application uses **OleSetBounds** to change the bounding rectangle. The client does not need to call **OleSetBounds** every time a server is opened.

The bounding rectangle specified in the **OleSetBounds** function does not necessarily have the same dimensions as the rectangle specified in the call to the **OleDraw** function. These dimensions may be different because of the view scaling used by the container application. An application can use **OleSetBounds** to cause the server to reformat the picture to fit the rectangle more closely.

In the MM_HIMETRIC mapping mode, the positive y-direction is up.

See Also
OleDraw, **OleQueryBounds**, **SetMapMode**, **RECT**

OleSetColorScheme (3.1)

#include ole.h

OLESTATUS OleSetColorScheme(*lpObject, lpPalette***)**

LPOLEOBJECT *lpObject;* /* address of object */
const LOGPALETTE FAR* *lpPalette;* /* address of preferred palette */

The **OleSetColorScheme** function specifies the palette a client application recommends be used when the server application edits the specified object. The server application can ignore the recommended palette.

Parameter	Description
lpObject	Points to an **OLEOBJECT** structure describing the object for which a palette is recommended.
lpPalette	Points to a **LOGPALETTE** structure specifying the recommended palette.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_COMM
OLE_ERROR_MEMORY
OLE_ERROR_OBJECT
OLE_ERROR_PALETTE
OLE_ERROR_STATIC
OLE_WAIT_FOR_RELEASE

The **OleSetColorScheme** function returns OLE_ERROR_OBJECT when it is called for a linked object.

Comments

A client application uses **OleSetColorScheme** to change the color scheme. The client does not need to call **OleSetColorScheme** every time a server is opened.

The first palette entry in the **LOGPALETTE** structure specifies the foreground color recommended by the client application. The second palette entry specifies the background color. The first half of the remaining palette entries are fill colors, and the second half are colors for lines and text.

Client applications should specify an even number of palette entries. When there is an uneven number of entries, the server interprets the odd entry as a fill color; that is, if there are five entries, three are interpreted as fill colors and two as line and text colors.

When server applications render metafiles, they should use the suggested palette.

See Also

LOGPALETTE

OleSetData (3.1)

#include ole.h

OLESTATUS OleSetData(*lpObject, cfFormat, hData***)**

```
LPOLEOBJECT lpObject;          /* address of object          */
OLECLIPFORMAT cfFormat;        /* format of data to send     */
HANDLE hData;                  /* memory containing data     */
```

The **OleSetData** function sends data in the specified format to the server associated with a specified object.

Parameter	Description
lpObject	Points to an object specifying the server to which data is to be sent.
cfFormat	Specifies the format of the data.
hData	Identifies a memory object containing the data in the specified format.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_BLANK
OLE_ERROR_MEMORY
OLE_ERROR_NOT_OPEN
OLE_ERROR_OBJECT
OLE_WAIT_FOR_RELEASE

If the specified object cannot accept the data, the function returns an error value. If the server is not open and the requested data format is different from the format of the presentation data, the return value is OLE_ERROR_NOT_OPEN.

See Also

OleGetData, **OleRequestData**

OleSetHostNames (3.1)

#include ole.h

OLESTATUS OleSetHostNames(*lpObject, lpszClient, lpszClientObj***)**

```
LPOLEOBJECT lpObject;      /* address of object                          */
LPCSTR lpszClient;         /* address of string with name of client app  */
LPCSTR lpszClientObj;      /* address of string with client's name for object */
```

The **OleSetHostNames** function specifies the name of the client application and the client's name for the specified object. This information is used in window titles when the object is being edited in the server application.

Parameter	Description
lpObject	Points to the object for which a name is to be set.
lpszClient	Points to a null-terminated string specifying the name of the client application.
lpszClientObj	Points to a null-terminated string specifying the client's name for the object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_MEMORY
OLE_ERROR_OBJECT
OLE_WAIT_FOR_RELEASE

The **OleSetHostNames** function returns OLE_ERROR_OBJECT when it is called for a linked object.

Comments

When a server application is started for editing of an embedded object, it displays in its title bar the string specified in the *lpszClientObj* parameter. The object name specified in this string should be the name of the client document containing the object.

A client application uses **OleSetHostNames** to set the name of an object the first time that object is activated or to change the name of an object. The client does not need to call **OleSetHostNames** every time a server is opened.

OleSetLinkUpdateOptions (3.1)

#include ole.h

OLESTATUS OleSetLinkUpdateOptions(*lpObject, UpdateOpt***)**

LPOLEOBJECT *lpObject;* /* address of object */
OLEOPT_UPDATE *UpdateOpt;* /* link-update options */

The **OleSetLinkUpdateOptions** function sets the link-update options for the presentation of the specified object.

Parameter	Description
lpObject	Points to the object for which the link-update option is set.
UpdateOpt	Specifies the link-update option for the specified object. This parameter can be one of the following values:

Option	Description
oleupdate_always	Update the linked object whenever possible. This option supports the Automatic link-update radio button in the Links dialog box.
oleupdate_oncall	Update the linked object only on request from the client application. This option supports the Manual link-update radio button in the Links dialog box.
oleupdate_onsave	Update the linked object when the source document is saved by the server.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_OBJECT
OLE_ERROR_OPTION
OLE_ERROR_STATIC
OLE_WAIT_FOR_RELEASE

See Also

OleGetLinkUpdateOptions

OleSetTargetDevice (3.1)

#include ole.h

OLESTATUS OleSetTargetDevice(*lpObject, hotd***)**

```
LPOLEOBJECT lpObject;     /* address of object                        */
HGLOBAL hotd;             /* handle of OLETARGETDEVICE structure      */
```

The **OleSetTargetDevice** function specifies the target output device for an object.

Parameter	Description
lpObject	Points to the object for which a target device is specified.
hotd	Identifies an **OLETARGETDEVICE** structure that describes the target device for the object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_MEMORY
OLE_ERROR_OBJECT
OLE_ERROR_STATIC
OLE_WAIT_FOR_RELEASE

Comments

The **OleSetTargetDevice** function allows a linked or embedded object to be formatted correctly for a target device, even when the object is rendered on a different device. A client application should call this function whenever the target device changes, so that servers can be notified to change the rendering of the object, if necessary. The client application should call the **OleUpdate** function to ensure that the information is sent to the server, so that the server can make the necessary changes to the object's presentation. The client application should call the library to redraw the object if it receives a notification from the server that the object has changed.

A client application uses the **OleSetTargetDevice** function to change the target device. The client does not need to call **OleSetTargetDevice** every time a server is opened.

See Also

OLETARGETDEVICE

OleUnblockServer (3.1)

#include ole.h

OLESTATUS OleUnblockServer(*lhSrvr, lpfRequest***)**

LHSERVER *lhSrvr;* /* handle of server */
BOOL FAR* *lpfRequest;* /* address of flag for more requests */

The **OleUnblockServer** function processes a request from a queue created by calling the **OleBlockServer** function.

Parameter	Description
lhSrvr	Identifies the server for which requests were queued.
lpfRequest	Points to a flag indicating whether there are further requests in the queue. If there are further requests in the queue, this flag is TRUE when the function returns. Otherwise, it is FALSE when the function returns.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_HANDLE
OLE_ERROR_MEMORY

Comments

A server application can use the **OleBlockServer** and **OleUnblockServer** functions to control when the server library processes requests from client applications. It is best to use **OleUnblockServer** outside the **GetMessage** function in a message loop, unblocking all blocked messages before getting the next message. Unblocking message loops should not be run inside server-defined functions that are called by the library.

See Also

OleBlockServer

OleUnlockServer (3.1)

#include ole.h

OLESTATUS OleUnlockServer(*hServer***)**

LHSERVER *hServer;* /* handle of server to unlock */

The **OleUnlockServer** function unlocks a server that was locked by the **OleLockServer** function.

Parameter	Description
hServer	Identifies the server to release from memory. This handle was retrieved by a call to the **OleLockServer** function.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_HANDLE
OLE_WAIT_FOR_RELEASE

Comments

When the **OleLockServer** function is called more than once for a given server, the server's lock count is incremented. Each call to **OleUnlockServer** decrements the lock count. The server remains locked until the lock count is zero.

If the **OleUnlockServer** function returns OLE_WAIT_FOR_RELEASE, the application should call the **OleQueryReleaseStatus** function to determine whether the unlocking process has finished. In the call to **OleQueryReleaseStatus**, the application can cast the server handle to a long pointer to an object linking and embedding (**OLE**) object (**LPOLEOBJECT**):

```
OleQueryReleaseStatus((LPOLEOBJECT) lhserver);
```

When **OleQueryReleaseStatus** no longer returns OLE_BUSY, the server has been unlocked.

See Also

OleLockServer, **OleQueryReleaseStatus**

OleUpdate (3.1)

#include ole.h

OLESTATUS OleUpdate(*lpObject***)**

LPOLEOBJECT *lpObject;* /* address of object */

The **OleUpdate** function updates the specified object. This function updates the presentation of the object and ensures that the object is up-to-date with respect to any linked objects it contains.

Parameter	Description
lpObject	Points to the object to be updated.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_BUSY
OLE_ERROR_OBJECT
OLE_ERROR_STATIC
OLE_WAIT_FOR_RELEASE

See Also

OleQueryOutOfDate

OLE functions (3.1)

OleActivate	Activates an object
OleBlockServer	Queues incoming requests for the server
OleClone	Makes a copy of an object
OleClose	Closes a specified open object
OleCopyFromLink	Makes an embedded copy of a linked object
OleCopyToClipboard	Puts the specified object on the clipboard
OleCreate	Creates an embedded object of a specified class
OleCreateFromClip	Creates an object from the clipboard
OleCreateFromFile	Creates an embedded object from a file
OleCreateFromTemplate	Creates an object from a template
OleCreateInvisible	Creates an object without displaying it
OleCreateLinkFromClip	Creates link to object from the clipboard
OleCreateLinkFromFile	Creates a link to an object in a file
OleDelete	Deletes an object and frees associated memory
OleDraw	Draws a specified object into a device context
OleEnumFormats	Enumerates data formats for an object
OleEnumObjects	Enumerates objects in a document
OleEqual	Compares two objects for equality
OleExecute	Sends DDE execute commands to a server
OleGetData	Retrieves data from an object in a specified format
OleGetLinkUpdateOptions	Retrieves link-update options for an object
OleIsDcMeta	Identifies a metafile device context
OleLoadFromStream	Loads an object from the containing document
OleLockServer	Keeps an open server application in memory
OleObjectConvert	Creates a new object using a specified protocol
OleQueryBounds	Retrieves a bounding rectangle for the object
OleQueryClientVersion	Retrieves the version number of a client library
OleQueryCreateFromClip	Retrieves presentation data for a clipboard object
OleQueryLinkFromClip	Retrieves link data for a clipboard object
OleQueryName	Retrieves the name of an object
OleQueryOpen	Determines whether an object is open
OleQueryOutOfDate	Determines whether an object is out-of-date
OleQueryProtocol	Determines whether an object supports a protocol
OleQueryReleaseError	Determines the status of a released operation
OleQueryReleaseMethod	Determines which server operation released
OleQueryReleaseStatus	Determines whether an operation released
OleQueryServerVersion	Retrieves the version number of a server library
OleQuerySize	Retrieves the size of an object
OleQueryType	Checks if object is linked, embedded, or static
OleReconnect	Reconnects to an open linked object
OleRegisterClientDoc	Registers an open client document with the library
OleRegisterServerDoc	Registers a document with the server library
OleRegisterServer	Registers the specified server
OleRelease	Releases an object from memory and closes it
OleRename	Informs library that an object is renamed
OleRenameClientDoc	Informs library that a document is renamed
OleRenameServerDoc	Informs library that a document is renamed
OleRequestData	Retrieves data from a server in a specified format
OleRevertClientDoc	Informs library that a doc reverted to saved state
OleRevertServerDoc	Informs library that a doc is reset to saved state
OleRevokeClientDoc	Informs library that a document is not open
OleRevokeServerDoc	Revokes the specified document
OleRevokeObject	Revokes access to an object
OleRevokeServer	Revokes the specified server
OleSavedClientDoc	Informs library that a document has been saved

OleSavedServerDoc	Informs library that a document has been saved
OleSaveToStream	Saves an object to the stream
OleSetBounds	Sets a bounding rectangle for the object
OleSetColorScheme	Specifies a client's recommended object colors
OleSetData	Sends data in specified format to server
OleSetHostNames	Sets the client name and object name for a server
OleSetLinkUpdateOptions	Sets link-update options for an object
OleSetTargetDevice	Sets target output device for an object
OleUnblockServer	Processes requests from a queue
OleUnlockServer	Releases a server locked with OleLockServer
OleUpdate	Updates an object

Windows Overviews (3.1)

File Formats (3.1)

Video Techniques

This topic describes some techniques that can improve the video performance of applications for the Microsoft Windows operating system. These techniques include using an identity palette to speed up image drawing, accommodating differences in video adapters, and modifying device-independent bitmaps (DIBs) by using the DIB driver.

Using an Identity Palette

Windows reserves a group of system palette entries for a fixed number of colors. These colors, which are named system colors, are used for drawing screen elements such as scroll bars. Windows also uses the system colors as replacement color entries when inactive windows request more color entries than are available in the system palette. Windows places the system colors at the top and bottom of the system palette to ensure that logical operations (such as XOR) work correctly.

By arranging logical palettes the same way that Windows arranges the system palette, you can avoid unexpected color changes and improve the speed at which your application draws DIBs. To do this, you must create an identity palette, a logical palette that matches the system palette. To use identity palettes, however, you need to understand how Windows sets up the system palette.

Understanding the System Palette

When an application realizes a palette (that is, requests the palette be given specified colors), Windows adds the logical palette entries to the system palette. Windows always reserves system palette entries for the system colors. For example, a 256-color video graphics adapter (VGA) driver with 20 system colors allows an application to use a maximum of 236 system palette entries. If a logical palette contains more entries than can fit in the system palette (after the system colors are added), Windows truncates the palette, using only as many colors as it can fit without encroaching on the reserved system colors. You can force Windows to relinquish the system color entries (by using the **SetSystemPaletteUse** function), but by doing so you change the coloring of all Windows screen elements to black and white.

The maximum number of colors available to a foreground window equals the number of colors supported by the video driver minus the number of system reserved colors and the number of palette entries reserved by the application.

Windows places the system colors at the top and bottom of the system palette. For example, a 256-color VGA driver uses the top 10 and bottom 10 system palette entries for the system colors. If a logical palette does not contain the system colors or if the system colors appear in locations other than the default positions, Windows changes the ordering of the palette entries when your application realizes its palette. At this point, logical palette entry *n* does not necessarily match system palette entry *n.* When your application draws a bitmap to the device context, Windows must translate the bitmap palette indices to the new locations on the system palette. This translation step takes time.

The goal is to make the logical palette exactly match the system palette. By doing so, your images can be colored exactly as you expect. The video driver can also draw the images faster because the translation step is avoided.

Creating an Identity Palette

An identity palette is a logical palette that exactly matches the system palette and therefore has the same number of entries as the system palette and includes color entries for the system colors. The system colors appear at the top and bottom of the color table.

The Microsoft Windows Paintbrush application always saves bitmaps with an identity palette. To convert a bitmap palette to an identity palette, you can open the bitmap in Paintbrush and then save it.

Accommodating Different Video Adapters and Drivers

This section contains information on adapting your logical palette to a different display type.

Distinguishing Between Standard VGA and Super VGA

Most super VGA adapters are single-plane devices, which makes them well-suited for displaying DIBs. On a super VGA adapter, there is little speed difference between drawing DIBs and drawing device-dependent bitmaps--you can choose whichever format is more convenient for your application.

Standard VGA adapters have multiple planes and are not as well suited for displaying DIBs. It is faster to work with device-dependent bitmaps on standard VGA. To determine whether a standard VGA adapter is present, use the following code:

```
hDC = CreateDC("DISPLAY", NULL, NULL, NULL);

bIsMultiplane = (GetDeviceCaps(hDC, PLANES) > 1);

DeleteDC(hDC);
```

Adapting Identity Palettes to Different Display Adapters

Even if two display devices use the same number of system colors, you cannot assume that the red, green, and blue (**RGB**) values for the low-intensity colors match. One particular problem is the difference between super VGA and 8514 systems. Both provide 256 colors and use 20 system colors, but the low-intensity system color values for the VGA are different from those for the 8514. An identity palette created on a VGA system is not the same as an identity palette on an 8514 system.

If you create an identity palette on a VGA system and then display the DIB on an 8514 system, Windows recognizes the low-intensity colors in the logical palette as custom colors rather than system colors. It puts these colors in the custom-color section of the palette (in entries 10 through 245) and the 8514 system colors in the top and bottom of the system palette.

To avoid misrecognition of colors, an application can do the following:

1 When the application loads, it should use the **GetSystemColors** function to retrieve the system colors from the system palette and compare these colors against the system colors used in the DIB palettes.

2 If the colors do not match, the application should copy the current system colors (retrieved from the system palette) over the DIB system colors.

Using a Device-Independent Bitmap Driver

Many MS-DOS applications manipulate screen memory directly. To maintain the device independence of Windows, it is not possible to allow an application to access screen memory directly. However, an application can use the DIB driver (DIB.DRV) to directly manipulate an image in memory.

Creating a Driver Display Context

An application can load the DIB driver by passing the DIB driver name and a **BITMAPINFO** structure containing the DIB bits to the **CreateDC** function. For example, the following example creates a DIB display context that represents the packed DIB described by the **BITMAPINFO** structure *bi:*

```
hdc = CreateDC("DIB", NULL, NULL, &bi);
```

An application must observe the following rules when working with a device context created in this manner:

- If the last parameter of **CreateDC** is NULL, the display context is associated with a 0-by-0 8-bit DIB. Any attempt to draw with it will fail.
- The **BITMAPINFO** structure must remain locked for the life of the device context.
- The DIB driver supports 1-bit, 4-bit, or 8-bit DIB bitmaps. The run-length encoding (RLE) format is not supported.
- The DIB driver supports only Windows version 3.0 or later DIB headers.
- Multiple DIB-driver display contexts can be active.

- DIBs reside in the memory-based image buffer in the CF_DIB (packed-DIB) format.
- The DIB driver expects the **RGBQUAD** structure for color matching; it does not use palette indices. (If an application uses an **RGB** value for drawing, the DIB driver uses the closest match found in the color table of the DIB.)

The following example uses the DIB driver to draw a circle in a DIB copied from the clipboard:

```
if (IsClipboardFormatAvailable(CF_DIB) && OpenClipboard()) {
    HANDLE hdib;
    HDC     hdc;

    /* Get the DIB from the clipboard.             */

    hdib = GetClipboardData(CF_DIB);

    /* Create a DIB driver hdc on the DIB surface. */

    hdc = CreateDC("DIB", NULL, NULL,
        (LPBITMAPINFO) GlobalLock(hdib));

    /* Draw a circle in the DIB.                   */

    Ellipse(hdc, 0, 0, 100, 100);

    /* Delete the DIB driver HDC now that you are done with it. */

    DeleteDC(hdc);

    /* Unlock the DIB.                             */

    GlobalUnlock(hdib);

    /* Release the clipboard.                      */

    CloseClipboard();
}
```

Moving Bitmaps to and from the Display

The DIB driver is a separate driver and is not associated with the display driver. Because of this, an application cannot use the **BitBlt** function to move bitmaps between a DIB-driver device context and a screen device context. An application can use the **GetDIBits** function to copy from the screen device context to a DIB device context. To copy a DIB device context to the screen device context, an application can use the **StretchDIBits** function.

An application can maximize the speed of **StretchDIBits** by using one of the following methods:

- One-to-one mapping for the palette
- **DIB_PAL_COLORS**, an option that prevents color matching by the graphics device interface (GDI)

Modifying Bitmaps

DIBs offer many advantages over device-dependent bitmaps. Unlike device-dependent bitmaps, however, DIBs cannot be selected into a video device context. Before the DIB driver was available, this meant that applications could not take advantage of the extensive graphics device interface (GDI) functions to modify DIBs directly. To use GDI routines to draw in or otherwise modify a DIB, an application would follow a procedure such as this:

1 Create a memory device context.

2 Use the **CreateDIBitmap** function to convert the DIB to device-dependent format.

3 Select the device-dependent bitmap into the memory device context.

4 Call GDI routines to modify the device-dependent bitmap.

5 Use the **GetDIBits** function to convert the device-dependent bitmap to DIB format.

This method works well if you only use GDI routines to modify the bitmap. If you want to speed up certain operations by writing replacement functions that directly modify the DIB bits, however, the procedure can become complicated. The direct-manipulation routines work on the DIB, but the GDI routines work on the device-dependent bitmap.

Direct manipulation can be considerably faster than using equivalent GDI routines; in one sample application, a direct-manipulation function (drawing a triangle) ran eight times faster than the equivalent GDI operation. Also, direct-manipulation routines for other products may be reusable.

The DIB driver makes it possible for you to mix GDI calls with direct-manipulation routines, so you can combine the advantages of both methods.

Creating a Driver Device Context

The DIB driver makes it possible for you to create a DIB device context. To create the DIB device context, call the **CreateDC** function, supplying a pointer to a **BITMAPINFO** structure:

```
hdc = CreateDC("DIB", NULL, NULL, lpbi);
```

You can use the device-context handle returned by the **CreateDC** function with most GDI functions to modify the bitmap. Concurrently, you can call your own direct-manipulation functions to modify the actual bitmap bits. Any changes made directly to the bitmap bits are reflected in the DIB-driver device context. When you finish modifying the bitmap, you can use the **StretchDIBits** function to transfer the DIB to the video device context.

The DIB driver can handle 1-bit, 4-bit, or 8-bit DIBs. You can create multiple DIB driver contexts. Note the following limitations:

1 The **BITMAPINFO** structure must be locked for the life of the device context.

2 The DIB driver handles only the Windows **BITMAPINFOHEADER** format.

3 The RLE format is not supported.

4 The DIB must use the **DIB_RGB_COLORS** format. The DIB driver does not support the **DIB_PAL_COLORS** (palette indexes) format.

You can distribute the DIB driver with applications that run under Windows.

Fonts Overview

This topic describes the fonts an application can use with the Microsoft Windows 3.1 operating system and discusses how to use Windows font functions in applications. The information includes a description of TrueType font technology, which is new for Windows 3.1.

The following topics discuss the use of fonts in Windows applications:

Font Fundamentals
Fonts in Windows
TrueType Font Technology
Using Fonts in Applications

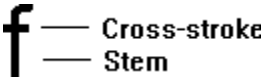
Font Fundamentals

The vocabulary used to describe fonts may be unfamiliar to application developers. This section defines some of the terms and concepts that a developer needs to use when describing a font.

Font Organization

A typeface is a collection of characters that share design characteristics; for example, Courier is a common typeface. A font is a collection of characters that have the same typeface and size.

The Windows graphics device interface (GDI) organizes fonts by family; each family consists of fonts that have a common design. Families are distinguished by stroke width and serif characteristics. A stroke is a horizontal or vertical line. A horizontal stroke is called a cross-stroke. The main vertical line in a character is called a stem.



Serifs are short cross-lines drawn at the ends of the main strokes of a letter. Typefaces without serifs are called sans serif typefaces.

Within a font family, fonts are distinguished by stylistic variations that generally involve their weight and slant. Weights are described by adjectives such as "extra light," "light," "demi," "demi bold," "book," "bold," "heavy bold," "extra bold," and "black." The slant of a font is described by "roman," "italic," and "oblique." A roman font is the upright form of the font; an oblique font is slanted; and an italic font is both slanted and relatively cursive. Font families usually do not include both italic and oblique fonts.

GDI uses five family names to categorize typefaces and fonts. A sixth name (FF_DONTCARE) allows an application to use the default font. Following are the font-family names, each described briefly:

Font-family name	Description
FF_DECORATIVE	Specifies a novelty font. An example is Old English.
FF_DONTCARE	Specifies a generic family name. This name is used when information about a font does not exist or does not matter.
FF_MODERN	Specifies a font that has a constant stroke width, with or without serifs. Fixed-pitch fonts are usually modern; examples include Pica, Elite, and Courier New®.
FF_ROMAN	Specifies a font that has a variable stroke width, with serifs. An example is Times New Roman®.
FF_SCRIPT	Specifies a font that is designed to look like handwriting; examples include Script and Cursive.
FF_SWISS	Specifies a font that has a variable stroke width, without serifs. An example is Arial®.

GDI family names do not always correspond to traditional typographic categories.

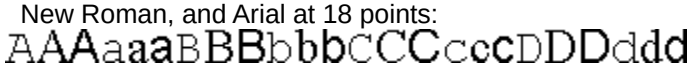
Measuring Characters

Both the visible and invisible parts of a character affect its measurement. The visible part of a character is called a glyph. The invisible part is a rectangular region that contains the character; this region is called a character cell. The origin of a character cell is its upper-left corner. When a text-output function specifies coordinates at which the text should appear, GDI places the origin of the first character cell at those coordinates. (This is the default behavior for GDI. An application can change

this at any time by using the **SetTextAlign** function.)

The most common unit of measurement for measuring characters is the point. In the computer industry, a point is exactly 1/72 of an inch. Font heights in Windows can be specified in "twips," which are 1/20 of a point (that is, 1/1440 of an inch). Point size refers to the size of the character cell, but only loosely to the size of the visible characters; the glyphs from different 12-point fonts can have different heights.

The following example shows the different font heights in alternating glyphs from Courier New, Times New Roman, and Arial at 18 points:



Following are some of the character-cell measurements an application can affect or query when it creates a font:

Measurement	Description
Ascent	Specifies the distance from the base line to the top of a character. The ascender of a character is the part of the character above the base line. In Windows, the value for the ascent is the distance from the base line to the top of the character cell; this can include white space. The typographic ascent, on the other hand, corresponds to the tallest character in a font. For TrueType fonts, this character is often the lowercase "f."
Base line	Specifies the line on which all characters stand. The base line is typically the lowest point of most of the capital letters in a font. (Though the tail of the "Q," for example, can extend below the base line.)
Descent	Specifies the distance from the base line to the bottom of a character. The descender of a character is the part of the character below the base line. For example, the tail of the letter "g" is a descender. In Windows, the value for the descent is the distance from the base line to the bottom of the character cell; this can include white space. The typographic descent, on the other hand, corresponds to the character in a font that extends farthest beneath the base line. For TrueType fonts, this character is often the lowercase "g."
Height	Specifies the vertical space required for a font. The height of a font is the sum of the ascent, descent, and internal leading for that font.
Width	Specifies the horizontal space required for a character cell in a font. GDI returns widths for the average character cell in a font and for the widest character cell. The average width can be simple or weighted, depending on the font. An application can also retrieve the widths for individual characters. These widths include the empty space preceding and following the glyph.

Measuring Line and Intercharacter Spacing

Line spacing, like character size, is typically specified in points. If a 10-point font is displayed with 12-point line spacing, this is abbreviated as "10/12" and is called "ten on twelve" line spacing.

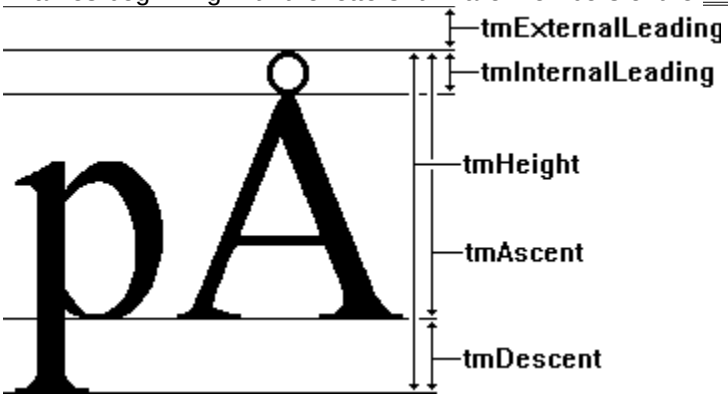
Following are some of the line and intercharacter measurements an application can affect or query when it creates a font:

Measurement	Description
External leading	Specifies the space between rows of text. External leading is not part of the character cell. When the internal leading for a font does not contain parts of characters, the apparent line spacing is the external leading plus the internal leading. Windows does not support negative values for external leading.
Internal leading	Specifies the difference between the height of the character glyphs for a font (the font's em square) and the height of the character cell for a font. Applications use internal leading to determine the point size for a font; the point size is the height of

	the character cell minus its internal leading. Some applications have used internal leading incorrectly; specifically, internal leading is not strictly reserved for diacritical marks, nor should it be used as the space to be removed from the first line on a page.
Overhang	Specifies a characteristic of some glyphs that occupy the same horizontal space as adjacent glyphs. All of the characters in most italic fonts use overhangs to keep the characters relatively close together--for example, in the italic word *Is,* the top part of the letter "I" is directly over the bottom of the letter "s."
Pitch	Specifies the general type of horizontal character spacing. A font can have either fixed or variable pitch. The character cells in a fixed-pitch font are all the same size, but in a variable-pitch font they vary depending on the width of the glyph. Another term for a fixed-pitch font is a monospace font.

The external leading for a font is specified by the designers of the font. The concept of internal leading is specific to Windows.

The following figure shows internal and external leading and their relationship to the height of a font. The names beginning with the letters "tm" are members of the **TEXTMETRIC** structure.



Character Sets

All fonts use a character set. A character set contains punctuation marks, numerals, uppercase and lowercase letters, and all other printable characters. Each element of a character set is identified by a number.

Most character sets used in Windows are supersets of the U.S. ASCII character set, which defines characters for the 96 numeric values from 32 through 127. There are four major groups of character sets:

- Windows
- OEM
- Symbol
- Vendor-specific

Windows Character Set

The Windows character set is the most commonly used character set in Windows programming. It is essentially equivalent to the ANSI character set. The blank character is the first character in the Windows character set. It has a hexadecimal value of 0x20 (decimal 32). The last character in the Windows character set has a hexadecimal value of 0xFF (decimal 255).

Many fonts specify a default character. Whenever a request is made for a character that is not in the font, GDI provides this default character. Many fonts using the Windows character set specify the period (.) as the default character. TrueType fonts typically use an open box as the default character.

Fonts use a break character to separate words and justify text. Most fonts using the Windows

character set specify the blank character, whose hexadecimal value is 0x20 (decimal 32).

For Windows version 3.1, 24 characters have been added to the Windows code page:

Character	Name	Windows character code
‚	base line single quote	130
f	florin	131
„	base line double quote	132
…	ellipsis	133
†	dagger	134
‡	double dagger	135
ˆ	circumflex	136
‰	permille	137
Š	S Hacek	138
‹	left single guillemet	139
Œ	OE ligature	140
‘	left single quote	145
’	right single quote	146
“	left double quote	147
”	right double quote	148
•	bullet	149
–	en dash	150
—	em dash	151
˜	tilde	152
™	trademark ligature	153
š	s Hacek	154
›	right single guillemet	155
œ	oe ligature	156
Ÿ	Y Dieresis	159

The characters for left and right single quote were added to the character set for the release of Windows version 3.0.

OEM Character Set

The OEM character set is typically used in full-screen MS-DOS sessions for screen display. Characters 32 through 127 are usually the same in the OEM, U.S. ASCII, and Windows character sets. The other characters in the OEM character set (0 through 31 and 128 through 255) correspond to the characters that can be displayed in a full-screen MS-DOS session. These characters are generally different from the Windows characters.

Symbol Character Set

The Symbol character set contains special characters typically used to represent mathematical and scientific formulas.

Vendor-Specific Character Sets

Many printers and other output devices provide fonts based on character sets that differ from the Windows and OEM sets--for example, the EBCDIC character set. To use one of these character sets, the printer driver translates from the Windows character set to the vendor-specific character set.

Fonts in Windows

Windows applications can use three different kinds of font technologies to display and print text. This section discusses these font technologies and gives Windows-specific background information about fonts.

Raster, Vector, and TrueType Fonts

Previous versions of Windows had two types of fonts: raster and vector. Windows version 3.1 introduces a third type--TrueType fonts.

Raster fonts are stored as bitmaps. These bitmaps are designed for output devices of a particular resolution. GDI typically synthesizes bold, italic, underline, and strikeout characteristics for raster fonts; however, the results are not always attractive. When GDI must change the size of a raster font, aliasing problems can also reduce the attractiveness of the text. Raster fonts are useful for specialized applications in which TrueType fonts are not available. Another possible advantage to using raster fonts derives from the large number of raster fonts that are often present on a user's system; an application could look for the name of a particular specialized or decorative font and use a TrueType font if the specified font was not present.

When an application requests an italic or bold font that is not available, GDI synthesizes the font by transforming the character bitmaps. When an application using only raster fonts requests a point size that is not available, GDI also transforms the bitmaps to produce the font. Because TrueType font families include bold, italic, and bold italic fonts, and because TrueType fonts are scalable to any requested point size, GDI does not synthesize fonts as frequently as it did for earlier versions of Windows.

Windows version 3.1 contains a new set of raster fonts. This set, called Small Fonts, is for use at resolutions of less than 8 points. Although TrueType fonts can be scaled to less than 8 points, glyphs this small may not be legible enough for regular use. Because glyphs this small contain very little detail, it is more efficient to use the raster small fonts than to scale TrueType fonts to the small size. (GDI synthesizes bold and italic attributes for the raster small fonts, when necessary.)

Vector fonts are stored as collections of GDI calls. They are time-consuming to generate but are useful for such devices as plotters, on which bitmapped characters cannot be used. (By drawing lines, GDI can simulate vector fonts on a device that does not directly support them.) Prior to the introduction of TrueType fonts, vector fonts were also useful for applications that used very large or distorted characters or characters that needed to be perpendicular to a base line that was at an angle across the display surface.

TrueType fonts are stored as collections of points and hints that define character outlines. (Hints are algorithms that distort scaled font outlines to improve the appearance of the bitmaps at specific resolutions.) When an application requests a TrueType font, the TrueType rasterizer uses the outline and the hints to produce a bitmap of the size requested by the application.

The default font for a device context is the System font, a proportionally spaced raster font representing characters in the Windows character set. Its font name is System. Windows uses the System font for menus, window titles, and other text.

It is possible to have multiple fonts in the system that have the same name (for example, a Courier device font and a Courier GDI raster font). However, applications typically do not present a font name to the user more than once--instead, they discard duplicates. Applications can control which font is presented to the user when duplicate font names occur by using the **lfOutPrecision** member of the **LOGFONT** structure.

Font Resource Files

The SYSTEM subdirectory of a user's Windows directory (the directory in which Windows is installed) contains the system's font resource files. A font resource file is an empty Windows library; it contains no code or data but does contain resources.

Raster and vector font resource files are identified by the .FON filename extension. TrueType font resource files have the .FOT filename extension. Each .FOT file is a relatively short header that refers to a file containing TrueType font information. These TrueType font-information files have the same base filename as the .FOT files, but have the .TTF filename extension.

Some of the filenames for raster and vector fonts are followed by a lowercase letter that indicates the resolution for which the font was designed. This letter varies according to the type of display device that was specified when the fonts were installed. Following are the lowercase letters used to identify different resolutions:

Letter	Device
a	CGA
b	EGA
c	Okidata printers
d	IBM and Epson printers
e	VGA
f	IBM 8514/A

For more information about the format of font resource files, see **Resource Formats**.

Basics of TrueType Fonts

The TrueType fonts incorporated into Windows 3.1 are much more versatile than the fonts that were available in previous versions of Windows. TrueType fonts can be scaled and rotated; they allow the same fonts to be used on the screen as are used on printers; and they allow documents to be portable between printers, applications, and systems.

The following table lists the 13 core TrueType fonts distributed with Windows version 3.1. (Windows 3.1 may include additional TrueType fonts that supplement this core set.)

Font family	Font name	Type
Arial	Arial	Sans serif, variable pitch
	Arial Bold	Sans serif, variable pitch
	Arial Italic	Sans serif, variable pitch
	Arial Bold Italic	Sans serif, variable pitch
Courier New	Courier New	Serif, fixed pitch
	Courier New Bold	Serif, fixed pitch
	Courier New Italic	Serif, fixed pitch
	Courier New Bold Italic	Serif, fixed pitch
Symbol®	Symbol	N/A
Times New Roman	Times New Roman	Serif, variable pitch
	Times New Roman Bold	Serif, variable pitch
	Times New Roman Italic	Serif, variable pitch
	Times New Roman Bold Italic	Serif, variable pitch

TrueType font technology offers many benefits to application designers, at little or no cost. It is not necessary to revise an application written for Windows version 3.0 for that application to use TrueType fonts. If you want your application to take full advantage of the greater precision and versatility available with TrueType fonts, however, you can use the following new font functions:

Function	Description
CreateScalableFontResource	Creates a font resource file for a specified TrueType font.
EnumFontFamilies	Retrieves the fonts available on a specified device.
GetCharABCWidths	Retrieves the widths of consecutive TrueType characters.

GetFontData	Retrieves font-metric data (or the entire font) from a TrueType font file.
GetGlyphOutline	Retrieves data describing an individual character in a TrueType font.
GetOutlineTextMetrics	Retrieves font metrics for TrueType fonts.
GetRasterizerCaps	Determines whether TrueType is installed.

Benefits of TrueType

TrueType fonts offer many advantages over previous font technologies for Windows:

- What you see is what you get (WYSIWYG).

  Applications can scale and rotate TrueType fonts. TrueType fonts are attractive at all sizes. An application can use the same fonts on the screen and the printer.
- Printer portability.

  TrueType fonts work on different printers. Because detailed font metrics are available, an application can compose documents in a device-independent fashion.
- Document portability.

  Applications can embed TrueType fonts in documents. TrueType fonts work on different platforms. Applications can use the detailed font metrics to compose documents in a platform-independent fashion.
- Simplicity.

  The versatility of TrueType fonts reduces the number of required choices and compromises.

TrueType solves two important problems: matching fonts to the printer in use, and presenting high-quality fonts at any size on all devices.

The most obvious benefit of TrueType fonts is that they are scalable. Users can use TrueType to get virtually any point size they like. With TrueType, Windows users no longer need to think about the availability of point sizes on their printer or screen, about running a utility to create raster fonts, or about disk storage for these bitmaps.

TrueType fonts are presented to applications through the same enumeration and selection functions as the raster fonts. As a result, TrueType fonts work with every Windows application. Windows printer drivers have also been modified as required to support the use of TrueType.

Compatibility with Earlier Windows Versions

The introduction of TrueType fonts introduces a few issues that are important for applications developed for earlier versions of Windows.

Identifying TrueType Fonts for Users

Before TrueType fonts were introduced, some users had many different fonts to choose between; now, these users have still more choices. (Users can simplify their choices by selecting the "Enable TrueType Fonts" and "Show Only TrueType Fonts in Applications" check boxes in the Fonts dialog box from Control Panel.) Applications can use the standard font dialog box to make it easier for users to manage the fonts on their systems.

Character Widths

TrueType fonts use **ABC** character spacing, a spacing method that does not rely on the width of a character cell and any overhang (the method used for raster fonts). The extra accuracy of ABC spacing can introduce a problem for applications written prior to Windows version 3.1. Older applications that use character widths instead of ABC widths with TrueType fonts incorrectly calculate the end of the last glyph in the line. This calculation could be off by as much as several pixels. It is also possible that a line could start slightly to the left of the starting point specified by the application. These inaccuracies sometimes lead to problems when the screen is redrawn or when a selection of text is highlighted; pieces of glyphs can be handled incorrectly at either end of a line of text.

Many applications written before TrueType became available use the **ExtTextOut** function to clip or redraw lines of text that extend beyond the visible margins of the document.This method prevents any extra pieces of glyphs from being left behind because of incorrect character-width calculations.

MS Serif and MS Sans Serif Fonts

In Windows version 3.1, the raster fonts Tms Rmn and Helv have been replaced by identical fonts named MS Serif and MS Sans Serif, respectively. The Tms Rmn and Helv font names are mapped to their replacements in a new section of WIN.INI called [FontSubstitutes]. Whenever an application requests Helv or Tms Rmn, the font mapper checks this section and makes the appropriate substitution. The [FontSubstitutes] section also maps Helvetica® to Arial and Times® to Times New Roman.

A user could change the [FontSubstitutes] section to map any font name to any other font name. For example, a user could map Tms Rmn and Helv to the Times New Roman and Arial TrueType fonts. Entries in [FontSubstitutes] do not change the names of fonts, however; a user could not force Arial to appear as Helvetica in font menus.

The **EnumFonts** and **EnumFontFamilies** functions use the [FontSubstitutes] section of WIN.INI so that applications written prior to Windows version 3.1 do not fail unexpectedly when enumerating preexisting font names. If an application specifies Helv in a call to **EnumFontFamilies**, GDI enumerates the available MS Sans Serif fonts. When an application calls either of these functions with a NULL family name, GDI enumerates a representative font from each available family, returning the actual names of the fonts, not the remapped names.

Because most Windows applications display font menus that include only the fonts that can be printed on the current printer, this change in font names does not affect most users. Only users of dot-matrix printers see the new names in font menus and dialog boxes.

Font-Height Metrics Can Depend on Attributes

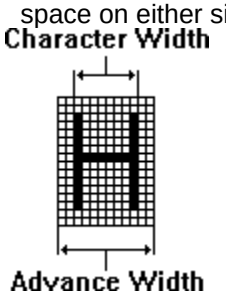
Because the members of a TrueType font family, such as bold and italic, come from different outlines, in some cases the font-height metrics could be different within a TrueType font family. For raster fonts this is not a problem, because when Windows simulates attributes, these metrics are preserved, and because hand-tuned bitmaps were made with matching heights. For the set of fonts shipped with Windows 3.1, most (but not all) of the height metrics match.

Text and Character Attributes

Character attributes are such features as whether a character is bold or italic and whether it has serifs. Text attributes are such features as line and character spacing and text justification. This section introduces some of these attribute categories. For descriptions of individual attributes, see the descriptions of the **LOGFONT**, **NEWTEXTMETRIC**, **TEXTMETRIC**, and **OUTLINETEXTMETRIC** structures in the *Microsoft Windows Programmer's Reference, Volume 3.*

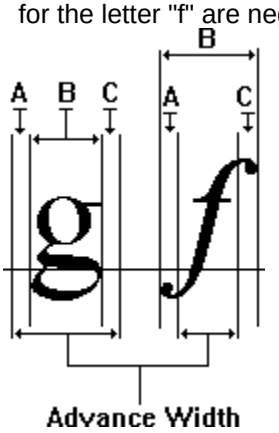
Line and Character Spacing

Before the introduction of TrueType fonts, it was difficult for an application to position characters exactly, especially if the characters were in a string that included bold or italic text. Instead of the width of the character glyph, most Windows functions use the advance width of characters, which includes space on either side of the glyph, as in the following figure:



Applications can control the spacing of TrueType characters accurately by using **ABC** character spacing. GDI constructs ABC spacing from information provided by the TrueType rasterizer. The "A" spacing is the width to add to the current position before placing the glyph. The "B" spacing is the width of the glyph itself. The "C" spacing is the white space to the right of the glyph. The total advance width is given by A+B+C.

Because either or both of the A and C increments can be negative, characters can overhang or underhang the character cell in a way that was not previously possible with GDI. For example, in the following figure the A, B, and C increments for the letter "g" are all positive, but the A and C increments for the letter "f" are negative.



An application can use the **GetCharABCWidths** function to retrieve the **ABC** spacing for characters in a TrueType font.

When an application using TrueType fonts calls a text-output function, GDI uses the font's complete set of **ABC** widths to provide character-placement information to the device driver.

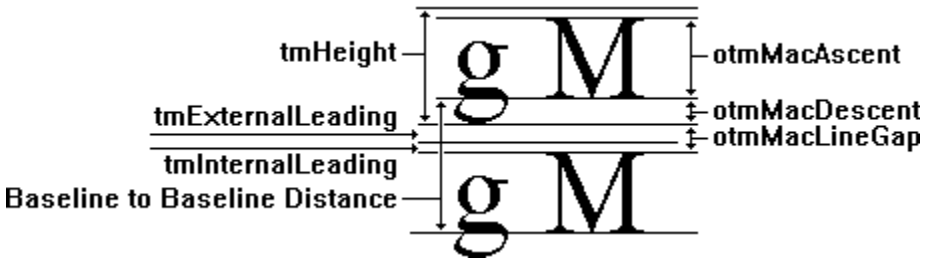
Some applications determine the line spacing between text lines of different sizes by using a font's maximum ascender and descender. An application can retrieve these values by calling the **GetTextMetrics** function and then checking the **tmAscent** and **tmDescent** members of the **NEWTEXTMETRIC** structure.

The maximum ascent and descent are different from the typographic ascent and descent; in TrueType fonts, the typographic ascent and descent are typically the top of the "f" glyph and bottom of the "g" glyph. Rounded characters typically extend slightly beyond the limits of characters with straight edges, to overcome an optical illusion that would make them appear too small otherwise. An application can retrieve the typographic ascender and descender for a TrueType font by calling the **GetOutlineTextMetrics** function and checking the values in the **otmAscent** and **otmDescent** members of the **OUTLINETEXTMETRIC** structure.

Applications that use the HPPCL5A printer driver may experience problems with line spacing for the scalable fonts that are built into the HP LaserJet III printer. These fonts use external leading in the place of internal leading; accent marks for capital letters print outside the character cell reported by the **tmHeight** member of the **NEWTEXTMETRIC** structure.

TrueType font metrics do not correspond exactly to the metrics for Windows raster fonts, because TrueType font metrics have been designed by Apple Computer, Inc. TrueType metrics are required for any application that produces a document that is portable between Windows and an Apple Macintosh computer.

The following figure shows the difference between the vertical text metric values returned in the **NEWTEXTMETRIC** and **OUTLINETEXTMETRIC** structures. (The names beginning with "otm" are members of the **OUTLINETEXTMETRIC** structure.)



The overhang added by GDI when it synthesizes a bold or italic font is not taken into account by the **GetTextExtent** function.

Logical and Physical Inches

A logical inch is a measure Windows uses for presenting legible fonts on the screen; it is generally 30 to 40 percent larger than a physical inch. A 10-point font on a screen is larger than a 10-point font produced by a printer. Fonts on the screen are made larger because most screens do not have high enough resolutions to make a 10-point font legible. Furthermore, users generally read text on screens from a greater distance than they read text on paper.

Although logical inches solve the problem of legible fonts on the screen, they prevent a perfect match between the output of the screen and printer. The text on a screen is not simply a scaled version of the text that will appear on the page, particularly if graphics are incorporated into the text.

An application can retrieve the physical dimensions of a font by calling the **GetOutlineTextMetrics** function. To determine the dimensions of an output device, an application can call the **GetDeviceCaps** function. **GetDeviceCaps** returns both physical and logical dimensions.

Font Sizes

Most Windows applications use the MM_TEXT mapping mode instead of MM_TWIPS, because MM_TEXT makes possible a relatively simple conversion from logical to physical font sizes. With MM_TEXT, each logical unit is mapped to one pixel.

To determine the point size for a font, an application must first convert the information returned in the **NEWTEXTMETRIC** or **OUTLINETEXTMETRIC** structure using the size of the logical inch for the output device. For example, an application using MM_TEXT units might use a font that has a cell height (**tmHeight**) of 12 and an internal leading (**tmInternalLeading**) of 2. The cell height minus the internal leading gives the point size in logical units; in this case, the point size of the font is 10 units (pixels).

To convert this value into a typographic point size (that is, a value in which one point equals 1/72 inch), the application should use the **GetDeviceCaps** function to determine the vertical size and resolution of the screen and the number of pixels per logical inch supported by that device. For example, if an application working in MM_TEXT mapping mode requires a 12-point font, it could use the value produced by the following algorithm in the **lfHeight** member of the **LOGFONT** structure:

-1 * ((LOGPIXELSY * 12) / 72)

Using a negative value in the **lfHeight** member causes GDI to use the value as the height of the character glyphs, not the height of the character cell. The LOGPIXELSY value is returned by a call to the **GetDeviceCaps** function. The point size of the requested font is 12, and the number of points in a physical inch is 72.

Similarly, an application could use the following algorithm to determine the point size of a font from information returned in the **NEWTEXTMETRIC** structure:

((**tmHeight** - **tmInternalLeading**) * 72) / LOGPIXELSY

Font Mapper

When calling a font-creation function, an application describes the font either by using a **LOGFONT** structure in a call to the **CreateFontIndirect** function or by using the parameters of the **CreateFont** function. The font returned by these functions is called a logical font, because a font matching the described characteristics is not necessarily available in the system. GDI uses the logical font to create a physical font, by finding the closest match to the logical font among the available TrueType, raster, vector, and device-dependent fonts.

The Windows font mapper determines which of the available fonts is the closest match to the requested logical font. The font mapper often chooses a TrueType font as the closest match; it will choose a raster or vector font only when the logical font matches the characteristics of the raster or vector font very closely or when the logical font specifies the name of the raster or vector font. Typically, a TrueType font is chosen when it is specifically requested or when GDI would otherwise have to synthesize the font. For example, if a font name is not specified in the logical font or if the specified name does not exist, the font mapper chooses a TrueType font that matches the requested point size, serif characteristics, and pitch.

When the font mapper determines that a TrueType font is the closest match for a requested logical font, the TrueType engine produces enhanced GDI raster characters that are presented to the raster device. (The characters are enhanced by the use of **ABC** character widths.) For devices that do not have raster font capabilities, the driver must request the TrueType engine to provide the glyphs in a form the driver can use.

When the font mapper chooses between raster fonts, it chooses the font that is closest to the requested size without being larger than that size.

When an application requests a very small font, the font mapper may choose one of the small fonts stored in the SMALL*X*.FON font resource file. TrueType fonts specify a suggested minimum size, which can be retrieved by calling the **GetOutlineTextMetrics** function and checking the **otmusMinimumPPEM** member of the **OUTLINETEXTMETRIC** structure. When an application requests a font smaller than this size, the font mapper typically chooses a small font instead of a TrueType font. If the requested size is not available as a small font, however, GDI scales the TrueType font instead. Microsoft's 13 core TrueType fonts are designed to be readable as small as 8 points on a VGA screen, although they can be used at smaller sizes.

Standard Font Dialog Box

Windows applications should take advantage of the standard font dialog box for Windows 3.1. Following are the advantages of this dialog box:

- It shows the user the font family name (for example, Times New Roman) along with the styles (for example, Regular, Bold Italic, and other combinations of italic and weight) for the installed fonts.
- It allows Windows version 3.0 simulations and effects to be applied, if the user wants them. When bold or italic simulations are applied, the user is warned that the font may not print as selected.
- It displays weights or styles outside the four standard styles (regular, bold, italic, bold italic).
- It clearly tells the user which fonts are TrueType and which are not.

The standard font dialog box also introduces a consistent user interface and frees applications from having to implement their own dialog boxes for fonts, while retaining enough flexibility for applications to add custom controls. The dialog box looks like this:

TrueType Font Technology

With TrueType fonts, applications have much greater control over the final appearance of documents than was possible with previous Windows font technologies. Much of this added control is the result of the portability of TrueType fonts: An application can move them from the system to a printer, from a printer to the system, from one system to another system (by "embedding" them in documents), and even port them between incompatible operating systems.

Sophisticated desktop-publishing and word-processing applications go to great lengths to make the screen output mimic the printer output. Some applications even change the way the fonts appear on the screen, in an attempt to show users what the printer output will look like. This kind of application benefits greatly from exploiting the advantages of TrueType.

What You See Is What You Get: WYSIWYG

WYSIWYG means that the screen output matches the printer output. With perfect WYSIWYG, the user would be able to place a page of printed output over the same screen output and see every character and graphic element in exactly the same place. If the screen and printer have different resolutions, however, this degree of matching is impossible. Usually, WYSIWYG simply means that line breaks, paragraph breaks, and page breaks are the same on both devices and that justified paragraphs are presented properly. WYSIWYG does not mean the same document on two different printers will be formatted in exactly the same way. Because most applications make the best use of the available printer, WYSIWYG often applies only to the correspondence between the screen and printer for a given printer.

TrueType offers a higher level of WYSIWYG than was available with earlier versions of Windows, because it works on every device. Most Windows applications lay out the screen based on the target printer. The fonts they enumerate for the user are the fonts that can be printed. Because TrueType fonts work on the target printer, they are enumerated by the printer driver to the application and are typically displayed to the user as printer fonts. When the application and GDI match screen fonts to the printer fonts, the TrueType fonts are used on the screen as well.

If no screen font matches the widths of characters in the chosen printer font, WYSIWYG is difficult to achieve. When this happens, applications sometimes make the average width of the characters match, with as little variation in specific characters as possible. More exact matching is achieved with a technique known as metric coercion. There are two basic methods of coercing character metrics: width coercion and shape coercion. Width coercion simply adjusts the spacing between words and characters, and shape coercion applies a transformation to each character to force it into a bounding box. Because shape coercion can lead to unacceptably deformed characters, width coercion is typographically preferred.

Although Windows does not include a function to deform individual characters, the **lfWidth** member of the **LOGFONT** structure allows an application to scale the width of a TrueType font independently of its height. (Most applications do not scale TrueType fonts in this manner, however, because the results are usually unattractive.)

Embedded Fonts

Embedding a font is the technique of bundling the fonts used by a document into the document itself for transmission to another computer. Embedding a font guarantees that a font specified in a transmitted document will be present on the computer receiving the document. Not all fonts can be moved from computer to computer, however, since most fonts are licensed to only one computer at a time. In Windows, only TrueType fonts can be embedded.

Applications should embed a font in a document only on request from a user. An application cannot be distributed along with documents that contain embedded fonts, nor can an application itself contain an embedded font. Whenever an application distributes a font, in any format, the proprietary rights of the owner of the font must be acknowledged.

A font's license may not allow embedding; it may give read-write permission for a font to be installed

and used on the destination computer; or it may give read-only permission. Read-only permission allows a document to be viewed and printed (but not modified) by the destination computer; documents with read-only embedded fonts are themselves read-only. Read-only embedded fonts may not be unbundled from the document and installed on the destination computer.

Applications that support embedded fonts determine the license status of a font by checking the **otmfsType** member of the **OUTLINETEXTMETRIC** structure. If bit 1 of **otmfsType** is set, embedding is not permitted for the font. If bit 1 is clear, the font can be embedded. If bit 2 is set, the embedding is read-only.

It may be a violation of a font vendor's proprietary rights and/or user license agreement to embed any fonts for which embedding is not permitted or to fail to observe the following guidelines on embedding fonts.

Embedding a Font in a Document

When an application has determined that a font can be embedded, it can use the **GetFontData** function to read the font file. (Setting the *dwTable* and *dwOffset* parameters of **GetFontData** to 0L and the *cbData* parameter to -1L ensures that the application will read the entire font file, starting at the beginning of the font).

After retrieving the font data, the application can store it with the document, using any applicable format. Most applications build a font directory in the document, listing which fonts are embedded and whether the embedding is read-write or read-only. (An application can use the **otmpStyleName** and **otmFamilyName** members of the **OUTLINETEXTMETRIC** structure to identify the font.)

If the read-only bit is set for the embedded font, applications must encrypt the font data before storing it with the document. The encryption method need not be complicated; for example, using the XOR operator to combine the font data with an application-specified constant is adequate and fast.

Installing and Using an Embedded Font

An embedded font must be separated from the containing document and installed in the user's system before Windows can use it. Although the exact procedure for separating the font from the document depends on the method the application uses to embed it, the following three steps are always taken:

1 Resolve name conflicts before installing the font.

2 Write the font data to a file, decoding read-only fonts as necessary.

3 Use the **CreateScalableFontResource** function to create a font resource file for the unembedded font.

An application should avoid installing a font with the same name as a preexisting font. To determine whether there is duplication in style names, an application could compare the information returned by **EnumFontFamilies** against the family name and style name stored with the embedded font.

Embedded fonts that have read-write permission (that is, that can be permanently installed on the user's system) should be written to a file that has the .TTF filename extension. Embedded fonts with read-only permission should not use the .TTF extension and should avoid the .FOT and .FON extensions. (A typical filename extension for read-only embedded fonts is .TTR.) Because files for read-only embedded fonts must be removed from the system and from storage as soon as the containing document is closed, their names do not need to be meaningful except to the application.

Most applications put the files for embedded fonts that have read-write permission into either the SYSTEM subdirectory of the user's Windows directory or into the application's working directory. Files for read-only embedded fonts are typically put into a temporary directory.

Before installing an embedded font, an application must use the **CreateScalableFontResource** function to create a font resource file. Font resource files for fonts with read-write permission should use the .FOT filename extension. Font resource files for read-only fonts should use a different extension (for example, .FOR) and should be hidden from other applications in the system by specifying 1 for the first parameter of **CreateScalableFontResource**. The font resource files can be installed by using the

AddFontResource function.

Applications should offer users the option of permanently installing embedded fonts that have read-write permission. To permanently install a font, applications should concatenate the family and style names and then use the **WriteProfileString** function to insert this string along with the .FOT file name in the [Fonts] section of the WIN.INI file. A typical font entry in the [Fonts] section looks like this example:

```
Times New Roman Bold (TrueType)=TIMESBD.FOT
```

If a document contains one or more read-only embedded fonts, the user must not be permitted to edit the document. If the user is allowed to edit the document in any way, the application must first strip away and delete the read-only embedded fonts. As mentioned earlier, read-only embedded fonts must be removed from the system and storage immediately when the document in which they were bundled is closed.

To delete read-only embedded fonts, an application should follow these steps:

1 Call the **RemoveFontResource** function for each font to be deleted.

2 Delete the font resource file for each font.

3 Delete each TrueType font file for each font.

When an application creating a file for a read-only embedded font specifies 1 for the first parameter of the **CreateScalableFontResource** function, the **EnumFonts** and **EnumFontFamilies** functions will not enumerate this font. Hiding read-only embedded fonts in this manner makes it unlikely that another application could use them, even though Windows resources are theoretically available to all processes in Windows. If an application does use a read-only embedded font installed by another application, it could be difficult for the installing application to delete the font. The **RemoveFontResource** function will not delete a font that is currently in use. In this case, an application should delete the resource file and the TrueType font file when the user closes the document that contained the read-only fonts.

It is very important that applications delete the TrueType font file for read-only embedded fonts. If the delete operation fails when the user closes the document, the application should periodically attempt to delete the file as the application runs, when it closes, and the next time it starts.

In some cases, an application could be unable to delete a TrueType font file for a read-only embedded font because of external events (such as a system failure). There is no legal liability for events that are out of the control of the application.

Printer Portability

A document with printer portability is formatted identically on all output devices under Windows--all monitors and all printers. Although TrueType allows the same font to be used on all output devices, this does not guarantee that line breaks will be the same on all devices. For line breaks to match, applications must take advantage of TrueType design metrics. These design metrics allow an application to compute the fractional portion of the spacing at the ends of lines and make up the difference in the interword spacing. This computation reduces the round-off error from a half-pixel per character to a half-pixel per line, preserving line breaks in all cases.

Line Breaks and Justification

Applications must cooperate in order to guarantee the printer portability enabled by TrueType technology, because different devices may have different resolutions. Even when fonts are portable across printers, glyphs designed or rasterized for different resolutions must have different pixel widths. For applications that use the **TextOut** function, for example, different character widths can lead to accumulated round-off errors that change line breaks and paragraph placement.

Applications that lay out a document at the highest printer resolution attempt to distribute any difference in character resolutions in white spaces. This method is not always successful; for example, it fails when all glyphs are one pixel larger at 600 dots per inch (DPI) than at 300 DPI. In this case, fonts with a width of 45 at 600 DPI would have a width of 23 at 300 DPI, a width of 11 at 150 DPI, and

so on. There could easily be insufficient white space to absorb the glyphs at the lower resolutions if line breaks were being preserved, because the glyphs become larger in relation to the resolution of the device. In this case, the characters would have to overlap to preserve the line breaks. Even if all the character widths exactly doubled when changing from a resolution of 300 DPI to 600 DPI, the line breaks might not be the same if an application justified text--that is, aligned it on both the left and right. It is possible that another half-pixel of white space at the lower resolution would allow one more word on the line. At the higher resolution, the half-pixel would become a full pixel and the line breaks would change. (Similar device-resolution problems occur in the vertical direction.) TrueType exposes the design width of characters to help applications maintain line breaks.

Different printers, or even different production runs of the same printer, can have different limits for their printable areas. If a document has been laid out up to the margins of one printer, it may not format identically on a different printer. If glyphs are in contact with the margins on the first printer, parts of the glyph may be beyond the printable area on the second printer. Depending on the printer, the glyph will either be clipped or dropped completely.

Prior to the introduction of TrueType, sophisticated desktop-publishing and word-processing applications were forced to "reflow" the entire document whenever a user selected a different printer. Applications can now use TrueType font metrics to solve this problem.

Performance and Printer Portability

Printer portability can potentially downgrade font performance, quality, or both, depending on such factors as the type of connection between the computer and printer, the speed of the computer, the memory in the printer and the computer, the number of fonts being used, differing resolutions between the screen and printer, and the number of characters used in each font. Documents that are fully portable between printers necessarily cannot take advantage of the specialized features of a particular printer.

GDI cannot perform text operations to printer-compatible memory device contexts. This means that it is not possible to build a bitmap describing a page to be printed and then send the completed bitmap to the printer.

Document Portability

A portable document appears the same on different operating systems. In the case of TrueType, documents can be portable between Windows and the Apple Macintosh computer; this could also be called platform portability. If a document appears the same on the Macintosh and with Windows, it can also look the same imported into different applications on either platform.

Since the same TrueType fonts work on the Macintosh, in Windows, and on all devices supported by both systems, the same characters and metrics could be exposed for all applications. Currently, however, fully portable documents are not possible. Windows and the Macintosh computer have slightly different character sets. Even though TrueType fonts contain the default Macintosh and PostScript character sets, Windows does not give applications access to the Macintosh characters. Likewise, a Macintosh application cannot gain access to the Windows characters present in TrueType fonts. Document portability is also a problem with international document exchange. Localized versions of TrueType fonts will still be in use for both the Apple System 7 and Windows version 3.1, leading to further character-set incompatibilities when documents that use these fonts are transmitted to a system that does not have them.

Disk Space, Memory Usage, and Speed

An application's overall font performance could decrease if a large font cache forced the paging of more segments to the disk. With previous font technologies, this could occur even in situations that were not "low memory." Because fonts are cached glyph by glyph as they are used, however, less memory is used for the cache than would be required to keep the corresponding raster fonts in memory; this leads to a net performance gain. The only time the font cache uses more memory than fonts required in earlier versions of Windows is when multiple logical fonts would have been mapped to the same raster font. Typically, however, any additional swapping to disk caused by these larger

caches is still faster overall than discarding and subsequently re-rendering bitmaps.

Hard-disk space is not a large problem for TrueType fonts, although more disk space is required for fonts with the introduction of TrueType. The two reasons for this increased space requirement are that raster fonts are shipped with TrueType fonts, for backward-compatibility reasons, and that users may have preexisting soft fonts on their hard disks.

Hard-disk space is not the only limitation imposed on TrueType fonts. GDI imposes an internal limit to the number of TrueType fonts that can exist simultaneously on a system. The maximum number of physical fonts is 1170. (The maximum number of logical fonts that can exist simultaneously on a system is 253.)

Font Design and Scaling

Raster fonts are designed to be attractive and readable at a particular aspect ratio. (The aspect ratio is the ratio of the width and height of a pixel.) The digitized aspect of a font is the ideal x-aspect and y-aspect of that font. Windows provides an aspect-ratio filter to select fonts designed for a particular aspect ratio from all of the available fonts. The **GetAspectRatioFilter** function retrieves the setting for the current aspect-ratio filter. An application can use the **SetMapperFlags** function to change the algorithm the font mapper uses when it maps physical fonts to logical fonts.

The aspect ratio of the screen is not as critical for scalable fonts as it is for raster fonts. The dimensions of the em square for a TrueType font are used when scaling the font to a specified point size. (An em square is a square whose width is approximately equal to the width of the uppercase M.) Because the height of the em square is given in pixels, it can be thought of as the point size in device units. For example, a font could be referred to as a 50-ppem (pixels per em square) font. The pixel size determines the physical point size. For example, a 75-ppem font on a 300-DPI device is an 18-point font, while on a 150-DPI device it would be a 36-point font. The number of pixels required for the desired point size is computed by using the resolution of the output device and the em square size, according to the following formula:

ppem = (*PointSize*/72) * *DeviceResolution*

According to this formula, a 12-point font on a 72-DPI screen is at 12 ppem, while on a 300-DPI device it is at 50 ppem.

TrueType fonts can be scaled linearly, nonlinearly, or optically, depending on their design. Linear scaling means that the character width is scaled and rounded to the appropriate ppem. Nonlinear scaling means that hinted character widths can be larger or smaller than the scaled widths. Optical scaling is a superset of nonlinear scaling; it includes the preservation of the color and contrast of a font across point sizes. Optical scaling can involve changing the proportions of the stroke widths to preserve their perceived width and color.

The TrueType fonts shipped with Windows 3.1 scale nonlinearly. Windows applications can also support linearly and optically scaled TrueType fonts.

Designing Portable Fonts

Most application developers need not be concerned with font-portability issues. This discussion is included here with other portability issues for those developers who need to create fonts that are portable between systems. Microsoft currently publishes a TrueType Font Files Specification, which teaches font vendors how to create a single TrueType font that will work in Windows, on the Macintosh computer, and in TrueImage.

Microsoft uses the same byte ordering in TrueType font files as Apple uses in its font files, to help make the fonts portable between the systems. As a result, Windows fonts can be moved directly to the Macintosh computer, where they can quickly be converted into font suitcases for installation. (The format of TrueType font files precisely follows the format of the Apple "sfnt" resource. To convert an MS-DOS binary TrueType font into an sfnt resource requires editing the file information, setting Type to sfnt and Creator to bass. The sfnt resource can then be integrated into a standard Macintosh font suitcase. To move a font suitcase to Windows, an application need only extract the sfnt portion from

the data fork and move the suitcase, unaltered, to Windows. After the suitcase has been moved to Windows, it can be installed by using Control Panel or the **CreateScalableFontResource** and **AddFontResource** functions.

If a Macintosh font is installed that does not contain the Windows "cmap" mapping table, the system maps text fonts (for example, Times or ITC Zapf Chancery®) from the Macintosh character set onto the Windows character set. Novelty fonts (like ITC Zapf Dingbats®), which have no formal character set, are not mapped; these fonts are taken along with the Macintosh character encodings. The decision whether to remap is based on a test that looks at the "post" table (which contains PostScript names). Whenever necessary, Windows compensates for missing metric tables based on other metric data in the font; anything that cannot be computed in a reasonable manner is given a default value.

The creation of portable fonts requires more than just the right characters and the right character-mapping tables. All the metrics needed by all systems must be included and must yield the same results. Matching metrics for the individual characters is not a problem; since the characters and their hints and metrics appear only once in the TrueType font, the same metrics are available across platforms. The more difficult problems in the creation of portable fonts have to do with line-spacing metrics, the determination of font styles, and making these factors match across systems.

The Apple System 7 core TrueType fonts ship with metrics designed to be compatible with the raster fonts in System 6. The "hdmx" table will be used to force widths onto TrueType fonts that match those for the bitmaps at bitmap sizes. The "name" table (and its ability to group fonts by separating the family and subfamily names) is not used. (The name used comes from the FOND Macintosh font resource.) Only the macStyle bits (from the "head" table) denoting regular, bold, italic, or bold italic are used.

Apple's line spacing recommendations are less robust than the line-spacing used by Microsoft. The following formula defines the default recommended line spacing for a Macintosh font:

line spacing = ascent - descent + leading

The values for ascent, descent and leading come directly from TrueType values:

Macintosh	TrueType
ascent	**otmMacAscent**
descent	**otmMacDescent**
leading	**otmMacLineGap**

For its TrueType fonts, Apple recommends that Ascender - Descender = unitsPerEm, and LineGap = 0. This recommendation is based on the definition of point size for Macintosh raster fonts. Macintosh documentation defines the point size of a font as being equal to the line spacing (ascent - descent + leading). Although this definition is compatible with previous Apple font metrics, it ties line spacing to the size of the em square. Because some fonts (for example, Palatino) have ascenders and descenders that extend beyond the em square, the line-spacing definition is inconsistent for these fonts.

Windows and the Macintosh have the same default line spacing for a font only if the following formula is true:

otmMacLineGap >= (**tmAscent** + **tmDescent**) -
(**otmMacAscent** - **otmMacDescent**)

Microsoft TrueType fonts follow this formula to ensure that default line spacing is preserved between the Macintosh and Windows. The core fonts and all fonts from vendors that follow the Microsoft specification will have the same character widths, the same default line spacing, and the same character forms.

Unless the Windows and Macintosh font heights are equal, a font with a line gap of zero will yield different default line spacings in Windows and on the Macintosh.

Despite some incompatibilities, TrueType and GDI accept Macintosh-only fonts. Metrics that are not present in Macintosh-only fonts are set to default values. Although these default values are imperfect, using them allows Macintosh-only fonts to work in Windows.

Using Fonts in Applications

The remainder of this topic discusses the implementation of font functions in Windows applications.

Using Stock Fonts

GDI offers a variety of stock fonts that an application can retrieve and use. For many applications, the stock fonts provide all the functionality required for basic text output. To use stock fonts, an application specifies the type of font in the **GetStockObject** function. **GetStockObject** creates a handle to a logical font. When the application selects that handle into a device context, the font mapper uses the logical font to create a physical font. The application can select and use this physical font for text output.

GDI offers the following stock fonts:

Font	Description
ANSI_FIXED_FONT	Specifies a fixed-pitch font based on the Windows character set. A Courier font is typically used.
ANSI_VAR_FONT	Specifies a variable-pitch font based on the Windows character set. MS Sans Serif is typically used.
DEVICE_DEFAULT_FONT	Specifies a font preferred by the given device. Because this font depends on how the GDI font mapper interprets font requests, the font may vary widely from device to device.
OEM_FIXED_FONT	Specifies a fixed-pitch font based on an OEM character set. OEM character sets vary from system to system. For IBM computers and compatibles, the OEM font is based on the IBM PC character set.
SYSTEM_FONT	Specifies the System font. This is a variable-pitch font based on the Windows character set, and is used by the system to display window titles, menu names, and text in dialog boxes. The System font is always available. Other fonts are available only if they have been installed.

The following example retrieves a handle of the Windows variable stock font, selects it into a device context, and then writes a string using that font:

```
HFONT hfnt, hOldFont;

    hfnt = GetStockObject(ANSI_VAR_FONT);
    if (hOldFont = SelectObject(hdc, hfnt)) {
        TextOut(hdc, 10, 50, "Sample ANSI_VAR_FONT text.", 26);
        SelectObject(hdc, hOldFont);
    }
```

If no other stock fonts are available, **GetStockObject** returns a handle to the System font (**SYSTEM_FONT**).

Applications that use the **GetStockObject** function to retrieve the handle of a logical font should work in MM_TEXT units. The logical font identified by the handle returned by **GetStockObject** may specify a height that does not match the height of the requested logical font when the application works in mapping modes other than MM_TEXT.

Enumerating Fonts

An application can discover which fonts are available for a given device by using the **EnumFonts** or **EnumFontFamilies** function. These functions send information about the available fonts to a callback function that the application supplies. The callback function receives information in **LOGFONT** and **NEWTEXTMETRIC** structures. (The **NEWTEXTMETRIC** structure contains information about a TrueType font. When the callback function receives information about a non-TrueType font, the

information is contained in a **TEXTMETRIC** structure.) By using this information, an application can allow the user to choose among only those fonts that are available.

The **EnumFontFamilies** function is similar to the **EnumFonts** function but includes some extra functionality. New and upgrading applications should use **EnumFontFamilies** instead of **EnumFonts**. **EnumFontFamilies** allows an application to take advantage of the style name that is available with TrueType fonts.

In previous versions of Windows, the only style attributes were weight and italic; any other styles were specified in the family name for the font. If an application used the **EnumFonts** function to query the available Courier fonts, for example, **EnumFonts** might return information for Courier, Courier Bold, Courier Bold Italic, and Courier Italic, but it would not return information about any other Courier fonts that might be installed, because any other Courier fonts would typically have a different family name.

TrueType fonts are organized around a family name (for example, Courier New) and style names (for example, italic, bold, and extra-bold). The **EnumFontFamilies** function enumerates all the styles associated with a given family name, not simply the bold and italic attributes; if the system included a TrueType font called Courier New Extra-Bold, **EnumFontFamilies** would list it with the other Courier New fonts. The capabilities of **EnumFontFamilies** are helpful for fonts with many or unusual styles and for fonts that cross international borders. (Because a style name often changes with the language spoken in a country, an application that depends on the **EnumFonts** function could enumerate fonts whose names would change from country to country, while **EnumFontFamilies** would continue to enumerate the font families correctly.)

If an application does not supply a typeface name, the **EnumFonts** and **EnumFontFamilies** functions supply information about one font in each available family. To enumerate all the fonts in a device context, an application can specify NULL for the typeface name, compile a list of the available typefaces, and then enumerate each font in each typeface.

The following example uses the **EnumFontFamilies** function to retrieve the number of available raster, vector, and TrueType fonts:

```
FONTENUMPROC lpEnumFamCallBack;
UINT uAlignPrev;
int aFontCount[] = { 0, 0, 0 };
char szCount[8];

lpEnumFamCallBack = (FONTENUMPROC) MakeProcInstance(
    (FARPROC) EnumFamCallBack, hinstApp);
EnumFontFamilies(hdc, NULL, lpEnumFamCallBack,
    (LPARAM) aFontCount);
FreeProcInstance((FARPROC) lpEnumFamCallBack);

uAlignPrev = SetTextAlign(hdc, TA_UPDATECP);

MoveTo(hdc, 10, 50);
TextOut(hdc, 0, 0, "Number of raster fonts: ", 24);
itoa(aFontCount[0], szCount, 10);
TextOut(hdc, 0, 0, szCount, strlen(szCount));

MoveTo(hdc, 10, 75);
TextOut(hdc, 0, 0, "Number of vector fonts: ", 24);
itoa(aFontCount[1], szCount, 10);
TextOut(hdc, 0, 0, szCount, strlen(szCount));

MoveTo(hdc, 10, 100);
TextOut(hdc, 0, 0, "Number of TrueType fonts: ", 26);
itoa(aFontCount[2], szCount, 10);
TextOut(hdc, 0, 0, szCount, strlen(szCount));
```

```
    SetTextAlign(hdc, uAlignPrev);
        .
        .
        .

BOOL FAR PASCAL EnumFamCallBack(lplf, lpntm, FontType, aFontCount)
LPLOGFONT lplf;
LPNEWTEXTMETRIC lpntm;
short FontType;
LPSTR aFontCount;
{
    int far * aiFontCount = (int far *) aFontCount;

    if (FontType & RASTER_FONTTYPE)
        aiFontCount[0]++;
    else if (FontType & TRUETYPE_FONTTYPE)
        aiFontCount[2]++;
    else
        aiFontCount[1]++;

    if (aiFontCount[0] || aiFontCount[1] || aiFontCount[2])
        return TRUE;
    else
        return FALSE;
}
```

This example uses two masks, RASTER_FONTTYPE and TRUETYPE_FONTTYPE, to determine the type of font being enumerated. If the RASTER_FONTTYPE bit is set, the font is a raster font. If the TRUETYPE_FONTTYPE bit is set, the font is a TrueType font. If neither bit is set, the font is a vector font. A third mask, DEVICE_FONTTYPE, is set when a device (for example, a laser printer) supports downloading TrueType fonts; it is zero if the device is a display adapter, dot-matrix printer, or other raster device. An application can also use the DEVICE_FONTTYPE mask to distinguish GDI-supplied raster fonts from device-supplied fonts. GDI can simulate bold, italic, underline, and strikeout attributes for GDI-supplied raster fonts, but not for device-supplied fonts.

An application can also check bit 1 and 2 in the **tmPitchandFamily** member of the **NEWTEXTMETRIC** structure to identify a TrueType font. If bit 1 is zero and bit 2 is 1, the font is a TrueType font.

Vector fonts are categorized as OEM_CHARSET instead of ANSI_CHARSET. Some applications identify vector fonts by using this information, checking the **tmCharSet** member of the **NEWTEXTMETRIC** structure. This categorization usually prevents the font mapper from choosing vector fonts unless they are specifically requested. (Most applications do not use vector fonts, because they are slow and generally unattractive, and because TrueType fonts offer many of the same scaling and rotation features that required the use of vector fonts in earlier versions of Windows.)

Checking a Device's Text Capabilities

Applications can use the **EnumFonts** and **EnumFontFamilies** functions to enumerate the fonts in a printer-compatible memory device context. An application can also use the **GetDeviceCaps** function to retrieve information about the text capabilities of a device. By calling the **GetDeviceCaps** function with the NUMFONTS index, an application can determine the minimum number of fonts supported by a printer. (An individual printer may support more fonts than specified in the return value from **GetDeviceCaps** with the NUMFONTS index.) By using the TEXTCAPS index, an application can identify many of the text capabilities of the specified device.

The following example uses the **GetDeviceCaps** function to determine whether a device supports text rotation:

```
int result;

result = GetDeviceCaps(hdc, TEXTCAPS);
if (result & TC_CR_90)
    TextOut(hdc, 10, 100, "Device can rotate text 90 degrees",
        33);
if (result & TC_CR_ANY)
    TextOut(hdc, 10, 120, "Device can rotate text at any angle",
        35);
else if ((result & TC_CR_90) == 0 && (result & TC_CR_ANY) == 0)
    TextOut(hdc, 10, 100, "Device cannot rotate text", 25);
```

Creating a Logical Font

A logical font is a list of font attributes, such as height, width, character set, and typeface. An application creates a logical font to describe the font that is best suited for a given task; the font mapper uses this logical font to choose the available physical font that best matches the specified characteristics.

An application can use either the **CreateFont** or the **CreateFontIndirect** function to create a logical font. Most applications use **CreateFontIndirect**, assigning values to a **LOGFONT** structure. These functions return a handle of a logical font, which can then be selected into a device context and used.

The following example is a function that takes a handle of a device context, the name of a font, and a nominal point size as input. It creates a logical font of the requested size and face name and selects that font into the specified device context.

```
BOOL FAR PASCAL CreateLogFont(hdc, pszFace, PointSize)
HDC hdc;
PSTR pszFace;
int PointSize;
{
    HFONT hfnt, hfntOld;
    PLOGFONT plf = (PLOGFONT) LocalAlloc(GPTR, sizeof(LOGFONT));

    if (GetMapMode(hdc) != MM_TEXT) {
        TextOut(hdc, 100, -200, "Mapping mode must be MM_TEXT",
            28);
        return FALSE;
    }

    plf->lfHeight = -MulDiv(PointSize,
        GetDeviceCaps(hdc, LOGPIXELSY), 72);
    lstrcpy(plf->lfFaceName, pszFace);

    hfnt = CreateFontIndirect(plf);

    hfntOld = SelectObject(hdc, hfnt);

        .
        . /* Use font for text output. */
        .
    LocalFree((LOCALHANDLE) plf);
    SelectObject(hdc, hfntOld);
    if (DeleteObject(hfnt))
        return TRUE;
    else
        return FALSE;
```

}

Memory for the logical font in this example is allocated and initialized to zero (by using the **LocalAlloc** function with the **GPTR** constant); this means the logical font created by the **CreateFontIndirect** function uses default values for all members except **lfHeight** and **lfFaceName**. (Applications should always specify values for at least these two members.) For a description of all of the members of the **LOGFONT** structure, see the *Microsoft Windows Programmer's Reference, Volume 3.*

The function in this example uses the Windows **MulDiv** function to convert the specified point size into a different negative value and then assigns that value to the **lfHeight** member. This conversion is required because logical inches are larger than physical inches. The **MulDiv** function multiplies the requested point size by the result of dividing the number of pixels per logical inch by the number of points in a physical inch (72). A negative value is specified for **lfHeight** to indicate that the system should interpret this value as the height of the character glyphs in the font; when a positive value is specified, GDI interprets it as the height of a font's character cells, including internal leading.

An application would use a positive value for the **lfHeight** member to choose a font that fits within a specific height. For example, to display a page in "print preview" mode, an application would retrieve the height of the printer font from the **tmHeight** member of the **NEWTEXTMETRIC** structure, scale that height to the screen resolution, and use this value for the **lfHeight** member. The formula in this case would look like this:

$$\textbf{lfHeight} = \frac{\textbf{tmHeight} * \text{DPI of screen}}{\text{DPI of printer}}$$

The results of this calculation should always be rounded down to the nearest whole number.

When an application specifies the handle of a logical font in a call to the **SelectObject** function, the font mapper returns a handle of the physical font that is the best match for the requested attributes.

An application that requires a raster font can identify the available raster fonts by calling the **EnumFontFamilies** function and checking the RASTER_FONTTYPE bit. The application can then specify the typeface name in a **LOGFONT** structure. Similarly, vector fonts can be selected by checking the RASTER_FONTTYPE and TRUETYPE_FONTTYPE bits. An application can also specify a vector font by specifying OEM_CHARSET in the **lfCharSet** member of the **LOGFONT** structure, as discussed in Section 18.4.2, "Enumerating Fonts."

An application can use TrueType fonts exclusively by specifying OUT_TT_ONLY_PRECIS in the **lfOutPrecision** member of the **LOGFONT** structure. This is important for applications that use object linking and embedding (OLE), because metafiles can be scaled much better when they use only TrueType fonts.

Retrieving Information About the Selected Font

Applications can retrieve font information from a device context by using the **GetTextMetrics**, **GetTextFace**, and **GetOutlineTextMetrics** functions.

The **GetTextMetrics** function copies a **TEXTMETRIC** structure into a buffer. The **TEXTMETRIC** structure contains a description of the physical font, including the average dimensions of the character cells within the font, the spacing between lines of text, the number of characters in the font, and the character set on which the font is based. An application working with TrueType fonts can call the **GetOutlineTextMetrics** function to retrieve information in an **OUTLINETEXTMETRIC** structure.

Applications often use the **TEXTMETRIC** structure to determine how much space to specify between lines of text. For example, to compute an appropriate value for single-line spacing, an application could add the values of the **tmHeight** and **tmExternalLeading** members. The **tmHeight** member specifies the height of each character cell, and **tmExternalLeading** specifies the font designer's recommended spacing between the bottom of one character cell and the top of the next. (More accurate information can be retrieved for TrueType fonts from the **OUTLINETEXTMETRIC** structure; in this case, applications can add the values of the **otmAscent**, **otmDescent**, and **otmLineGap**

members.) The following example writes several lines of single-spaced text:

```
TEXTMETRIC tm;
int LineSpacing, i, YIncrement;

GetTextMetrics(hdc, &tm);
LineSpacing = tm.tmHeight + tm.tmExternalLeading;

YIncrement = 50;
for (i = 0; i < 4; i++) {
    TextOut(hdc, 10, YIncrement, "Single-line spacing", 19);
    YIncrement += LineSpacing;
}
```

The **GetTextFace** function copies a name identifying the typeface of the selected font into a buffer. An application can use this information in dialog boxes and menus.

Retrieving Information About a Logical Font

An application can retrieve information about a font by specifying the font handle in a call to the **GetObject** function. The **GetObject** function copies logical-font information to a **LOGFONT** structure.

The following example uses the **GetObject** function to retrieve logical-font information for a font and then checks whether the font is italic:

```
LOGFONT lf;

GetObject(hfnt, sizeof(LOGFONT), &lf);
if (lf.lfItalic)
    return TRUE;
else
    return FALSE;
```

Drawing Text

An application can use the following functions to draw text:

Function	Description
DrawText	Draws formatted text in a rectangle. **DrawText** formats text by expanding tabs into appropriate spaces, aligning text to the left, right, or center of the given rectangle, and breaking text into lines that fit within the given rectangle. This is not a GDI function; it is in USER.EXE.
ExtTextOut	Writes a character string within a rectangular region. The rectangular region can be opaque (filled with the current background color), and it can be a clipping region.
GrayString	Draws gray text by writing the text in a memory bitmap, graying the bitmap, and then copying the bitmap to the device. **GrayString** grays the text regardless of the selected brush and background. This is not a GDI function; it is in USER.EXE.
TabbedTextOut	Writes a character string, expanding tabs to the values specified in an array of tab-stop positions.
TextOut	Writes a character string at a specified location.

The **ExtTextOut** function is the fastest Windows text-output function. The **DrawText** function is the slowest (although it offers the richest formatting options).

Instead of using the **GrayString** function, an application could simply set the text color to gray, as follows:

```
dwColorPrevious = SetTextColor(hdc, GetSysColor(COLOR_GRAYTEXT));
```

Setting the Text Alignment

An application can query and set the text alignment for a device context by using the **GetTextAlign** and **SetTextAlign** functions. The text-alignment settings determine how text is positioned relative to a given location. Text can be aligned to the right or left of the position or centered over it; it can also be aligned above or below the point. In addition, an application can use the **SetTextAlign** function to update the current position when a text-output function is called.

For example, the following example uses the **SetTextAlign** function to update the current position when the **TextOut** function is called. In this example, cArial is an integer that specifies the number of Arial fonts:

```
UINT uAlignPrev;
char szCount[8];

uAlignPrev = SetTextAlign(hdc, TA_UPDATECP);
MoveTo(hdc, 10, 50);
TextOut(hdc, 0, 0, "Number of Arial fonts: ", 23);
itoa(cArial, szCount, 10);
TextOut(hdc, 0, 0, (LPSTR) szCount, strlen(szCount));
SetTextAlign(hdc, uAlignPrev);
```

Using Color

When an application first creates a device context, the text color is black and the background color is white. An application can add color to text by setting the text and background colors of the device context. The text color determines the color of the character to be written; the background color determines the color of everything in the character cell except the character.

An application can set the text and background colors by using the **SetTextColor** and **SetBkColor** functions. The following example sets the text color to red and the background color to green:

```
SetTextColor(hdc, RGB(255,0,0));
SetBkColor(hdc, RGB(0,255,0));
```

The background color applies only when the background mode is opaque. The background mode determines whether the background color in the character cell has any effect on what is already on the screen. If the mode is opaque, the background color overwrites anything already on the screen; if the mode is transparent, anything on the screen that would otherwise be overwritten by the background is preserved. The background color for an italic string that GDI has synthesized is sheared along with the characters; this can lead to unexpected results when the text background color is different from the window background color. An application can set and retrieve the background mode by using the **SetBkMode** function and **GetBkMode** functions. Similarly, an application can retrieve the current text and background color by using the **GetTextColor** and **GetBkColor** functions.

Using Multiple Fonts in a Line

Different type styles within a font family can have different widths. For example, bold and italic styles of a family are always wider than the roman style for a given point size. An application that can display or print several type styles on a single line must keep track of the width of the line to avoid having characters print on top of one another.

An application can use the following functions to retrieve the width (or extent) of text in the current font:

Function	Description
GetTabbedTextExtent	Computes the width and height of a character string. If the string contains one or more tab characters, the width of the string is based upon a specified array of tab-stop positions.
GetTextExtent	Computes the width and height of a line of text.

When necessary, GDI synthesizes a font by changing the character bitmaps. To synthesize a character in a bold font, GDI draws the character twice: once at the starting point, and again one pixel to the right of the starting point. To synthesize a character in an italic font, GDI draws the two rows of pixels at the bottom of the character cell, moves the starting point one pixel to the right, draws the next two rows, and continues until the character has been drawn. The base line of a synthesized italic character is shifted to the right by an amount determined by the height of the character cell. To determine the amount a base line is shifted to the right, an application can perform the following calculation, using values retrieved by a call to the **GetTextMetrics** function:

units base line shifted right = (**tmDescent** * **tmOverhang**) / **tmAscent**

One way to write a line of text that contains multiple fonts is to use the **GetTextExtent** function after each call to **TextOut** and add the length to a current position. The following example writes the line "This is a sample string.", using bold characters for the words "This is a", italic characters for the word "sample", and system default characters for "string.":

```
int XIncrement;
TEXTMETRIC tm;
HFONT hfntDefault, hfntItalic, hfntBold;

XIncrement = 10;
hfntDefault = SelectObject(hdc, hfntBold);
TextOut(hdc, XIncrement, 50, "This is a ", 10);

XIncrement += LOWORD(GetTextExtent(hdc, "This is a ", 10));
GetTextMetrics(hdc, &tm);
XIncrement -= tm.tmOverhang;
SelectObject(hdc, hfntItalic);
GetTextMetrics(hdc, &tm);
XIncrement -= tm.tmOverhang;
TextOut(hdc, XIncrement, 50, "sample ", 7);

XIncrement += LOWORD(GetTextExtent(hdc, "sample ", 7));
SelectObject(hdc, hfntDefault);
TextOut(hdc, XIncrement - tm.tmOverhang, 50, "string.", 7);
```

In this example, the **GetTextExtent** function returns a 32-bit value (of type **DWORD**) containing both the length and height of the specified string. The **LOWORD** macro then retrieves the length of the string, which is added to the current position. The **GetTextMetrics** function retrieves the overhang for the current font. Because the overhang is zero if the font is a TrueType font, the overhang value does not change the string placement in that case. For raster fonts, however, it is important to use the overhang value. The overhang is subtracted from the bold string once, to bring subsequent characters closer to the end of the string if the font is a raster font. Because overhang affects both the beginning and end of the italic string in a raster font, the glyphs begin to the right of the specified location and end to the left of the endpoint of the last character cell. (The **GetTextExtent** function retrieves the extent of the character cells, not the extent of the glyphs.) To account for the overhang for the raster italic string, this example subtracts the overhang before placing the string and subtracts it again before placing subsequent characters.

An application that must place characters with greater precision can use the **GetCharWidth** or **GetCharABCWidths** function to retrieve the widths of individual characters in a font. The **GetCharABCWidths** function is more accurate than the **GetCharWidth** function, but only when it is used with TrueType fonts; when **GetCharABCWidths** is used with non-TrueType fonts, it retrieves the same information as **GetCharWidth**.

The **SetTextJustification** function adds extra space to the break characters in a line of text. An application can use the **GetTextExtent** function to determine the extent of a string, subtract the extent from the total amount of space the line should occupy, and use the **SetTextJustification** function to

distribute the extra space among the break characters in the string. The **SetTextCharacterExtra** function adds extra space to every character cell in the selected font, including the break character. (An application can use the **GetTextCharacterExtra** function to determine the current amount of extra space being added to the character cells; the default setting is zero.)

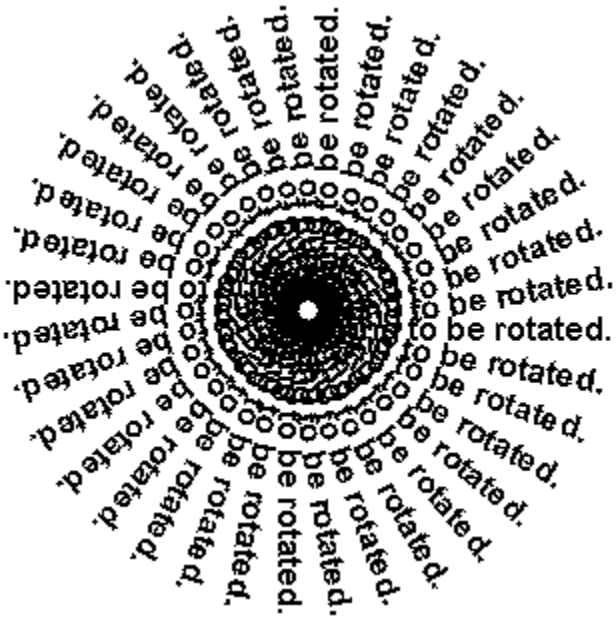
ABC spacing also allows an application to perform very accurate text alignment. For example, when an application right aligns a raster roman font without using ABC spacing, the advance width is calculated as the character width. This means the white space to the right of the glyph in the bitmap is aligned, not the glyph itself. By using ABC widths, applications have more flexibility in the placement and removal of white space when aligning text, because they have information that allows them to finely control intercharacter spacing.

Rotating Text

Applications can rotate TrueType fonts at any angle. This is useful for labeling charts and other illustrations. The following example rotates a string in 10-degree increments around the center of the client area by changing the value of the **lfEscapement** member of the **LOGFONT** structure used to create the font:

```
RECT rc;
int angle;
HFONT hfnt, hfntPrev;
LPSTR lpszRotate = "String to be rotated.";
PLOGFONT plf = (PLOGFONT) LocalAlloc(LPTR, sizeof(LOGFONT));

lstrcpy(plf->lfFaceName, "Arial");
plf->lfWeight = 700;

GetClientRect(hwnd, &rc);
SetBkMode(hdc, TRANSPARENT);

for (angle = 0; angle < 3600; angle += 100) {
    plf->lfEscapement = angle;
    hfnt = CreateFontIndirect(plf);
    hfntPrev = SelectObject(hdc, hfnt);
    TextOut(hdc, rc.right / 2, rc.bottom / 2,
        lpszRotate, lstrlen(lpszRotate));
    SelectObject(hdc, hfntPrev);
    DeleteObject(hfnt);
}

SetBkMode(hdc, OPAQUE);
LocalFree((LOCALHANDLE) plf);
```

This example produces the following pattern:



The **lfOrientation** member of the **LOGFONT** structure is ignored by GDI, which currently, assumes that the values for **lfEscapement** and **lfOrientation** are identical.

TrueType Font Functions and Structures

Some of the functions and structures that allow an application to take advantage of the extra functionality of TrueType are discussed elsewhere in this topic. This section describes some of the TrueType functions that are useful for applications that must take full advantage of the new font technology.

Retrieving Character Outlines

Applications can use the **GetGlyphOutline** function to retrieve the outline of a glyph from a TrueType font. **GetGlyphOutline** returns the outline as a bitmap or as a series of polylines and splines.

When an application retrieves a glyph outline as a series of polylines and splines, the information is returned in a **TTPOLYGONHEADER** structure followed by as many **TTPOLYCURVE** structures as are required to describe the glyph. All points are returned as **POINTFX** structures and represent absolute positions, not relative moves. The starting point given by the **pfxStart** member of the **TTPOLYGONHEADER** structure is the point at which the outline for a contour begins. The **TTPOLYCURVE** structures that follow can be either polyline records or spline records. Polyline records are a series of points; lines drawn between the points describe the outline of the character. Spline records represent the quadratic curves used by TrueType (that is, quadratic b-splines).

Each polyline and spline record contains as many sequential points as possible, to minimize the number of records returned.

The starting point given in the **TTPOLYGONHEADER** structure is always on the outline of the glyph. The specified point is both the starting point and the ending point for the contour.

A polyline record begins with the last point in the previous record (or with the starting point, for the first record in the contour). Each point in the record is on the glyph outline and can be connected simply by using straight lines.

A spline record begins with the last point in the previous record (or with the starting point, for the first record in the contour). For the first spline record, the starting point and the last point in the record are on the glyph outline. For all other spline records, only the last point is on the glyph outline. All other points in the spline records are off the glyph outline and must be rendered as the control points of b-

splines.

The last spline or polyline record in a contour always ends with the contour's starting point. This ensures that every contour is closed.

Because b-splines require three points (one point that is off the glyph outline between two that are on the outline), applications must perform some calculations when a spline record contains more than one off-curve point.

For example, if a spline record contains three points (A, B, and C) and it is not the first record, points A and B are off the glyph outline. To interpret point A, an application can use the current position (which is always on the glyph outline) and the point on the glyph outline between points A and B. To find this point between A and B, the application can perform the following calculation:

M = A + (B - A)/2

The midpoint between consecutive off-outline points in a spline record is a point that is on the glyph outline, according to the definition of the spline format used in TrueType fonts. In preceding formula, M is the midpoint on the line between points A and B.

If the current position is designated by P, the two quadratic splines defined by this spline record are (P, A, M) and (M, B, C).

To render a TrueType character outline in GDI, an application must use both the polyline and the spline records. GDI can render polylines easily, but it does not support any spline formats. To use the spline records, an application must convert them into a series of polylines that approximate the spline.

The glyph outline returned by the **GetGlyphOutline** function is for a grid-fitted glyph. (A grid-fitted glyph has been modified so that its bitmap image conforms as closely as possible to the original design of the glyph.) If an application requires an unmodified glyph outline, it should request the glyph outline for a character in a font whose size is equal to the font's em units. (To create a font with this size, an application can set the **lfHeight** member of the **LOGFONT** structure to the negative of the value of the **ntmSizeEM** member of the **NEWTEXTMETRIC** structure.)

Using Portable TrueType Metrics

Applications that use the TrueType font metrics can achieve a high degree of printer and document portability. Applications that must maintain compatibility with earlier versions of Windows can use the TrueType metrics, as can applications that are written specifically for Windows version 3.1.

Design Widths

Design widths overcome most of the problems of device-dependent text introduced by physical devices. Design widths are a kind of logical width. Independent of any rasterization problems or scaling transformations, each glyph has a logical width and height. Composed to a logical page, each character in a string has a place independent of the physical device widths. Although a logical width implies that widths can be scaled linearly at all point sizes, this is not necessarily true for either nonportable or most TrueType fonts. At smaller point sizes, some glyphs are made wider relative to their height for better readability.

The characters in TrueType core fonts are designed against a 2048-by-2048 grid. The design width is the width of a character in these grid units. (TrueType supports any integer grid size up to 16,384 by 16,384; grid sizes that are integer powers of 2 scale faster than other grid sizes.)

The outline of a font is designed in notional units. The em square is the notional grid against which the font outline is fitted. (The **otmEMSquare** member of **OUTLINETEXTMETRIC** and the **ntmSizeEM** member of **NEWTEXTMETRIC** give the size of the em square in notional units.) When a font is created that has a point size (in device units) equal to the size of its em square, the **ABC** widths for this font are the desired design widths. For example, if the size of an em square is 1000 and the ABC widths of a character in the font are 150, 400, and 150, a character in this font that has a height of 10 in device units would have ABC widths of 1.5, 4, and 1.5, respectively. Since the MM_TEXT mapping mode is most commonly used with fonts (and MM_TEXT is equivalent to device units), this is a simple

calculation.

Because of the high resolution of TrueType design widths, applications that use them must take into account the large numeric values that can be created.

Device vs. Design Units

Portable metrics in fonts are known as design units. To apply to a given device, design units must be converted to device units. An application can use the following formula to convert design units to device units:

DeviceUnits = (*DesignUnits*/*unitsPerEm*) * (*PointSize*/72) * *DeviceResolution*

The variables in this formula have the following meanings:

Variable	Description
DeviceUnits	Specifies the *DesignUnits* font metric converted to device units. This value is in the same units as the value given for *DeviceResolution.*
DesignUnits	Specifies the font metric to be converted to device units. This value could be any font metric, including the width of a character or the ascender value for an entire font.
unitsPerEm	Specifies the em square size for the font.
PointSize	Specifies size of the font in points. (One point equals 1/72 of an inch.)
DeviceResolution	Specifies number of device units (pixels) per inch. Typical values might be 300 for a laser printer or 96 for a VGA screen.

Note: This formula should not be used to convert device units back to design units. Device units are always rounded to the nearest pixel. The propagated round-off error can become very large, especially when an application is working with screen sizes.

Requesting Design-Unit Metrics

Font metrics for a physical font can be retrieved only after a font has been selected into a device context. When a font is selected into a device context, it is scaled for the device, which makes the font metrics specific to the device. To request design units, an application should create a logical font whose height is specified as *-unitsPerEm.* Applications can retrieve the value for *unitsPerEm* by calling the **EnumFontFamilies** function and checking the **ntmSizeEM** member of the **NEWTEXTMETRIC** structure.

Metrics for Portable Documents

The following table specifies the most important font metrics for applications that require portable documents and the functions that allow an application to retrieve them:

Function	Metric	Use
EnumFontFamilies	**ntmSizeEM**	Retrieving design metrics; conversion to device metrics
GetCharABCWidths	**ABCWidths**	Accurate placement of characters at the start and end of margins, picture boundaries, and other text breaks
GetCharWidth	**AdvanceWidths**	Placement of characters on a line. (This function is not new for Windows 3.1.)
GetOutlineTextMetrics	**otmfsType**	Font-embedding bits
	otmsCharSlopeRise	Y-component for slope of cursor for italic fonts
	otmsCharSlopeRun	X-component for slope of cursor for italic fonts
	otmAscent	Line spacing
	otmDescent	Line spacing

otmLineGap	Line spacing
otmpFamilyName	Font identification
otmpStyleName	Font identification
otmpFullName	Font identification (typically, family and style name)

The **otmsCharSlopeRise**, **otmsCharSlopeRun**, **otmAscent**, **otmDescent**, and **otmLineGap** members of the **OUTLINETEXTMETRIC** structure are scaled or transformed to correspond to the current device mode and physical height (as given in the **tmHeight** member of the **NEWTEXTMETRIC** structure).

Font identification is important if the same font must be selected when a document is reopened or moved to a different system. The font mapper always selects the correct font when it is asked for by full name. The family and style names are needed in order to provide input to the standard font dialog box for proper placement of the selection bars.

The **otmsCharSlopeRise** and **otmsCharSlopeRun** values are used to produce a close approximation of the main italic angle of the font. For typical roman fonts, **otmsCharSlopeRise** is 1 and **otmsCharSlopeRun** is 0. For italic fonts, the values attempt to approximate the sine and cosine of the main italic angle of the font (in counterclockwise degrees past vertical); note that the italic angle for upright fonts is 0. Because these values are not expressed in design units, they should not be converted into device units.

The character placement and line spacing metrics allow an application to compute device-independent line breaks that are portable across screens, printers, typesetters, and even platforms. If all applications adopt these techniques, documents moved from one application to another will not reflow.

Device-independent page layout requires seven basic steps:

1 Normalize all design metrics to a common ultra-high resolution (UHR) value (for example, 65,536 DPI); this prevents round-off errors.

2 Compute line breaks based on UHR metrics and physical page width; this yields a starting point and an ending point of a line within the text stream.

3 Compute the device page width in device units (for example, pixels).

4 Fit each line of text into the device page width, using the line breaks computed in step 2.

5 Compute page breaks by using UHR metrics and the physical page length; this yields the number of lines per page.

6 Compute the line heights in device units.

7 Fit the lines of text onto the page, using the lines per page from step 5 and the line heights from step 6.

Panose Numbers

TrueType font files include Panose numbers, which applications can use to choose a font that closely matches their specifications. The Panose system classifies faces by 10 different attributes. These attributes are each rated on a scale. The resulting values are concatenated to produce a number. Given this number for a font and a mathematical metric to measure distances in the Panose space, an application can determine nearest neighbors. A **PANOSE** structure is part of the **OUTLINETEXTMETRIC** structure (whose values are filled in by calling the **GetOutlineTextMetrics** function).

Creating Customized Fonts

GDI keeps a system font table containing all the fonts that applications can use. GDI chooses a font from this table when an application calls the **CreateFont** or **CreateFontIndirect** function. There can be up to 253 entries in the system font table.

A font resource is a group of individual fonts representing characters in a given character set that have various combinations of heights, widths, and pitches. Applications can load font resources and add the fonts in the resource to the system font table by using the **AddFontResource** function. After a font resource has been added, the application can use the individual fonts in the resource. In other words, the **CreateFont** function takes the fonts into account when it tries to match a physical font with the specified logical font. (Fonts in the system font table are never directly accessible to an application. They are available only through the **CreateFontIndirect** and **CreateFont** functions, which return handles of the fonts, not memory addresses.)

An application can add a font resource to the system font table by using the **AddFontResource** function. To remove a font resource, an application can use the **RemoveFontResource** function.

Whenever an application adds or removes a font resource, it should inform all other applications of the change by sending a **WM_FONTCHANGE** message to them. An application can use the following call to the **SendMessage** function to send the message to all windows:

```
SendMessage(HWND_BROADCAST, WM_FONTCHANGE, 0, 0);
```

An application can use the **GetProfileString** function to retrieve a list of any fonts the user has used Control Panel to install. The application would use **GetProfileString** to search the [Fonts] section of the WIN.INI file.

An application can create font resources by creating font files and adding them as resources to a font resource file. To create a font resource file, an application should follow these steps:

1 Create the font files.

2 Create a resource-definition file for the font.

3 Create a dummy code module.

4 Create a module-definition file that describes the fonts and the devices that use the fonts.

5 Compile and link the sources.

A font resource file is an empty Windows dynamic-link library; it contains no code or data, but does contain resources. An application can add a font file to an empty library, along with such resources as icons, cursors, and menus, by using Microsoft Windows Resource Compiler (RC).

Creating Font Files

An application can create raster font files by using Microsoft Windows Font Editor (FONTEDIT.EXE), as described in *Microsoft Windows Programming Tools.* (Font Editor cannot be used to generate vector or TrueType fonts.) The application can use any number, size, and type of font files in a font resource. In most cases, enough fonts should be included to reasonably satisfy most logical-font requests for the target device.

GDI can scale device-independent raster fonts by 1 to 8 times vertically and 1 to 5 times horizontally. GDI can also simulate bold, underlined, strikeout, and italic fonts. Font designers may choose to allow GDI to synthesize some sizes and properties of a font, rather than providing separate font files.

Font Editor modifies existing .FNT files; it cannot create font files from scratch. The Microsoft Windows 3.1 Software Development Kit (SDK) includes two .FNT files that font designers can load into Font Editor, modify, and save as customized fonts. The file named ATRM1111.FNT is a fixed-width font. The file named VGASYS.FNT is a variable-width font.

The Save As dialog box in Font Editor includes two File Format radio buttons. Font files saved in Font Editor 3.0 format can be used only in 386 enhanced mode. Font files saved in Font Editor 2.0 format can be used in all modes.

Creating the Resource-Definition File for a Font

An application can add resources to a font file by adding one or more **FONT** statements to the

resource-definition file. The resource-definition file can add .FNT files to a Windows library, a device driver, or a resource-only file that contains only icons, cursor, fonts, and other resources. Because font resources are available to all applications, they should not be added to application modules.

The **FONT** statement has the following form:

number **FONT** *filename*

One statement is required for each font file to be placed in the resource. The *number* must be unique, because it is used to identify the font later. The following is a typical resource-definition file for a font resource:

```
1  FONT FNTFIL01.FNT
2  FONT FNTFIL02.FNT
3  FONT FNTFIL03.FNT
4  FONT FNTFIL04.FNT
5  FONT FNTFIL05.FNT
6  FONT FNTFIL06.FNT
```

You can add fonts to modules that contain other resources by adding them to the existing resource-definition file. An application can have icon, menu, cursor, and dialog box definitions in the resource-definition file, as well as **FONT** statements.

Creating a Dummy Code Module

A dummy code module provides the object file from which the font resource file is made. A developer can create the dummy code module by using the assembler and the Cmacros. The module's source file could look like this:

```
 TITLE   FONTRES - Stub file to build a .FON resource file

 .xlist
 include cmacros.inc
 .list

 sBegin CODE
 db 0
 sEnd   CODE
 end
```

Microsoft Segmented Executable Linker LINK version 4 allows empty code segments, but LINK versions 5.12 and later does not. The inclusion of "db 0" between sBegin and sEnd in the preceding example prevents an empty code segment.

The developer can assemble this source file by using the **masm** command. The object file that will be created will contain no code and no data, but it can be linked to an empty Windows library to which the font resources can be added.

Developers who build font files using version 6.0 of Microsoft Macro Assembler (ML) should use version 5.3 of the CMACROS.INC file (included with ML) instead of version 5.2 of the file, which is included with the SDK.

Creating a Module-Definition File

The module-definition file for the font resource must contain a **LIBRARY** statement that defines the resource name, a **DESCRIPTION** statement that describes the font resource characteristics, and a **DATA** statement. The module-definition file for a font resource should look like this:

```
LIBRARY FONTRES

DESCRIPTION 'FONTRES 133,96,72 : System, Terminal (Set #3)'
```

```
EXETYPE WINDOWS

STUB 'WINSTUB.EXE'
DATA NONE
```

The **DESCRIPTION** statement provides device-specific information about the font that is used to match a font with a given screen or printer. The following are the three possible formats for the **DESCRIPTION** statement in a font resource. In each case, the first characters in the description must be a single quote and the name of the library module (FONTRES):

DESCRIPTION 'FONTRES *Aspect*, *LogPixelsX*, *LogPixelsY*: *Cmt*' **DESCRIPTION 'FONTRES CONTINUOUSSCALING:** *Cmt*' **DESCRIPTION 'FONTRES DEVICESPECIFIC** *DeviceTypeGroup*: *Cmt*'

The first format specifies a font that was designed for a specific aspect ratio and logical pixel width and height, and can be used with any device having the same aspect and logical pixel dimensions. *Aspect* is the value (100**AspectY*)/*AspectX* rounded to an integer. The *AspectX, AspectY, LogPixelsX,* and *LogPixelsY* values are the same as the values given in the corresponding device's **GDIINFO** structure (values that are accessible by using the **GetDeviceCaps** function). You can specify more than one set of *Aspect, LogPixelsX,* and *LogPixelsY* values. The *Cmt* value is a comment. The following statements are examples:

```
DESCRIPTION 'FONTRES 133,96,72: System, Terminal (Set #3)'
DESCRIPTION 'FONTRES 200,96,48; 133,96,72; 83,60,72; 167,120,72: \
    MS Sans Serif'
```

The second format specifies a continuous scaling font. This typically corresponds to vector fonts that can be drawn to any size and that do not depend on the aspect or logical pixel width of the output device. The following statement is an example:

```
DESCRIPTION 'FONTRES CONTINUOUSSCALING : Modern, Roman, Script'
```

The third format specifies a font that is specific to a particular device or group of devices. The *DeviceTypeGroup* can be **DISPLAY** or a list of device-type names--the same names an application might specify as the second parameter in a call to the **CreateDC** function. Following is an example of the third format:

```
DESCRIPTION 'FONTRES DISPLAY: HP 7470 plotters'
DESCRIPTION 'FONTRES DEVICESPECIFIC HP 7470A, HP 7475A: \
    HP 7470 plotters'
```

Note: The maximum length of a **DESCRIPTION** line is 127 characters. Because GDI is capable of synthesizing attributes, such as bold, italic, and underline, the font designer need not create separate .FNT files for fonts with these attributes. Windows may use other fonts that do not correspond to the user's screen aspect ratio. These are generic raster fonts that are intended for output devices such as bitmap printers, which rely on the display driver to draw text.

Compiling and Linking a Font Resource File

The following makefile lists the commands required to compile and link a font resource file:

```
fontres.obj: fontres.asm
    masm fontres;

fontres.exe: fontres.def fontres.obj fontres.rc fontres.exe \
                fntfil01.fnt fntfil02.fnt fntfil03.fnt \
                fntfil04.fnt fntfil05.fnt fntfil06.fnt
    link fontres.obj, fontres.exe, NUL, /nod, fontres.def
    rc fontres.rc
    rename fontres.exe custom.fon
```

By convention, all raster font resource files have the .FON filename extension. The last line in the makefile renames the executable file to CUSTOM.FON.

Adding TrueType Fonts

Because Windows cannot directly interpret the native TrueType font file format, a file that mimics the standard .FON file (called a .FOT file) is required to make internal bookkeeping and enumeration easier. The **CreateScalableFontResource** function produces a .FOT file that points to the TrueType font file. Once this .FOT file is produced, Windows applications can use TrueType fonts transparently by using the **AddFontResource** and **RemoveFontResource** functions. Applications could also use the **CreateScalableFontResource** function to install special fonts for logos, icons, and other graphics.

Related Topics

Window Management (3.1)

The following topics describe the functions in the Microsoft Windows operating system that process messages; create, move, or alter a window; or create system output. These functions constitute the window manager interface.

Caret functions
Cursor functions
Dialog box procedures
Hook functions
Message functions
Painting functions
Property functions
Rectangle functions
Scrolling functions
Window-creation functions

Messages

Messages are the input to an application. They represent events that the application may need to respond to. A message is a structure that contains a message identifier and message parameters. The content of the parameters varies with the message type.

Generating and Processing Messages

Windows generates an input message for each input event, such as when the user moves the mouse or presses a key. Windows collects input messages in a systemwide message queue and then places the messages, as well as timer and paint messages, in an application message queue. An application message queue is a first in, first out queue. Timer and paint messages are exceptions to the first in, first out rule; these messages are held in an application's message queue until the application has processed all other messages. Windows places messages that belong to a specific application in that application's message queue. The application then reads the messages by using the **GetMessage** function and dispatches them to the appropriate window procedure by using the **DispatchMessage** function.

Windows sends some messages directly to the window procedure in the appropriate application instead of placing the messages in the application's message queue. Such messages are called unqueued messages. Typically, an unqueued message is any message that affects the window only. The **SendMessage** function sends messages directly to a window procedure. For more information about window procedures, see Window Procedures.

For example, the **CreateWindow** function directs Windows to send a **WM_CREATE** message to a window procedure of an application and to wait until the window procedure has processed the message. Windows sends this message directly to the window procedure and does not place it in the application's message queue.

Although Windows generates most messages, an application can create its own messages and place them in its own message queue or that of another application.

An application typically uses the **GetMessage** function in a loop within its **WinMain** function to remove messages from the application's message queue. This loop is called the main message loop. The **GetMessage** function searches an application's message queue and, if any messages exist, returns the top message in the queue. If the message queue is empty, **GetMessage** waits for a message to be placed in the queue. While waiting, **GetMessage** relinquishes control to Windows, allowing other applications to take control and process their own messages.

Once an application's **WinMain** function has retrieved a message from the application's message queue, it can dispatch the message to a window procedure by using the **DispatchMessage** function. This function directs Windows to call the window procedure of the window associated with the message, and then passes the content of the message as function arguments. The window procedure can then process the message and carry out any requested changes to the window. When the window procedure returns, Windows returns control to the main message loop in the **WinMain** function. The main message loop can then retrieve the next message from the queue.

Note: Unless noted otherwise, Windows can send messages in any sequence. An application should not rely on receiving messages in a particular order.

Windows generates a message each time the user presses a key. The message contains a virtual-key code that defines which key was pressed, but does not define the character value of that key. To retrieve the character value, the main message loop in the **WinMain** function must translate the virtual-key message by using the **TranslateMessage** function. This function puts another message with an appropriate character value in the application's message queue. The message can then be dispatched to a window procedure.

Translating Messages

In general, a **WinMain** function should use the **TranslateMessage** function to translate every message, not just virtual-key messages. Although **TranslateMessage** has no effect on other types of

messages, it guarantees that keyboard input is translated correctly.

The following example illustrates the typical main message loop that a **WinMain** function uses to retrieve messages from the application's message queue and dispatch them to the application's window procedures:

```
int PASCAL WinMain(HINSTANCE hinstCurrent, HINSTANCE hinstPrevious,
    LPSTR lpszCmdLine, int nCmdShow)
{
    MSG msg;

        .
        .
        .

    while (GetMessage(&msg, NULL, 0, 0)) {
        TranslateMessage(&msg); /* translates virtual key codes    */
        DispatchMessage(&msg);  /* dispatches message to window    */
    }
    return (int) msg.wParam;    /* return value of PostQuitMessage */
}
```

An application that uses accelerator keys must load an accelerator table from the resource-definition file by using the **LoadAccelerators** function and then translate keyboard messages into accelerator-key messages by using the **TranslateAccelerator** function.

The main message loop for an application that uses accelerator keys should have the following form:

```
while (GetMessage(&msg, NULL, 0, 0)) {
    if (TranslateAccelerator(hwnd, haccel, &msg) == 0) {
        TranslateMessage(&msg);
        DispatchMessage(&msg);
     }
}
return (int) msg.wParam;
```

The **TranslateAccelerator** function must appear before the standard **TranslateMessage** and **DispatchMessage** functions. Furthermore, because **TranslateAccelerator** automatically dispatches the accelerator-key message to the appropriate window procedure, the **TranslateMessage** and **DispatchMessage** functions should not be called if **TranslateAccelerator** returns a nonzero value.

Examining Messages

An application can use the **PeekMessage** function to examine its message queue for specific messages without removing them from the queue. The function returns a nonzero value if a message exists in the queue and lets the application retrieve the message and process it without going through the application's main message loop.

Typically, an application uses **PeekMessage** to check periodically for messages when the application is carrying out a lengthy operation, such as processing input and output. For example, this function can be used to check for messages that end the operation. **PeekMessage** also gives the application a chance to yield control if no messages are present, because **PeekMessage** can yield if no messages are in the message queue.

Sending Messages

The **SendMessage** and **PostMessage** functions let applications pass messages to their windows or to the windows of other applications. The **PostAppMessage** function is a variation on **PostMessage** that posts a message using the application's module handle rather than a window handle.

The **PostMessage** function directs Windows to post a message--that is, place the message in an

application's message queue. The **PostMessage** function immediately returns control to the calling application, and any action to be carried out as a result of the message does not occur until the message is read from the queue.

The **SendMessage** function directs Windows to send a message directly to the given window procedure, bypassing the application's message queue. Windows does not return control to the calling application until the window procedure that receives the message processes the message or returns control as a result of a call to the **ReplyMessage** function.

When an application transmits a message, it must do so by calling **SendMessage** if the application relies on the return value of a message. The return value of **SendMessage** is the same as the value returned by the window procedure that processed the message. **PostMessage** returns immediately after sending the message, so its return value is only a Boolean value indicating whether the message was successfully placed in the queue and does not indicate how the message was processed.

Avoiding Message Deadlocks

An application can create a deadlock condition in Windows if it yields control while processing a message sent from another application (or by Windows on behalf of another application) by using the **SendMessage** function.

Typically, a task that calls **SendMessage** to send a message to another task does not continue running until the window procedure that receives the message returns. When the task that receives the message yields control, the sending task cannot continue to run and to process messages because it is waiting for **SendMessage** to return, resulting in a message deadlock.

The application processing the message does not have to yield explicitly to cause the problem. Calling any one of the following functions can result in the application yielding control:

- **DialogBox**
- **DialogBoxIndirect**
- **DialogBoxIndirectParam**
- **DialogBoxParam**
- **GetMessage**
- **MessageBox**
- **PeekMessage**
- **Yield**

Before calling any of these functions while processing a message, a window procedure should first call the **InSendMessage** function to find out whether the message was sent by the **SendMessage** function from another application. If **InSendMessage** returns a nonzero value, the window procedure must call the **ReplyMessage** function before calling any function that yields control.

Creating and Managing Windows

This section describes how to create, destroy, modify, and obtain information about windows.

Window Classes

A window class is a set of attributes that defines how a window looks and behaves. Before an application can create and use a window, a window class must have been created and registered for that window. An application registers a class by filling a **WNDCLASS** structure and passing a pointer to the structure to the **RegisterClass** function. Any number of window classes can be registered. Once a class has been registered, Windows lets the application create any number of windows belonging to that class. The registered class remains available until it is deleted or the application closes.

Although the complete window class consists of many elements, Windows requires only that an application supply a class name, the address of the window procedure that will process all messages sent to windows belonging to this class, and an instance handle identifying the application that registered the class. The other elements of the window class define default attributes for windows of the class, such as the shape of the cursor and the content of the menu for the window.

There are three types of window classes: system global classes, application global classes, and application local classes. These types differ in scope and in when and how they are created and destroyed.

System Global Classes

Windows creates system global classes when it starts. These classes are available for use by all applications at all times. Because Windows creates system global classes on behalf of all applications, an application cannot create or destroy any of these classes. System global classes include edit-control and list-box control classes.

Application Global Classes

An application or (more likely) a dynamic-link library (DLL) creates an application global class by specifying the **CS_GLOBALCLASS** style for the class. Once created, it is globally available to all applications within the system. Typically, a DLL creates an application global class so that applications that call the DLL can use the class. Windows destroys an application global class when the application that created it closes or the DLL that created it is unloaded. For this reason, it is essential that all applications destroy all windows using that class before the application that created the class closes or the DLL that created the class is unloaded. Use the **UnregisterClass** function to remove an application global class and free the storage associated with it.

Application Local Classes

An application local class is any window class created by an application for its exclusive use. This is the more common type of class created by an application. Use the **UnregisterClass** function to remove an application local class and free the storage associated with it.

How Windows Locates a Class

When an application creates a window with a specified class, Windows uses the following procedure to find the class:

1. Windows searches for a local class of the specified name.
2. If Windows does not find a local class with the name, it searches the application global class list.
3. If Windows does not find the name in the application global class list, it searches the system global class list.

This procedure is used for all windows created by the application, including windows created by Windows on the application's behalf, such as dialog boxes. It is possible, then, to override system global

classes without affecting other applications.

Class Ownership

Windows determines class ownership from the **hInstance** member of the **WNDCLASS** structure passed to the **RegisterClass** function when the application or DLL registers the class. For Windows DLLs, the **hInstance** member *must* be the instance handle of the DLL. When the application that registered the class closes or the DLL that registered the class is unloaded, the class is destroyed. For this reason, all windows using the class must be destroyed before the application closes or the DLL is unloaded.

Registering a Window Class

When Windows registers a window class, it copies the attributes into its own memory area. Windows uses these internally stored attributes when an application refers to the window class by name; it is not necessary for the application that originally registers the class to keep the structure available.

Shared Window Classes

An application must not share its registered classes with other applications. Some information in a window class, such as the address of the window procedure, is specific to a given application and cannot be used by other applications. However, applications can share an application global class. For more information, see Application Global Classes.

Although an application must not share one of its registered classes with other applications, different instances of the same application can share a registered class. Once a window class has been registered by an application, it is available to all subsequent instances of that application. This means that new instances of an application do not need to, and should not, register window classes that have been registered by previous instances.

Predefined Window Classes

Windows provides several predefined system-global window classes. These classes define special control windows that carry out common input tasks, such as letting the user direct scrolling, type text, and select from a list of names. The predefined window classes are available to all applications and can be used any number of times to create any number of control windows.

Elements of a Window Class

The elements of a window class define the default behavior of windows created from that class. The application that registers a window class assigns elements to the class by setting appropriate members in a **WNDCLASS** structure and passing the structure to the **RegisterClass** function. An application can retrieve information about a given window class with the **GetClassInfo** function. The window class elements are as follows:

Element	Purpose
Class name	Distinguishes the class from other registered classes.
Window-procedure address	Points to the function that processes all messages that are sent to windows in the class, and defines the behavior of the window.
Instance handle	Identifies the application or DLL that registered the class.
Class cursor	Defines the shape of the cursor when the cursor is in a window of the class.
Class icon	Defines the shape of the icon Windows displays when a window belonging to the class is minimized.
Class background brush	Defines the color and pattern Windows uses to fill the client area when the window is opened or painted. If this parameter is set to NULL, the window must paint its own background whenever it receives the **WM_ERASEBKGND** message.
Class menu	Specifies the default menu used for any window belonging to the class

	that does not explicitly define a menu.
Class styles	Defines how to update the window after moving or resizing, how to process double-clicks of the mouse, how to allocate space for the display context, and other aspects of the window.
Class extra	Specifies the amount of extra memory, in bytes, that Windows should reserve at the end of the **WNDCLASS** structure. Windows initializes this memory to zero.
Window extra	Specifies the amount of extra memory, in bytes, that Windows should reserve at the end of any window structure an application creates that has this class. Windows initializes this memory to zero.

The following sections describe the elements of a window class and explain the default values for these elements if no explicit value is given when the class is registered.

Class Name

Every window class needs a class name. The class name distinguishes one class from another. An application assigns a class name to the class by setting the **lpszClassName** member of the **WNDCLASS** structure to the address of a null-terminated string that specifies the name.

In the case of an application global class, the class name must be unique to distinguish it from other application global classes. If an application registers another application global class with the name of an existing application global class, the **RegisterClass** function returns zero, indicating failure. The conventional method for ensuring this uniqueness is to include the application name in the name of the application global class.

The class name must be unique among all the classes registered by an application. An application cannot register an application local class and an application global class with the same class name.

Window-Procedure Address

Every class needs a window-procedure address. The address defines the entry point of the window procedure that is used to process all messages for windows in the class. Windows passes messages to the procedure when it requires the window to carry out tasks, such as painting its client area or responding to input from the user. An application assigns a window-procedure to a class by copying its address to the **lpfnWndProc** member of the **WNDCLASS** structure. The window procedure must be exported in the module-definition (.DEF) file. For more information about exporting functions, see the EXPORTS topic.

Instance Handle

Every window class needs an instance handle to identify the application or DLL that registered the class. As a multitasking system, Windows lets several applications or DLLs run at the same time, so it needs instance handles to keep track of all applications and DLLs. Windows assigns a unique handle to each copy of a running application or DLL.

Multiple instances of the same application or DLL all use the same code segment, but each has its own data segment. Windows uses an instance handle to identify the data segment that corresponds to a particular instance of an application or DLL.

Windows passes an instance handle to an application or DLL when the application first begins operation. The application or DLL assigns this instance handle to the class by copying it to the **hInstance** member of the **WNDCLASS** structure.

Class Cursor

The class cursor defines the shape of the cursor when the cursor is in the client area of a window in the class. Windows automatically sets the cursor to the given shape as soon as the cursor enters the window's client area, and ensures that the cursor keeps that shape while it remains in the client area. To assign a cursor shape to a window class, an application typically loads a predefined cursor shape by using the **LoadCursor** function, and then assigns the returned cursor handle to the **hCursor**

member of the **WNDCLASS** structure. Alternatively, you can use Microsoft Image Editor (IMAGEDIT.EXE) to create your own custom cursor, and use Microsoft Windows Resource Compiler (RC) to add the cursor as a resource to your application's executable file. The application can then use the **LoadCursor** function to load the custom cursor from the application's resources.

Windows does not require a class cursor. If an application sets the **hCursor** member of the **WNDCLASS** structure to NULL, a class cursor is not defined. Windows assumes that the window will set the cursor shape each time the cursor moves into the window. A window can set the cursor shape by calling the **SetCursor** function whenever the window receives the **WM_MOUSEMOVE** message.

Class Icon

The class icon defines the shape of the icon used when the window of the given class is minimized. To assign an icon to a window class, an application typically loads the icon from the application's resources by using the **LoadIcon** function, and then assigns the returned icon handle to the **hIcon** member of the **WNDCLASS** structure.

Windows does not require that a window class have a class icon. If an application sets the **hIcon** member of the **WNDCLASS** structure to NULL, a class icon is not defined. In this case, Windows sends the **WM_ICONERASEBKGND** message to a window of the class whenever the window must paint the background of the icon. If the window does not process the WM_ICONERASEBKGND message, Windows draws an image of the contents of the window's client area onto the icon when it is minimized.

Class Background Brush

A class background brush is the brush used to prepare the client area of a window for subsequent drawing by the application. Windows uses the brush to fill the client area with a solid color or pattern, thereby removing all previous images from that location whether they belonged to the window or not. Windows notifies a window that its background needs to be painted by sending the **WM_ERASEBKGND** message to the window.

To assign a background brush to a class, an application can create a brush by using the appropriate functions from the graphics device interface (GDI) and then assign the returned brush handle to the **hbrBackground** member of the **WNDCLASS** structure.

Instead of creating a brush, an application can use a standard system color by setting the **hbrBackground** member to one of the standard system color values.

To use a standard system color, the application must increase the background-color value by one. For example, **COLOR_BACKGROUND** + 1 is the system background color.

Class Menu

A class menu defines the default menu to be used by the windows in the class if no explicit menu is given when the windows are created. A menu is a list of commands from which a user can select actions for the application to carry out. To assign a menu to a class, an application sets the **lpszMenuName** member of the **WNDCLASS** structure to the address of a null-terminated string that specifies the resource name of the menu. The menu is assumed to be a resource in the given application. Windows automatically loads the menu when it is needed. Note that if the menu resource is identified by an integer and not by a name, the application can set the **lpszMenuName** member to that integer value by applying the **MAKEINTRESOURCE** macro before assigning the value.

Windows does not require a class menu. If an application sets the **lpszMenuName** member of the **WNDCLASS** structure to NULL, Windows assumes that the windows in the class have no menu bars. Even if no class menu is given, an application can still define a menu bar for a window when it creates the window.

Windows does not allow menu bars with child windows. If a menu is given for a class and a child window of that class is created, the menu is ignored. For more information about menus, see Menus.

Class Styles

The class styles define additional elements of the window class. Two or more styles can be combined by using the bitwise OR (|) operator. The class styles are as follows:

Style	Description
CS_BYTEALIGNCLIENT	Aligns the window's client area on a byte boundary (in the x direction).
CS_BYTEALIGNWINDOW	Aligns the window on a byte boundary (in the x direction).
CS_CLASSDC	Allocates one display context to be shared by all windows in the class. For more information about device contexts, see Class and Private Display Contexts, and Display Context Types.
CS_DBLCLKS	Sends double-click messages to the window procedure.
CS_GLOBALCLASS	Specifies that the window class is an application global class. An application global class is created by an application or DLL and is available to all applications. The class is destroyed when the application or DLL that created the class closes; it is essential, therefore, that all windows created with the application global class be closed before the application or DLL closes.
CS_HREDRAW	Requests that the entire client area be redrawn if a movement or size adjustment changes the width of the client area.
CS_NOCLOSE	Inhibits the Close command on the System menu (sometimes referred to as the Control menu).
CS_OWNDC	Allocates a unique display context for each window in the class. For more information about device contexts, see Class and Private Display Contexts, and Display Context Types.
CS_PARENTDC	Gives the parent window's display context to the child windows. For more information about device contexts, see Class and Private Display Contexts, and Display Context Types.
CS_SAVEBITS	Saves, as a bitmap, the portion of the screen image that is obscured by a window; Windows uses the saved bitmap to re-create the screen image when the window is removed. Windows displays the bitmap at its original location and does not send **WM_PAINT** messages to windows that had been obscured by the window if the memory used by the bitmap has not been discarded and if other screen actions have not invalidated the stored image.
CS_VREDRAW	Requests that the entire client area be redrawn if a movement or size adjustment changes the height of the client area.

To assign a style to a window class, an application assigns the style value to the **style** member of the **WNDCLASS** structure.

Internal Data Structures

Windows maintains internal data structures for each window class and window. These structures are not directly accessible to applications but can be examined and modified by using the following functions:

- **GetClassInfo**
- **GetClassLong**
- **GetClassName**
- **GetClassWord**
- **GetWindowLong**
- **GetWindowWord**
- **SetClassLong**
- **SetClassWord**
- **SetWindowLong**
- **SetWindowWord**

Window Subclassing

A subclass is a window or set of windows that belong to the same window class, and whose messages are intercepted and processed by another window procedure (or procedures) before being passed to the class window procedure.

To create the subclass, the **SetWindowLong** function is used to change which window procedure is associated with a particular window, causing Windows to call the new window procedure instead of the previous one. An application must call the **CallWindowProc** function to pass to the previous window procedure any messages not processed by the new window procedure. This allows Windows to create a chain of window procedures. The application can retrieve the address of the previous window procedure by using the **GetWindowLong** function before using the **SetWindowLong** function.

Similarly, the **SetClassLong** function changes which window procedure is associated with a window class. Any window that is subsequently created with that class will be associated with the replacement window procedure for that class, as will the window whose handle is passed to **SetClassLong**. Other existing windows that were previously created with the class are not affected, however.

When an application subclasses a window or class of windows, it must export the replacement window procedure in its module-definition file, call the **MakeProcInstance** function to create the address of the procedure, and pass the address to the **SetWindowLong** or **SetClassLong** function.

Redrawing the Client Area

When a window is moved, Windows automatically copies the contents of the client area to the new location. This saves time because a window does not have to recalculate and redraw the contents of the client area as part of the move. If the window moves and changes size, Windows copies only as much of the previous client area as is needed to fill the new location. If the window increases in size, Windows copies the entire client area and sends a **WM_PAINT** message to the window to fill in the newly exposed areas.

When a window is moved, Windows assumes the contents of the client area remain valid and can be copied without modification to the new location. For some windows, however, the contents of the client area are not valid after a move, especially if the move includes a change in size. For example, a clock application whose window must always contain the complete image of the clock has to redraw the window anytime the window changes size, *and* has to update the time after the move. To redraw the entire client area instead of copying the previous contents each time a window changes size, a window should specify the **CS_VREDRAW** and **CS_HREDRAW** styles in the window class.

Class and Private Display Contexts

A display context is a special set of values that applications use for drawing in the client area of their windows. Windows requires a display context for each window on the system display but allows some flexibility in how that display context is stored and treated by the system.

If no display-context style is explicitly given, Windows assumes that each window will use a display context retrieved from a pool of contexts maintained by Windows. In such cases, each window must retrieve and initialize the display context before painting, and then free it after painting.

To avoid retrieving a display context each time it needs to paint inside a window, an application can specify the **CS_OWNDC** style for the window class. This class style directs Windows to create a private display context--that is, to allocate a unique display context for each window in the class. The application need only retrieve the context once, and then use it for all subsequent painting. Although the CS_OWNDC style is convenient, it must be used carefully because each display context uses a significant amount of system resources.

By specifying the **CS_CLASSDC** style, an application can have some of the convenience of a private display context without allocating a separate display context for each window. The CS_CLASSDC style directs Windows to create a single class display context--that is, one display context to be shared by all windows in the class. An application need only retrieve the display context for a window; as long as no other window in the class retrieves that display context, the window can continue to use the

context.

Similarly, by specifying the **CS_PARENTDC** style, an application can create child windows that inherit the device context of their parent.

Window Procedures

A window procedure processes all messages sent to all windows in a given class. Windows sends messages to a window procedure when it receives input from the user that is intended for the given window, or when it needs the procedure to carry out some action on its window, such as painting inside the client area.

A window procedure receives the following types of messages:

- Input messages from the keyboard, mouse or other pointing device, and timer
- Requests for information, such as a request for the window title
- Reports of changes made to the system by other windows, such as a change to the WIN.INI file
- Messages that give the window procedure an opportunity to modify the standard system response to certain actions, such as an opportunity to adjust a menu before it is displayed
- Requests to carry out some action on its window or client area, such as a request to update the client area
- Information about its status in relation to other windows, such as its losing access to the keyboard or becoming the active window

Most of the messages a window procedure receives are from Windows, but it can also receive messages from other windows, including windows it owns. These messages can be requests for information or notification that a given event has occurred within another window.

A window procedure continues to receive messages from the system and possibly other windows in the system until the window procedure, the window procedure of a parent window, or the system destroys the window. Even while the window is in the process of being destroyed, the window procedure receives additional messages that give it the opportunity to carry out any cleanup tasks before terminating. These messages include **WM_CLOSE**, **WM_DESTROY**, **WM_QUERYENDSESSION**, and WM_ENDSESSION. But once the window is destroyed, no more messages are passed to the procedure for that particular window. If there is more than one window of the class, however, the window procedure continues to receive messages for the other windows until they, too, are destroyed.

A window procedure defines how all windows of a given window actually behave; that is, it defines what response the windows make to commands from the user or system. The window procedure must examine messages it receives from the system and determine what action, if any, to take. For example, if the user clicks the scroll bar, the window procedure may scroll the contents of the client area. Windows passes information that affects a window and provides some tools to carry out tasks, such as drawing and scrolling, but the window procedure must carry out each actual task.

A window procedure can also choose not to respond to a given message. If it does not respond, the procedure must pass the message to the **DefWindowProc** function to give the system the opportunity to respond. This function carries out default actions based on the given message and its parameters. Many messages, especially nonclient-area messages, must be processed, so the **DefWindowProc** function is required in all window procedures.

A window procedure also receives messages that are really intended to be processed by the system. These messages, called nonclient-area messages, inform the procedure either that the user has carried out some action in a nonclient area of the window, such as clicking the title bar, or that some information about the window is required by the system to carry out an action, such as to move or adjust the size of the window. Although Windows passes these messages to the window procedure, the procedure should pass them to the **DefWindowProc** function and not attempt to process them. In any case, the window procedure must not ignore the message or return without passing it to **DefWindowProc**.

Window Messages

A window message is a set of values that Windows sends to a window procedure to provide input to the window or request the window to carry out some action. Windows includes a wide variety of

messages that it or applications can send to a window procedure. Most messages are sent to a window as a result of a given function being executed or as a result of input from the user.

Every message consists of four values: a handle that identifies the window, a message identifier, a 16-bit message-specific value, and a 32-bit message-specific value. These values are passed as individual parameters to the window procedure. The window procedure then examines the message identifier to determine what response to make and how to interpret the 16- and 32-bit values.

A window procedure must use the Pascal calling convention. The following illustrates the window procedure syntax:

LONG FAR PASCAL *WndProc***(***hwnd***,** *wMsg***,** *wParam***,** *lParam***)**
HWND *hwnd***;**
WORD *wMsg***;**
WORD *wParam***;**
DWORD *lParam***;**

The *hwnd* parameter identifies the window receiving the message; the *wMsg* parameter is the message identifier; the *wParam* parameter is 16 bits of additional message-specific information; and *lParam* is 32 bits of additional message-specific information. The window procedure must return a 32-bit value that indicates the result of message processing. The possible return values depend on the actual message sent.

Windows expects to make an intersegment call to the window procedure, so the procedure must be declared with the **FAR** attribute. The window-procedure name must be exported by including it in an **EXPORTS** statement in the application's module-definition file.

Default Window Procedure

The **DefWindowProc** function is the default message processor for window procedures that do not or cannot process some of the messages sent to them. For most window procedures, the **DefWindowProc** function carries out most, if not all, processing of nonclient-area messages. These are the messages that signify actions to be carried out on parts of the window other than the client area. The messages that **DefWindowProc** processes and the default actions for each are as follows:

Message	Default action
WM_ACTIVATE	Activates or deactivates a window.
WM_CANCELMODE	Cancels internal processing of standard scroll bar input, cancels internal menu processing, and releases mouse capture.
WM_CHARTOITEM	Returns -1.
WM_CLOSE	Calls the **DestroyWindow** function.
WM_CTLCOLOR	Sets the background and text color and returns a handle of the brush used to fill the control background.
WM_DRAWITEM	Draws the focus rectangle for an owner-drawn list box item.
WM_ERASEBKGND	Fills the client area with the color and pattern specified by the class brush, if any.
WM_GETTEXT	Copies the window title into a specified buffer.
WM_GETTEXTLENGTH	Returns the length, in bytes, of the window title.
WM_ICONERASEBKGND	Fills the icon's client area with the window's background brush.
WM_KEYUP	Sends a **WM_SYSCOMMAND** message to the top-level window if the F10 key or the ALT key was released. The *wParam* parameter of the message is set to SC_KEYMENU.
WM_MOUSEACTIVATE	Sends the **WM_MOUSEACTIVATE** response to the parent window. The parent determines whether to activate the child window.
WM_NCACTIVATE	Activates or deactivates the window and draws the icon or title bar to show the new state.

WM_NCCALCSIZE	Computes the size of the client area.
WM_NCCREATE	Initializes standard scroll bars, if any, and sets the default title for the window.
WM_NCDESTROY	Frees any space internally allocated for the window title.
WM_NCHITTEST	Finds out what part of the window the mouse is in.
WM_NCLBUTTONDBLCLK	Tests the given point to find out the location of the mouse and, if necessary, generates additional messages.
WM_NCLBUTTONDOWN	Finds out whether the left mouse button was pressed while the mouse was in the nonclient area of a window.
WM_NCLBUTTONUP	Tests the given point to find out the location of the mouse and, if necessary, generates additional messages.
WM_NCMOUSEMOVE	Tests the given point to find out the location of the mouse and, if necessary, generates additional messages.
WM_NCPAINT	Paints the nonclient areas of the window.
WM_PAINT	Validates the current update region, but does not paint the region.
WM_QUERYENDSESSION	Returns TRUE.
WM_QUERYOPEN	Returns TRUE.
WM_SETCURSOR	Displays the appropriate mouse cursor, based on the position of the cursor.
WM_SETREDRAW	Forces an immediate update of information about the clipping region of the complete window.
WM_SETTEXT	Sets and displays the window title.
WM_SHOWWINDOW	Opens or closes a window.
WM_SYSCHAR	Generates a **WM_SYSCOMMAND** message for menu input.
WM_SYSCOMMAND	Carries out the requested system command.
WM_SYSKEYDOWN	Examines the given key and generates a **WM_SYSCOMMAND** message if the key is either TAB or ENTER.
WM_SYSKEYUP	Sends a **WM_SYSCOMMAND** message to the top-level window if the F10 key or the ALT key was released. The *wParam* parameter of the message is set to SC_KEYMENU.
WM_VKEYTOITEM	Returns -1.
WM_WINDOWPOSCHANGED	Sends the **WM_SIZE** and **WM_MOVE** messages to the window.
WM_WINDOWPOSCHANGING	Sends the **WM_GETMINMAXINFO** message to the window if the window has the **WS_OVERLAPPED** or **WS_THICKFRAME** style.

Window Styles

Windows provides several different window styles that can be combined to form different kinds of windows. The styles are used in the **CreateWindow** function when the window is created.

Overlapped Windows

An overlapped window is always a top-level window. In other words, an overlapped window never has a parent window. It has a client area, a border, and a title bar. It can also have a System menu, Minimize and Maximize buttons, scroll bars, and a menu, if these items are specified when the window is created. For a window used as a main interface, the System menu and Minimize and Maximize buttons are strongly recommended.

Every overlapped window can have a corresponding icon that Windows displays when the window is minimized. A minimized window is not destroyed. It can be restored to its previous size and position. An application minimizes a window to save screen space when several windows are open at the same time.

An application creates an overlapped window by using the **WS_OVERLAPPED** or **WS_OVERLAPPEDWINDOW** style with the **CreateWindow** function. An overlapped window created with the WS_OVERLAPPED style always has a title bar and a border. The WS_OVERLAPPEDWINDOW style creates an overlapped window with a title bar, a thick-frame border, a System menu, and Minimize and Maximize buttons.

Owned Windows

An owned window is a special type of overlapped window. Every owned window must be owned by an overlapped window. Being owned forces several constraints on a window:

- An owned window is always in front of its owner when the windows are in z-order. Attempting to move the owner--that is, on an imaginary z-axis extending in front of the owned window from the screen toward the user--causes the owned window also to change position to ensure that it will always be in front of its owner.
- Windows automatically destroys an owned window when it destroys the window's owner.
- An owned window is hidden when its owner is minimized.

An application creates an owned window by specifying the owner's window handle as the *hWndParent* parameter of the **CreateWindow** function when creating a window that has the **WS_OVERLAPPED** style.

Dialog boxes are owned windows by default. The function that creates the dialog box receives the handle of the owner window as its *hWndParent* parameter.

Pop-up Windows

Pop-up windows are another special type of overlapped window. The main difference between a pop-up window and other overlapped windows is that an overlapped window always has a title bar, whereas the title bar is optional for a pop-up window. Like other overlapped windows, pop-up windows can be owned.

You create a pop-up window by using the **WS_POPUP** window style with the **CreateWindow** function. An application can use the **ShowWindow** function to open or close a pop-up window.

Child Windows

A child window is a window that is confined to the client area of a parent window. Child windows are typically used to divide the client area of a parent window into different functional areas.

You create a child window by using the **WS_CHILD** window style with the **CreateWindow** function. An application can use the **ShowWindow** function to show or hide a child window.

Every child window must have a parent window. The parent window can be an overlapped window, a pop-up window, or even another child window. The parent window relinquishes a portion of its client area to the child window, and the child window receives all input from this area. The window class does not have to be the same for each of the child windows of the parent window. This means an application can fill a parent window with child windows that look different and carry out different tasks.

A child window has a client area, but it does not have any other features unless these are explicitly requested. An application can request a border, title bar, Minimize and Maximize buttons, and scroll bars for a child window. In most cases, the application designs its own features for the child window.

Although it is not required, every child window should have a unique integer identifier. The identifier, given in the *hmenu* parameter of the **CreateWindow** function in place of a menu, helps identify the child window when its parent window has other child windows. The child window should use this identifier in any messages it sends to the parent window. This is the way a parent window with multiple child windows can identify which child window is sending the message. Child windows that share the same parent window are sibling windows.

Windows always positions the child window relative to the upper-left corner of the parent window's client area. The coordinates are always client coordinates. (For information about mapping, see Graphics Device Interface Overview.) If all or part of a child window is moved outside the visible

portion of the parent window's client area, the child window is clipped; that is, the portion outside the parent window's client area is not displayed.

A child window is an independent window that receives its own input and other messages. Input intended for a child window goes directly to the child window and is not passed through the parent window. The only exception is if input to the child window has been disabled by the **EnableWindow** function. In this case, Windows passes any input that would have gone to the child window to the parent window instead. This gives the parent window an opportunity to examine the input and enable the child window, if necessary.

Actions that affect the parent window can also affect the child window, as follows:

Parent window	Child window
Shown	Shown after the parent window is shown.
Hidden	Hidden before the parent window is hidden. A child window can be visible only when the parent window is visible.
Destroyed	Destroyed before the parent window is destroyed.
Moved	Moved with the parent window's client area. The child window is responsible for painting after the move.
Increased in size or maximized	Paints any portions of the parent window that have been exposed as a result of the increased size of the client area.

Windows does not automatically clip a child window from the parent window's client area. This means the parent window draws over the child window if it carries out any drawing in the same location as the child window. Windows does clip the child window from the parent window's client area if the parent window has a **WS_CLIPCHILDREN** style. If the child window is clipped, the parent window cannot draw over it.

A child window can overlap other child windows in the same client area. Sibling windows can draw in each other's client area unless one child window has a **WS_CLIPSIBLINGS** style. If the application specifies this style for a child window, any portion of that child's sibling window that lies within this window is clipped.

If a window has either the **WS_CLIPCHILDREN** or **WS_CLIPSIBLINGS** style, a slight loss in performance occurs.

Each window takes up system resources, so an application should not use child windows indiscriminately. For optimum performance, an application that needs to logically divide its main window should do so in the window procedure of the main window rather than by using child windows.

Multiple Document Interface Windows

Windows MDI provides applications with a standard interface for displaying multiple documents within the same instance of an application. An MDI application creates a frame window that contains a client window in place of its client area. An application creates an MDI client window by calling **CreateWindow** with the class MDICLIENT and passing a **CLIENTCREATESTRUCT** structure as the function's *lpParam* parameter. This client window in turn can own multiple child windows, each of which displays a separate document. An MDI application controls these child windows by sending messages to its client window.

Title Bar

The title bar, a rectangle at the top of the window, provides space for the window title or name. An application defines the window title when it creates the window. It can also change this name anytime by using the **SetWindowText** function. A title bar makes it possible for the user to move the window by using a mouse or other pointing device.

System Menu

The System menu, identified by a box at the left end of the title bar, is a pop-up menu that contains the

system commands. (The System menu is sometimes referred to as the Control menu.) The system commands are commands that can be selected by the user to direct Windows to carry out actions that affect the window, such as moving and closing it.

To create a window with a System menu or Close box, the application must specify both the **WS_SYSMENU** and **WS_CAPTION** window styles when the window is created.

Scroll Bars

The horizontal and vertical scroll bars are bars on the lower and right sides of a window, respectively, making it possible for a user to scroll the contents of the client area. Windows sends scroll requests to a window as **WM_HSCROLL** and **WM_VSCROLL** messages. If the window permits scrolling, the window procedure must process these messages.

A window can have one or both scroll bars. To create a window with a scroll bar, the application must specify the **WS_HSCROLL** or **WS_VSCROLL** window style when the window is created. An application can use the **ShowScrollBar** function to show or hide a scroll bar of a window with the WS_HSCROLL or WS_VSCROLL style.

Menus

A menu is a list of commands from which the user can select using the mouse or other pointing device or the keyboard. When the user selects an item, Windows sends a corresponding message to the window procedure to indicate which command was selected. Windows provides two types of menus: menu bars (sometimes called static menus) and pop-up menus.

A menu bar is a horizontal menu that appears at the top of a window and below the title bar, if one exists. Any window except a child window can have a menu bar. If an application does not specify a menu when it creates a window, the window receives the default menu bar (if any) defined by the window class.

A pop-up menu contains a vertical list of items and is often displayed when a user selects a menu-bar item. In turn, a pop-up menu item can display another pop-up menu. A pop-up menu can float--that is, it can appear anywhere on the screen designated by the application. An application creates an empty pop-up menu by calling the **CreatePopupMenu** function, and then fills in the menu using the **AppendMenu** and **InsertMenu** functions. It displays the pop-up menu by calling **TrackPopupMenu**.

An application can create or modify an individual menu item with the **MF_OWNERDRAW** style, indicating that the item is an owner-drawn item. In this case, the owner of the menu is responsible for drawing all visual aspects of the menu item, including checked, grayed, and highlighted states. When the menu is displayed for the first time, the window that owns the menu receives a **WM_MEASUREITEM** message. The *lParam* parameter of this message points to a **MEASUREITEMSTRUCT** structure. The owner then fills in this structure with the dimensions of the item and returns. Windows uses the information in the structure to determine the size of the item so that Windows can appropriately detect the user's interaction with the item. Windows sends the **WM_DRAWITEM** message whenever the owner of the menu must update the visual appearance of an owner-drawn menu item. A top-level menu item cannot be an owner-drawn item.

An application can call the **AppendMenu**, **InsertMenu**, or **ModifyMenu** function to add an owner-drawn menu item to a menu or to change an existing menu item to be an owner-drawn menu item. To maintain additional data associated with the item, the application can supply a 32-bit value for the *lpNewItem* parameter of the function. This value is available to the application as the **itemData** member of the structures pointed to by the *lParam* parameter of the **WM_MEASUREITEM** and **WM_DRAWITEM** messages. For example, if an application were to draw the text in a menu item by using a specific color, the 32-bit value could contain a pointer to a string. The application could then set the text color before drawing the item when it received the WM_DRAWITEM message.

Window State

The window state can be open (minimized, maximized, or restored), hidden or visible, and enabled or disabled. The initial state of a window depends on whether the following window styles are used:

- **WS_DISABLED**
- **WS_MINIMIZE**
- **WS_MAXIMIZE**
- **WS_VISIBLE**

By default, Windows creates windows that are initially enabled--that is, windows that can start receiving input messages immediately. An application can disable input to a new window by specifying the **WS_DISABLED** window style.

A new window is not displayed until an application opens it by using the **ShowWindow** function or specifies the **WS_VISIBLE** window style when it creates the window. For overlapped windows, the **WS_ICONIC** window style creates a window that is minimized initially.

Life Cycle of a Window

Because the purpose of any window is to make it possible for the user to specify data or for the application to display information, a window starts its life cycle when the application has a need for input or output. A window continues its life cycle until there is no longer a need for it or the application is closed. Some windows, such as the window used for the application's main user interface, last the life of the application. Other windows, such as a window used as a dialog box, may last only a few seconds.

The first step in a window's life cycle is creation. Given a registered window class with a corresponding window procedure, the application uses the **CreateWindow** function to create the window. This function directs Windows to prepare internal structures for the window and to return a unique integer value, called a window handle, that the application can use to identify the window in subsequent function calls.

The first message most windows process is **WM_CREATE**, the window-creation message. The **CreateWindow** function sends this message to inform the window procedure that it can now perform any initialization, such as allocating memory and preparing data files. The *wParam* parameter is not used, but the *lParam* parameter contains a long pointer to a **CREATESTRUCT** structure, whose members correspond to the parameters passed to **CreateWindow**.

The **WM_CREATE** message is sent directly to the window procedure, bypassing the application's message queue. This means an application creates a window and processes the WM_CREATE message before it enters the main message loop.

After a window has been created, it must be opened (displayed) before it can be used. An application can open the window in one of two ways: It can specify the **WS_VISIBLE** window style in the **CreateWindow** function to open the window immediately after creation, or it can wait until later and call the **ShowWindow** function to open the window. When creating a main window, an application should not specify WS_VISIBLE, but should call **ShowWindow** from the **WinMain** function with the *nCmdShow* parameter set to specify the window state.

When the window is no longer needed or the application is terminated, the window must be destroyed. This is done by using the **DestroyWindow** function. **DestroyWindow** removes the window from the system display and invalidates the window handle. It also sends **WM_DESTROY** and **WM_NCDESTROY** messages to the window procedure. The **DestroyWindow** function also destroys all of the window's child and owned windows.

The window procedure also receives a **WM_DESTROY** message when the **WM_CLOSE** message is processed by the **DefWindowProc** function. When a window procedure receives a WM_DESTROY message, it should free any allocated memory and close any open data files.

The window used as the application's main user interface should always be the last window destroyed and should always cause the application to terminate. When this window receives a **WM_DESTROY** message, it should call the **PostQuitMessage** function. This function copies a **WM_QUIT** message to the application's message queue as a signal for the application to close when the message is read from the queue.

Painting

This section describes the system display and the preparation of windows for painting and other general-purpose graphics operations.

How Windows Manages the Display

The system display is the principal display device for all applications running with Windows. All applications are free to display some form of output on the system display; but because many applications can run at one time, the complete system display must be shared. Windows shares the system display by carefully managing the access that applications have to it. Windows ensures that each application has space to display output but does not draw in the space reserved for other applications.

Windows manages the system display by using display contexts. The display context is a special device context that treats each window as a separate display surface. An application that retrieves a display context for a specific window has complete control of the system display within that window, but cannot access or paint over any part of the display outside the window.

Display Context Types

There are four types of display contexts: common, class, private, and window. The common, class, and private display contexts permit drawing in the client area of a given window. The window display context permits drawing anywhere in the window. When a window is created, Windows assigns a common, class, or private display context to it, based on the type of display context specified in that window's class style. A window display context can be used for painting within a window's nonclient area.

Common Display Context

A common display context is the default context for all windows. Windows assigns a common display context to the window if a display-context type is not explicitly specified in the window's class style.

A common display context permits drawing in a window's client area, but it is not immediately available for use by a window. A common display context must be retrieved from a cache of display contexts before a window can carry out any drawing in its client area. The **GetDC** or **BeginPaint** function retrieves the display context and returns a handle of the context. The handle can be used with GDI functions to draw in the client area of the given window. After drawing is complete, an application must use the **ReleaseDC** or **EndPaint** function to return the context to the cache. After the context is released, drawing cannot occur until another display context is retrieved.

When a common display context is retrieved, Windows gives it default selections for the tools currently available to carry out the actual drawing. The default selections for a common display context are as follows:

Attribute	Default
Background color	Background color setting from Windows Control Panel (typically, white).
Background mode	OPAQUE.
Bitmap	No default.
Brush	WHITE_BRUSH.
Brush origin	(0,0).
Clipping region	Entire client area with the update region clipped as appropriate. Child and pop-up windows in the client area may also be clipped.
Color palette	DEFAULT_PALETTE.
Current pen position	(0,0).
Device origin	Upper-left corner of client area.
Drawing mode	R2_COPYPEN.

Font	**SYSTEM_FONT** (**SYSTEM_FIXED_FONT** for applications written to run with Windows versions 3.0 or earlier).
Intercharacter spacing	0.
Mapping mode	MM_TEXT.
Pen	BLACK_PEN.
Polygon-filling mode	ALTERNATE.
Relative-absolute flag	ABSOLUTE.
Stretching mode	BLACKONWHITE.
Text color	Text color setting from Control Panel (typically, black).
Viewport extent	(1,1).
Viewport origin	(0,0).
Window extent	(1,1).
Window origin	(0,0).

An application can modify the attributes of the display context by using the selection functions and display-context attribute functions. For example, applications typically change the selected pen, brush, and font.

When a common display context is released, the current selections, such as mapping mode and clipping region, are lost. Windows does not preserve the previous selections of a common display context. Applications that modify the attributes of a common display context must do so each time another context is retrieved.

Class Display Context

A window has a class display context if the window class specifies the **CS_CLASSDC** style. A class display context is shared by all windows in a given class. A class display context is not part of the display context cache. Instead, Windows specifically allocates a class context for exclusive use by the window class.

A class display context must be retrieved before it can be used, but it does not have to be released after use. As long as only one window from the class uses the context, the class display context can be kept and reused. If another window in the class needs to use the context, that window must retrieve it before any drawing occurs. Retrieving the context sets the correct device origin and clipping region for the new window and ensures that the context is applied to the correct window. An application can use the **GetDC** or **BeginPaint** function to retrieve a handle of the class display context. The **ReleaseDC** and **EndPaint** functions have no effect on a class display context.

A class display context is given the same default selections as a common display context when the first window of the class is created. These selections can be modified at any time. Windows preserves all new selections made for the class display context, except for the clipping region and device origin, which are adjusted for the current window when the context is retrieved. This means a change made by one window applies to all windows that subsequently use the context.

Note: Changing the mapping mode of a class display context may have an undesirable effect on how a window's background is erased. For more information, see Window Background, and Graphics Device Interface Overview.

Private Display Context

A window has a private display context if the window class specifies the **CS_OWNDC** style. A private display context is used exclusively by a given window. A private display context is not part of the display context cache. Instead, Windows specifically allocates the context for exclusive use by the window. Although using private display contexts is convenient, they are expensive in terms of system resources, so an application should use them sparingly.

A private display context needs to be retrieved only once. Thereafter, it can be kept and used any number of times by the window. Windows automatically updates the context to reflect changes to the

window, such as moving or sizing. An application can use the **GetDC** or **BeginPaint** function to retrieve a handle of a private display context. The **ReleaseDC** and **EndPaint** functions have no effect on a private display context.

A private display context is given the same default selections as a common display context when the window is created. These selections can be modified at any time. Windows preserves any new selections made for the context. New selections, such as of a clipping region or brush, remain selected until the window specifically makes a change.

Note: Changing the mapping mode of a private display context may have an undesirable effect on how the window's background is erased. For more information, see Window Background, and Graphics Device Interface Overview.

Window Display Context

A window display context permits painting anywhere in a window, including the title bar, menus, and scroll bars. Its origin is the upper-left corner of the window instead of the upper-left corner of the client area.

The **GetWindowDC** function retrieves a window display context from the same cache as it does common display contexts. Therefore, a window that uses a window display context must release it with the **ReleaseDC** function immediately after drawing.

Windows always sets the current selections of a window display context to the same default selections as a common display context and does not preserve any change the window may have made to these selections. The **CS_OWNDC** and **CS_CLASSDC** class styles have no effect on the window display context.

A window display context is intended to be used for special painting within a window's nonclient area. Because painting in nonclient areas of overlapped windows is not recommended, most applications reserve a display context for designing custom child windows. For example, an application can use the display context to draw a custom border around the window. In such cases, the window usually processes the **WM_NCPAINT** message instead of passing it to the **DefWindowProc** function. For applications that do not process WM_NCPAINT messages but still need to paint within the nonclient area, the **GetSystemMetrics** function can be used to retrieve the dimensions of various parts of the nonclient area, such as the title bar, menu bar, and scroll bars.

Display-Context Cache

Windows maintains a cache of display contexts that it uses for common display contexts and window display contexts. This cache contains five display contexts, which means only five common display contexts can be active at any one time. To prevent more than five from being retrieved, a window that uses a common or window display context must release that context immediately after drawing.

If a window fails to release a common display context, all five display contexts may eventually be active and unavailable for any other window. In such a case, Windows ignores all subsequent requests for a common display context. In the retail version of Windows, the system appears to be deadlocked, while the debugging version of Windows undergoes a fatal exit, alerting you of a problem.

The **ReleaseDC** function releases a display context and returns it to the cache. Class and private display contexts are individually allocated for each class or window; they do not belong to the cache, so they do not need to be released after use.

Painting Sequence

To manage the system display, Windows carries out many operations that affect the contents of the client area. If Windows moves, sizes, or alters the appearance of the screen, the change may affect a given window. If so, Windows marks the area changed by the operation as ready for updating and, at the next opportunity, sends a **WM_PAINT** message to the window so that it can update the window in the update region. If a window paints in its client area, it must call the **BeginPaint** function to retrieve a handle of a display context, must update the changed area as defined by the update region, and finally, must call the **EndPaint** function to complete the operation.

A window can paint within its client area at any time--that is, at times other than in response to a **WM_PAINT** message. The only requirement is that it retrieve a display context for the client area before carrying out any operations.

WM_PAINT Message

The **WM_PAINT** message is a request from Windows to a given window to update its display. Windows sends a WM_PAINT message to a window whenever it is necessary to repaint a portion of the window. When a window receives a WM_PAINT message, it should retrieve the update region by using the **BeginPaint** function, and it should carry out whatever operations are necessary to update that part of the client area.

The **InvalidateRect** and **InvalidateRgn** functions do not actually generate **WM_PAINT** messages. Instead, Windows accumulates the changes made by these functions and its own changes while a window processes other messages in its message queue. Postponing the WM_PAINT message lets a window process all changes at once instead of updating bits and pieces in time-consuming individual steps.

To direct Windows to send a **WM_PAINT** message, an application can use the **UpdateWindow** function. The **UpdateWindow** function sends the message directly to the window, regardless of the number of other messages in the application's message queue. **UpdateWindow** is typically used when a window needs to update its client area immediately, such as just after the window is created.

Once a window receives a **WM_PAINT** message, it must call the **BeginPaint** function to retrieve the display context for the client area and to retrieve other information such as the update region and whether the background has been erased.

Windows automatically selects the update region as the clipping region of the display context. Since GDI discards (clips) drawing that extends outside the clipping region, only drawing that is in the update region is actually visible. For more information about the clipping region, see Graphics Device Interface Overview.

The **BeginPaint** function clears the update region to prevent the same region from generating subsequent **WM_PAINT** messages.

After completing the painting operation, the window must call the **EndPaint** function to release the display context.

Update Region

An update region defines the part of the client area that is marked for painting on the next **WM_PAINT** message. The purpose of the update region is to save applications the time it takes to paint the entire contents of the client area. If only the part that needs painting is added to the update region, only that part is painted. For example, if a word changes in the client area of a word-processing application, only the word needs to be painted, not the entire line of text. This saves the time it takes the application to draw the text, especially if there are many different sizes and fonts.

The **InvalidateRect** and **InvalidateRgn** functions add a given rectangle or region to the update region. The rectangle or region must be given in client coordinates. The update region itself is defined in client coordinates. Windows adds its own rectangles and regions to a window's update region after operations such as moving, sizing, and scrolling the window.

The **ValidateRect** and **ValidateRgn** functions remove a given rectangle or region from the update region. These functions are typically used when the window has updated a specific part of the display in the update region before receiving the **WM_PAINT** message.

The **GetUpdateRect** function retrieves the smallest rectangle that encloses the entire update region. The **GetUpdateRgn** function retrieves the update region itself. These functions can be used to compute the current size of the update region to determine if painting is required.

Window Background

The window background is the color or pattern the client area is filled with before a window begins

painting in the client area. Windows paints the background for a window or gives the window the opportunity to do so by sending a **WM_ERASEBKGND** message to the window when the application calls the **BeginPaint** function.

The background is important because if it is not erased, the client area will contain whatever was originally on the screen before the window was moved there. Windows erases the background by filling it with the background brush specified by the window's class.

Windows applications that use class or private display contexts should be careful about erasing the background. Windows assumes the background is to be computed by using the MM_TEXT mapping mode. If the display context has any other mapping mode, the area erased may not be within the visible part of the client area.

Brush Alignment

Brush alignment is particularly important on the system display where scrolling and moving are commonplace. A brush is a pattern of bits with a minimum size of 8-by-8 bits. GDI paints with a brush by repeating the pattern again and again within a given rectangle or region. If the region is moved by an arbitrary amount--for example, if the window is scrolled--and the brush is used again to fill empty areas around the original area, there is no guarantee that the original pattern and the new pattern will be aligned. For example, if the scroll moves the original filled area up one pixel, the intersection of the original area and any new painting will be out of alignment by one pixel, or bit. Depending on the pattern, this may have an undesirable visual effect. For more information about brushes, see Graphics Device Interface Overview.

To ensure that a brush is aligned after a window is moved, an application must take the following steps:

1. Call the **SelectObject** function to select a different brush to be the current brush.
2. Call the **SetBrushOrg** function to realign the current brush.
3. Call the **UnrealizeObject** function to realign the origin of the original brush when it is selected next. (**UnrealizeObject** should not be used on stock objects, only on brushes created by the application.)
4. Call the **SelectObject** function to select the original brush.

Painting Rectangular Areas

The **FillRect**, **FrameRect**, and **InvertRect** functions provide an easy way to carry out painting operations on rectangles in the client area.

The **FillRect** function fills a rectangle with the color and pattern of a given brush. This function fills all parts of the rectangle, including the edges or borders.

The **FrameRect** function uses a brush to draw a border around a rectangle. The border width and height is one unit.

The **InvertRect** function inverts the contents of the given rectangle. On monochrome displays, white pixels become black, and vice versa. On color displays, the results depend on the method used by the display to generate color. In either case, calling **InvertRect** twice with the same rectangle restores the screen to its original colors.

Drawing Icons

The **DrawIcon** function draws an icon at a given location in the client area. An icon is a bitmap that a window uses as a symbol to represent an item, such as an application or a warning.

You can use the Image Editor to create an icon and then use Microsoft Windows Resource Compiler (RC) to add the icon to your application's resources. Your application can then call the **LoadIcon** function to load the icon into memory.

Applications can also call the **CreateIcon** function to create an icon and can modify a previously

loaded or created icon at any time. An icon resource is in global memory, and the icon's handle is the handle of that memory. An application can free memory used to store an icon created by **CreateIcon** by calling the **DeleteIcon** function.

Drawing Formatted Text

The **DrawText** function formats and draws text within a given rectangle in the client area. This function provides simple text processing that most applications can use to display text. **DrawText** output is similar to the output generated by a terminal, except it uses the selected font and can clip the text if it extends outside a given rectangle. **DrawText** provides many different formatting styles.

The **DrawText** function uses the currently selected font, so applications can draw formatted text in a font other than the system font.

DrawText does not hyphenate, and although it can left align, right align, or center text, it cannot combine alignment styles. In other words, it cannot align to both the left and right.

DrawText recognizes a number of control characters and carries out special actions when it encounters them. The control characters and their respective actions are as follows:

Windows character	Action
Carriage return (13)	Interpreted as a line-break character. The text is immediately broken and continued on the next line down in the rectangle.
Linefeed (10)	Interpreted as a line-break character. The text is immediately broken and continued on the next line down in the rectangle. A carriage return–linefeed character combination is interpreted as a single line-break character.
Space (32)	Interpreted as a wordwrap character if the **DT_WORDBREAK** style is given. If the text is too long to fit on the current line in the formatting rectangle, the line is broken at the wordwrap character that is closest to the end of the line.
Tab (9)	Expanded into a given number of spaces if the **DT_EXPANDTABS** style is given. The number of spaces depends on which tab-stop value is given with the **DT_TABSTOP** style. The default value is eight.

Drawing Gray Text

An application can draw gray text by calling the **SetTextColor** function to set the current text color to **COLOR_GRAYTEXT**, the solid gray system color used to draw disabled text. However, if the current display driver does not support a solid gray color, this value is set to zero.

The **GrayString** function is a multiple-purpose function that gives applications another way to gray text or carry out other customized operations on text or bitmaps before drawing the result in a client area. To gray text, the function creates a memory bitmap, draws the string in the bitmap, and then grays the string by combining it with a gray brush. The **GrayString** function finally copies the gray text to the display. However, an application can intercept or modify each step of this process to carry out custom effects, such as changing the gray brush to a patterned brush or drawing an icon instead of a string.

If **GrayString** is used to draw gray text only, **GrayString** uses the selected font of the given display context. First, **GrayString** sets text color to black. It then creates a bitmap and uses the **TextOut** function to write a given string to the bitmap. It then uses the **PatBlt** function and a gray brush to gray the text, and uses the **BitBlt** function to copy the bitmap to the client area.

GrayString assumes that the display context for the client area has MM_TEXT mapping mode. Other mapping modes cause undesirable results.

GrayString lets an application modify this graying procedure in three ways: by defining an additional brush to be combined with the text before the text is displayed, by replacing the call to the **TextOut** function with a call to an application-supplied function, and by disabling the call to the **PatBlt** function.

If an additional brush is combined with text, it is defined for the *hbr* parameter of **GrayString**. The brush is combined with the text as the text is copied to the client area by the **BitBlt** function. The

additional brush is intended to be used to give the text a desired color, because the bitmap used to draw the text is a monochrome bitmap.

If an application-supplied function replaces **TextOut**, it is defined for the *gsprc* parameter of **GrayString**. When *gsprc* is not NULL, **GrayString** automatically calls the application-supplied function instead of the **TextOut** function and passes it a handle of the display context for the memory bitmap and the long pointer and count passed to **GrayString**. The function can carry out any operation and interpret the long pointer and count in any way. For example, a negative count could be used to indicate that the long pointer points to an icon handle that signals the application-supplied function to draw the icon and let **GrayString** gray and display it. No matter what type of drawing the function carries out, **GrayString** assumes it is successful if the application-supplied function returns a nonzero value.

GrayString suppresses graying if it receives a *cch* parameter equal to -1 and the application-supplied function returns zero. This provides a way to combine custom patterns with the text without interference from the gray brush.

Nonclient-Area Painting

Windows sends a **WM_NCPAINT** message to the window whenever a part of the nonclient area of the window, such as the title bar, menu bar, or window frame, needs painting. Processing this message is not recommended because a window that does so must be able to paint all the required parts of the nonclient area for the window. Unless the Windows application is creating a custom nonclient area for a child window, a window should pass this message to the **DefWindowProc** function for default processing.

Dialog Boxes

A dialog box is a temporary window that Windows creates for special-purpose input and then destroys immediately after use. An application typically uses a dialog box to prompt the user for additional information about a current command selection.

Uses for Dialog Boxes

For convenience and to keep from introducing device-dependent values into the application code, applications use dialog boxes instead of creating their own windows. This device independence is maintained by using logical coordinates in the dialog box template. A dialog box is convenient to use because all aspects of the dialog box, except how to carry out its tasks, are predefined. A dialog box supplies a window class and procedure; the window for the dialog box is created automatically. The application supplies a dialog box procedure to carry out tasks and a dialog box template that describes the dialog box style and content.

Modeless Dialog Box

A modeless dialog box allows the user to supply information to the dialog box and return to the previous task without canceling or removing the dialog box. A modeless dialog box makes it possible for a user to supply more than one piece of information about the current task without having to select a command from a menu each time. For example, a modeless dialog box is often used with a text-search command in word-processing applications. The dialog box remains displayed while the search is carried out. The user can then return to the dialog box and search for the same word again, or change the entry in the dialog box and search for a new word.

An application with a modeless dialog box processes messages for that box by using the **IsDialogMessage** function inside the main message loop. The dialog box procedure of a modeless dialog box must send a message to the parent window when it has input for the parent window. The dialog box procedure must also destroy the dialog box when it is no longer needed. An application can call the **DestroyWindow** function to destroy a modeless dialog box. The application must not call the **EndDialog** function to destroy a modeless dialog box.

Modal Dialog Box

A modal dialog box requires the user to respond to a request before the application continues. Typically, a modal dialog box is used when a chosen command needs additional information before it can proceed.

A modal dialog box disables its parent window, and it creates its own message loop, temporarily taking control of the application's message queue from the application's main message loop.

By default, a modal dialog box cannot be moved by the user. An application can create a movable modal dialog box by specifying the **WS_CAPTION** window style.

The dialog box is displayed until the dialog box procedure calls the **EndDialog** function, or until Windows is closed. The parent window remains disabled unless the dialog box enables it. Note that enabling the parent window is not recommended because it defeats the purpose of the modal dialog box.

System-Modal Dialog Box

A system-modal dialog box is identical to a modal dialog box except that all windows, not just the parent window, are disabled. System-modal dialog boxes must be used with care because they effectively shut down the system until the user supplies the required information.

Creating a Dialog Box

A dialog box is typically created by using either the **CreateDialog** or **DialogBox** function. These functions load a dialog box template from the application's executable file and then create a pop-up window that matches the template's specifications. The dialog box belongs to the predefined dialog

box class unless another class is explicitly defined. The **DialogBox** function creates a modal dialog box; the **CreateDialog** function creates a modeless dialog box.

Use the **WS_VISIBLE** style for the dialog box template if you want the dialog box to appear upon creation.

Dialog Box Template

The dialog box template is a description of the dialog box: its height and width, the controls it contains, its style, the type of border it uses, and so on. A template is an application's resource. You use the Resource Compiler to convert the text description of the template to the required binary form and to add that binary form to the application's executable file.

Because a dialog box is system-independent, you can easily modify the template without changing the source code.

The **CreateDialog** or **DialogBox** function loads the resource into memory when it creates the dialog box and then uses the information in the dialog box template to create the dialog box, position it, and create and position the controls for the dialog box.

Dialog Box Measurements

Dialog box and control dimensions and coordinates are device-independent. Because a dialog box may be displayed on system displays that have widely varying pixel resolutions, dialog box dimensions are specified in system-character widths and heights instead of pixels. This ensures the best possible appearance of characters. One unit in the x-direction is equal to one-fourth of the dialog box base width unit. One unit in the y-direction is equal to one-eighth of the dialog box base height unit. The dialog box base units are computed from the height and width of the system font; the **GetDialogBaseUnits** function returns the dialog box base units for the current display. Applications can convert these measurements to pixels by using the **MapDialogRect** function.

Windows does not allow the height of a dialog box to exceed the height of a full-screen window, and it does not allow the width of a dialog box to be greater than the width of the screen.

Return Values from a Dialog Box

The **DialogBox** function that creates a modal dialog box does not return until the dialog box procedure has called the **EndDialog** function to signal the destruction of the dialog box. When control finally returns from the **DialogBox** function, the return value is equal to the value specified in the **EndDialog** function. This means a modal dialog box can return a value through the **EndDialog** function.

Modeless dialog boxes cannot return values in this way because they do not use the **EndDialog** function to close and do not return control in the same way a modal dialog box does. Instead, a modeless dialog box returns values to its parent window by using the **SendMessage** function to send a notification message to the parent window. Although Windows does not explicitly define the content of a notification message, most applications use a **WM_COMMAND** message with an integer value that identifies the dialog box in the *wParam* parameter and the return value in the *lParam* parameter. A modal dialog box can also use this technique to return values to its parent window before closing.

Controls in a Dialog Box

A control is a child window that belongs to a predefined or application-defined window class and that gives the user a method of supplying input to the application. A dialog box can contain any number and any types of controls. Examples of controls are push buttons and edit controls. Most dialog boxes contain one or more controls of the predefined class. The number of controls, the order in which they should be created, and the location of each in the dialog box are defined by the control statements given in the dialog box template.

Control Identifiers

Every control in a dialog box needs a unique control identifier, or ID, to distinguish it from other controls. Because all controls send information to the dialog box procedure through **WM_COMMAND**

messages, the control identifiers are essential for the dialog box to determine which control sent a given message.

Each control in the dialog box must have a unique identifier. If a dialog box has a menu bar, there must be no conflict between menu-item identifiers and control identifiers. Because Windows sends menu input to a dialog box procedure as **WM_COMMAND** messages, conflicts with menu and control identifiers can cause errors. Menus in dialog boxes are not recommended.

The dialog box procedure usually identifies each dialog box control by using its control identifier. Occasionally the dialog box procedure requires the window handle that was given to the control when it was created. The dialog box procedure can retrieve this window handle by using the **GetDlgItem** function.

The WS_TABSTOP and WS_GROUP Control Styles

The **WS_TABSTOP** style specifies that the user can move the input focus to the given control by pressing the TAB key or SHIFT+TAB keys. Typically, every control in the dialog box has this style, so the user can move the input focus from one control to the other. If two or more controls are in the dialog box, the TAB key moves the input focus to the controls in the order in which they have been created. The SHIFT+TAB keys move the input focus in reverse order. For modal dialog boxes, the TAB and SHIFT+TAB keys are automatically enabled for moving the input focus. For modeless dialog boxes, the **IsDialogMessage** function must be used to filter messages for the dialog box and to process these keystrokes. Otherwise, the keys have no special meaning and the WS_TABSTOP style is ignored.

The **WS_GROUP** style specifies that the user can move the input focus within a group of controls by using the arrow keys. The first control in a group of controls must have the WS_GROUP style. The next control that has the WS_GROUP style marks the bottom boundary of the group; the input focus cannot be moved to this control by using the arrow keys. The DOWN ARROW and RIGHT ARROW keys move the input focus to controls in the order in which they have been created. The UP ARROW and LEFT ARROW keys move the input focus in reverse order. For modal dialog boxes, the arrow keys are automatically enabled for moving the input focus. For modeless dialog boxes, the **IsDialogMessage** function must be used to filter messages for the dialog box and to process these keystrokes. Otherwise, the keys have no special meaning and the WS_GROUP style is ignored.

Buttons

Buttons are the principal interface of a dialog box. Almost all dialog boxes have at least one push button, and most have one default push button (a push button having the **BS_DEFPUSHBUTTON** style) and one or more other push buttons. Many dialog boxes have collections of radio buttons enclosed in group boxes or have lists of check boxes.

Most modal or modeless dialog boxes that use the special keyboard interface have a default push button whose control identifier is set to **IDOK** so that the action the dialog box procedure takes when the button is chosen is identical to the action taken when the ENTER key is pressed. There can be only one button with the default style; however, an application can assign the default style to any button at any time. Most dialog boxes that use the special keyboard interface can also set the control identifier of another push button to **IDCANCEL** so that the action of the ESC key is duplicated by choosing that button.

When a dialog box first starts, the dialog box procedure can set the initial state of each button by using the **CheckDlgButton** function, which sets or clears the button state. This function is most useful when used to set the state of radio buttons or check boxes. If the dialog box contains a group of radio buttons in which only one button should be set at any given time, the dialog box procedure can use the **CheckRadioButton** function to set the appropriate radio button and automatically clear any other radio button.

Before a dialog box terminates, the dialog box procedure can check the state of each button control by using the **IsDlgButtonChecked** function, which returns the current state of the button. A dialog box typically saves this information to initialize the buttons the next time the dialog box is created.

Edit Controls

Many dialog boxes have edit controls that let the user supply text as input. Most dialog box procedures initialize an edit control when the dialog box first starts. For example, the dialog box procedure may place a proposed filename in the control that the user can select, modify, or replace. The dialog box procedure can set the text in an edit control by using the **SetDlgItemText** function, which copies text from a given buffer to the edit control. When the edit control receives the input focus, the complete text is automatically selected for editing.

Because edit controls do not automatically return their text to the dialog box, the dialog box procedure must retrieve the text before terminating. It can retrieve the text by using the **GetDlgItemText** function, which copies the edit-control text to a buffer. The dialog box procedure typically saves this text to initialize the edit control later or passes it on to the parent window for processing.

Some dialog boxes use edit controls that let the user enter numbers. The dialog box procedure can retrieve a number from an edit control by using the **GetDlgItemInt** function, which retrieves the text from the edit control and converts the text to a decimal value. The user enters the number in decimal digits. It can be either signed or unsigned. The dialog box procedure can display an integer by using the **SetDlgItemInt** function. **SetDlgItemInt** converts a signed or unsigned integer to a string of decimal digits.

List Boxes and Directory Listings

Some dialog boxes display lists, such as a list of filenames, from which the user can select one or more items. To display a list of filenames, a dialog box typically uses a list box and the **DlgDirList** and **DlgDirSelect** functions. The **DlgDirList** function automatically fills a list box with the filenames in the current directory. The **DlgDirSelect** function retrieves the selected filename from the list box. Together, these two functions provide a convenient way for a dialog box to display a directory listing that makes it possible for the user to select a file without having to type the location and name of the file.

Combo Boxes

Another method for providing a list of items to a user is by using a combo box. A combo box consists of either a static control or edit control combined with a list box. The list box can be displayed at all times or pulled down by the user. If the combo box contains a static control, that control always displays the current selection (if any) from the list box portion of the combo box. If the combo box uses an edit control, the user can type a selection; the list box highlights the first item (if any) that matches what the user has entered in the edit control. The user can choose the OK button or press ENTER to complete the choice.

Owner-Drawn Dialog Box Controls

List boxes, combo boxes, and buttons can be designated as owner-drawn controls by creating them with the appropriate style. Following are available styles:

Style	Meaning
LBS_OWNERDRAWFIXED	Creates an owner-drawn list box with items that have the same, fixed height.
LBS_OWNERDRAWVARIABLE	Creates an owner-drawn list box with items that have different heights.
CBS_OWNERDRAWFIXED	Creates an owner-drawn combo box with items that have the same, fixed height.
CBS_OWNERDRAWVARIABLE	Creates an owner-drawn combo box with items that have different heights.
BS_OWNERDRAW	Creates an owner-drawn button.

When a control has the owner-drawn style, Windows handles the user's interaction with the control as usual, performing such tasks as detecting when a user has chosen a button and notifying the button's owner of the event. However, because the control is owner-drawn, the owner of the control is completely responsible for the visual appearance of the control. Owner-drawn list boxes and combo boxes can control the display of only the individual elements within a list box or combo box, not the entire list box or

combo box.

When Windows first creates a dialog box containing owner-drawn controls, it sends the owner a **WM_MEASUREITEM** message for each owner-drawn control. The *lParam* parameter of this message contains a pointer to a **MEASUREITEMSTRUCT** structure. When the owner receives the message for a control, the owner fills in the appropriate members of the structure and returns. This informs Windows of the dimensions of the control or of its items so that Windows can appropriately detect the user's interaction with the control. If a list box or combo box is created with the **LBS_OWNERDRAWVARIABLE** or **CBS_OWNERDRAWVARIABLE** style, the WM_MEASUREITEM message is sent to the owner for each item in the control, because each item can differ in height. Otherwise, this message is sent once for the entire owner-drawn control.

Whenever an owner-drawn control needs to be redrawn, Windows sends the **WM_DRAWITEM** message to the owner of the control. The *lParam* parameter of this message contains a pointer to a **DRAWITEMSTRUCT** structure that contains information about the drawing required for the control. Similarly, if an item is deleted from a list box or combo box, Windows sends the **WM_DELETEITEM** message containing a pointer to a **DELETEITEMSTRUCT** structure that describes the deleted item.

Messages for Dialog Box Controls

Many controls recognize predefined messages that, when sent to the control, cause it to carry out some action. A dialog box procedure can send a message to a control by supplying the control identifier and using the **SendDlgItemMessage** function, which is identical to the **SendMessage** function except that it uses a control identifier instead of a window handle to identify the control that is to receive the message.

Keyboard Interface for Dialog Boxes

Windows provides a special keyboard interface for modal dialog boxes and modeless dialog boxes that use the **IsDialogMessage** function to filter messages. This keyboard interface carries out special processing for several keys and generates messages that correspond to certain buttons in the dialog box or change the input focus from one control to another. The keys used in this interface and the respective actions are as follows:

Key	Action
DOWN ARROW	Moves the input focus to the next control in the group.
ENTER	Sends a **WM_COMMAND** message to the dialog box procedure. The *wParam* parameter is set to 1 or the default button.
ESC	Sends a **WM_COMMAND** message to the dialog box procedure. The *wParam* parameter is set to 2.
LEFT ARROW	Moves the input focus to the previous control in the group.
RIGHT ARROW	Moves the input focus to the next control in the group.
SHIFT+TAB	Moves the input focus to the previous control that has the **WS_TABSTOP** style.
TAB	Moves the input focus to the next control that has the **WS_TABSTOP** style.
UP ARROW	Moves the input focus to the previous control in the group.

The TAB key and the arrow keys have no effect if the controls in the dialog box do not have the **WS_TABSTOP** or **WS_GROUP** style. The keys have no effect in a modeless dialog box if the **IsDialogMessage** function is not used to filter messages for the dialog box.

Note: For applications that use accelerator keys and have modeless dialog boxes, the **IsDialogMessage** function must be called before the **TranslateAccelerator** function. Otherwise, the keyboard interface for the dialog box may not be processed correctly.

Applications that have modeless dialog boxes and need those boxes to have the special keyboard interface must filter all messages retrieved from the application's message queue through the **IsDialogMessage** function before carrying out any other processing. This means that the application must pass the message to **IsDialogMessage** immediately after retrieving the message by using the

GetMessage or **PeekMessage** function. Most applications that have modeless dialog boxes incorporate the **IsDialogMessage** function as part of the main message loop in the **WinMain** function. The **IsDialogMessage** function automatically processes any messages for the dialog box. This means that if the function returns a nonzero value, the message does not require additional processing and must not be passed to the **TranslateMessage** or **DispatchMessage** function.

The **IsDialogMessage** function also processes ALT+application-defined mnemonic key sequences.

In modal dialog boxes, the arrow keys have specific functions that depend on the controls in the box. For example, the keys move the input focus from control to control in group boxes, move the cursor in edit controls, and scroll the contents of list boxes. The arrow keys cannot be used to scroll the contents of any dialog box that has its own scroll bars. If a dialog box has scroll bars, the application must provide an appropriate keyboard interface for the scroll bars. Note that the mouse interface for scrolling is available if the system has a mouse.

Scrolling

Scrolling is the movement of data in and out of the client area at the request of the user. It is a way for the user to see a document or graphic in parts if Windows cannot fit the entire document or graphic inside the client area. A scroll bar allows the user to control scrolling.

Standard Scroll Bars and Scroll-Bar Controls

A standard scroll bar is a part of the nonclient area of a window. It is created with the window and displayed when the window is displayed. The sole purpose of a standard scroll bar is to let users generate scrolling requests for the window's client area. A window has standard scroll bars if it is created with the **WS_VSCROLL** or **WS_HSCROLL** style. A standard scroll bar is either vertical or horizontal. A vertical scroll bar, if used, always appears at the right of the client area; a horizontal scroll bar, if used, always appears at the bottom. A standard scroll bar always has the standard scroll-bar height and width as defined by the **SM_CXVSCROLL** and **SM_CYHSCROLL** system metric values.

A scroll-bar control is a control window that looks and acts like a standard scroll bar. But unlike a standard scroll bar, a scroll-bar control is not part of any window. As a separate window, a scroll-bar control can receive the input focus and indicates that it has the focus by displaying a flashing caret in the scroll box (also called the thumb). When a scroll-bar control has the input focus, the user can use the keyboard to direct the scrolling. Unlike standard scroll bars, a scroll-bar control provides a built-in keyboard interface. Scroll-bar controls also can be used for other purposes. For example, a scroll-bar control can be used to select values from a range of values, such as a color from a spectrum of colors.

Scroll Box

The scroll box is the small rectangle in a scroll bar. It shows the approximate location within the current document or file of the data currently displayed in the client area. For example, the scroll box is in the middle of the scroll bar when page three of a five-page document is in the client area.

The **SetScrollPos** function sets the scroll box position in a scroll bar. Because Windows does not automatically update the scroll box position when an application scrolls, **SetScrollPos** must be used to update the position. The **GetScrollPos** function retrieves the current position.

A scroll box position is represented as an integer. The position is relative to the left or upper end of the scroll bar, depending on whether the scroll bar is horizontal or vertical. The position must be within the scroll-bar range, which is defined by minimum and maximum values. The positions are distributed equally along the scroll bar. For example, if the range is 0 through 100, there are 101 positions along the scroll bar, each equally spaced so that position 50 is in the middle of the scroll bar. The initial range depends on the scroll bar. Standard scroll bars have an initial range of 0 through 100; scroll-bar controls have an empty range (both minimum and maximum values are 0) if no explicit range is given when the control is created. An application can change the range by using the **SetScrollRange** function to set new minimum and maximum values so that applications can change the range at any time. The **GetScrollRange** function retrieves the current minimum and maximum values. The minimum and maximum values can be any integers. For example, a spreadsheet program with 255 rows can set the vertical scroll range to 1 through 255.

If **SetScrollPos** specifies a position value that is less than the minimum or more than the maximum, the minimum or maximum value is used instead. **SetScrollPos** moves the scroll box along the scroll bar.

Scrolling Requests

A user makes a scrolling request by clicking in a scroll bar. Windows sends the request to the given window in the form of **WM_HSCROLL** and **WM_VSCROLL** messages. The messages' *lParam* parameter contains a position value and the handle of the scroll-bar control that generated the message (*lParam* is zero if a standard scroll bar generated the message). The *wParam* parameter specifies the type of scrolling; for example, the user may scroll up one line, scroll down a page, or scroll to the bottom. The type of scrolling is determined by which area of the scroll bar the user clicks.

The user can also make a scrolling request by using the scroll box, the small rectangle inside the scroll bar. The user moves the scroll box by moving the mouse while holding the left mouse button down when the cursor is positioned on the scroll box. The scroll bar sends SB_THUMBTRACK and SB_THUMBPOSITION flags with a **WM_HSCROLL** or **WM_VSCROLL** message to an application as the user moves the scroll box. Each message specifies the current position of the scroll box.

Processing Scroll Messages

A window that permits scrolling needs a standard scroll bar or a scroll-bar control to let the user generate scrolling requests, and it needs a window procedure to process the **WM_HSCROLL** and **WM_VSCROLL** messages that represent the scrolling requests. Although the result of a scrolling request depends entirely on how the window processes it, a window typically carries out a scroll operation by moving through the application's displayed information in some direction from the current location or to a known beginning or end and by displaying the data at the new location. For example, a word-processing application can scroll to the next line, the next page, or to the end of the document.

Scrolling the Client Area

The simplest way to scroll is to erase the current contents of the client area, and then paint the new information. This is the method an application is likely to use with SB_PAGEUP, SB_PAGEDOWN, SB_TOP, and SB_END requests, which require completely new contents.

For some requests, such as SB_LINEUP and SB_LINEDOWN, not all the contents need to be erased, since some are still visible after the scroll. The **ScrollWindow** function preserves a portion of the client area's contents, moves the preserved portion the specified amount, and prepares the rest of the client area for painting new information. **ScrollWindow** uses the **BitBlt** function to move a specific part of the client area to a new location within the client area. Any part of the client area that is uncovered (not in the part to be preserved) is invalidated and is erased and painted over at the next **WM_PAINT** message.

ScrollWindow also lets an application clip a part of the client area from the scroll. This keeps items that have fixed positions in the client area, such as child windows, from moving. This action automatically invalidates the part of the client area that is to receive the new information so that the application does not have to compute its own clipping regions.

Hiding a Standard Scroll Bar

For standard scroll bars, if the minimum and maximum values are equal, the scroll bar is hidden and, in effect, disabled. Using this technique, you can temporarily hide a scroll bar when it is not needed for the current contents of the client area.

The **SetScrollRange** function hides and disables a standard scroll bar when equal minimum and maximum values are specified. No scrolling requests can be made through the scroll bar when it is hidden. **SetScrollRange** enables the scroll bar and shows it again when it sets the minimum and maximum values to unequal values. The **ShowScrollBar** function can also be used to hide or show a scroll bar. It does not affect the scroll bar's range or scroll box's position.

The Caret

The Windows caret is a flashing line, block, or bitmap that marks a location in a window's client area. The caret is especially useful in word-processing applications to mark a location in text for keyboard editing.

Creating and Displaying a Caret

Windows forms a caret by inverting the pixel color within the rectangle given by the caret's position, width, and height. Windows flashes the caret by alternately inverting the display and restoring it to its previous appearance. The caret's flash rate, in milliseconds, defines the elapsed time between inverting and restoring the display. A complete flash (on-off-on) takes twice the blink time.

The **CreateCaret** function creates the caret shape and assigns ownership of the caret to the given window. The caret can vary in color and shape; a bitmap caret can be given any pattern.

Windows displays a solid caret by inverting everything in the rectangle defined by the caret's width and height. For a gray caret, Windows inverts every other pixel. For a pattern, Windows inverts only the white bits of the bitmap that defines the pattern. The width and height of a caret are given in logical units, which means they are subject to the window's mapping mode.

Sharing the Caret

There is only one caret, so only one caret shape can be active at a time. All applications must cooperatively share the caret. Because Windows does not inform an application when a caret is created or destroyed, each window should create, move, show, or hide a caret only when it has the input focus or is active. A window should destroy the caret before losing the input focus or becoming inactive.

Your application can use the **CreateBitmap** function to create a bitmap for the caret; or, after you have used the Image Editor to create a bitmap and have used the Resource Compiler to add it to your application's resources, your application can use the **LoadBitmap** function to load the bitmap from the application's resources.

The Cursor

The cursor is a bitmap, displayed on the screen. The user can use a mouse or other pointing device to move this bitmap to an item on the screen, such as a window or an icon. (In the remainder of section, the term mouse is used for any pointing device.)

The Mouse and the Cursor

When a system has a mouse, the cursor shows the current location of the mouse. Windows automatically displays and moves the cursor when the mouse is moved. If a system does not have a mouse, Windows does not automatically display or move the cursor. Applications can use the cursor functions to display or move the cursor when a system does not have a mouse.

Displaying and Hiding the Cursor

In a system without a mouse, Windows does not display or move the cursor unless the user chooses certain system commands, such as commands for sizing and moving. This means that after a call to the **SetCursor** function, the cursor remains on the screen until a subsequent call to **SetCursor** with the parameter set to NULL removes the cursor, or until a system command is carried out. Applications that need to use the cursor without a mouse usually simulate mouse input by using keys, such as the arrow keys, and display and move the cursor by using the cursor functions.

The **ShowCursor** function shows or hides the cursor. It is used to temporarily hide the cursor, and then restore it without changing the current cursor shape. This function actually sets an internal counter that determines whether the cursor should be drawn. Showing the cursor increments the counter; hiding the cursor decrements the counter. The cursor is only visible when the count is not a negative value.

Positioning the Cursor

The **SetCursorPos** and **GetCursorPos** functions set and retrieve the current screen coordinates of the cursor. Although the cursor can be set at a location other than the current mouse location, if the system has a mouse any mouse movement causes the cursor to be redrawn at the mouse location. The **SetCursorPos** and **GetCursorPos** functions are most often used in applications that use the keyboard and specified keystrokes to move the cursor. Note that screen coordinates are not affected by the mapping mode in a window's client area.

The Cursor Hot Spot and Confining the Cursor

The hot spot of the cursor is the location in the cursor bitmap that is tracked and recognized as the position of the mouse or keyboard arrow key. For example, the hot spot on the pointer is the point at the tip of the arrow.

The **ClipCursor** function confines the cursor to a given rectangle on the screen. The cursor can move to the edge of the rectangle but cannot move out of it. **ClipCursor** is typically used to restrict the cursor to a given window, such as a dialog box that contains a warning about a serious error. The rectangle is always given in screen coordinates and does not have to be within the window of the active application.

Creating a Custom Cursor

The **SetCursor** function sets the cursor shape and draws the cursor. When a system has a mouse, Windows automatically changes the shape of the cursor when it crosses a window border or enters a different part of a window, such as a title or menu bar. Windows uses standard cursor shapes for the different parts of the screen, such as a pointer in a title bar. The **SetCursor** function lets an application delete the standard cursor and draw its own custom cursor. The cursor keeps its new shape until the mouse moves or a system command is carried out.

Cursor Functions

Cursor functions set, move, show, hide, and confine the cursor. Following are the cursor functions:

Function	Description
ClipCursor	Restricts the cursor to a given rectangle.
CopyCursor	Copies a cursor.
CreateCursor	Creates a cursor from two bit masks.
DestroyCursor	Destroys a cursor created by the **CreateCursor** function.
GetClipCursor	Retrieves the screen coordinates of the rectangle to which the cursor has been restricted.
GetCursor	Retrieves the handle of the current cursor.
GetCursorPos	Stores the cursor position (in screen coordinates).
LoadCursor	Loads a cursor from the resource file.
SetCursor	Sets the cursor shape.
SetCursorPos	Sets the position of the cursor.
ShowCursor	Increases or decreases the cursor display count.

Hooks

A hook is a point in the Windows message-handling mechanism that an application can use to gain access to the message stream. Windows provides many types of hooks; each type provides access to a particular type or range of messages. To take advantage of a particular hook, an application can install a filter function that processes the messages associated with the hook. A filter function processes the messages before they reach the destination window procedure.

Filter-Function Chain

A filter-function chain is a series of connected filter functions for a particular system hook. For example, all keyboard filter functions are installed by **WH_KEYBOARD** and all journaling-record filter functions are installed by WH_JOURNALRECORD. An application passes a filter function to a system hook with a call to the **SetWindowsHook** function. Each call adds a new filter function to the beginning of the chain. Whenever an application passes the address of a filter function to a system hook, it must reserve space for the address of the next filter function in the chain. **SetWindowsHook** installs a hook function into a hook chain and returns a handle of the hook.

Once each filter function completes its task, it must call the **DefHookProc** function. **DefHookProc** uses the address stored in the location reserved by the application to access the next filter function in the chain.

To remove a filter function from a filter chain, an application must call the **UnhookWindowsHook** function with the type of hook and a pointer to the function.

The standard window hooks and debugging hooks are as follows:

Type	Purpose
WH_CALLWNDPROC	Installs a window filter.
WH_CBT	Installs a computer-based training (CBT) filter.
WH_DEBUG	Installs a debugging filter.
WH_GETMESSAGE	Installs a message filter (on debugging versions only).
WH_HARDWARE	Installs a nonstandard hardware-message filter.
WH_JOURNALPLAYBACK	Installs a journaling playback filter.
WH_JOURNALRECORD	Installs a journaling record filter.
WH_KEYBOARD	Installs a keyboard filter.
WH_MOUSE	Installs a mouse-message filter.
WH_MSGFILTER	Installs a message filter.
WH_SYSMSGFILTER	Installs a systemwide message filter.

Note: The **WH_CALLWNDPROC** and **WH_GETMESSAGE** hooks will affect system performance. They are supplied for debugging purposes only.

Installing a Filter Function

To install a filter function, an application must do the following:

1 Export the function in its module-definition (.DEF) file.

2 Obtain the function's address by using the **GetProcAddress** function. (The **MakeProcInstance** function is used only when the filter function is not in a DLL.)

3 Call the **SetWindowsHook** function, specifying the type of hook function and the address of the function (returned by **GetProcAddress**).

4 Store the return value from **SetWindowsHook** in a reserved location. This value is the handle of the previous filter function.

Note: Filter functions for system-wide hooks must reside in a dynamic-link library (DLL). Application-

specific filter functions can reside in a DLL or the application.

Property Lists

A property list is a storage area that contains handles for data that the application needs to associate with a window.

Using Property Lists

Once a data handle is in a window's property list, any application that can access the window can also access the handle. Using the property list is a convenient way to make data (for example, an alternate title or menu for a window) available when the application needs to modify a window.

Every window has its own property list. When a window is created, the list is empty. The **SetProp** function adds entries to the list. Each entry contains a unique Windows character string and a data handle.

The data handle can identify any object that the application needs to associate with the window. The **GetProp** function retrieves the data handle of an entry from the list without removing the entry. The handle can then be used to retrieve or use the data. The **RemoveProp** function removes an entry from the list when it is no longer needed.

Although the purpose of the property list is to associate data with a window for use by the application that owns the window, the handles in a property list are accessible to any application that has access to the window. This means an application can retrieve and use a data handle from the property list of a window created by another application. But using another application's data handles must be done with care. Only shared, global memory objects, such as GDI drawing objects, can be used by other applications. If a property list contains local or global memory handles or resource handles, only the application that has created the window can use them. An application can use the Windows clipboard to share global memory handles with other applications. Local memory handles cannot be shared.

The contents of a property list can be enumerated by using the **EnumProps** function. The function passes the string and data handle of each entry in the list to an application-supplied function. The application-supplied function can then carry out the necessary task.

The data handles in a property list always belong to the application that created them. The property list itself, like other window-related data, belongs to Windows. A window's property list is allocated in the USER heap, the local heap of the USER library. Although there is no defined limit to the number of entries in a property list, the number of entries depends on how much space is available in the USER heap. The available space depends on how many windows, window classes, and other window-related objects have been created.

The application creates the entries in a property list. Before a window is destroyed or the application that owns the window closes, all entries in the property list must be removed by using the **RemoveProp** function. Failure to remove the entries leaves the property list in the USER heap and makes the space it occupies unusable for subsequent applications. This can ultimately cause an overflow of the USER heap.

An application can use the **RemoveProp** function at any time to remove entries from the property list. If there are entries in the property list when the **WM_DESTROY** message is received for the window, the entries must be removed at that time. To ensure that all entries are removed, use the **EnumProps** function to enumerate all entries in the property list. An application should remove only those properties that it added to the property list. Windows adds properties for its own use and disposes of them automatically. An application must not remove properties that Windows has added to the list.

Rectangles

In Windows, a rectangle is defined by a **RECT** structure. The structure specifies two points: the upper-left and lower-right corners of the rectangle. The sides of a rectangle extend from these two points and are parallel to the x- and y-axes.

Using Rectangles in a Windows Application

Rectangles are used to specify rectangular areas on the screen or in a window, such as the cursor clipping region, the client repaint area, a formatting area for formatted text, and the scroll area. Rectangles are also used to fill, frame, or invert an area in the client area with a given brush, and to retrieve the coordinates of a window or a window's client area.

Because rectangles are used for many different purposes, the rectangle functions do not use an explicit unit of measure. Instead, all rectangle coordinates and dimensions are given in signed, logical values. The units of measure are determined by the function in which the rectangle is used.

Rectangle Coordinates

Valid coordinate values for a rectangle are in the range -32,768 through 32,767. Valid widths and heights, which must be positive, are in the range 0 through 32,767. This means that a rectangle whose left and right sides or whose top and bottom are further apart than 32,768 units is not valid.

Creating and Manipulating Rectangles

The **SetRect** function creates a rectangle, the **CopyRect** function makes a copy of a given rectangle, and the **SetRectEmpty** function creates an empty rectangle. An empty rectangle is any rectangle that has zero width, zero height, or both.

The **InflateRect** function increases or decreases the width or height of a rectangle, or both. It can add or remove width from both ends of the rectangle; it can add or remove height from both the top and bottom of the rectangle.

The **OffsetRect** function moves the rectangle by a given amount. It moves the rectangle by adding the given x-amount, y-amount, or x- and y-amounts to the corner coordinates.

The **PtInRect** function finds out whether a given point lies within a given rectangle. The point is in the rectangle if it lies on the left or top side or is completely within the rectangle.

The **IsRectEmpty** function finds out whether the given rectangle is empty.

The **IntersectRect** function creates a new rectangle that is the intersection of two existing rectangles. The intersection is the largest rectangle contained in both existing rectangles.

The **UnionRect** function creates a new rectangle that is the union of two existing rectangles. The union is the smallest rectangle that contains both existing rectangles.

For information about functions that draw ellipses and polygons, see Graphics Device Interface Overview.

Graphics Device Interface Overview

The following topics describe the functions that perform device-independent graphics operations in an application for the Microsoft Windows operating system. These operations include the creation of line, text, and bitmap output on different output devices. The functions performing those operations constitute the Windows graphics device interface (GDI).

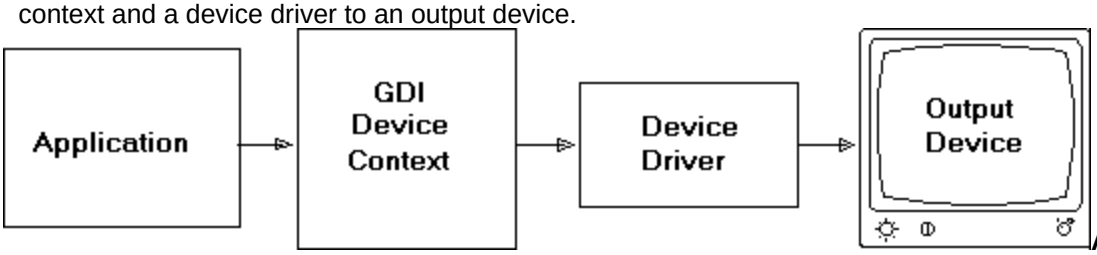
Device Contexts
Specifying Colors
Color-palette functions
Drawing-attribute functions
Mapping functions
Coordinate functions
Line-output functions
Ellipse and polygon functions
Metafile functions

Some Windows functions in the USER application programming interface (API) are closely related to these GDI function groups.

Device Contexts

A device context (DC) is a link between a Windows application, a device driver, and an output device, such as a printer or plotter. Windows maintains a cache of five special device contexts for the system display. Applications must release these device contexts after using them.

The following illustration shows the flow of information from a Windows application through a device context and a device driver to an output device.



Accessing Output Devices

Any Windows application can use GDI functions to access an output device. GDI passes calls, which are device independent, from the application to the device driver. The device driver then translates the calls into device-dependent operations.

Saving and Restoring a Device Context

The **SaveDC** and **RestoreDC** functions save and restore device contexts. The former saves the original attributes, and the latter makes them available at a later time. For example, a Windows application may need to save its original clipping region so that it can restore the original state of the client area after a series of alterations occur.

Deleting a Device Context

The **DeleteDC** function deletes a device context and ensures that shared resources are not removed until the last context is deleted. The device driver is a shared resource. **DeleteDC** should be used to delete device contexts created by the application. If the application uses the **GetDC** function to retrieve a device context, it should use the **ReleaseDC** function, not **DeleteDC**.

Creating a Compatible Device Context

The **CreateCompatibleDC** function causes Windows to treat a portion of memory as a virtual device. Then Windows prepares a device context that has the same attributes as the device for which the virtual device was created, but the device context has no connected output device.

To use the compatible device context, the application creates a compatible bitmap and selects it into the device context. Any output the application sends to the device is drawn in the selected bitmap. Because the device context is compatible with an actual device, the context of the bitmap can be copied directly to the actual device, or vice versa. This also means that the application can send output to memory (prior to sending it to the device).

Note: The **CreateCompatibleDC** function works only for devices that support raster operations. To discover whether a device supports raster operations, an application can call the **GetDeviceCaps** function with the RC_BITBLT index.

Creating an Information Context

The **CreateIC** function creates an information context for a device. An information context is a device context with limited capabilities; it cannot be used to write to the device. An application uses an information context to gather information about the selected device. Information contexts are useful in large applications that require memory conservation.

By using an information context and the **GetDeviceCaps** function, you can obtain the following device information:

- Device technology

- Physical display size
- Color capabilities of the device
- Color-palette capabilities of the device
- Drawing objects available on the device
- Clipping capabilities of the device
- Raster capabilities of the device
- Curve-drawing capabilities of the device
- Line-drawing capabilities of the device
- Polygon-drawing capabilities of the device
- Text capabilities of the device

Device-Context Attributes

Device-context attributes describe selected drawing objects (pens and brushes), the selected font and its color, the way in which objects are drawn (or mapped) to the device, the area on the device available for output (clipping region), and other important information. The structure that contains the device-context attributes is called the device-context data block. The default attributes and the GDI functions that affect or use them are as follows.

Attribute	Default	GDI functions
Background color	White	**SetBkColor**
Background mode	OPAQUE	**SetBkMode**
Bitmap	No default	**CreateBitmap** **CreateBitmapIndirect** **CreateCompatibleBitmap** **SelectObject**
Brush	WHITE_BRUSH	**CreateBrushIndirect** **CreateDIBPatternBrush** **CreateHatchBrush** **CreatePatternBrush** **CreateSolidBrush** **SelectObject**
Brush origin	(0,0)	**SetBrushOrg** **UnrealizeObject**
Clipping region	Display surface	**CreateEllipticRgn** **CreateEllipticRgnIndirect** **CreatePolygonRgn** **CreatePolyPolygonRgn** **CreateRectRgn** **CreateRoundRectRgn** **ExcludeClipRect** **IntersectClipRect** **OffsetClipRgn** **SelectClipRgn**
Color palette	DEFAULT_PALETTE	**CreatePalette** **RealizePalette** **SelectPalette** **UnrealizeObject**
Current pen position	(0,0)	**LineTo** **MoveTo**
Drawing mode	R2_COPYPEN	**SetROP2**
Font	SYSTEM_FONT	**CreateFont** **CreateFontIndirect** **SelectObject**
Intercharacter spacing	0	**SetTextCharacterExtra**
Mapping mode	MM_TEXT	**SetMapMode**
Pen	BLACK_PEN	**CreatePen** **CreatePenIndirect** **SelectObject**
Polygon-filling mode	ALTERNATE	**SetPolyFillMode**
Stretching mode	BLACKONWHITE	**SetStretchBltMode**
Text color	Black	**SetTextColor**
Viewport extent	(1,1)	**SetViewportExt**
Viewport origin	(0,0)	**SetViewportOrg**
Window extent	(1,1)	**SetWindowExt**
Window origin	(0,0)	**SetWindowOrg**

Specifying Colors

Many of the GDI functions that create pens and brushes require that the calling application specify a color in the form of a doubleword. The color can be specified as:

- An explicit **RGB** value
- An index to a logical-palette entry
- A palette-relative **RGB** value

The second and third methods of specifying color require the application to create a logical palette.

An explicit **RGB** doubleword value is a long integer that contains a red, a green, and a blue color field. The first (low-order) byte contains the red field, the second byte contains the green field, the third byte contains the blue field, and the fourth (high-order) byte must be zero. Each field specifies the intensity of the color; zero indicates the lowest intensity, and 255 indicates the highest. For example, 0x00FF0000 specifies pure blue, and 0x0000FF00 specifies pure green. The RGB macro accepts values for the relative intensities of the three colors and returns an explicit RGB doubleword value.

When GDI receives the **RGB** value as a function parameter, it passes the RGB color value directly to the output device driver, which selects the closest available color on the device. The **GetNearestColor** function returns the logical color closest to a specified logical color that a given device can represent.

If the device is a plotter, the driver converts the **RGB** value to a single color that matches one of the pens on the device.

If the device uses color raster technology and the **RGB** value specifies a color for a pen, the driver selects a solid color. If the device uses color raster technology and the RGB value specifies a color for a brush, the driver selects from a variety of available color combinations. Because many color devices can display only a few colors, the actual color is simulated by dithering (that is, mixing pixels of colors that the device can actually render).

If the device is monochrome (black-and-white), the driver selects black, white, or a shade of gray, depending on the **RGB** value. If the sum of the RGB values is zero, the driver selects a black brush. If the sum of the RGB values is 765, the driver selects a white brush. If the sum of the RGB values is between zero and 765, the driver selects one of the gray patterns available.

The **GetRValue**, **GetGValue**, and **GetBValue** macros extract the values for red, green, and blue from an explicit **RGB** doubleword value.

Color Palettes

Many color graphics displays are capable of displaying a wide range of colors. In most cases, however, the actual number of colors that the display can render at any given time is more limited. For example, a display that is potentially able to produce over 262,000 different colors may be able to show only 256 of those colors at a time because of hardware limitations.

To render colors, a display device often maintains a palette of colors. When an application requests a color that is not currently displayed, the display device adds the requested color to the palette. However, when the number of requested colors exceeds the maximum number for the device, it must replace an existing color with the requested color. As a result, if the total number of colors requested by one or more windows exceeds the number available on the display, many of the actual colors displayed will be incorrect.

Windows color palettes act as a buffer between color-intensive applications and the system. When a window has the input focus, Windows ensures that the window displays all the colors it requests, up to the maximum number simultaneously available on the display, and displays additional colors by matching them to available colors. In addition, Windows matches the colors requested by inactive windows as closely as possible to the available colors. This process significantly reduces undesirable changes in the colors displayed in inactive windows.

Understanding Color Palettes

Color palettes provide a device-independent method for accessing the color capabilities of a display device by managing the physical, or system, palette of the device, if one is available. Typically, devices that can display at least 256 colors use a system palette.

An application employs the system palette by creating and using one or more logical palettes. Each entry in the system palette contains a specific color. Then, instead of specifying an explicit value for a color when performing graphics operations, the application indicates which color is to be displayed by supplying an index into the logical palette.

Because more than one application can use logical palettes, it is possible that the total number of colors requested for display can exceed the capacity of the display device. Windows acts as a mediator among the applications.

When a window requests that its logical palette be given its requested colors (a process known as realizing its palette), Windows first matches entries in the logical palette to current entries in the system palette. If an exact match for a given logical palette entry is not possible, Windows sets the entry in the logical palette into an unused entry in the system palette.

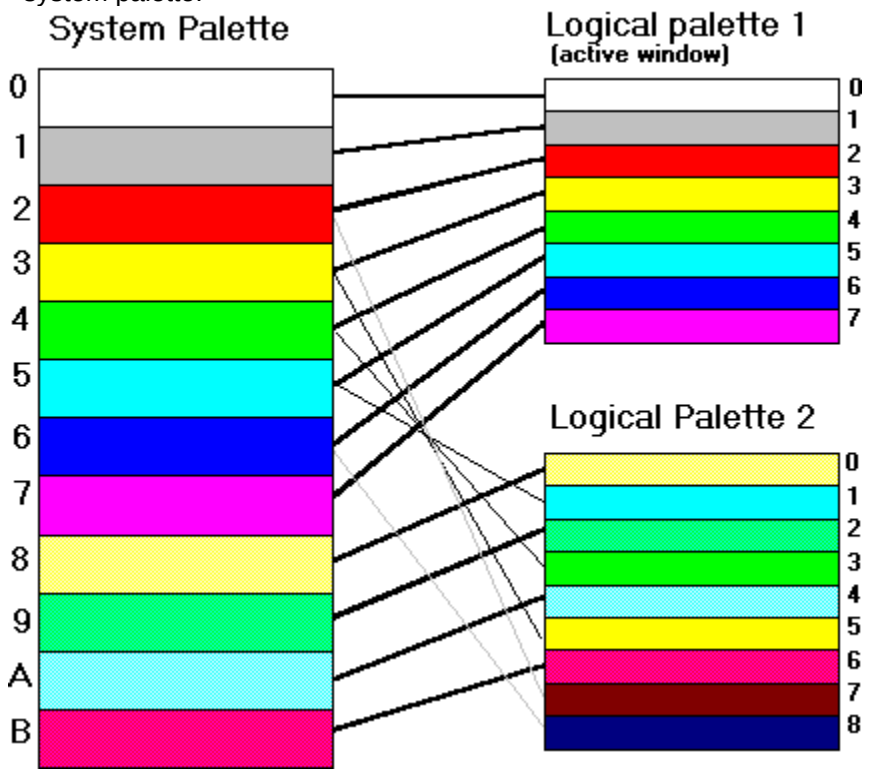
When all entries in the system palette have been used, Windows takes the logical palette entries that do not exactly match and matches them as closely as possible to entries already in the system palette. To further aid color matching, Windows sets aside 20 static colors in the system palette (the default palette) to which it can match entries in a background palette.

Windows always satisfies the color requests of the foreground window first; this procedure ensures that the active window has the best color display possible. For the remaining windows, Windows satisfies the color requests of the window that most recently received the input focus, the window that was active before that one, and so on.

The following illustration shows this process. In this illustration, a hypothetical display has a system palette capable of containing 12 colors. The application that created Logical Palette 1 owns the active window and was the first to realize its logical palette, which consists of 8 colors. Because the active window was active when it realized its palette, Windows mapped all of the colors in Logical Palette 1 directly to the system palette.

Logical Palette 2 is owned by a window that realized its logical palette while it was inactive. Three of the colors (1, 3, and 5) in Logical Palette 2 were identical to colors in the system palette. To save space in the palette, Windows simply matched those colors to existing system colors when the second application realized its palette. Colors 0, 2, 4, and 6 were not already in the system palette, however,

so Windows mapped those colors into the system palette. Because the system palette became full, Windows was not able to map the remaining two colors (which did not exactly match existing colors in the system palette) into the system palette. Instead, it matched them to the closest colors in the system palette.



Using a Color Palette

Before drawing to the display device with a color palette, an application must first create a logical palette by calling the **CreatePalette** function and then use the **SelectPalette** function to select the palette for the device context of the output device for which it will be used. An application cannot select a palette into a device context by using the **SelectObject** function.

All functions with a color parameter accept an index to an entry in the logical palette. The palette index specifier is a long integer value with the first bit in its high-order byte set to 1 and the palette index in the two low-order bytes. For example, 0x01000005 specifies the palette entry with an index of 5. The **PALETTEINDEX** macro accepts an integer value representing the index of a logical palette entry and returns a palette index value, which an application can use as a parameter for GDI functions that require a color.

An application can also specify a palette index indirectly by using a palette-relative **RGB** value. If the target display device supports logical palettes, Windows matches the palette-relative RGB value to the closest palette entry. If the target device does not support palettes, the RGB value is used as though it were an explicit RGB value. The palette-relative RGB value is identical to an explicit RGB value except that the second bit of the high-order byte is set to 1. For example, 0x02FF0000 specifies a palette-relative RGB value for pure blue. The **PALETTERGB** macro accepts values for red, green, and blue and returns a palette-relative RGB value, which an application can use as a parameter for GDI functions that require a color.

If an application specifies an **RGB** value instead of a palette entry, Windows uses the closest matching color in the default palette of 20 static colors.

If the source and destination device contexts have selected and realized different palettes, the **BitBlt**

function does not properly move bitmap bits to or from a memory device context. In this case, you must call the **GetDIBits** function with the **DIB_RGB_COLORS** flag to retrieve the bitmap bits from the source bitmap in a device-independent format. Then you use the **SetDIBits** function to set the retrieved bits in the destination bitmap. This ensures that Windows properly matches colors between the two device contexts.

Note: The **BitBlt** function successfully moves bitmap bits between two screen display contexts, even if they have selected and realized different palettes. The **StretchBlt** function properly moves bitmap bits between device contexts whether or not they use different palettes.

Color-Palette Functions

Windows color palettes allow an application to use as many colors as needed without interfering with its own color display or colors displayed by other windows. Following are the functions an application calls to use color palettes:

Function	Description
AnimatePalette	Replaces entries in a logical palette; Windows maps the new entries into the system palette immediately.
CreatePalette	Creates a logical palette.
GetNearestColor	Retrieves the solid color closest to a specified logical color that a given device can represent.
GetNearestPaletteIndex	Retrieves the index of a logical palette entry most nearly matching a specified **RGB** value.
GetPaletteEntries	Retrieves entries from a logical palette.
GetSystemPaletteEntries	Retrieves a range of palette entries from the system palette.
GetSystemPaletteUse	Determines whether an application has access to the full system palette.
ResizePalette	Changes the size of the specified logical palette.
SetPaletteEntries	Sets new palette entries in a logical palette; Windows does not map the new entries to the system palette until the application realizes the logical palette.
SetSystemPaletteUse	Allows an application to use the full system palette.
UpdateColors	Performs a pixel-by-pixel translation of each pixel's current color to the system palette. This process allows an inactive window to correct its colors without redrawing its client area.

The USER API also provides two palette-management functions:

Function	Description
RealizePalette	Maps entries in a logical palette to the system palette.
SelectPalette	Selects a logical palette into a device context.

For more information about these USER functions, Window Management.

Drawing Attributes

A drawing attribute can take one of the following forms: line, brush, text, or bitmap output.

Setting Colors

Line output can be solid or broken (dashed, dotted, or a combination of the two). If it is broken, the space between the breaks can be filled by setting the background mode to **OPAQUE** and selecting a color. By setting the background mode to **TRANSPARENT**, the space between breaks is left in its original state. The **SetBkMode** and **SetBkColor** functions set the background mode and color.

Brush output is solid, patterned, or hatched. The space between hatch marks can be filled by setting the background mode to **OPAQUE** and selecting a color. When Windows creates brush output on a display, it combines the existing color on the display surface with the brush color to yield a new and final color; this is a binary raster operation. If the default raster operation is not appropriate, a new one is chosen by using the **SetROP2** function.

The appearance of text output is limited only by the number of available fonts and the color capabilities of the output device. The **SetBkColor** function sets the color of the text background (the unused portion of each character cell), and the **SetTextColor** function sets the color of the character itself.

Controlling Stretch

The appearance of bitmap output can be affected by the stretch mode, which determines how lines eliminated from the bitmap are combined. If an application copies a bitmap to a device and it is necessary to shrink or expand the bitmap before drawing, the effects of the **StretchBlt** and **StretchDIBits** functions can be controlled by calling the **SetStretchBltMode** function to set the current stretch mode for a device context.

Mapping Modes

To maintain device independence, GDI creates output in a logical space and maps it to the display. The mapping mode defines the relationship between units in the logical space and pixels on a device.

There are eight different GDI mapping modes, each of which has a specific use in a Windows application. Following are these mapping modes:

Mapping mode	Description
MM_ANISOTROPIC	Maps one logical unit to an arbitrary physical unit. The x-axis and y-axis are arbitrarily scaled.
MM_HIENGLISH	Maps one logical unit to 0.001 inch. The positive y-axis extends upward.
MM_HIMETRIC	Maps one logical unit to 0.01 millimeter. The positive y-axis extends upward.
MM_ISOTROPIC	Maps one logical unit to an arbitrary physical unit. One unit along the x-axis is always equal to one unit along the y-axis.
MM_LOENGLISH	Maps one logical unit to 0.01 inch. The positive y-axis extends upward.
MM_LOMETRIC	Maps one logical unit to 0.1 millimeter. The positive y-axis extends upward.
MM_TEXT	Maps one logical unit to one pixel. The positive y-axis extends downward.
MM_TWIPS	Maps one logical unit to 1/1440 inch (1/20 of a point; a point is 1/72 inch). The positive y-axis extends upward.

Constrained Mapping Modes

GDI classifies six of the mapping modes as constrained mapping modes. These mapping modes are constrained because the scaling factor is fixed, so an application cannot change the number of logical units that Windows maps to a physical unit. The relationship of logical units to physical units for each constrained mapping mode follows:

Mapping mode	Logical units	Physical unit
MM_HIENGLISH	1000	1 inch
MM_HIMETRIC	100	1 millimeter
MM_LOENGLISH	100	1 inch
MM_LOMETRIC	10	1 millimeter
MM_TEXT	1	Device pixel
MM_TWIPS	1440	1 inch

> Note: The MM_HIENGLISH, MM_HIMETRIC, MM_LOENGLISH, MM_LOMETRIC, and MM_TWIPS mapping modes sometimes map logical units to device units in ways that do not correspond exactly to the preceding table. This typically occurs on displays; for example, on an VGA display there is a 33 percent increase in the dimensions of the device units. The increase in the dimensions of device units occurs so that the same output looks equally crisp and readable whatever the device resolution and the display technology for the device. An application can use the **GetDeviceCaps** function with the LOGPIXELSX and LOGPIXELSY indices to discover the scaling factor.

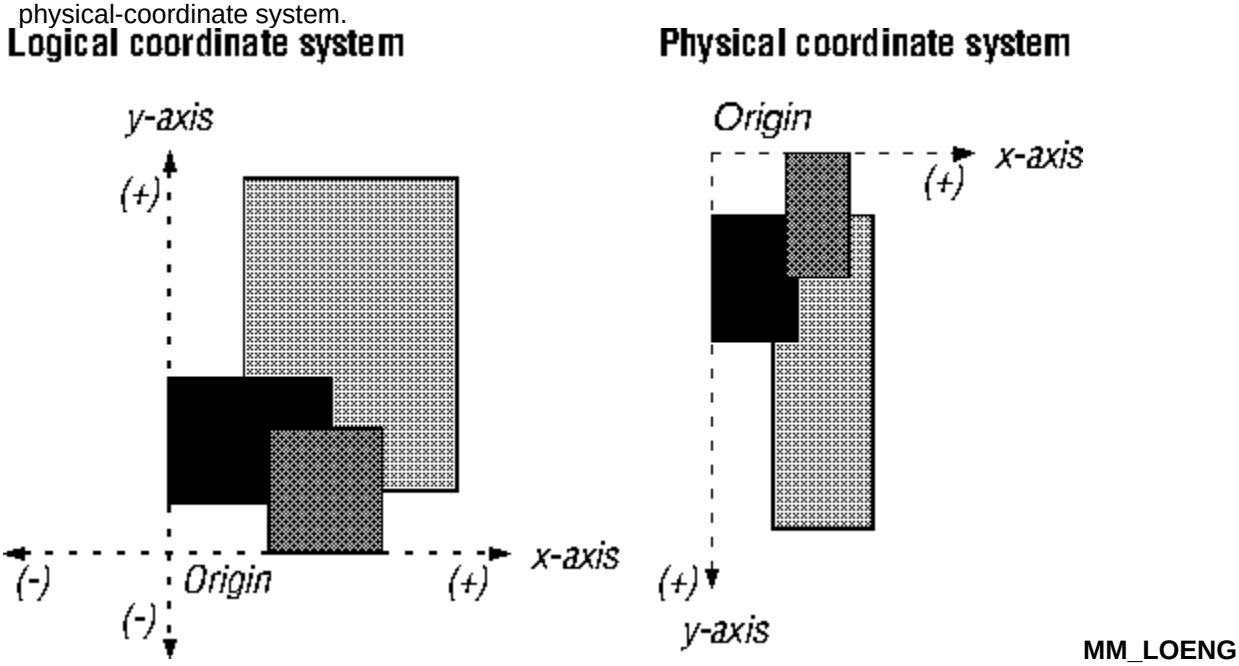
In each of the six constrained modes, one logical unit is mapped to a predefined physical unit. For instance, the MM_TEXT mapping mode maps one logical unit to one device pixel, and the MM_LOENGLISH mapping mode maps one logical unit to 0.01 inch on the device. Examples for these two modes follow.

MM_TEXT Mapping Mode

The default mapping mode is MM_TEXT. In this mapping mode, one logical unit is mapped to one pixel on the device or display.

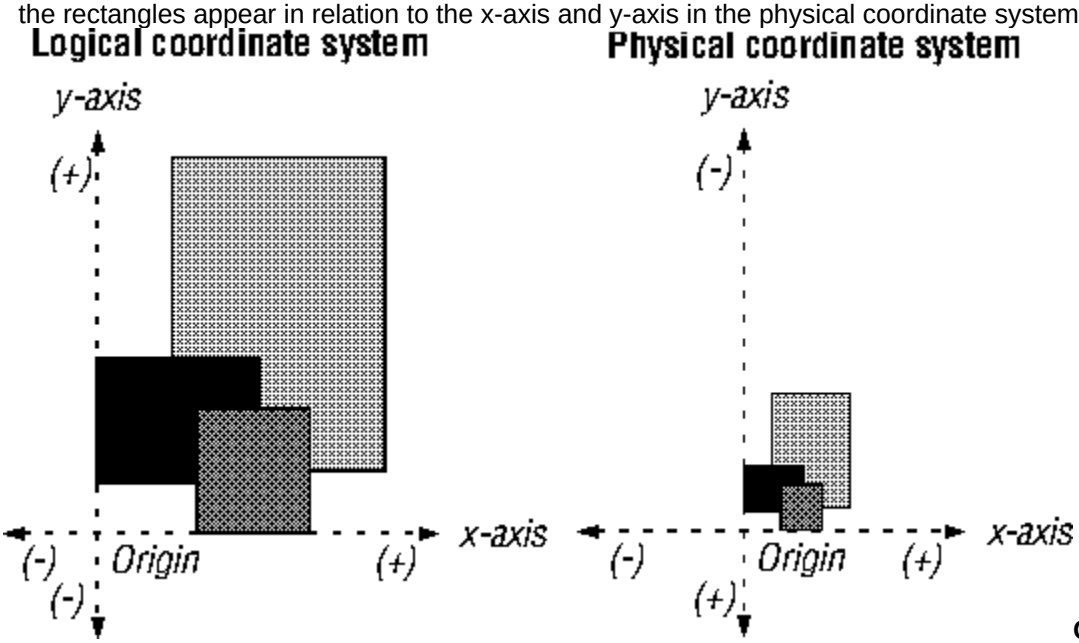
The following illustration shows three rectangles created by a Windows application by using the MM_TEXT mapping mode. The drawing on the left illustrates the logical coordinate space, and the

one on the right illustrates the device, or physical, coordinate space. The rectangles appear vertically elongated in the physical space because pixels on the chosen display are longer than they are wide. The rectangles appear to be upside-down because the positive y-axis extends downward in the physical-coordinate system.



MM_LOENGLISH Mapping Mode

The following illustration shows three rectangles created by a Windows application by using the MM_LOENGLISH mapping mode. The drawing on the left illustrates how the rectangles appear in relation to the x-axis and y-axis in the logical coordinate system. The one on the right illustrates how the rectangles appear in relation to the x-axis and y-axis in the physical coordinate system.



Other Mapping Modes

The MM_ISOTROPIC and MM_ANISOTROPIC mapping modes, which are not constrained, use two rectangular regions to derive a scaling factor and an orientation: the window and the viewport. The window lies within the logical-coordinate space, and the viewport lies within the physical-coordinate space. Both possess an origin, an x-extent, and a y-extent. The origin may be any one of the four

corners. The x-extent is the horizontal distance from the origin to its opposing corner. The y-extent is the vertical distance from the origin to its opposing corner.

Windows creates a horizontal scaling factor by dividing the viewport's x-extent by the window's x-extent and creates a vertical scaling factor by dividing the viewport's y-extent by the window's y-extent. These scaling factors determine the number of logical units that Windows maps to a number of pixels. In addition to determining scaling factors, the window and viewport determine the orientation of an object. Windows always maps the window origin to the viewport origin, the window x-extent to the viewport x-extent, and the window y-extent to the viewport y-extent.

Partially Constrained Mapping Mode

An application creates output with equally scaled axes by using the MM_ISOTROPIC mapping mode. As the term isotropic implies, Windows maps a symmetrical object (for example, a square or a circle) in the logical space as a symmetrical object in the physical space. In order to maintain this symmetry, GDI shrinks one of the viewport extents. The amount of shrinkage depends on the requested extents and the aspect ratio of the device. This mapping mode is called partially constrained because the application does not have complete control in altering the scaling factor.

Unconstrained Mapping Mode

An application can completely alter the horizontal and vertical scaling factors by using the MM_ANISOTROPIC mapping mode and setting the window and viewport extents to any value after selecting this mapping mode. Windows does not alter either scaling factor in this mode.

Coordinate Functions

Coordinate functions convert client coordinates to screen coordinates (or vice versa). These functions are useful in graphics-intensive applications. Following are the coordinate functions:

Function	Description
DPtoLP	Converts device points (that is, points relative to the window origin) into logical points.
GetCurrentPosition	Retrieves the current position, in logical coordinates.
GetCurrentPositionEx	Retrieves position in logical units.
LPtoDP	Converts logical points into device points.

GDI uses the following equations to transform logical points to device points and device points to logical points:

- Transforming logical points to device points:

  D*x* = (L*x* - *x*WO) * *x*VE/*x*WE + *x*VO
  D*y* = (L*y* - *y*WO) * *y*VE/*y*WE + *y*VO

- Transforming device points to logical points:

  L*x* = (D*x* - *x*VO) * *x*WE/*x*VE + *x*WO
  L*y* = (D*y* - *y*VO) * *y*WE/*y*VE + *y*WO

Following are descriptions of the variables used in these transformation equations:

Variable	Description
*x*WO	Window origin x-coordinate
*y*WO	Window origin y-coordinate
*x*WE	Window extent x-coordinate
*y*WE	Window extent y-coordinate
*x*VO	Viewport origin x-coordinate
*y*VO	Viewport origin y-coordinate
*x*VE	Viewport extent x-coordinate
*y*VE	Viewport extent y-coordinate
L*x*	Logical-coordinate system x-coordinate
L*y*	Logical-coordinate system y-coordinate
D*x*	Device x-coordinate
D*y*	Device y-coordinate

The following four ratios are scaling factors used to determine the necessary stretching or compressing of logical units: *x*VE/*x*WE, *y*VE/*y*WE, *x*WE/*x*VE, and *y*WE/*y*VE.

The subtraction and addition of viewport and window origins is referred to as the translational component of the equation.

In addition, applications can use the following functions from the USER API to convert coordinates from one system to another:

Function	Description
ChildWindowFromPoint	Determines which, if any, of the child windows belonging to a given parent window contains a specified point.
ClientToScreen	Converts the client coordinates of a given point on the display to screen coordinates.
ScreenToClient	Converts the screen coordinates of a given point on the display to client coordinates.

WindowFromPoint	Retrieves the handle of the window that contains a given point.

Line Output

Line output functions require coordinates in logical units, which GDI uses to draw a line in logical space. (The use of logical units ensures device independence in Windows.) GDI maps this line from the logical space to pixels on the device. The number of logical units that GDI maps to a pixel depends on the current mapping mode. When GDI draws a line, it excludes the last specified point.

If an application draws lines and does not create a new pen, GDI uses the default pen. This pen is black and is one pixel wide when the mapping mode is MM_TEXT. An application can create a new pen of a different width, style, and color by using the **CreatePen** function. The new color is dependent on the color capabilities of the output device. The new style can be solid, dotted, dashed, or combined (dotted and dashed). Once an application creates a new pen, it can select the pen into a display context by using the **SelectObject** function.

Ellipses and Polygons

Ellipse and polygon functions require coordinates in logical units, which GDI uses to determine the location and size of an object in logical space. (The use of logical units ensures device independence in Windows.) GDI maps the object from logical space to pixels on the device. The number of logical units that Windows maps to a pixel depends on the current mapping mode. The default mapping mode, MM_TEXT, maps one logical unit to one pixel.

Rectangles

The **Rectangle** function draws a rectangle, using the current pen. The **RoundRect** function also draws a rectangle, but with rounded rather than square corners.

When GDI draws a rectangle, it uses four arguments. The first two arguments specify the upper-left corner of the rectangle. The last two arguments do not actually specify part of the rectangle; they specify the point adjacent to the lower-right corner. For example, if the first point is specified by (*x1, y1*) and the second point is specified by (*x2, y2*), the rectangle's upper-left corner will be (*x1, y1*) and the lower-right corner will be (*x2* - 1, *y2* - 1).

Bounding Rectangles

The **Chord**, **Ellipse**, and **Pie** functions use a bounding rectangle, instead of a radius or circumference measurement, to define the size of the object they create. The bounding rectangle is hidden; GDI uses it only to describe the location and size of the object.

Ellipse and Polygon Functions

Ellipse and polygon functions, which draw ellipses and polygons, are particularly useful in drawing and charting applications. GDI draws the perimeter of each object with the selected pen and fills the interior by using the selected brush. Following are the ellipse and polygon functions:

Function	Description
Chord	Draws a chord.
Ellipse	Draws an ellipse.
Pie	Draws a pie.
Polygon	Draws a polygon.
PolyPolygon	Draws a series of closed polygons that are filled as though they were a single polygon.
Rectangle	Draws a rectangle.
RoundRect	Draws a rounded rectangle.

Metafiles

A metafile is a collection of GDI commands that creates desired text or images. Metafiles provide a convenient method of storing graphics commands that create text or images. Metafiles are especially useful in applications that use specific text or a particular image repeatedly. They are also device-independent; by creating text or images with GDI commands and then placing the commands in a metafile, an application can re-create the text or images repeatedly on a variety of devices. Metafiles are also useful in applications that need to pass graphics information to other applications.

Creating a Metafile

A Windows application must create a metafile in a special device context. It cannot use the device contexts that the **CreateDC** or **GetDC** function returns; instead, it must use the device context that the **CreateMetaFile** function returns.

Windows allows an application to use a subset of the GDI functions to create a metafile. This subset consists of all GDI functions that create output (rather than functions that provide state information, such as the **GetDeviceCaps** function). The following list shows GDI functions that an application can use in a metafile:

AnimatePalette	**OffsetViewportOrg**	**SetBkMode**
Arc	**OffsetWindowOrg**	**SetDIBitsToDevice**
BitBlt	**PatBlt**	**SetMapMode**
Chord	**Pie**	**SetMapperFlags**
CreateBrushIndirect	**Polygon**	**SetPixel**
CreateDIBPatternBrush	**Polyline**	**SetPolyFillMode**
CreateFontIndirect	**PolyPolygon**	**SetROP2**
CreatePatternBrush	**RealizePalette**	**SetStretchBltMode**
Ellipse	**RestoreDC**	**SetTextColor**
Escape	**RoundRect**	**SetTextJustification**
ExcludeClipRect	**SaveDC**	**SetViewportExt**
ExtTextOut	**ScaleViewportExt**	**SetViewportOrg**
FloodFill	**ScaleWindowExt**	**SetWindowExt**
IntersectClipRect	**SelectClipRgn**	**SetWindowOrg**
LineTo	**SelectObject**	**StretchBlt**
MoveTo	**SelectPalette**	**StretchDIBits**
OffsetClipRgn	**SetBkColor**	**TextOut**

To create output in a metafile, an application must follow four steps:

1 Create a special device context by using the **CreateMetaFile** function.

2 Send GDI commands to the metafile by using the special device context.

3 Close the metafile by calling the **CloseMetaFile** function. This function returns a metafile handle.

4 Display the image or text on a device by using the **PlayMetaFile** function and passing to the function the metafile handle obtained from **CloseMetaFile** and a device-context handle for the device on which the metafile is to be played.

The device context that the **CreateMetaFile** function creates does not have default attributes of its own. Whatever device-context attributes are in effect for the output device when an application plays a metafile will be the defaults for the metafile. The metafile can change these attributes while it is playing. If the application needs to retain the same device-context attributes after the metafile has finished playing, it should save the output device context by calling the **SaveDC** function before calling the

PlayMetaFile function. Then, when **PlayMetaFile** returns, the application can call the **RestoreDC** function to restore the original device-context attributes.

Although the maximum size of a metafile is 2^32 bytes or records, the actual size of a metafile is limited by the amount of memory or disk space available.

Storing a Metafile

An application can store a metafile in system memory or in a disk file.

To store the metafile in memory, an application calls the **CreateMetaFile** function and passes NULL as the function parameter. The application can free the memory that Windows uses to store the metafile by calling the **DeleteMetaFile** function. This function removes a metafile from memory and invalidates its handle. **DeleteMetaFile** has no effect on disk files.

There are two ways of storing a metafile in a disk file:

- When the application calls the **CreateMetaFile** function to open a metafile, it passes a filename as the function parameter; the metafile is then recorded in a disk file.
- After the application has created a metafile in memory, it calls the **CopyMetaFile** function. This function accepts the handle of a memory metafile and the name of the disk file to which the metafile will be saved.

The **GetMetaFile** function opens a metafile stored in a disk file and makes it available for replay or modification. This function accepts the filename of a metafile stored on disk and returns a metafile handle.

Changing How Windows Plays a Metafile

A metafile does not have to be played back in its entirety or exactly in the form in which it was recorded. An application can use the **EnumMetaFile** function to locate a specific metafile record. **EnumMetaFile** calls a callback function supplied by the application and passes it the following information:

- The metafile device context
- A pointer to the metafile handle table
- A pointer to a metafile record
- The number of associated objects with handles in the handle table
- A pointer to application-supplied data

The callback function can then use this information to play a single record, to query the record, to copy it, or to modify it.

The **PlayMetaFileRecord** function plays a metafile record by executing the GDI function contained in the record.

When Windows plays or enumerates the records in a metafile, it identifies each object with an index into a handle table. Functions that select objects (such as **SelectObject** and **SelectPalette**) identify the object by means of the object handle that the application passes to the function.

Objects are added to the table in the order in which they are created. For example, if a brush is the first object created in a metafile, the brush is given index 0. If the second object is a pen, it is given index 1, and so on. For information about the format of the handle table, see the description of the **HANDLETABLE** structure in the *Microsoft Windows Programmer's Reference, Volume 3.*

Common Dialog Box Overview (3.1)

Common dialog boxes make it easier for you to develop applications for the Microsoft Windows operating system. A common dialog box is a dialog box that an application displays by calling a single function rather than by creating a dialog box procedure and a resource file containing a dialog box template. The dynamic-link library COMMDLG.DLL provides a default procedure and template for each type of common dialog box. Each default dialog box procedure processes messages and notifications for a common dialog box and its controls. A default dialog box template defines the appearance of a common dialog box and its controls.

In addition to simplifying the development of Windows applications, a common dialog box assists users by providing a standard set of controls for performing certain operations. As Windows developers begin using the common dialog boxes in their applications, users will find that after they master using a common dialog box in one application, they can easily perform the same operations in other applications.

This topic describes the various common dialog boxes and includes sample code to help you use common dialog boxes in your Windows applications.

Following are the types of common dialog boxes in the order in which they are presented in this topic:

Name	Description
Color	Displays available colors, from which the user can select one; displays controls that let the user define a custom color.
Font	Displays lists of fonts, point sizes, and colors that correspond to available fonts; after the user selects a font, the dialog box displays sample text rendered with that font.
Open	Displays a list of filenames matching any specified extensions, directories, and drives. By selecting one of the listed filenames, the user indicates which file an application should open.
Save As	Displays a list of filenames matching any specified extensions, directories, and drives. By selecting one of the listed filenames, the user indicates which file an application should save.
Print	Displays information about the installed printer and its configuration. By altering and selecting controls in this dialog box, the user specifies how output should be printed and starts the printing process.
Print Setup	Displays the current list of available printers. The user can select a printer from this list. This common dialog box also provides options for setting the paper orientation, size, and source (when the printer driver supports these options). In addition to being called directly, the Print Setup dialog can be opened from within the Print dialog.
Find	Displays an edit control in which the user can type a string for which the application should search. The user can specify the direction of the search, whether the application should match the case of the specified string, and whether the string to match is an entire word.
Replace	Displays two edit controls in which the user can type strings: the first string identifies a word or value that the application should replace, and the second string identifies the replacement word or value.

Applications that use the common dialog boxes should specify at least 8K for the stack size, as shown in the following example:

```
NAME cd

EXETYPE WINDOWS

STUB    'WINSTUB.EXE'
```

```
CODE    PRELOAD MOVEABLE DISCARDABLE

DATA    PRELOAD MOVEABLE MULTIPLE

HEAPSIZE  1024

STACKSIZE 8192

EXPORTS
  FILEOPENHOOKPROC  @1
```

See Also

Customizing Common Dialog Boxes

Color Dialog Box (3.1)

Using Color Dialog Boxes

The Color dialog box contains controls that make it possible for a user to select and create colors.

Following is a Color dialog box.

The Basic Colors control displays up to 48 colors. The actual number of colors displayed is determined by the display driver. For example, a VGA driver displays 48 colors, and a monochrome display driver displays only 16. With the Basic Colors control, the user can select a displayed color.

To display the Custom Colors control, the user clicks the Define Custom Colors button. The Custom Colors control displays custom colors. The user can select one of the 16 rectangles in this control and then create a new color by using one of the following methods:

- Specifying red, green, and blue (**RGB**) values by using the Red, Green, and Blue edit controls, and then choosing the Add to Custom Colors button to display the new color in the selected rectangle.
- Moving the cursor in the color spectrum control (at the upper-right of the dialog box) to select hue and saturation values; moving the cursor in the luminosity control (the rectangle to the right of the spectrum control); and then choosing the Add to Custom Colors button to display the new color in the selected rectangle.
- Specifying hue, saturation, and luminosity (HSL) values by using the Hue, Sat, and Lum edit controls and then choosing the Add to Custom Colors button to display the new color in the selected rectangle.

The Color|Solid control displays the dithered and solid colors that correspond to the user's selection. (A dithered color is a color created by combining one or more pure or solid colors.) The **Flags** member of the **CHOOSECOLOR** structure contains a flag bit that, when set, displays a Help button.

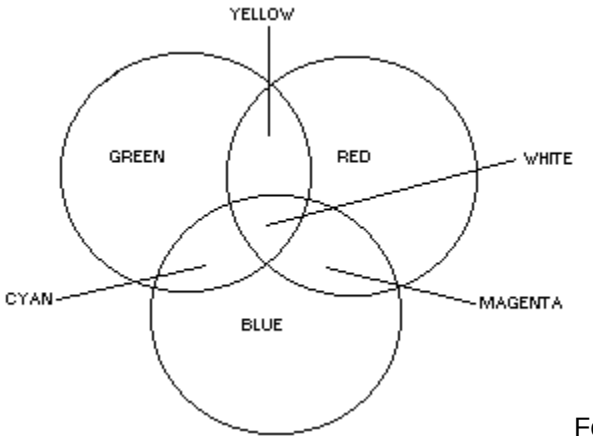
An application can display the Color dialog box in one of two ways: fully open or partially open. When the Color dialog box is displayed partially open, the user cannot change the custom colors.

Color Models Used by the Color Dialog Box

The Color dialog box uses two models for specifying colors: the **RGB** model and the HSL model. Regardless of the model used, internal storage is accomplished by use of the RGB model.

RGB Color Model

The **RGB** model is used to designate colors for displays and other devices that emit light. Valid red, green, and blue values are in the range 0 through 255, with 0 indicating the minimum intensity and 255 indicating the maximum intensity. The following illustration shows how the primary colors red, green, and blue can be combined to produce four additional colors. (With display devices, the color black results when the red, green, and blue values are set to 0--that is, with display technology, black is the absence of all colors.)



Following are eight colors and their associated **RGB**

values:

Color	RGB values
Red	255, 0, 0
Green	0, 255, 0
Blue	0, 0, 255
Cyan	0, 255, 255
Magenta	255, 0, 255
Yellow	255, 255, 0
White	255, 255, 255
Black	0, 0, 0

Windows stores internal colors as 32-bit **RGB** values. The high-order byte of the high-order word is reserved; the low-order byte of the high-order word specifies the intensity of the blue component; the high-order byte of the low-order word specifies the intensity of the green component; and the low-order byte of the low-order word specifies the intensity of the red component.

HSL Color Model

The Color dialog box provides controls for specifying HSL values. The following illustration shows the color spectrum control and the vertical luminosity control that appear in the Color dialog box and shows the ranges of values the user can specify with these controls.

In the Color dialog box, the saturation and luminosity values must be in the range 0 through 240 and the hue value must be in the range 0 through 239.

Converting HSL Values to RGB Values

The dialog box procedure provided in COMMDLG.DLL for the Color dialog box contains code that converts HSL values to the corresponding **RGB** values. Following are several colors with their associated HSL and RGB values:

Color	HSL values	RGB values
Red	(0, 240, 120)	(255, 0, 0)
Yellow	(40, 240, 120)	(255, 255, 0)
Green	(80, 240, 120)	(0, 255, 0)
Cyan	(120, 240, 120)	(0, 255, 255)
Blue	(160, 240, 120)	(0, 0, 255)
Magenta	(200, 240, 120)	(255, 0, 255)
White	(0, 0, 240)	(255, 255, 255)
Black	(0, 0, 0)	(0, 0, 0)

Using the Color Dialog Box to Display Basic Colors

An application can display the Color dialog box so that a user can select one color from a list of basic screen colors. This section describes how you can provide code and structures in your application that make this possible.

Initializing the CHOOSECOLOR Structure

Before you display the Color dialog box you need to initialize a **CHOOSECOLOR** structure. This structure should be global or declared as a **static** variable. The members of this structure contain information about such items as the following:

- Structure size
- Which window owns the dialog box
- Whether the application is customizing the common dialog box
- The hook function and custom dialog box template to use for a customized version of the Color dialog box
- **RGB** values for the selected basic color

If your application does not customize the dialog box and you want the user to be able to select a single color from the basic colors, you should initialize the **CHOOSECOLOR** structure in the following manner:

```
/* Color variables */

CHOOSECOLOR cc;
COLORREF clr;
COLORREF aclrCust[16];
int i;

/* Set the custom color controls to white. */

for (i = 0; i < 16; i++)
    aclrCust[i] = RGB(255, 255, 255);

/* Initialize clr to black. */

clr = RGB(0, 0, 0);

/* Set all structure fields to zero. */

memset(&cc, 0, sizeof(CHOOSECOLOR));

/* Initialize the necessary CHOOSECOLOR members. */

cc.lStructSize = sizeof(CHOOSECOLOR);
cc.hwndOwner = hwnd;
cc.rgbResult = clr;
cc.lpCustColors = aclrCust;
cc.Flags = CC_PREVENTFULLOPEN;

if (ChooseColor(&cc))
    .
    . /* Use cc.rgbResult to select the user-requested color. */
    .
```

In the previous example, the array to which the **lpCustColors** member points contains 16 doubleword **RGB** values that specify the color white, and the CC_PREVENTFULLOPEN flag is set in the **Flags** member to disable the Define Custom Colors button and prevent the user from selecting a custom color.

Calling the ChooseColor Function

After you initialize the structure, you should call the **ChooseColor** function. If the function is successful and the user chooses the OK button to close the dialog box, the **rgbResult** member contains the **RGB** values for the basic color that the user selected.

Using the Color Dialog Box to Display Custom Colors

An application can display the Color dialog box so that the user can create and select a custom color. This section describes how you can provide code and structures in your application that make this possible.

Initializing the CHOOSECOLOR Structure

Before you display the Color dialog box, you need to initialize a **CHOOSECOLOR** structure. This structure should be global or declared as a **static** variable. The members of this structure contain information about such items as the following:

- Structure size
- Which window owns the dialog box
- Whether the application is customizing the common dialog box
- The hook function and custom dialog box template to use for a customized version of the Color dialog box
- **RGB** values for the custom color control

If your application does not customize the dialog box and you want the user to be able to create and select custom colors, you should initialize the **CHOOSECOLOR** structure in the following manner:

```
/* Color Variables */

CHOOSECOLOR chsclr;
DWORD dwCustClrs[16] = { RGB(255, 255, 255), RGB(239, 239, 239),
                         RGB(223, 223, 223), RGB(207, 207, 207),
                         RGB(191, 191, 191), RGB(175, 175, 175),
                         RGB(159, 159, 159), RGB(143, 143, 143),
                         RGB(127, 127, 127), RGB(111, 111, 111),
                         RGB(95, 95, 95),    RGB(79, 79, 79),
                         RGB(63, 63, 63),    RGB(47, 47, 47),
                         RGB(31, 31, 31),    RGB(15, 15, 15)
                       };
BOOL fSetColor = FALSE;
int i;

chsclr.lStructSize = sizeof (CHOOSECOLOR);
chsclr.hwndOwner = hwnd;
chsclr.hInstance = NULL;
chsclr.rgbResult = 0L;
chsclr.lpCustColors = (LPDWORD) dwCustClrs;
chsclr.Flags = CC_FULLOPEN;
chsclr.lCustData = 0L;
chsclr.lpfnHook = (FARPROC) NULL;
chsclr.lpTemplateName = (LPSTR)NULL;
```

In the previous example, the array to which **lpCustColors** points contains sixteen 32-bit **RGB** values that specify 16 scales of gray, and the CC_FULLOPEN flag is set in the **Flags** member to display the complete Color dialog box.

Calling the ChooseColor Function

After you initialize the structure, you should call the **ChooseColor** function as shown in the following code fragment:

```
if (fSetColor = ChooseColor(&chsclr))
.
. /* Use chsclr.lpCustColors to select user specified colors*/
.
```

If the function is successful and the user chooses the OK button to close the dialog box, the **lpCustColors** member points to an array that contains the **RGB** values for the custom colors requested by the application's user.

Applications can exercise more control over custom colors by creating a new message identifier for the string defined by the COLOROKSTRING constant. The application creates the new message identifier by calling the **RegisterWindowMessage** function and passing this constant as the single parameter. After calling **RegisterWindowMessage**, the application receives a message immediately prior to the dismissal of the dialog box. The *lParam* parameter of this message contains a pointer to the **CHOOSECOLOR** structure. The application can use the **lpCustColors** member of this structure to check the current color. If the application returns a nonzero value when it processes this message, the dialog box is not dismissed.

Similarly, applications can create a new message identifier for the string defined by the SETRGBSTRING constant. The application's hook function can use the message identifier returned by calling **RegisterWindowMessage** with the SETRGBSTRING constant to set a color in the dialog box. For example, the following line of code sets the color selection to blue:

```
SendMessage(hwhndDlg, wSetRGBMsg, 0, (LPARAM) RGB(0, 0, 255));
```

In this example, wSetRGBMsg is the message identifier returned by the **RegisterWindowMessage** function. The *lParam* parameter of the **SendMessage** function is set to the **RGB** values of the desired color. The *wParam* parameter is not used.

The application can specify any valid **RGB** values in this call to **SendMessage**. If the RGB values match one of the basic colors, the system selects the basic color and updates the spectrum and luminosity controls. If the RGB values do not match one of the basic colors, the system updates the spectrum and luminosity controls, but the basic color selection remains unchanged.

Note that if the Color dialog box is not fully open and the application sends **RGB** values that do not match one of the basic colors, the system does not update the dialog box. Updates are unnecessary because the spectrum and luminosity controls are not visible when the dialog box is only partially open.

For more information about processing registered window messages, see Using Find and Replace Dialog Boxes.

Font Dialog Box (3.1)

Using Font Dialog Boxes

The Font dialog box contains controls that make it possible for a user to select a font, a font style (such as bold, italic, or regular), a point size, and an effect (such as underline, strikeout, or a text color).

Following is a Font dialog box.

Displaying the Font Dialog Box in Your Application

The Font dialog box appears after you initialize the members in a **CHOOSEFONT** structure and call the **ChooseFont** function. This structure should be global or declared as a **static** variable. The members of the **CHOOSEFONT** structure contain information about such items as the following:

- The attributes of the font that initially is to appear in the dialog box.
- The attributes of the font that the user selected.
- The point size of the font that the user selected.
- Whether the list of fonts corresponds to a printer, a screen, or both.
- Whether the available fonts listed are TrueType only.
- Whether the Effects box should appear in the dialog box.
- Whether dialog box messages should be processed by an application-supplied hook function.
- Whether the point sizes of the selectable fonts should be limited to a specified range.
- Whether the dialog box should display only what-you-see-is-what-you-get (WYSIWIG) fonts. (These fonts are resident on both the screen and the printer.)
- The color that the **ChooseFont** function should use to render text in the Sample box the first time the application displays the dialog box.
- The color that the user selected for text output.

To display the Font dialog box, an application should perform the following steps:

1. If the application requires printer fonts, retrieve a device-context handle for the printer and use this handle to set the **hDC** member of the **CHOOSEFONT** structure. (If the Font dialog box displays only screen fonts, this member should be set to NULL.)
2. Set the appropriate flags in the **Flags** member of the **CHOOSEFONT** structure. This setting must include CF_SCREENFONTS, CF_PRINTERFONTS, or CF_BOTH.
3. Set the **rgbColors** member of the **CHOOSEFONT** structure if the default color (black) is not appropriate.
4. Set the **nFontType** member of the **CHOOSEFONT** structure using the appropriate constant.
5. Set the **nSizeMin** and **nSizeMax** members of the **CHOOSEFONT** structure if the CF_LIMITSIZE value is specified in the **Flags** member.
6. Call the **ChooseFont** function.

The following example initializes the **CHOOSEFONT** structure and calls the **ChooseFont** function:

```
LOGFONT lf;
CHOOSEFONT cf;

/* Set all structure fields to zero. */

memset(&cf, 0, sizeof(CHOOSEFONT));

cf.lStructSize = sizeof(CHOOSEFONT);
cf.hwndOwner = hwnd;
cf.lpLogFont = &lf;
```

```
cf.Flags = CF_SCREENFONTS | CF_EFFECTS;
cf.rgbColors = RGB(0, 255, 255); /* light blue */
cf.nFontType = SCREEN_FONTTYPE;

ChooseFont(&cf);
```

When the user closes the Font dialog box by choosing the OK button, the **ChooseFont** function returns information about the selected font in the **LOGFONT** structure to which the **lpLogFont** member points. An application can use this **LOGFONT** structure to select the font that will be used to render text. The following example selects a font by using the **LOGFONT** structure and renders a string of text:

```
hdc = GetDC(hwnd);
hFont = CreateFontIndirect(cf.lpLogFont);
hFontOld = SelectObject(hdc, hFont);
TextOut(hdc, 50, 150,
     "AaBbCcDdEeFfGgHhIiJjKkLlMmNnOoPpQqRrSsTtUuVvWwXxYyZz", 52);
SelectObject(hdc, hFontOld);
DeleteObject(hFont);
ReleaseDC(hwnd, hdc);
```

An application can also use the **WM_CHOOSEFONT_GETLOGFONT** message to retrieve the current **LOGFONT** structure for the Font dialog box before the user closes the dialog box.

Filename Dialog Boxes (3.1)

Using Open and Save As Dialog Boxes

The Open dialog box and the Save As dialog box are similar in appearance. Each contains controls that make it possible for the user to specify the location and name of a file or set of files. In the case of the Open dialog box, the user selects the file or files to be opened; in the case of the Save As dialog box, the user selects the file or files to be saved.

Displaying the Open Dialog Box in Your Application

The Open dialog box appears after you initialize the members of an **OPENFILENAME** structure and call the **GetOpenFileName** function.

Following is an Open dialog box.

Before the call to **GetOpenFileName**, structure members contain such data as the name of the directory and the filter that are to appear in the dialog box. (A filter is a filename extension. The common dialog box code uses the extension to filter appropriate filenames from a directory.) After the call, structure members contain such data as the name of the selected file and the number of characters in that filename.

To display an Open dialog box, an application should perform the following steps:

1 Store the valid filters in a character array.

2 Set the **lpstrFilter** member to point to this array.

3 Set the **nFilterIndex** member to the value of the index that identifies the default filter.

4 Set the **lpstrFile** member to point to an array that contains the initial filename and receives the selected filename.

5 Set the **nMaxFile** member to the value that specifies the length of the filename array.

6 Set the **lpstrFileTitle** member to point to a buffer that receives the title of the selected file.

7 Set the **nMaxFileTitle** member to specify the length of the buffer.

8 Set the **lpstrInitialDir** member to point to a string that specifies the initial directory. (If this member does not point to a valid string, it must be set to 0 or point to a string that is set to NULL.)

9 Set the **lpstrTitle** member to point to a string specifying the name that should appear in the title bar of the dialog box. (If this pointer is NULL, the title will be Open.)

10 Initialize the **lpstrDefExt** member to point to the default extension. (This extension can be 0, 1, 2, or 3 characters long.)

11 Call the **GetOpenFileName** function.

The following example initializes an **OPENFILENAME** structure, calls the **GetOpenFileName** function, and opens the file by using the **lpstrFile** member of the structure. The **OPENFILENAME** structure should be global or declared as a **static** variable.

```
OPENFILENAME ofn;
char szDirName[256];
char szFile[256], szFileTitle[256];
UINT  i, cbString;
char  chReplace;    /* string separator for szFilter */
char  szFilter[256];
HFILE hf;

/* Get the system directory name, and store in szDirName */
```

```
GetSystemDirectory(szDirName, sizeof(szDirName));
szFile[0] = '\0';

if ((cbString = LoadString(hinst, IDS_FILTERSTRING,
        szFilter, sizeof(szFilter))) == 0) {
    ErrorHandler();
    return 0L;
}
chReplace = szFilter[cbString - 1]; /* retrieve wildcard */

for (i = 0; szFilter[i] != '\0'; i++) {
    if (szFilter[i] == chReplace)
       szFilter[i] = '\0';
}

/* Set all structure members to zero. */

memset(&ofn, 0, sizeof(OPENFILENAME));

ofn.lStructSize = sizeof(OPENFILENAME);
ofn.hwndOwner = hwnd;
ofn.lpstrFilter = szFilter;
ofn.nFilterIndex = 1;
ofn.lpstrFile= szFile;
ofn.nMaxFile = sizeof(szFile);
ofn.lpstrFileTitle = szFileTitle;
ofn.nMaxFileTitle = sizeof(szFileTitle);
ofn.lpstrInitialDir = szDirName;
ofn.Flags = OFN_SHOWHELP | OFN_PATHMUSTEXIST | OFN_FILEMUSTEXIST;

if (GetOpenFileName(&ofn)) {
    hf = _lopen(ofn.lpstrFile, OF_READ);
        .
        . /* Perform file operations. */
        .
}
else
    ErrorHandler();
```

The string referred to by the IDS_FILTERSTRING constant in the preceding example is defined as follows in the resource-definition file:

```
STRINGTABLE
BEGIN
 IDS_FILTERSTRING  "Write Files(*.WRI)|*.wri|Word Files(*.DOC)|*.doc|"
END
```

The vertical bars in this string are used as wildcards. After using the **LoadString** function to retrieve the string, the wildcards are replaced with NULL. The wildcard can be any unique character and must be included as the last character in the string. Initializing strings in this manner guarantees that the parts of the string are contiguous in memory and that the string is terminated with two null characters.

Applications that can open files over a network can create a new message identifier for the string defined by the SHAREVISTRING constant. The application creates the new message identifier by calling the **RegisterWindowMessage** function and passing this constant as the single parameter. After calling **RegisterWindowMessage**, the application is notified whenever a sharing violation occurs during a call to the **OpenFile** function. For more information about processing registered window messages,

see Using Find and Replace Dialog Boxes.

Displaying the Save As Dialog Box in Your Application

The Save As dialog box appears after you initialize the members of an **OPENFILENAME** structure and call the **GetSaveFileName** function.

Following is a Save As dialog box.

Before the call to **GetSaveFileName**, structure members contain such data as the name of the initial directory and a filter string. After the call, structure members contain such data as the name of the file to be saved and the number of characters in that filename.

The following example initializes an **OPENFILENAME** structure, calls **GetSaveFileName** function, and saves the file. The **OPENFILENAME** structure should be global or declared as a **static** variable.

```
OPENFILENAME ofn;
char szDirName[256];
char szFile[256], szFileTitle[256];
UINT  i, cbString;
char  chReplace;    /* string separator for szFilter */
char  szFilter[256];
HFILE hf;

/*
 * Retrieve the system directory name, and store it in
 * szDirName.
 */

GetSystemDirectory(szDirName, sizeof(szDirName));

if ((cbString = LoadString(hinst, IDS_FILTERSTRING,
        szFilter, sizeof(szFilter))) == 0) {
    ErrorHandler();
    return 0;
}

chReplace = szFilter[cbString - 1]; /* retrieve wildcard */

for (i = 0; szFilter[i] != '\0'; i++) {
    if (szFilter[i] == chReplace)
       szFilter[i] = '\0';
}

/* Set all structure members to zero. */

memset(&ofn, 0, sizeof(OPENFILENAME));

/* Initialize the OPENFILENAME members. */

szFile[0] = '\0';

ofn.lStructSize = sizeof(OPENFILENAME);
ofn.hwndOwner = hwnd;
ofn.lpstrFilter = szFilter;
ofn.lpstrFile= szFile;
ofn.nMaxFile = sizeof(szFile);
```

```
ofn.lpstrFileTitle = szFileTitle;
ofn.nMaxFileTitle = sizeof(szFileTitle);
ofn.lpstrInitialDir = szDirName;
ofn.Flags = OFN_SHOWHELP | OFN_OVERWRITEPROMPT;

if (GetSaveFileName(&ofn)) {
    .
    . /* Perform file operations. */
    .
}
else
    ErrorHandler();
```

The string referred to by the IDS_FILTERSTRING constant in the preceding example is defined in the resource-definition file. It is used in exactly the same way as the IDS_FILTERSTRING constant discussed in Displaying the Open Dialog Box in Your Application.

Monitoring List Box Controls in an Open or Save As Dialog Box

An application can monitor list box selections in order to process and display data in custom controls. For example, an application can use a custom control to display the total length, in bytes, of all of the files selected in the File Name box. One method the application can use to obtain this value is to recompute the total count of bytes each time the user selects a file or cancels the selection of a file. A faster method is for the application to use the LBSELCHSTRING message to identify a new selection and add the corresponding file length to the value that appears in the custom control. (Note that in this example, the custom control is a standard Windows control that you identify in a resource file template for one of the common dialog boxes.)

An application registers the selection-change message with the **RegisterWindowMessage** function. Once the application registers the message, it uses this function's return value to identify messages from the dialog box. The message is processed in the application-supplied hook function for the common dialog box. The *wParam* parameter of each message identifies the list box in which the selection occurred. The low-order word of the *lParam* parameter identifies the list box item. The high-order word of the *lParam* parameter is one of the following values:

Value	Meaning
CD_LBSELCHANGE	Specifies that the item identified by the low-order word of *lParam* was the item in a single-selection list box.
CD_LBSELSUB	Specifies that the item identified by the low-order word of *lParam* is no longer selected in a multiple-selection list box.
CD_LBSELADD	Specifies that the item identified by the low-order word of *lParam* was selected from a multiple-selection list box.
CD_LBSELNOITEMS	Specifies that no items exist in a multiple-selection list box.

For an example that registers a common dialog box message, see **Find and Replace Dialogs**.

Monitoring Filenames in an Open or Save As Dialog Box

Applications can alter the normal processing of an Open or Save As dialog box by monitoring which filename the user types and by performing other, unique operations. For example, one application could prevent the user from closing the dialog box if the selected filename is prohibited; another application could make it possible for the user to select multiple filenames.

To monitor filenames, an application should register the **FILEOKSTRING** message. An application registers this message by calling the **RegisterWindowMessage** function and passing the message name as its single parameter. After the message is registered, the dialog box procedure in COMMDLG.DLL uses it to signal that the user has selected a filename and chosen the OK button and that the dialog box has checked the filename and is ready to return. The dialog box procedure signals these actions by sending the message to the application's hook function. After receiving the message,

the hook function should return a value to the dialog box procedure that called it. If the hook function did not process the message, it should return 0; if the hook function did process the message and the dialog box should close, the hook function should return 0; if the hook function did process the message but the dialog box should not close, the hook function should return 1. (All other return values are reserved.)

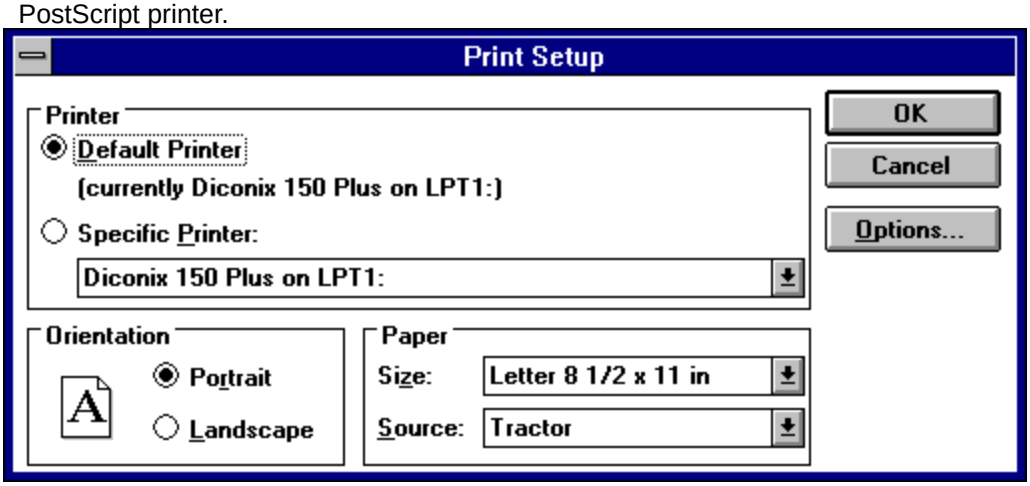
Print Dialog Box (3.1)

Using Print and Print Setup Dialog Boxes

A Print dialog box contains controls that let a user configure a printer for a particular print job. The user can make such selections as print quality, page range, and number of copies (if the printer supports multiple copies).

Following is a Print dialog box.

Choosing the Setup button in the Print dialog box displays the following Print Setup dialog box for a PostScript printer.



The Print Setup dialog box provides controls that make it possible for the user to reconfigure the selected printer.

Device Drivers and the Print Dialog Box

The Print dialog box differs from other common dialog boxes in that part of its dialog box procedure resides in COMMDLG.DLL and part in a printer driver. A printer driver is a program that configures a printer, converts graphics device interface (GDI) commands to low-level printer commands, and stores commands for a particular print job in a printer's queue.

A printer driver exports a function called **ExtDeviceMode**, which displays a dialog box and its controls. In previous versions of Windows, an application called the **LoadLibrary** function to load a device driver and the **GetProcAddress** function to obtain the address of the **ExtDeviceMode** function. This is no longer necessary with the Windows common dialog box interface. Instead of calling **LoadLibrary** and **GetProcAddress**, a Windows application can call a single function, **PrintDlg**, to display the Print dialog box and begin a print job. The code for **PrintDlg** resides in COMMDLG.DLL. The dialog box that appears when an application calls **PrintDlg** differs slightly from the dialog box that appears when the application calls directly into the device driver. The functionality is very similar in spite of the different appearance.

Displaying a Print Dialog Box for the Default Printer

To display a Print dialog box for the default printer, an application must initialize a **PRINTDLG** structure and then call the **PrintDlg** function.

The members of the **PRINTDLG** structure can contain information about such items as the following:

- The printer device context
- Values that should appear in the dialog box controls
- The hook function and custom dialog box template to use for a customized version of the Print dialog box or Print Setup dialog box

An application can display a Print dialog box for the currently installed printer by performing the following

steps:

1 Setting the PD_RETURNDC flag in the **Flags** member of the **PRINTDLG** structure. (This flag should only be set if the application requires a device-context handle.)

2 Initializing the **lStructSize**, **hDevMode**, and **hDevNames** members.

3 Calling the **PrintDlg** function and passing a pointer to the **PRINTDLG** structure just initialized.

Setting the PD_RETURNDC flag causes **PrintDlg** to display the Print dialog box and return a handle identifying a printer device context in the **hDC** member of the **PRINTDLG** structure. (The application passes the device-context handle as the first parameter to the GDI functions that render output on the printer.)

The following example initializes the members of the **PRINTDLG** structure and calls the **PrintDlg** function prior to printing output. This structure should be global or declared as a **static** variable.

```
PRINTDLG pd;

/* Set all structure members to zero. */

memset(&pd, 0, sizeof(PRINTDLG));

/* Initialize the necessary PRINTDLG structure members. */

pd.lStructSize = sizeof(PRINTDLG);
pd.hwndOwner = hwnd;
pd.Flags = PD_RETURNDC;

/* Print a test page if successful */

if (PrintDlg(&pd) != 0) {
    Escape(pd.hDC, STARTDOC, 8, "Test-Doc", NULL);

    /* Print text and rectangle */

    TextOut(pd.hDC, 50, 50, "Common Dialog Test Page", 23);
    Rectangle(pd.hDC, 50, 90, 625, 105);
    Escape(pd.hDC, NEWFRAME, 0, NULL, NULL);
    Escape(pd.hDC, ENDDOC, 0, NULL, NULL);
    DeleteDC(pd.hDC);
    if (pd.hDevMode != NULL)
       GlobalFree(pd.hDevMode);
    if (pd.hDevNames != NULL)
       GlobalFree(pd.hDevNames);
}
else {
    if (pd.hDevMode != NULL)
       GlobalFree(pd.hDevMode);
    if (pd.hDevNames != NULL)
       GlobalFree(pd.hDevNames);
    ErrorHandler();
}
```

Find and Replace Dialog Boxes (3.1)

Using Find and Replace Dialog Boxes

The Find dialog box and the Replace dialog box are similar in appearance. You can use the Find dialog box to add string-search capabilities to your application and use the Replace dialog box to add both string-search and string-substitution capabilities.

Displaying the Find Dialog Box

The Find dialog box contains controls that make it possible for a user to specify the following:

- The string that the application should find
- Whether the string specifies a complete word or part of a word
- Whether the application should match the case of the specified string
- The direction in which the application should search (preceding or following the current cursor location)
- Whether the application should resume the search, searching for the next occurrence of the string

Following is a Find dialog box.

To display the Find dialog box, you need to initialize a **FINDREPLACE** structure and call the **FindText** function. Members of the **FINDREPLACE** structure contain information about such items as the following:

- Which window owns the dialog box
- How the application should perform the search
- A character buffer that is to receive the string

To initialize the **FINDREPLACE** structure, you need to perform the following tasks:

1. Set the **lStructSize** member by using the **sizeof** operator.
2. Set the **hwndOwner** member by using the handle that identifies the owner window of the dialog box.
3. If you are customizing the Find dialog box, set the **hInstance** member to identify the instance of the module that contains your custom dialog box template.
4. Set the **Flags** member to indicate the selection state of the dialog box options. (For example, setting the FR_NOUPDOWN flag disables the Up and Down buttons, setting the FR_NOWHOLEWORD flag disables the Match Whole Word Only check box, and setting the FR_NOMATCHCASE flag disables the Match Case check box).
5. If you are supplying a custom dialog box template or hook function, set additional flags in the **Flags** member.
6. Set the **lpstrFindWhat** member to point to the buffer that will receive the string to be found.
7. Set the **wFindWhatLen** member to specify the size, in bytes, of the buffer to which **lpstrFindWhat** points.
8. Set the **lCustData** member with any custom data your application may need to access.
9. If your application customizes the Find dialog box, set the **lpfnHook** member to point to your hook function.
10. If your application uses a custom dialog box template, set the **lpTemplateName** member to point to the string that identifies the template.

The following example initializes the **FINDREPLACE** structure and then calls the **FindText** function. This structure should be global or declared as a **static** variable.

```
static FINDREPLACE fr;
```

```
/* Set all structure fields to zero. */

memset(&fr, 0, sizeof(FINDREPLACE));

fr.lStructSize = sizeof(FINDREPLACE);
fr.hwndOwner = hwnd;
fr.lpstrFindWhat = szFindWhat;
fr.wFindWhatLen = sizeof(szFindWhat);

hDlg = FindText(&fr);

break;
```

Displaying the Replace Dialog Box

The Replace dialog box is similar to the Find dialog box. However, the Replace dialog box has no Direction box and has three additional controls that make it possible for the user to specify the following:

- The replacement string
- Whether the application should replace the occurrence of the string that is currently highlighted
- Whether the application should replace all occurrences of the string

Following is a Replace dialog box.

To display the Replace dialog box, you need to initialize a **FINDREPLACE** structure and call the **ReplaceText** function.

Processing Dialog Box Messages for a Find or Replace Dialog Box

The Find and Replace dialog boxes differ from the other common dialogs in two respects: First, they are modeless; and second, their respective dialog box procedures send messages to the application that calls the **FindText** or **ReplaceText** function. These messages contain data specified by the user in the dialog box controls, such as the direction in which the application should search for a string, whether the application should match the case of the specified string, and whether the application should match the entire string.

To process messages from a Find or Replace dialog box, an application must register the dialog box's unique message, **FINDMSGSTRING**.

The application registers this message with the **RegisterWindowMessage** function. Once the application registers the message, it uses the function's return value to identify messages from the Find or Replace dialog box. The following example registers the message with the **RegisterWindowMessage** function:

```
UINT uFindReplaceMsg;

/* Register the FindReplace message. */

uFindReplaceMsg = RegisterWindowMessage(FINDMSGSTRING);
```

After the application registers this message, it can process messages for the Find or Replace dialog box by using the **RegisterWindowMessage** return value. The following example processes messages for the Find dialog box and then calls its own **SearchFile** function to locate the string of text. If the user is closing the dialog box (that is, if the **Flags** member of the **FINDREPLACE** structure is FR_DIALOGTERM), the handle is invalidated and the procedure returns zero.

```
LRESULT CALLBACK MainWndProc(HWND hwnd, UINT msg, WPARAM wParam,
    LPARAM lParam)
{
```

```
static FINDREPLACE FAR* lpfr;

if (msg == uFindReplaceMsg) {
    lpfr = (FINDREPLACE FAR*) lParam;
    if (lpfr->Flags & FR_DIALOGTERM) {
        hDlg = NULL;
        return 0;
    }
    SearchFile((BOOL) (lpfr->Flags & FR_DOWN),
        (BOOL) (lpfr->Flags & FR_MATCHCASE));
    return 0;
}
```

Customizing Common Dialog Boxes (3.1)

A custom common dialog box is a common dialog box that has been altered to suit a particular Windows application. The customization may be complex and include the hiding of original controls, the addition of new controls, or a change in the size of the original dialog box; or it may be simple, such as the alteration of a single existing control.

Developers who need to customize a common dialog box must provide a special hook function and, in most cases, a custom dialog box template. Customizations of this kind require a significant amount of additional code--displaying a customized common dialog box is not as simple as initializing the members of a structure and calling a single function.

Applications that subclass controls in any of the common dialog boxes must do so while processing the **WM_INITDIALOG** message in the application's hook function. This allows the application to receive the control-specific messages first, because it will have subclassed the control after the common dialog box has installed its subclassing procedures. (The previous hook function should be called for all messages that are not handled by the application's subclass function, as is standard for subclassing.)

An application cannot subclass a control by defining a local class to override a specific control type. The reason is that the data segment would not be correctly initialized when the class was called--the data segment would be the common dialog box's data segment, not the application's data segment.

Appropriate and Inappropriate Customizations

From the user's perspective, the chief benefit of the common dialog box is its consistent appearance and functionality from application to application. Therefore, it becomes important that a developer only customize a common dialog box when it is absolutely necessary for an application. Otherwise, the consistent appearance and simple coding interface are lost. Appropriate customizations leave intact as many of the original controls as possible. Increasing the size of the dialog box or adding new controls in available space that already appears in the dialog box would be an appropriate customization. Hiding original controls or otherwise changing the intended functionality of the original controls would be an inappropriate customization.

Hook Functions and Custom Dialog Box Templates

Each common dialog box uses the dialog box procedure and dialog box template provided for it in COMMDLG.DLL. The dialog box procedure processes messages and notifications for the common dialog box and its controls. The dialog box template defines the appearance of the dialog box--its dimensions, its location, and the dimensions and locations of controls that appear within it.

In addition to the provided dialog box procedure and dialog box template, a custom dialog box requires a hook function that you provide and, usually, a custom version of the dialog box template.

The Hook Function

The dialog box procedure provided in COMMDLG.DLL for a common dialog box calls the application's hook function if the application sets the appropriate flag and pointer in the structure for that common dialog box. The structure for each common dialog box contains a **Flags** member that specifies whether the application supplies a hook function and contains an **lpfnHook** member that points to the hook function if one exists. If the application sets the **Flags** member to indicate that a hook function exists, it must also set the **lpfnHook** member. The following example sets the **Flags** and **lpfnHook** members of an **OPENFILENAME** structure to support an application's hook function:

```
#define STRICT

#include <windows.h>    /* required for all Windows applications */
#include <commdlg.h>
#include <string.h>
#include "header.h"     /* specific to this program              */
```

```
OPENFILENAME ofn;

    /* Get the system directory name, and store in szDirName. */

    GetSystemDirectory((LPSTR)szDirName, 255);

    /* Initialize the OPENFILENAME members. */

    szFile[0] = '\0';
    ofn.lStructSize = sizeof(OPENFILENAME);
    ofn.hwndOwner = hwnd;
    ofn.hInstance = hInst;
    ofn.lpstrFilter = szFilter[0];
    ofn.lpstrCustomFilter = NULL;
    ofn.nMaxCustFilter = 0L;
    ofn.nFilterIndex = 1L;
    ofn.lpstrFile= szFile;
    ofn.nMaxFile = sizeof(szFile);
    ofn.lpstrFileTitle = szFileTitle;
    ofn.nMaxFileTitle = sizeof(szFileTitle);
    ofn.lpstrInitialDir = szDirName;
    ofn.lpstrTitle = NULL;
    ofn.Flags = OFN_ENABLEHOOK | OFN_ENABLETEMPLATE;
    ofn.nFileOffset = 0;
    ofn.nFileExtension = 0;
    ofn.lpstrDefExt = NULL;
    ofn.lpfnHook = MakeProcInstance((FARPROC) FileOpenHookProc, hInst);
    ofn.lpTemplateName = "FileOpen";
```

In the previous example, the **MakeProcInstance** function is called to create a procedure-instance address for the hook function. This address is assigned to the **lpfnHook** member of the **OPENFILENAME** structure. If the hook function is part of a dynamic-link library (rather than an application), the procedure address is obtained by calling the **GetProcAddress** function (instead of **MakeProcInstance**).

The hook function processes any messages or notifications that the custom dialog box requires. With the exception of one message (**WM_INITDIALOG**), the hook function receives messages and notifications before the dialog box procedure provided in COMMDLG.DLL receives them. In the case of WM_INITDIALOG, the hook function receives the message after the dialog box procedure. When the hook function finishes processing a message, it returns a value that indicates whether the dialog box procedure provided in COMMDLG.DLL should also process the message. If the dialog box procedure should process the message, the return value is FALSE; if the dialog box procedure should ignore the message, the return value is TRUE.

To process the message from the OK button after the dialog box procedure processes it, an application must post a message to itself when the OK message is received. When the application receives the message it has posted, the common dialog box procedure will have finished processing messages for the dialog box. This technique is particularly useful when working with the Find and Replace dialog boxes, because the **Flags** member of the **FINDREPLACE** structure does not reflect changes to the dialog box until after the messages have been processed by COMMDLG.DLL.

The following example shows a hook function for a custom Open dialog box:

```
UINT CALLBACK FileOpenHookProc(HWND hdlg, UINT msg, WPARAM wParam,
    LPARAM lParam)
{
    switch(msg) {
        case WM_INITDIALOG:
```

```
            return TRUE;

        case WM_COMMAND:

            /* Use IsDlgButtonChecked to set lCustData. */

            if (wParam == IDOK) {

                /* Set backup flag. */

                ofn.lCustData =
                    (DWORD) IsDlgButtonChecked(hdlg, ID_CUSTCHX);
            }

            return FALSE; /* Allow standard processing. */
    }

    /* Allow standard processing. */

    return FALSE;
}
```

This hook function tests a custom check box when the user chooses the OK button. If the check box was selected, the hook function sets the **lCustData** member of the **OPENFILENAME** structure to 1; otherwise, it sets the **lCustData** member to 0.

A hook function should never call the **EndDialog** function. Instead, if a hook function contains code that abnormally terminates a common dialog box, this code should pass the **IDABORT** value to the dialog box procedure by using the **PostMessage** function as shown in the following example:

```
PostMessage(hDlg, WM_COMMAND, IDABORT, (LONG) FALSE);
```

When a hook function posts the **IDABORT** value, the common dialog box function returns the value contained in the low word of the *lParam* parameter. For example, if the hook function for **GetOpenFileName** called the **PostMessage** function with (**LONG**) 100 as the last parameter, **GetOpenFileName** would return 100.

A hook function must be exported in an application's module-definition (.DEF) file as shown in the following example:

```
NAME cd

EXETYPE WINDOWS

STUB    'WINSTUB.EXE'

CODE    PRELOAD MOVEABLE DISCARDABLE

DATA    PRELOAD MOVEABLE MULTIPLE

HEAPSIZE  1024

STACKSIZE 8192

EXPORTS
  FILEOPENHOOKPROC  @1
```

Customizing a Dialog Box Template

The dialog box template provided in COMMDLG.DLL for each common dialog box contains the data that the dialog box procedure uses to display that common dialog box. Most applications that customize a common dialog box also need to create a custom dialog box template to use instead of the dialog box template in COMMDLG.DLL. (A custom dialog box template is not required for all custom dialog boxes. For instance, a template would not be necessary if an application changed a dialog box in a relatively minor way and only in an unusual situation.)

A developer should create a custom dialog box template by modifying the appropriate dialog box template in COMMDLG.DLL. Following are the template filenames and the names of their corresponding common dialog boxes:

Template filename	Corresponding dialog box
COLOR.DLG	Color
FILEOPEN.DLG	Open (single selection)
FILEOPEN.DLG	Open (multiple selection)
FINDTEXT.DLG	Find
FINDTEXT.DLG	Replace
FONT.DLG	Font
PRNSETUP.DLG	Print
PRNSETUP.DLG	Print Setup

The following excerpt is from a custom dialog box template created for an Open dialog box:

```
    CONTROL "&Backup File", ID_CUSTCHX, "button",
            BS_AUTOCHECKBOX | WS_CHILD | WS_TABSTOP | WS_GROUP,
            208,  86,  50,  12

END
```

This entry supports the addition of a new Backup File check box immediately below the existing Read Only check box.

The custom template should be added to the application's resource file. You must use all of the unique control identifiers (that is, all identifiers whose values are other than -1) in the template, even if the dialog box does not use those controls. If you do not want to display all of the controls, you can specify coordinates for them that are outside the dialog box. You should also disable the unwanted buttons and remove unnecessary tab stops.

Displaying the Custom Dialog Box

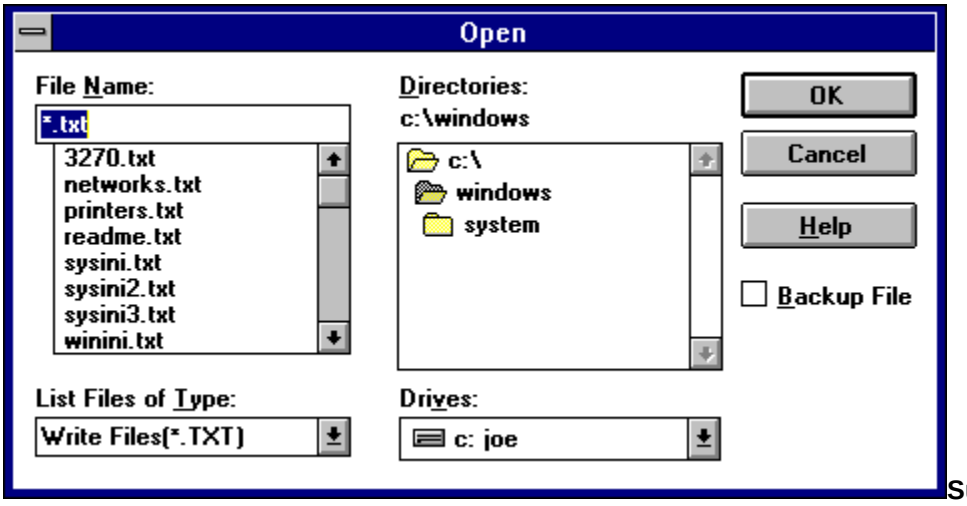
After your application creates the hook function and the dialog box template, it should set the members of the structure for the common dialog box being customized and call the appropriate function to display the custom dialog box.

The following example calls the **GetOpenFileName** function and creates a backup file if the user selected the custom Backup File check box in the custom Open dialog box:

```
/* Open the file and create a backup. */

if (GetOpenFileName(&ofn)) {

    hf = _lopen(ofn.lpstrFile, OF_READWRITE);

    /* Create the backup file. */

    if (ofn.lCustData) {

        /* Process files with extension. */
```

```
        if (ofn.nFileExtension){

           for (i=0; i<(int)ofn.nFileExtension; i++)
                szChar[i] = *ofn.lpstrFile++;

        }/*endif */

        /* Process files without extension. */

        else {

           i=0;

           while (*ofn.lpstrFile!='\0')
               szChar[i++] = *ofn.lpstrFile++;

           szChar[i]='.';
        }/*end else*/

        pszNewPAFN = lstrcat(szChar, "BAK");

        /* Create the backup file. */

        hfBackup = _lcreat(pszNewPAFN, 0);

        /* Copy contents of original file to the backup file. */

        while ((cBufLngth=_lread(hf, cBuf1, 256)) == 256)
             _lwrite(hfBackup, cBuf1, cBufLngth);
        _lwrite(hfBackup, cBuf1, cBufLngth);
        _lclose(hfBackup);
    } /*endif GetOpenFileName*/

    /* File operations begin here. */

}   /* endif (GetOpenFileName)     */
```

The following is the custom Open dialog box. The new Backup File check box appears in the lower-right corner.



Supporting and Processing Help for the Common Dialog Boxes

An application can display a Help button in any of the common dialog boxes by setting the appropriate flag in the **Flags** member of the structure for that common dialog box. Following are the structures for the common dialog boxes and the Help flag that corresponds to each structure:

Structure	Flag value
OPENFILENAME	OFN_SHOWHELP
CHOOSECOLOR	CC_SHOWHELP
FINDREPLACE	FR_SHOWHELP
CHOOSEFONT	CF_SHOWHELP
PRINTDLG	PD_SHOWHELP

If an application displays the Help button, it must process the user's request for Help. This can be done either in one of the application's window procedures or in a hook function.

If the application processes the request for Help in one of the application's window procedures, it must first create a new message identifier for the string defined by the HELPMSGSTRING constant. The application creates the new message identifier by calling the **RegisterWindowMessage** function and passing this constant as the single parameter. (For more information about processing registered window messages, see Using Find and Replace Dialog Boxes.) In addition to creating a new message identifier, the application must set the **hwndOwner** member of the appropriate structure for the common dialog box so that this member contains the handle of the dialog box's owner window. After the message identifier is created and the **hwndOwner** member is set, the dialog box procedure notifies the window procedure of the owner window whenever the user chooses the Help button.

The following example processes a user's request for Help in the window procedure of its owner window. The **if** statement should be in the **default:** section of the switch statement that processes messages.

```
MyHelpMsg = RegisterWindowMessage(HELPMSGSTRING);
          .
          .
          .
if (message == MyHelpMsg)
   WinHelp(hWnd, "appfile.hlp", HELP_CONTEXT, ID_MY_CONTEXT);
```

If the application processes the request for Help in a hook function, it should test for the following condition in the **WM_COMMAND** message:

```
wParam == pshHelp
```

When this condition is true, the hook function should call the **WinHelp** function as shown in the preceding example. (To process Help in a hook function, you must include the header file DLGS.H in the source file that contains the hook-function code.)

Error Detection

Whenever a common dialog box function fails, an application can call the **CommDlgExtendedError** function to find out the cause of the failure. The **CommDlgExtendedError** function returns an error value that identifies the cause of the most recent error.

Six constants are defined in the CDERR.H header file that identify the ranges of error values for categories of errors returned by **CommDlgExtendedError**. Following are these constants in ascending order by value range:

Constant	Meaning
CDERR_GENERALCODES	General error codes for common dialog boxes. These errors are in the range 0x0000 through 0x0FFF.
PDERR_PRINTERCODES	Error codes for the Print common dialog box. These errors are in the range 0x1000 through 0x1FFF.

CFERR_CHOOSEFONTCODES	Error codes for the Font common dialog box. These errors are in the range 0x2000 through 0x2FFF.
FNERR_FILENAMECODES	Error codes for the Open and Save As common dialog boxes. These errors are in the range 0x3000 through 0x3FFF.
FRERR_FINDREPLACECODES	Error codes for the Find and Replace common dialog boxes. These errors are in the range 0x4000 through 0x4FFF.
CCERR_CHOOSECOLORCODES	Error codes for the Color common dialog box. These errors are in the range 0x5000 through 0x5FFF.

Dynamic Data Exchange Management Library (3.1)

This topic describes how to use the Dynamic Data Exchange Management Library (**DDEML**). The DDEML is a dynamic-link library (DLL) that applications running with the Microsoft Windows operating system can use to share data.

The following topics discuss the concepts of DDE and describe how to use the DDE Management Library to add DDE functionality to an application:

DDEML Concepts
DDEML Initialization
Callback Function
String Management
Conversation Management
Data Management
Transaction Management
Server-Name Service
Error Detection
DDEML Monitor Applications

Dynamic data exchange (DDE) is a form of interprocess communication that uses shared memory to exchange data between applications. Applications can use DDE for one-time data transfers and for ongoing exchanges in which the applications send updates to one another as new data becomes available.

Dynamic data exchange differs from the clipboard data-transfer mechanism that is also part of the Windows operating system. One difference is that the clipboard is almost always used as a one-time response to a specific action by the user--such as choosing the Paste command from a menu. Although DDE may also be initiated by a user, it typically continues without the user's further involvement.

The **DDEML** provides an application programming interface (API) that simplifies the task of adding DDE capability to a Windows application. Instead of sending, posting, and processing DDE messages directly, an application uses the functions provided by the DDEML to manage DDE conversations. (A DDE conversation is the interaction between client and server applications.) The DDEML also provides a facility for managing the strings and data that are shared among DDE applications. Instead of using atoms and pointers to shared memory objects, DDE applications create and exchange string handles, which identify strings, and data handles, which identify global memory objects. DDEML provides a service that makes it possible for a server application to register the service names that it supports. The names are broadcast to other applications in the system, which can then use the names to connect to the server. The DDEML also ensures compatibility among DDE applications by forcing them to implement the DDE protocol in a consistent manner.

Existing applications that use the message-based DDE protocol are fully compatible with those that use the DDEML. That is, an application that uses message-based DDE can establish conversations and perform transactions with applications that use the DDEML. Because of the many advantages of the **DDEML**, new applications should use it rather than the DDE messages.

The **DDEML** can run on systems that have Microsoft Windows version 3.0 or later installed. The DDEML does not support real mode. To use the API elements of the DDE management library, you must include the DDEML.H header file in your source files, link with DDEML.LIB, and ensure that DDEML.DLL resides in the system's path.

DDEML Concepts

Basic Concepts

The concepts in this section are key to understanding DDE and the DDEML.

Client and Server Interaction

Dynamic data exchange always takes place between a client application and a server application. The client initiates the exchange by establishing a conversation with the server so that it can send transactions to the server. (A transaction is a request for data or services.) The server responds to these transactions by providing data or services to the client. A server can have many clients at the same time, and a client can request data from multiple servers. Also, an application can be both a client and a server. A client terminates a conversation when it no longer needs a server's data or services.

For example, a graphics application might contain a bar graph that represents a corporation's quarterly profits, and the data for the bar graph might be contained in a spreadsheet application. To obtain the latest profit figures, the graphics application (the client) establishes a conversation with the spreadsheet application (the server). The graphics application then sends a transaction to the spreadsheet application, requesting the latest profit figures.

Transactions and the DDE Callback Function

The **DDEML** notifies an application of DDE activity that affects the application by sending transactions to the application's DDE callback function. A transaction is similar to a message--it is a named constant accompanied by other parameters that contain additional information about the transaction.

The **DDEML** passes a transaction to an application-defined DDE callback function, which carries out the appropriate action depending on the type of the transaction. For example, when a client application attempts to establish a conversation with a server application, the client calls the **DdeConnect** function. This causes the DDEML to send an **XTYP_CONNECT** transaction to the server's DDE callback function. The callback function can allow the conversation by returning TRUE to the DDEML, or it can deny the conversation by returning FALSE.

For a detailed discussion of transactions, see Transaction Management.

Service Names, Topic Names, and Item Names

A DDE server uses a three-level hierarchy--service name (called "application name" in previous DDE documentation), topic name, and item name--to uniquely identify a unit of data that the server can exchange during a conversation. A service name is a string that a server application responds to when a client attempts to establish a conversation with the server. A client must specify this service name to be able to establish a conversation with the server. Although a server can respond to many service names, most servers respond to only one name.

A topic name is a string that identifies a logical data context. For servers that operate on file-based documents, topic names are typically filenames; for other servers, they are other application-specific strings. A client must specify a topic name along with a server's service name when it attempts to establish a conversation with a server.

An item name is a string that identifies a unit of data that a server can pass to a client during a transaction. For example, an item name might identify an integer, a string, several paragraphs of text, or a bitmap.

To a client, these names are the keys that make it possible for the client to establish a conversation with a server and to receive data from the server.

System Topic

The System topic provides a context for information that may be of general interest to any DDE client. Server applications are encouraged to support the System topic at all times. (The System topic is

defined in the **DDEML** header file as SZDDESYS_TOPIC.)

To find out which servers are present and the kinds of information they can provide, a client can request a conversation on the System topic with the service name set to NULL when the client application starts. Such wildcard conversations should be kept to a minimum, because they are costly in terms of system performance.

For more information about initiating DDE conversations, see Conversation Management.

A server should support the following item names within the System topic and any other item names that may be useful to a client:

Item	Description
SZDDE_ITEM_ITEMLIST	A list of the items that are supported under a non-System topic. (This list may vary from moment to moment and from topic to topic.)
SZDDESYS_ITEM_FORMATS	A list of clipboard format numbers that the server can render. This list should be ordered with the most descriptive formats first. A server may not be able to render all items in all formats within this list. At a minimum, a server should support the CF_TEXT clipboard format for item names associated with the System topic.
SZDDESYS_ITEM_HELP	General help information.
SZDDESYS_ITEM_RTNMSG	Supporting detail for the most recently used **WM_DDE_ACK** message. This is useful when more than 8 bits of application-specific return data are required.
SZDDESYS_ITEM_STATUS	An indication of the current status of the server. Typically, this item supports only the CF_TEXT format and contains the Ready or Busy string.
SZDDESYS_ITEM_SYSITEMS	A list of the items supported under the System topic by this server.
SZDDESYS_ITEM_TOPICS	A list of the topics supported by the server at the current time. (This list may vary from moment to moment.)

These item names are string constants defined in the **DDEML** header files. To obtain string handles for these strings, an application must use the DDEML string-management functions, just as it would for any other string in a DDEML application. For more information about managing strings, see String Management.

DDEML Initialization

The **DDEML** requires that Windows be running; otherwise, the system cannot load the DDEML dynamic-link library. Before calling any DDEML function, an application should call the **GetWinFlags** function, checking the return value for the **WF_PMODE** flag. If this flag is returned, the application can call DDEML functions.

Before calling any other **DDEML** function, an application must call the **DdeInitialize** function. The **DdeInitialize** function obtains an instance identifier for the application, registers the application's DDE callback function with the DDEML, and specifies the transaction filter flags for the callback function.

The **DDEML** uses instance identifiers so that it can support applications that allow multiple DDEML instances. Each instance of an application must pass its instance identifier as the *idInst* parameter to any other DDEML function that requires it. An application that uses multiple DDEML instances should assign a different DDE callback function to each instance. This makes it possible for the application to identify each instance within its callback function.

The purpose for multiple **DDEML** instances is to support DLLs using the DDEML. It is not recommended that an application have multiple DDE instances.

Transaction filters optimize system performance by preventing the **DDEML** from passing unwanted transactions to the application's DDE callback function. An application sets the transaction filters when it calls the **DdeInitialize** function. An application should specify a transaction filter flag for each type of transaction that it does not process in its callback function. An application can change its transaction filters with a subsequent call to the **DdeInitialize** function. For a complete list of transaction filter flags, see the description of the **DdeInitialize** function in the *Microsoft Windows Programmer's Reference, Volume 2.*

For more information about transactions, see Transaction Management.

The following example shows how to initialize an application to use the **DDEML**:

```
DWORD idInst = 0L;  /* instance identifier        */
HANDLE hInst;       /* instance handle            */
FARPROC lpDdeProc;  /* procedure instance address */

lpDdeProc = MakeProcInstance((FARPROC) DdeCallback, hInst);
if (DdeInitialize(&idInst,       /* receives instance identifier     */
        (PFNCALLBACK) lpDdeProc, /* address of callback function     */
        CBF_FAIL_EXECUTES |      /* filter XTYP_EXECUTE transactions */
        CBF_FAIL_POKES, 0L);     /* filter XTYP_POKE transactions    */
    return FALSE;
```

This example obtains a procedure-instance address for the callback function named **DdeCallback** and then passes the address to the DDEML. The CBF_FAIL_EXECUTES and CBF_FAIL_POKES filters prevent the **DDEML** from passing **XTYP_EXECUTE** or **XTYP_POKE** transactions to the callback function.

An application should call the **DdeUninitialize** function when it no longer needs to use the DDEML. This function terminates any conversations currently open for the application and frees the **DDEML** resources that the system allocated for the application.

The **DDEML** may have difficulty terminating a conversation. This occurs when the other partner in a conversation fails to terminate its end of the conversation. In this case, the system enters a modal loop while it waits for any conversations to be terminated. A system-defined timeout period is associated with this loop. If the timeout period expires before the conversations have been terminated, a message box appears that gives the user the choice of waiting for another timeout period (Retry), waiting indefinitely (Ignore), or exiting the modal loop (Abort). An application should call **DdeUninitialize** after it has become invisible to the user and after its message loop has terminated.

DDEML Callback Function

An application that uses the **DDEML** must provide a callback function that processes the DDE events that affect the application. The DDEML notifies an application of such events by sending transactions to the application's DDE callback function. The transactions that a callback function receives depend on the callback-filter flags that the application specified in the **DdeInitialize** function and on whether the application is a client, a server, or both. The following example shows the general structure of a callback function for a typical client application:

```
HDDEDATA CALLBACK DdeCallback(<type>, <fmt>, <hconv>, <hsz1>,
    <hsz2>, <hData>, <dwData1>, <dwData2>)
UINT <type>,        /* transaction type                */
UINT <fmt>,         /* clipboard data format           */
HCONV <hconv>,      /* handle of conversation          */
HSZ <hsz1>,         /* handle of string                */
HSZ <hsz2>,         /* handle of string                */
HDDEDATA <hData>,   /* handle of global memory object  */
DWORD <dwData1>,    /* transaction-specific data       */
DWORD <dwData2>,    /* transaction-specific data       */
{
    switch (type) {
        case XTYP_REGISTER:
        case XTYP_UNREGISTER:
            .
            .
            .
            return (HDDEDATA) NULL;

        case XTYP_ADVDATA:
            .
            .
            .
            return (HDDEDATA) DDE_FACK;

        case XTYP_XACT_COMPLETE:
            .
            .
            .
            return (HDDEDATA) NULL;

        case XTYP_DISCONNECT:
            .
            .
            .
            return (HDDEDATA) NULL;

        default:
            return (HDDEDATA) NULL;
    }
}
```

The *type* parameter specifies the transaction type sent to the callback function by the DDEML. The values of the remaining parameters depend on the transaction type. The transaction types and the events that generate them are described in the following sections of this topic. For detailed information about each transaction type, see Transaction Management.

DDEML String Management

Many **DDEML** functions require access to strings in order to carry out a DDE task. For example, a client must specify a service name and a topic name when it calls the **DdeConnect** function to request a conversation with a server. An application specifies a string by passing a string handle rather than a pointer in a DDEML function. A string handle is a doubleword value, assigned by the system, that identifies a string.

An application can obtain a string handle for a particular string by calling the **DdeCreateStringHandle** function. This function registers the string with the system and returns a string handle to the application. The application can pass the handle to **DDEML** functions that need to access the string. The following example obtains string handles for the System topic string and the service-name string:

```
HSZ hszServName;
HSZ hszSysTopic;

hszServName = DdeCreateStringHandle(
    idInst,         /* instance identifier */
    "MyServer",     /* string to register  */
    CP_WINANSI);    /* code page           */

hszSysTopic = DdeCreateStringHandle(
    idInst,         /* instance identifier */
    SZDDESYS_TOPIC, /* System topic        */
    CP_WINANSI);    /* code page           */
```

The *idInst* parameter in the preceding example specifies the instance identifier obtained by the **DdeInitialize** function.

An application's DDE callback function receives one or more string handles during most DDE transactions. For example, a server receives two string handles during the **XTYP_REQUEST** transaction: One identifies a string specifying a topic name; the other identifies a string specifying an item name. An application can obtain the length of the string that corresponds to a string handle and copy the string to an application-defined buffer by calling the **DdeQueryString** function, as the following example demonstrates:

```
DWORD idInst;
DWORD cb;
HSZ hszServ;
PSTR pszServName;

cb = DdeQueryString(idInst, hszServ, (LPSTR) NULL, 0L, CP_WINANSI) + 1;
pszServName = (PSTR) LocalAlloc(LPTR, (WORD) cb);
DdeQueryString(idInst, hszServ, pszServName, cb, CP_WINANSI);
```

An instance-specific string handle is not mappable from string handle to string to string handle again. For instance, in the following example, the **DdeQueryString** function creates a string from a string handle and then **DdeCreateStringHandle** creates a string handle from that string, but the two handles are not the same:

```
DWORD cb;
HSZ hszInst, hszNew;
PSZ pszInst;

DdeQueryString(idInst, hszInst, pszInst, cb, CP_WINANSI);
hszNew = DdeCreateStringHandle(idInst, pszInst, CP_WINANSI);
/* hszNew != hszInst ! */
```

A string handle that is passed to an application's DDE callback function becomes invalid when the

callback function returns. An application can save a string handle for use after the callback function returns by using the **DdeKeepStringHandle** function.

When an application calls **DdeCreateStringHandle**, the system enters the specified string into a systemwide string table and generates a handle that it uses to access the string. The system also maintains a usage count for each string in the string table.

When an application calls the **DdeCreateStringHandle** function and specifies a string that already exists in the table, the system increments the usage count rather than adding another occurrence of the string. (An application can also increment the usage count by using the **DdeKeepStringHandle** function.) When an application calls the **DdeFreeStringHandle** function, the system decrements the usage count.

A string is removed from the table when its usage count equals zero. Because more than one application can obtain the handle of a particular string, an application should not free a string handle more times than it has created or kept the handle. Otherwise, the application could cause the string to be removed from the table, denying other applications access to the string.

The **DDEML** string-management functions are based on the Windows atom manager and are subject to the same size restrictions as atoms.

DDEML Server Name Service

The **DDEML** makes it possible for a server application to register the service names that it supports and to prevent the DDEML from sending **XTYP_CONNECT** transactions for unsupported service names to the server's DDE callback function. The remaining topics in this section describe this service.

Service-Name Registration

By registering its service names with the **DDEML**, a server informs other DDE applications in the system that a new server is available. A server registers a service name by calling the **DdeNameService** function, specifying a string handle that identifies the name. As a result, the DDEML sends an **XTYP_REGISTER** transaction to the callback function of each DDEML application in the system (except those that specified the CBF_SKIP_REGISTRATIONS filter flag in the **DdeInitialize** function). The XTYP_REGISTER transaction passes two string handles to a callback function: The first identifies the string specifying the base service name; the second identifies the string specifying the instance-specific service. A client typically uses the base service name in a list of available servers, so that the user can select a server from the list. The client uses the instance-specific service name to establish a conversation with a specific instance of a server application if more than one instance is running.

A server can use the **DdeNameService** function to unregister a service name. This causes the **DDEML** to send **XTYP_UNREGISTER** transactions to the other DDE applications in the system, informing them that they can no longer use the name to establish conversations.

A server should call the **DdeNameService** function to register its service names soon after calling the **DdeInitialize** function. A server should unregister its service names just before calling the **DdeUninitialize** function.

Service-Name Filter

Besides registering service names, the **DdeNameService** function makes it possible for a server to turn its service-name filter on or off. When a server turns off its service-name filter, the **DDEML** sends the **XTYP_CONNECT** transaction to the server's DDE callback function whenever any client calls the **DdeConnect** function, regardless of the service name specified in the function. When a server turns on its service-name filter, the DDEML sends the XTYP_CONNECT transaction to the server only when the **DdeConnect** function specifies a service name that the server has specified in a call to the **DdeNameService** function.

By default, the service-name filter is on when an application calls the **DdeInitialize** function. This prevents the **DDEML** from sending the **XTYP_CONNECT** transaction to a server before the server has created the string handles that it needs. A server can turn off its service-name filter by specifying the DNS_FILTEROFF flag in a call to the **DdeNameService** function. The DNS_FILTERON flag turns on the filter.

DDEML Conversation Management

A conversation between a client and a server is always established at the request of the client. When a conversation is established, each partner receives a handle that identifies the conversation. The partners use this handle in other **DDEML** functions to send transactions and manage the conversation.

A client can request a conversation with a single server, or it can request multiple conversations with one or more servers. The remaining topics in this section describe how an application establishes conversations and explain how an application can obtain information about conversations that are already established.

Single Conversations

A client application requests a single conversation with a server by calling the **DdeConnect** function, specifying string handles that identify the strings specifying the service name of the server and the topic name of interest. The **DDEML** responds by sending the **XTYP_CONNECT** transaction to the DDE callback function of each server application that either has registered a service name that matches the one specified in the **DdeConnect** function or has turned service-name filtering off by calling the **DdeNameService** function. A server can also filter the XTYP_CONNECT transactions by specifying the CBF_FAIL_CONNECTIONS filter flag in the **DdeInitialize** function. During the XTYP_CONNECT transaction, the DDEML passes the service name and the topic name to the server. The server should examine the names and return TRUE if it supports the service/topic name pair or FALSE if it does not.

If no server returns TRUE from the **XTYP_CONNECT** transaction, the client receives NULL from the **DdeConnect** function and no conversation is established. If a server does return TRUE, a conversation is established and the client receives a conversation handle--a doubleword value that identifies the conversation. The client uses the handle in subsequent **DDEML** calls to obtain data from the server. The server receives the **XTYP_CONNECT_CONFIRM** transaction (unless the server specified the CBF_FAIL_CONFIRMS filter flag). This transaction passes the conversation handle to the server.

The following example requests a conversation on the System topic with a server that recognizes the service name MyServer. The *hszServName* and *hszSysTopic* parameters are previously created string handles.

```
HCONV hConv;
HWND hwndParent;
HSZ hszServName;
HSZ hszSysTopic;

hConv = DdeConnect(
    idInst,         /* instance identifier              */
    hszServName,    /* service-name string handle       */
    hszSysTopic,    /* System-topic string handle       */
    (PCONVCONTEXT) NULL); /* reserved--must be NULL     */

if (hConv == NULL) {
    MessageBox(hwndParent, "MyServer is unavailable.",
        (LPSTR) NULL, MB_OK);
    return FALSE;
}
```

The **DdeConnect** function in the preceding example causes the DDE callback function of the MyServer application to receive an **XTYP_CONNECT** transaction.

In the following example, the server responds to the **XTYP_CONNECT** transaction by comparing the topic-name string handle that the **DDEML** passed to the server with each element in the array of topic-name string handles that the server supports. If the server finds a match, it establishes the conversation.

```
#define CTOPICS 5

HSZ hsz1;                   /* string handle passed by DDEML  */
HSZ ahszTopics[CTOPICS];    /* array of supported topics      */
int i;                      /* loop counter                   */

.
. /* Use switch statement to examine transaction types. */
.

case XTYP_CONNECT:
    for (i = 0; i < CTOPICS; i++) {
        if (hsz1 == ahszTopics[i])
            return TRUE;    /* establish a conversation       */
    }

    return FALSE; /* topic not supported; deny conversation  */

.
. /* Process other transaction types. */
.
```

If the server returns TRUE in response to the **XTYP_CONNECT** transaction, the **DDEML** sends an **XTYP_CONNECT_CONFIRM** transaction to the server's DDE callback function. The server can obtain the handle for the conversation by processing this transaction.

A client can establish a wildcard conversation by specifying NULL for the service-name string handle, the topic-name string handle, or both in a call to the **DdeConnect** function. When at least one of the string handles is NULL, the **DDEML** sends the **XTYP_WILDCONNECT** transaction to the callback functions of all DDE applications (except those that filter the XTYP_WILDCONNECT transaction). Each server application should respond by returning a data handle that identifies a null-terminated array of **HSZPAIR** structures. If the server application has not called the **DdeNameService** function to register its service names and filtering is on, the server does not receive XTYP_WILDCONNECT transactions. For more information about data handles, see Data Management.

The array should contain one structure for each service/topic name pair that matches the pair specified by the client. The **DDEML** selects one of the pairs to establish a conversation and returns to the client a handle that identifies the conversation. The DDEML sends the **XTYP_CONNECT_CONFIRM** transaction to the server (unless the server filters this transaction). The following example shows a typical server response to the **XTYP_WILDCONNECT** transaction:

```
#define CTOPICS 2

UINT type;
UINT fmt;
HSZPAIR ahp[(CTOPICS + 1)];
HSZ ahszTopicList[CTOPICS];
HSZ hszServ, hszTopic;
WORD i, j;

if (type == XTYP_WILDCONNECT) {

     /*
      * Scan the topic list, and create array of HSZPAIR
      * structures.
      */
```

```
    j = 0;
    for (i = 0; i < CTOPICS; i++) {
        if (hszTopic == (HSZ) NULL ||
                hszTopic == ahszTopicList[i]) {
            ahp[j].hszSvc = hszServ;
            ahp[j++].hszTopic = ahszTopicList[i];
        }
    }

    /*
     * End the list with an HSZPAIR structure that contains NULL
     * string handles as its members.
     */

    ahp[j].hszSvc = NULL;
    ahp[j++].hszTopic = NULL;

    /*
     * Return a handle to a global memory object containing the
     * HSZPAIR structures.
     */

    return DdeCreateDataHandle(
        idInst,           /* instance identifier     */
        &ahp,             /* points to HSZPAIR array */
        sizeof(HSZ) * j,  /* length of the array     */
        0,                /* start at the beginning  */
        NULL,             /* no item-name string     */
        fmt,              /* return the same format  */
        0);               /* let the system own it   */
}
```

Either the client or the server can terminate a conversation at any time by calling the **DdeDisconnect** function. This causes the callback function of the partner in the conversation to receive the **XTYP_DISCONNECT** transaction (unless the partner specified the CBF_SKIP_DISCONNECTS filter flag). Typically, an application responds to the XTYP_DISCONNECT transaction by using the **DdeQueryConvInfo** function to obtain information about the conversation that terminated. After the callback function returns from processing the XTYP_DISCONNECT transaction, the conversation handle is no longer valid.

A client application that receives an **XTYP_DISCONNECT** transaction in its DDE callback function can attempt to reestablish the conversation by calling the **DdeReconnect** function. The client must call **DdeReconnect** from within its DDE callback function.

Multiple Conversations

A client application can use the **DdeConnectList** function to determine whether any servers of interest are available in the system. A client specifies a service name and topic name when it calls the **DdeConnectList** function, causing the **DDEML** to broadcast the **XTYP_WILDCONNECT** transaction to the DDE callback functions of all servers that match the service name (except those that filter the transaction). A server's callback function should return a data handle that identifies a null-terminated array of **HSZPAIR** structures. The array should contain one structure for each service/topic name pair that matches the pair specified by the client. The DDEML establishes a conversation for each **HSZPAIR** structure filled by the server and returns a conversation-list handle to the client. The server receives the conversation handle by way of the **XTYP_CONNECT_CONFIRM** transaction (unless the server filters this transaction).

A client can specify NULL for the service name, topic name, or both when it calls the **DdeConnectList**

function. If the service name is NULL, all servers in the system that support the specified topic name respond. A conversation is established with each responding server, including multiple instances of the same server. If the topic name is NULL, a conversation is established on each topic recognized by each server that matches the service name.

A client can use the **DdeQueryNextServer** and **DdeQueryConvInfo** functions to identify the servers that respond to the **DdeConnectList** function. The **DdeQueryNextServer** function returns the next conversation handle in a conversation list; the **DdeQueryConvInfo** function fills a **CONVINFO** structure with information about the conversation. The client can keep the conversation handles that it needs and discard the rest from the conversation list.

The following example uses the **DdeConnectList** function to establish conversations with all servers that support the System topic and then uses the **DdeQueryNextServer** and **DdeQueryConvInfo** functions to obtain the servers' service-name string handles and store them in a buffer:

```
HCONVLIST hconvList; /* conversation list       */
DWORD idInst;        /* instance identifier     */
HSZ hszSystem;       /* System topic            */
HCONV hconv = NULL;  /* conversation handle     */
CONVINFO ci;         /* holds conversation data */
UINT cConv = 0;      /* count of conv. handles  */
HSZ *pHsz, *aHsz;    /* point to string handles */

/* Connect to all servers that support the System topic. */

hconvList = DdeConnectList(idInst, NULL, hszSystem, NULL, NULL);

/* Count the number of handles in the conversation list. */

while ((hconv = DdeQueryNextServer(hconvList, hconv)) != NULL) cConv++;

/* Allocate a buffer for the string handles. */

hconv = NULL;
aHsz = (HSZ *) LocalAlloc(LMEM_FIXED, cConv * sizeof(HSZ));

/* Copy the string handles to the buffer. */

pHsz = aHsz;
while ((hconv = DdeQueryNextServer(hconvList, hconv)) != NULL) {
    DdeQueryConvInfo(hconv, QID_SYNC, (PCONVINFO) &ci);
    DdeKeepStringHandle(idInst, ci.hszSvcPartner);
    *pHsz++ = ci.hszSvcPartner;
}

.
. /* Use the handles; converse with servers. */
.

/* Free the memory, and terminate conversations. */

LocalFree((HANDLE) aHsz);
DdeDisconnectList(hconvList);
```

An application can terminate an individual conversation in a conversation list by calling the **DdeDisconnect** function. An application can terminate all conversations in a conversation list by calling the **DdeDisconnectList** function. Both functions cause the **DDEML** to send **XTYP_DISCONNECT** transactions to each partner's DDE callback function. The **DdeDisconnectList** function sends a

XTYP_DISCONNECT transaction for each conversation handle in the list.

A client can use the **DdeConnectList** function to enumerate the conversation handles in a conversation list by passing an existing conversation-list handle to the **DdeConnectList** function. The enumeration process removes the handles of terminated conversations from the list.

If the **DdeConnectList** function specifies an existing conversation-list handle and a service name or topic name that is different from those used to create the existing conversation list, the function creates a new conversation list that contains the handles of any new conversations and the handles from the existing list.

The **DdeConnectList** function attempts to prevent duplicate conversations in a conversation list. A duplicate conversation is a second conversation with the same server on the same service name and topic name. Two such conversations would have different handles, yet they would be duplicate conversations.

DDEML Data Management

Because DDE uses global memory to pass data from one application to another, the **DDEML** provides a set of functions that DDE applications can use to create and manage global memory objects.

All transactions that involve the exchange of data require the application supplying the data to create a local buffer containing the data and then to call the **DdeCreateDataHandle** function. This function allocates a global memory object, copies the data from the buffer to the memory object, and returns a data handle of the application. A data handle is a doubleword value that the **DDEML** uses to provide access to data in the global memory object. To share the data in a global memory object, an application passes the data handle to the DDEML, and the DDEML passes the handle to the DDE callback function of the application that is receiving the data transaction.

The following example shows how to create a global memory object and obtain a handle of the object. During the **XTYP_ADVREQ** transaction, the callback function converts the current time to an ASCII string, copies the string to a local buffer, then creates a global memory object that contains the string. The callback function returns the handle of the global memory object to the **DDEML**, which passes the handle to the client application.

```
typedef struct { /* tm */
    int hour;
    int minute;
    int second;
} TIME;

TIME tmTime;
HSZ hszTime;
HSZ hszNow;
HDDEDATA EXPENTRY DdeProc(wType, wFmt, hConv, hsz1, hsz2,
    hData, dwData1, dwData2)
WORD wType;
WORD wFmt;
HCONV hConv;
HSZ hsz1;
HSZ hsz2;
HDDEDATA hData;
DWORD dwData1;
DWORD dwData2;
{
    char szBuf[32];

    switch (wType) {

        case XTYP_ADVREQ:
            if ((hsz1 == hszTime && hsz2 == hszNow)
                    && (wFmt == CF_TEXT)) {

                /* Copy formatted time string to buffer. */

                itoa(tmTime.hour, szBuf, 10);
                strcat(szBuf, ":");
                if (tmTime.minute < 10)
                    strcat(szBuf, "0");
                itoa(tmTime.minute, &szBuf[strlen(szBuf)], 10);
                strcat(szBuf, ":");
                if (tmTime.second < 10)
                    strcat(szBuf, "0");
```

```
                itoa(tmTime.second, &szBuf[strlen(szBuf)], 10);
                szBuf[strlen(szBuf)] = '\0';

                /* Create global object, and return data handle. */

                return (DdeCreateDataHandle(
                    idInst,             /* instance identifier   */
                    (LPBYTE) szBuf,     /* source buffer         */
                    strlen(szBuf) + 1, /* size of global object */
                    0L,                 /* offset from beginning */
                    hszNow,             /* item-name string      */
                    CF_TEXT,            /* clipboard format      */
                    0));                /* no creation flags     */
            } else
                return (HDDEDATA) NULL;

        .
        . /* Process other transaction types. */
        .
    }
}
```

The receiving application obtains a pointer to the global memory object by passing the data handle to the **DdeAccessData** function. The pointer returned by **DdeAccessData** provides read-only access. The application should use the pointer to review the data and then call the **DdeUnaccessData** function to invalidate the pointer. The application can copy the data to a local buffer by using the **DdeGetData** function.

The following example obtains a pointer to the global memory object identified by the *hData* parameter, copies the contents to a local buffer, and then invalidates the pointer:

```
HDDEDATA hData;
LPBYTE lpszAdviseData;
DWORD cbDataLen;
DWORD i;
char szData[32];

case XTYP_ADVDATA:

    lpszAdviseData = DdeAccessData(hData, &cbDataLen);
    for (i = 0; i < cbDataLen; i++)
        szData[i] = *lpszAdviseData++;
    DdeUnaccessData(hData);
    return (HDDEDATA) TRUE;
```

Usually, when an application that created a data handle passes that handle to the **DDEML**, the handle becomes invalid in the creating application. This is fine if the application needs to share data with just a single application. If an application needs to share the same data with multiple applications, however, the creating application should specify the HDATA_APPOWNED flag in **DdeCreateDataHandle**. Doing so gives ownership of the memory object to the creating application and prevents the DDEML from invalidating the data handle. When the creating application finishes using a memory object it owns, it should free the object by calling the **DdeFreeDataHandle** function.

If an application has not yet passed the handle of a global memory object to the **DDEML**, the application can add data to the object or overwrite data in the object by using the **DdeAddData** function. Typically, an application uses **DdeAddData** to fill an uninitialized global memory object. After an application passes a data handle to the DDEML, the global memory object identified by the handle cannot be changed; it can only be freed.

The **DDEML** data-management functions can handle huge memory objects. A DDEML application should check the size of a global memory object and allocate a huge buffer of the appropriate size before copying the object.

DDEML Transaction Management

After a client has established a conversation with a server, the client can send transactions to obtain data and services from the server. The remaining topics in this section describe the types of transactions that clients can use to interact with a server.

Request Transaction

A client application can use the **XTYP_REQUEST** transaction to request a data item from a server application. The client calls the **DdeClientTransaction** function, specifying XTYP_REQUEST as the transaction type and specifying the data item the application needs.

The **DDEML** passes the **XTYP_REQUEST** transaction to the server, specifying the topic name, item name, and data format requested by the client. If the server supports the requested topic, item, and data format, the server should return a data handle that identifies the current value of the item. The DDEML passes this handle to the client as the return value from the **DdeClientTransaction** function. The server should return NULL if it does not support the topic, item, or format requested.

The **DdeClientTransaction** function uses the *lpdwResult* parameter to return a transaction status flag to the client. If the server does not process the **XTYP_REQUEST** transaction, **DdeClientTransaction** returns NULL, and *lpdwResult* points to the DDE_FNOTPROCESSED or DDE_FBUSY flag. If the DDE_FNOTPROCESSED flag is returned, the client has no way to determine why the server did not process the transaction.

If a server does not support the **XTYP_REQUEST** transaction, it should specify the CBF_FAIL_REQUESTS filter flag in the **DdeInitialize** function. This prevents the **DDEML** from sending this transaction to the server.

Poke Transaction

A client can send unsolicited data to a server by using the **DdeClientTransaction** function to send an **XTYP_POKE** transaction to a server's callback function.

The client application first creates a buffer that contains the data to send to the server and then passes a pointer to the buffer as a parameter to the **DdeClientTransaction** function. Alternatively, the client can use the **DdeCreateDataHandle** function to obtain a data handle that identifies the data and then pass the handle to **DdeClientTransaction**. In either case, the client also specifies the topic name, item name, and data format when it calls **DdeClientTransaction**.

The **DDEML** passes the **XTYP_POKE** transaction to the server, specifying the topic name, item name, and data format that the client requested. To accept the data item and format, the server should return DDE_FACK. To reject the data, the server should return DDE_FNOTPROCESSED. If the server is too busy to accept the data, the server should return DDE_FBUSY.

When the **DdeClientTransaction** function returns, the client can use the *lpdwResult* parameter to access the transaction status flag. If the flag is DDE_FBUSY, the client should send the transaction again later.

If a server does not support the **XTYP_POKE** transaction, it should specify the CBF_FAIL_POKES filter flag in the **DdeInitialize** function. This prevents the **DDEML** from sending this transaction to the server.

Advise Transaction

A client application can use the **DDEML** to establish one or more links to items in a server application. When such a link is established, the server sends periodic updates about the linked item to the client (typically, whenever the value of the item associated with the server application changes). This establishes an advise loop between the two applications that remains in place until the client ends it.

There are two kinds of advise loops: "hot" and "warm." In a hot advise loop, the server immediately sends a data handle that identifies the changed value. In a warm advise loop, the server notifies the client that the value of the item has changed but does not send the data handle until the client

requests it.

A client can request a hot advise loop with a server by specifying the **XTYP_ADVSTART** transaction type in a call to the **DdeClientTransaction** function. To request a warm advise loop, the client must combine the XTYPF_NODATA flag with the XTYP_ADVSTART transaction type. In either event, the **DDEML** passes the XTYP_ADVSTART transaction to the server's DDE callback function. The server's DDE callback function should examine the parameters that accompany the XTYP_ADVSTART transaction (including the requested format, topic name, and item name) and then return TRUE to allow the advise loop or FALSE to deny it.

After an advise loop is established, the server application should call the **DdePostAdvise** function whenever the value of the item associated with the requested item name changes. This results in an **XTYP_ADVREQ** transaction being sent to the server's own DDE callback function. The server's DDE callback function should return a data handle that identifies the new value of the data item. The **DDEML** then notifies the client that the specified item has changed by sending the **XTYP_ADVDATA** transaction to the client's DDE callback function.

If the client requested a hot advise loop, the **DDEML** passes the data handle for the changed item to the client during the **XTYP_ADVDATA** transaction. Otherwise, the client can send an **XTYP_REQUEST** transaction to obtain the data handle.

It is possible for a server to send updates faster than a client can process the new data. This can be a problem for a client that must perform long processing operations on the data. In this case, the client should specify the XTYPF_ACKREQ flag when it requests an advise loop. This causes the server to wait for the client to acknowledge that it has received and processed a data item before the server sends the next data item. Advise loops that are established with the XTYPF_ACKREQ flag are more robust with fast servers but may occasionally miss updates. Advise loops established without the XTYPF_ACKREQ flag are guaranteed not to miss updates as long as the client keeps up with the server.

A client can end an advise loop by specifying the **XTYP_ADVSTOP** transaction type in a call to the **DdeClientTransaction** function.

If a server does not support advise loops, it should specify the CBF_FAIL_ADVISES filter flag in the **DdeInitialize** function. This prevents the **DDEML** from sending the **XTYP_ADVSTART** and **XTYP_ADVSTOP** transactions to the server.

Execute Transaction

A client can use the **XTYP_EXECUTE** transaction to cause a server to execute a command or series of commands.

To execute a server command, the client first creates a buffer that contains a command string for the server to execute and then passes either a pointer to the buffer or a data handle identifying the buffer when it calls the **DdeClientTransaction** function. Other required parameters include the conversation handle, the item-name string handle, the format specification, and the **XTYP_EXECUTE** transaction type. When an application creates a data handle for passing execute data, the application must specify NULL for the *hszItem* parameter of the **DdeCreateDataHandle** function.

The **DDEML** passes the **XTYP_EXECUTE** transaction to the server's DDE callback function specifying the format name, conversation handle, topic name, and data handle identifying the command string. If the server supports the command, it should use the **DdeAccessData** function to obtain a pointer to the command string, execute the command, and then return DDE_FACK. If the server does not support the command or cannot complete the transaction, it should return DDE_FNOTPROCESSED. The server should return DDE_FBUSY if it is too busy to complete the transaction.

When the **DdeClientTransaction** function returns, the client can use the *lpdwResult* parameter to access the transaction status flag. If the flag is DDE_FBUSY, the client should send the transaction again later.

If a server does not support the **XTYP_EXECUTE** transaction, it should specify the CBF_FAIL_EXECUTES filter flag in the **DdeInitialize** function. Doing so prevents the **DDEML** from

sending this transaction to the server.

Synchronous and Asynchronous Transactions

A client can send either synchronous or asynchronous transactions. In a synchronous transaction, the client specifies a timeout value that indicates the maximum amount of time to wait for the server to process the transaction. The **DdeClientTransaction** function does not return until the server processes the transaction, the transaction fails, or the timeout value expires. The client specifies the timeout value when it calls **DdeClientTransaction**.

During a synchronous transaction, the client enters a modal loop while waiting for the transaction to be processed. The client can still process user input but cannot send another synchronous transaction until the **DdeClientTransaction** function returns.

A client sends an asynchronous transaction by specifying the TIMEOUT_ASYNC flag in the **DdeClientTransaction** function. The function returns after the transaction is begun, passing a transaction identifier to the client. When the server finishes processing the asynchronous transaction, the **DDEML** sends an **XTYP_XACT_COMPLETE** transaction to the client. One of the parameters that the DDEML passes to the client during the XTYP_XACT_COMPLETE transaction is the transaction identifier. By comparing this transaction identifier with the identifier returned by the **DdeClientTransaction** function, the client identifies which asynchronous transaction the server has finished processing.

A client can use the **DdeSetUserHandle** function as an aid to processing an asynchronous transaction. This function makes it possible for a client to associate an application-defined doubleword value with a conversation handle and transaction identifier. The client can use the **DdeQueryConvInfo** function during the **XTYP_XACT_COMPLETE** transaction to obtain the application-defined doubleword value. This saves an application from having to maintain a list of active transaction identifiers.

If a server does not process an asynchronous transaction in a timely manner, the client can abandon the transaction by calling the **DdeAbandonTransaction** function. The **DDEML** releases all resources associated with the transaction and discards the results of the transaction when the server finishes processing it.

The asynchronous transaction method is provided for applications that must send a high volume of DDE transactions while simultaneously performing a substantial amount of processing, such as calculations. The asynchronous method is also useful in applications that need to stop processing DDE transactions temporarily so they can complete other tasks without interruption. In most other situations, an application should use the synchronous method.

Synchronous transactions are simpler to maintain and faster than asynchronous transactions. However, only one synchronous transaction can be performed at a time, whereas many asynchronous transactions can be performed simultaneously. With synchronous transactions, a slow server can cause a client to remain idle while waiting for a response. Also, synchronous transactions cause the client to enter a modal loop that could bypass message filtering in the application's own message loop.

Transaction Control

An application can suspend transactions to its DDE callback function--either those transactions associated with a specific conversation handle or all transactions regardless of the conversation handle. This is useful when an application receives a transaction that requires lengthy processing. In this case, an application can return CBR_BLOCK to suspend future transactions associated with that transaction's conversation handle, leaving the application free to process other conversations.

When processing is complete, the application calls the **DdeEnableCallback** function to resume transactions associated with the suspended conversation. Calling **DdeEnableCallback** causes the **DDEML** to resend the transaction that resulted in the application suspending the conversation. Therefore, the application should store the result of the transaction in such a way that it can obtain and return the result without reprocessing the transaction.

An application can suspend all transactions associated with a specific conversation handle by specifying the handle and the EC_DISABLE flag in a call to the **DdeEnableCallback** function. By specifying a NULL handle, an application can suspend all transactions for all conversations.

When a conversation is suspended, the **DDEML** saves transactions for the conversation in a transaction queue. When the application reenables the conversation, the DDEML removes the saved transactions from the queue, passing each transaction to the appropriate callback function. Even though the capacity of the transaction queue is large, an application should reenable a suspended conversation as soon as possible to avoid losing transactions.

An application can resume usual transaction processing by specifying the EC_ENABLEALL flag in the **DdeEnableCallback** function. For a more controlled resumption of transaction processing, the application can specify the EC_ENABLEONE flag. This removes one transaction from the transaction queue and passes it to the appropriate callback function; after the single transaction is processed, any conversations are again disabled.

Transaction Classes

The **DDEML** has four classes of transactions. Each class is identified by a constant that begins with the XCLASS_ prefix. The classes are defined in the DDEML header file. The class constant is combined with the transaction-type constant and is passed to the DDE callback function of the receiving application.

A transaction's class determines the return value that a callback function is expected to return if it processes the transaction. The following table shows the return values and transaction types associated with each of the four transaction classes:

Class	Return value	Transaction
XCLASS_BOOL	TRUE or FALSE	XTYP_ADVSTART XTYP_CONNECT
XCLASS_DATA	A data handle, CBR_BLOCK, or NULL	XTYP_ADVREQ XTYP_REQUEST XTYP_WILDCONNECT
XCLASS_FLAGS	A transaction flag: DDE_FACK, DDE_FBUSY, or DDE_FNOTPROCESSED	XTYP_ADVDATA XTYP_EXECUTE XTYP_POKE
XCLASS_NOTIFICATION	None	XTYP_ADVSTOP XTYP_CONNECT_CONFIRM XTYP_DISCONNECT XTYP_ERROR XTYP_REGISTER XTYP_UNREGISTER XTYP_XACT_COMPLETE

Transaction Summary

The following list shows each DDE transaction type, the receiver of each type, and a description of the activity that causes the **DDEML** to generate each type:

Transaction type	Receiver	Cause
XTYP_ADVDATA	Client	A server responded to an XTYP_ADVREQ transaction by returning a data handle.
XTYP_ADVREQ	Server	A server called the **DdePostAdvise** function, indicating that the value of a data item in an advise loop had changed.

XTYP_ADVSTART	Server	A client specified the XTYP_ADVSTART transaction type in a call to the **DdeClientTransaction** function.
XTYP_ADVSTOP	Server	A client specified the XTYP_ADVSTOP transaction type in a call to the **DdeClientTransaction** function.
XTYP_CONNECT	Server	A client called the **DdeConnect** function, specifying a service name and topic name supported by the server.
XTYP_CONNECT_CONFIRM	Server	The server returned TRUE in response to an XTYP_CONNECT or XTYP_WILDCONNECT transaction.
XTYP_DISCONNECT	Client/Server	A partner in a conversation called the **DdeDisconnect** function, causing both partners to receive this transaction.
XTYP_ERROR	Client/Server	A critical error has occurred. The DDEML may not have sufficient resources to continue.
XTYP_EXECUTE	Server	A client specified the XTYP_EXECUTE transaction type in a call to the **DdeClientTransaction** function.
XTYP_MONITOR	DDE monitoring application	A DDE event occurred in the system.
XTYP_POKE	Server	A client specified the XTYP_POKE transaction type in a call to the **DdeClientTransaction** function.
XTYP_REGISTER	Client/Server	A server application used the **DdeNameService** function to register a service name.
XTYP_REQUEST	Server	A client specified the XTYP_REQUEST transaction type in a call to the **DdeClientTransaction** function.
XTYP_UNREGISTER	Client/Server	A server application used the **DdeNameService** function to unregister a service name.
XTYP_WILDCONNECT	Server	A client called the **DdeConnect** or **DdeConnectList** function, specifying NULL for the service name, the topic name, or both.
XTYP_XACT_COMPLETE	Client	An asynchronous transaction, sent when the client specified the TIMEOUT_ASYNC flag in a call to the **DdeClientTransaction** function, has concluded.

DDEML Error Detection

Whenever a **DDEML** function fails, an application can call the **DdeGetLastError** function to determine the cause of the failure. The **DdeGetLastError** function returns an error value that specifies the cause of the most recent error.

Monitoring Applications

Microsoft Windows **DDESpy** (DDESPY.EXE) monitors DDE activity in the system. You can use DDESpy as a tool for debugging your DDE applications.

You can use the API elements of the **DDEML** to create your own DDE monitoring applications. Like any DDEML application, a DDE monitoring application contains a DDE callback function. The DDEML notifies a monitoring application's DDE callback function whenever a DDE event occurs, passing information about the event to the callback function. The application typically displays the information in a window or writes it to a file.

To receive notifications from the **DDEML**, an application must have registered itself as a DDE monitor by specifying the APPCLASS_MONITOR flag in a call to the **DdeInitialize** function. In this same call, the application can specify one or more monitor flags to indicate the types of events of which the DDEML is to notify the application's callback function. The following table describes each of the monitor flags an application can specify:

Flag	Meaning
MF_CALLBACKS	Notifies the callback function whenever a transaction is sent to any DDE callback function in the system.
MF_CONV	Notifies the callback function whenever a conversation is established or terminated.
MF_ERRORS	Notifies the callback function whenever a **DDEML** error occurs.
MF_HSZ_INFO	Notifies the callback function whenever a **DDEML** application creates, frees, or increments the use count of a string handle or whenever a string handle is freed as a result of a call to the **DdeUninitialize** function.
MF_LINKS	Notifies the callback function whenever an advise loop is started or ended.
MF_POSTMSGS	Notifies the callback function whenever the system or an application posts a DDE message.
MF_SENDMSGS	Notifies the callback function whenever the system or an application sends a DDE message.

The following example shows how to register a DDE monitoring application so that its DDE callback function receives notifications of all DDE events:

```
DWORD idInst;
PFNCALLBACK lpDdeProc;
hInst = hInstance;

lpDdeProc = (PFNCALLBACK) MakeProcInstance(
    (FARPROC) DDECallback,   /* points to callback function      */
    hInstance);              /* instance handle                  */

if (DdeInitialize(
        (LPDWORD) &idInst,  /* instance identifier              */
        lpDdeProc,          /* points to callback function      */
        APPCLASS_MONITOR |  /* this is a monitoring application */
        MF_CALLBACKS     |  /* monitor callback functions       */
        MF_CONV          |  /* monitor conversation data        */
        MF_ERRORS        |  /* monitor DDEML errors             */
        MF_HSZ_INFO      |  /* monitor data-handle activity     */
        MF_LINKS         |  /* monitor advise loops             */
        MF_POSTMSGS      |  /* monitor posted DDE messages      */
        MF_SENDMSGS,        /* monitor sent DDE messages        */
        0L))                /* reserved                         */
    return FALSE;
```

The **DDEML** informs a monitoring application of a DDE event by sending an **XTYP_MONITOR** transaction to the application's DDE callback function. During this transaction, the DDEML passes a monitor flag that specifies the type of DDE event that has occurred and a handle of a global memory object that contains detailed information about the event. The DDEML provides a set of structures that the application can use to extract the information from the memory object. There is a corresponding structure for each type of DDE event. The following table describes each of these structures:

Structure	Description
MONCBSTRUCT	Contains information about a transaction.
MONCONVSTRUCT	Contains information about a conversation.
MONERRSTRUCT	Contains information about the latest DDE error.
MONLINKSTRUCT	Contains information about an advise loop.
MONHSZSTRUCT	Contains information about a string handle.
MONMSGSTRUCT	Contains information about a DDE message that was sent or posted.

The following example shows the DDE callback function of a DDE monitoring application that formats information about each string handle event and then displays the information in a window. The function uses the **MONHSZSTRUCT** structure to extract the information from the global memory object.

```
HDDEDATA CALLBACK DDECallback(wType, wFmt, hConv, hsz1, hsz2,
    hData, dwData1, dwData2)
WORD wType;
WORD wFmt;
HCONV hConv;
HSZ hsz1;
HSZ hsz2;
HDDEDATA hData;
DWORD dwData1;
DWORD dwData2;
{
    LPVOID lpData;
    char *szAction;
    char buf[256];
    DWORD cb;

    switch (wType) {
        case XTYP_MONITOR:

            /* Obtain a pointer of the global memory object. */

            if (lpData = DdeAccessData(hData, &cb)) {

                /* Examine the monitor flag. */

                switch (dwData2) {
                    case MF_HSZ_INFO:

#define PHSZS ((MONHSZSTRUCT FAR *)lpData)

                        /*
                         * The global memory object contains
                         * string-handle data. Use the MONHSZSTRUCT
                         * structure to access the data.
                         */
```

```
                        switch (PHSZS->fsAction) {

                            /*
                             * Examine the action flags to determine
                             * the action performed on the handle.
                             */

                            case MH_CREATE:
                                szAction = "Created";
                                break;

                            case MH_KEEP:
                                szAction = "Incremented";
                                break;

                            case MH_DELETE:
                                szAction = "Deleted";
                                break;

                            case MH_CLEANUP:
                                szAction = "Cleaned up";
                                break;

                            default:
                                DdeUnaccessData(hData);
                                return ((HDDEDATA) 0);
                        }

                        /* Write formatted output to a buffer. */

                        wsprintf(buf,
                            "Handle %s, Task: %x, Hsz: %lx(%s)",
                            (LPSTR) szAction, PHSZS->hTask, PHSZS->hsz,
                            (LPSTR) PHSZS->str);
                        .
                        . /* Display text in window or write to file. */
                        .

                        break;

#undef PHSZS

                    .
                    . /* Process other MF_* flags. */
                    .

                    default:
                        break;
                }
            }

            /* Free the global memory object. */

            DdeUnaccessData(hData);
            break;

        default:
```

```
            break;
        }
        return ((HDDEDATA) 0);
    }
```

Object Linking and Embedding Overview (3.1)

This topic describes the implementation of object linking and embedding (OLE) for applications that run with the Microsoft Windows operating system. The topic also describes how an application can use linked and embedded objects to create compound documents. The following topics discuss the behavior and implementation of object linking and embedding:

Compound Documents
Data Transfer in OLE
Client Applications
Server Applications
Object Handlers
Direct Use of Dynamic Data Exchange

This topic does not go into detail about the recommended user interface for applications that use linked and embedded objects.

Compound Documents

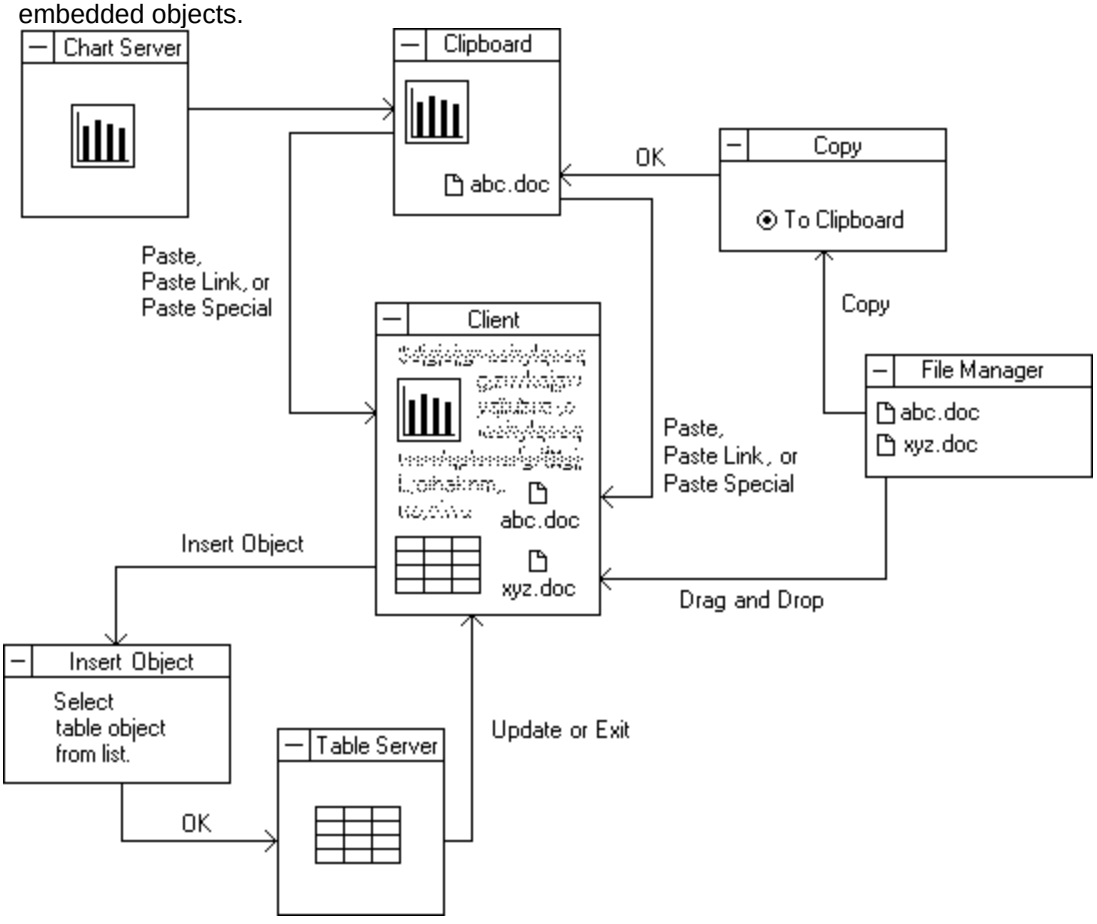
Compound Documents

An application that uses OLE can cooperate with other OLE applications to produce a document containing different kinds of data, all of which can be easily manipulated by the user. The user editing such a document is able to improve the document by using the best features of many different applications. An application that implements OLE gives its users the ability to move away from an application-centered view of computing and toward a document-centered view. In application-centered computing, the tool used to complete a task is often a single application; whereas, in document-centered computing, a user can combine the advantages of many tools to complete a job.

A document that uses linked and embedded objects can contain many kinds of data in many different formats; such a document is called a compound document. A compound document uses the facilities of different OLE applications to manipulate the different kinds of data it displays. Any kind of data format can be incorporated into a compound document; with little or no extra code, OLE applications can even support data formats that have not yet been invented. The user working with a compound document does not need to know which data formats are compatible with one another or how to find and start any applications that created the data. Whenever a user chooses to work with part of a compound document, the application responsible for that part of the document starts automatically.

For example, a compound document could be a brochure that included text, charts, ranges of cells in a spreadsheet, and illustrations. The information could be embedded in the document, or the document could contain links to certain information instead of containing the information itself. The user working with the brochure could automatically switch between the applications that produced its components.

The following illustration shows the relationships between a compound document and its linked and embedded objects.



Linked and Embedded Objects

An object is any data that can be presented in a compound document and manipulated by a user. Anything from a single cell in a spreadsheet to an entire document can be an object. When an object is incorporated into a document, it maintains an association with the application that produced it. That association can be a link, or the object can be embedded in the file.

If the object is linked, the document provides only minimal storage for the data to which the object is linked, and the object can be updated automatically whenever the data in the original application changes. For example, if a range of spreadsheet cells were linked to information in a text file, the data would be stored in some other file and only a link to the data would be saved with the text file.

If an object is embedded, all the data associated with it is saved as part of the file in which it is embedded. If a range of spreadsheet cells were embedded in a text file, the data in the cells would be saved with the text file, including any necessary formulas; the name of the server for the spreadsheet cells would be saved along with this data. The user could select this embedded object while working with the text file, and the spreadsheet application would be started automatically for editing those cells. The presentation and the behavior of the data is the same for a linked and an embedded object.

Packages

A package is a type of OLE object that encapsulates another object, a file, or a command line inside a graphic representation (such as an icon or bitmap). When the user double-clicks the graphic object, the OLE libraries activate the object inside the package. The package itself is always an embedded object, not a link. The contents of a package can be an embedded object, a link, or even a file dropped from Windows File Manager.

Packages are useful for presenting compact token views of large files or OLE objects. An application could also use a package as it would use a hyperlink--that is, to connect information in different documents.

Windows version 3.1 includes the application Microsoft Windows Object Packager (PACKAGER.EXE). With Packager, a user can associate a file or data selection with an icon or graphic.

Verbs

The types of actions a user can perform on an object are called verbs. Two typical verbs for an object are Play and Edit.

The nature of an object determines its behavior when a user works with it. The most typical use for some objects, such as voice annotations and animated scripts, is to play them. For example, a user could play an animated script by double-clicking it. In this case, Play is the primary verb for the object.

For other objects, the most typical use is to edit them. In the case of text produced by a word processor, for example, the primary verb could be Edit.

The client application typically specifies the primary verb when the user double-clicks an object. However, the server application determines the meaning of that verb. A user can invoke an object's subsidiary verbs by using the *Class Name* Object command or the Links dialog box. For more information about these topics, see Client User Interface.

The action taken when a user double-clicks a package is that of the primary verb of the object inside the package. The secondary verb for a packaged object is Edit Package; when the user chooses this verb, Packager starts. The user can use Packager to gain access to the secondary verb for the object inside the package.

Many objects support only one verb--for example, an object created by a text editor might support only Edit. If an object supports only one verb, that verb is used no matter what the client application specifies.

For more information about verbs, see Registration.

Benefits of Object Linking and Embedding

OLE offers the following benefits:

- An application can specialize in performing one job very well. For example, a drawing application that implements OLE does not need any text-editing tools; a user could put text into the drawing and edit that text by using any text editor that supports OLE.
- An application is automatically extensible for future data formats, because the content of an object does not matter to the containing document.
- A user can concentrate on the task instead of on any software required to complete the task.
- A file can be more compact, because linking to objects allows a file to use an object without having to store that object's data.
- A document can be printed or transmitted without using the application that originally produced the document.
- Linked objects in a file can be updated dynamically.

Future implementations of this protocol could take advantage of a wide variety of object types. For example, the user of a voice-recorder application could dictate a comment, package the comment as an object with a visual representation, and embed the graphic as an object in a text file. When a user double-clicked the graphic for this object (a pair of lips, perhaps), the voice-recorder application would play the recorded comment. Linked and embedded objects also lend themselves to implementations such as animated drawings, executable macro scripts, hypertext, and annotations.

Choosing Between OLE and the DDEML

Applications can exchange data by using either OLE or the DDEML. Unless an application has a strong requirement for managing multiple items in a single conversation with another application, the application should use OLE instead of the DDEML.

Both OLE and the **DDEML** are message-based systems supported by dynamic-link libraries. Developers are encouraged to use these libraries rather than using the underlying message-based protocols. For more information about the message-based OLE protocol, see Direct Use of Dynamic Data Exchange.

Unlike OLE, the **DDEML** supports multiple items per conversation. With OLE, a client needing links to several objects in a document must establish a separate conversation for each object.

OLE offers the following advantages that the **DDEML** does not:

Advantage	Description
Extensibility to future enhancements	The OLE libraries may be updated in future releases to support new data formats, link tracking, editing without exiting the client application, and other enhancements that will not be immediately available to applications that use the DDEML.
Persistent embedding and linking of objects	The OLE libraries do most of the work of activating objects when an embedded document is reopened, by reestablishing the conversation between a client and server. In contrast, establishing a DDE link (DDE advise loop) is the responsibility of either the user (if the link is not persistent) or of the application (if the link is persistent).
Rendering of common data formats	The OLE libraries assume the burden of rendering common data formats on a display context. DDE applications, however, must do this work themselves.
Server rendering of specialized data formats	The OLE libraries facilitate the rendering of specialized data formats in the client's display context. (The server application or object handler actually performs the rendering.) The client application has to do very little work to render the embedded or linked data in its

	display context. Such rendering of embedded or linked data is beyond the scope of the **DDEML** alone.
Activating embedded and linked objects	The OLE libraries support activating a server to edit a linked or embedded object or to render data. Activating servers for data rendering and editing is beyond the scope of the DDEML.
Creating objects and links from the clipboard	The OLE libraries do most of the work when an application is using the clipboard to copy and paste links or exchange objects. In contrast, DDE applications must call the Windows clipboard functions directly to perform such operations.
Creating objects and links from files	The OLE libraries provide direct support for using files to exchange data. No DDE protocol is defined for this purpose.

The OLE libraries use DDE messages instead of the **DDEML**, because the libraries were written before the DDEML was available.

Using OLE for Standard DDE Operations

Although most of the OLE application programming interface (API) was designed for linked and embedded objects, it can also be applied to standard DDE items. In particular, an application can use the OLE API to perform the following DDE tasks:

- Initializing conversations based on application and topic names or wildcards.
- Requesting data for named items in negotiated formats from a server.
- Establishing an advise loop--that is, requesting that a DDE server notify the client of changes to the values of specified items and, optionally, that the server send the data when the change occurs.
- Sending data from a server to a client.
- Poking data from a client to a server.
- Sending a DDE command. (This is supported by the **OleExecute** function.)

An OLE client application receives a pointer to an **OLEOBJECT** structure; this structure includes class name, document name, and item name information. These names correspond exactly to DDE counterparts, as follows:

OLE name	DDE name
Class name	Service name (formerly called "application name")
Document name	Topic name
Item name	Item name

The client can use the **OleCreateFromFile** function to make an object and specify all three names. If the client application needs multiple items from the same topic, it must have an **OLEOBJECT** structure for each item, which causes a DDE conversation to be created for each item.

The client library maps OLE functions that work on the **OLEOBJECT** structure to DDE messages as follows:

OLE function	DDE message
OleExecute	**WM_DDE_EXECUTE**
OleRequestData	**WM_DDE_REQUEST**
OleSetData	**WM_DDE_POKE**

Some functions (such as **OleActivate**) are too complicated for this one-to-one mapping of function to DDE message. For these functions, the DDE message depends on the circumstance.

If a client application needs to duplicate the functionality of **WM_DDE_ADVISE** with OLE, the client must create the link with **olerender_format** for the *renderopt* parameter, specify the required format, and use the **OleGetData** function to retrieve the value when the callback function receives the OLE_CHANGED

notification. If more than one item or format is required, the client must create an **OLEOBJECT** structure for each item/format pair. Although this method creates a conversation for each advise transaction, it may be inefficient if the client needs to create many such conversations.

A server application can make itself accessible to DDE by calling the **OleRegisterServer** function to make the System topic available and the **OleRegisterServerDoc** function to make other topics available. When a client connects and asks for an item, the server library calls the **GetObject** function in the server's **OLESERVERDOCVTBL** structure, followed by other server-implemented functions that are appropriate to the client's request. (Usually, the library calls the **GetData** function in the server's **OLEOBJECTVTBL** structure.) As long as the object allocated by the call to **GetObject** has not been released, the server should send a notification when the item has changed, so that the OLE libraries can send data to clients that have sent WM_DDE_ADVISE.

Using Both OLE and the DDEML

Some applications may need features supported only by OLE and may also need to use the **DDEML** to support simultaneous links for many items that are updated frequently. Client applications of this kind can use the OLE libraries to initiate conversations with OLE servers and the DDEML to initiate conversations with DDE servers.

Server applications that need to support both OLE and the **DDEML** must use different service names (DDE application names) for OLE and DDE conversations; otherwise, the OLE and DDEML libraries cannot determine which library should respond when an initiation request is received. Typically, the application changes the service name for the OLE conversation in this case, because other applications and the user must use the service name for the DDE conversation, but the OLE service name is hidden.

Data Transfer

Data Transfer in OLE

This section gives a brief overview of how applications share information under OLE. Details of the implementation are given in later sections of this topic.

Applications use three dynamic-link libraries (DLLs), OLECLI.DLL, OLESVR.DLL, and SHELL.DLL, to implement object linking and embedding. Object linking and embedding is supported by OLECLI.DLL and OLESVR.DLL. The registration database is supported by SHELL.DLL.

Client Applications

An OLE client application can accept, display, and store OLE objects. The objects themselves can contain any kind of data. A client application typically identifies an object by using a distinctive border or other visual cue, as described in *Microsoft Windows User Interface Guidelines.*

Server Applications

An OLE server is any application that can edit an object when the OLE libraries inform it that the user of a client application has selected the object. (Some servers can perform operations on an object other than editing.) When the user double-clicks an object in a client application, the server associated with that object starts and the user works with the object inside the server application. When the server starts, its window is typically sized so that only the object is visible. If the user double-clicks a linked object, the entire linked file is loaded and the linked portion of the file is selected. For embedded objects, the user chooses the Update command from the File menu to save changes to the object and chooses Exit when finished.

Many applications are capable of acting as both clients and servers for linked and embedded objects.

Object Handlers

Some OLE server applications implement an additional kind of OLE library called an object handler. Object handlers are dynamic-link libraries that act as intermediaries between client and server applications. Typically, an object handler is supplied by the developers of a server application as a way of improving performance. For example, an object handler could be used to redraw a changed object if the presentation data for that object could not be rendered by the client library.

Communication Between OLE Libraries

Client applications use functions from the OLE API to inform the client library, OLECLI.DLL, that a user wants to perform an operation on an object. The client library uses DDE messages to communicate with the server library, OLESVR.DLL. The server library is responsible for starting and stopping the server application, directing the interaction with the server's callback functions, and maintaining communication with the client library.

When a server application modifies an embedded object, the server notifies the server library of changes. The server library then notifies the client library, and the client library calls back to the client application, informing it that the changes have occurred. Typically, the client application then forces a repaint of the embedded object in the document file. If the server changes a linked object, the server library notifies the client library that the object has changed and should be redrawn.

Clipboard Conventions

When first embedding or linking an object, OLE client and server applications typically exchange data by using the clipboard. When a server application puts an object on the clipboard, it represents the object with data formats, such as Native data, OwnerLink data, ObjectLink data, and a presentation format. The order in which these formats are put on the clipboard is very important, because the order determines the type of object. For example, if the first format is Native and the second is OwnerLink, client applications can use the data to create an embedded object. If the first format is OwnerLink,

however, the data describes a linked object.

Native data completely defines an object for a particular server. The data can be meaningful only to the server application. The client application provides storage for Native data, in the case of embedded objects.

OwnerLink data identifies the owner of a linked or embedded object.

Presentation formats allow the client library to display the object in a document. CF_METAFILEPICT, CF_DIB, and CF_BITMAP are typical presentation formats. Native data can be used as a presentation format, typically when an object handler has been defined for that class of data. Native data cannot be used twice in the definition of an object, however; if the server puts Native and OwnerLink data on the clipboard to describe an embedded object, it cannot use Native data as a presentation format for that object. The ability of object handlers to use Native data as the presentation data accounts for the significance of the order of the formats: the order is the only way to distinguish between an embedded object and a link that uses Native data for its presentation.

ObjectLink data identifies a linked object's class and document and the item that is the source for the linked object. (If the item name specified in the ObjectLink format is NULL, the link refers to the entire server document.)

The following table describes the contents of the ObjectLink, OwnerLink, and Native clipboard formats:

Format name	Contents
ObjectLink	Null-terminated string for class name, null-terminated string for document name, string for item name with two terminating null characters.
OwnerLink	Null-terminated string for class name, null-terminated string for document name, string for item name with two terminating null characters.
Native	Stream of bytes interpreted only by the server application or object-handler library. This format can be unique to the server application and must allow the server to load and work with the object.

Although the ObjectLink and OwnerLink formats contain the same information, the OLE libraries use them differently. The libraries use OwnerLink format to identify the owner of an object (which can be different from the source of the object) and ObjectLink format to identify the source of the data for an object.

The class name in the ObjectLink or OwnerLink format is a unique name for a class of objects that a server supports. Server applications register the class name or names they support in the registration database. (For example, the class name used by Windows Paintbrush™ is PBrush.) An application can use the class name to look up information about a server in the registration database. (For more information about registration, see Registration.) The document name is typically a fully qualified path that identifies the file containing a document. The item name uniquely identifies the part of a document that is defined as an object. Item names are assigned by server applications; an item name can be any string that the server uses to identify part of a document. Items names cannot contain the forward-slash (/) character.

Data in OwnerLink or ObjectLink format could look like the following example:

```
Microsoft Excel Worksheet\0c:\directry\docname.xls\0R1C1:R5C3\0\0
```

The order in which various data formats are put on the clipboard depends on the type of data being copied to the clipboard and the capabilities of the server application. The following table shows the order of clipboard data formats for four different types of data selections. An object does not necessarily use all of the formats listed for it.

Source selection	Clipboard contents, in order
Embedded object	Native& OwnerLink& Picture or other presentation format (optional)& ObjectLink (included only if the server also supports links)
Linked object	OwnerLink& Picture or other presentation format (optional; for linked objects,

	this can be Native data)& ObjectLink
Pictorial data	Application-specific formats& Native& OwnerLink& Picture& ObjectLink
Structured data	Structured data formats (if selection is structured data only)& Native& OwnerLink& Picture, text, and so on& ObjectLink

Before copying data for an embedded or linked object to the clipboard, a server puts descriptions of the data formats on the clipboard. These data formats are listed in order of their level of description, from most descriptive to least. (For example, Microsoft Word would put rich-text format (RTF) onto the clipboard first, then the CF_TEXT clipboard format.)

When a user chooses the Paste command, the client application queries the formats on the clipboard and uses the first format that is compatible with the destination for the object. Because server applications put data onto the clipboard in order of their fidelity of description, the first acceptable format found by a client application is the best format for it to use. If the client application finds an acceptable format prior to the Native format, it incorporates the data into the target document without making it an embedded object. (For example, a Microsoft Word document would not make an embedded object from clipboard data that was in RTF format. Similarly, structured data or a structured document would be embedded into a drawing application but would be converted into the destination document's native data type if the destination were a worksheet or structured document.) If the client application cannot accept any of the data formats prior to Native and OwnerLink, it uses the Native and OwnerLink formats to make an embedded object and then finds an appropriate presentation format. The destination application may require different formats depending on where the selection is to be placed in the destination document; for example, pasting into a picture frame and pasting into a stream of text could require different formats.

When a user chooses the Paste Link command from the Edit menu, the client application looks for the ObjectLink format on the clipboard and ignores the Native and OwnerLink formats. The ObjectLink format identifies the source class, document, and object. If the application finds the ObjectLink format and a useful presentation format, it uses them to make an OLE link to the source document for the object. If the ObjectLink format is not available, the client application may look for the Link format and create a DDE link. This type of link does not support the OLE protocol.

When an application that does not support OLE copies from an OLE item on the clipboard, it ignores the Native, OwnerLink and ObjectLink formats; the behavior of the copying application does not change.

Registration

The registration database supports linked and embedded objects by providing a systemwide source of information about whether server applications support the OLE protocol, the names of the executable files for these applications, the verbs for classes of objects, and whether an object-handler library exists for a given class of object. For more information about this database, see The Windows Shell Overview.

When a server application is installed, it registers itself as an OLE server with the registration database. (This database is supported by the dynamic-link library SHELL.DLL.) To register itself as an OLE server, a server application records in the database that it supports one or more OLE protocols. The only protocols supported by version 1.*x* of the Microsoft OLE libraries are StdFileEditing and StdExecute. StdFileEditing is the current protocol for linked and embedded objects. StdExecute is used only by applications that support the **OleExecute** function. (A third name, Static, describes a picture than cannot be edited by using standard OLE techniques.)

When a client activates a linked or embedded object, the client library finds the command line for the server in the database, appends the **/Embedding** or **/Embedding** *filename* command-line option, and uses the new command line to start the server. Starting the server with either of these options differs from the user starting it directly. Either a slash (/) or a hyphen (-) can precede the word Embedding. For details about how a server reacts when it is started with these options, see Opening and Closing Objects.

The entries in the registration database are used whenever an application or library needs information about an OLE server. For example, client applications that support the Insert Object command refer to

the database in order to list the OLE server applications that could provide a new object. The client application also uses the registration database to retrieve the name of the server application for the Paste Special dialog box.

Registration Database

Applications typically add key and value pairs to the registration database by using Microsoft Windows Registration Editor (REGEDIT.EXE). Applications could also use the registration functions to add this information to the database.

The registration database stores keys and values as null-terminated strings. Keys are hierarchically structured, with the names of the components of the keys separated by backslash characters (\) . The class name and server path should be registered for every class the server supports. (This class name must be the same string as the server uses when it calls the **OleRegisterServer** function.) If a class has an object-handler library, it should be registered using the **handler** keyword. An application should also register all the verbs its class or classes support. (An application's verbs must be sequential; for example, if an object supports three verbs, the primary verb is 0 and the other verbs must be 1 and 2.)

To be available for OLE transactions, a server should register the key and value pairs shown in the following example when it is installed. This example shows the form of key and value pairs as they would be added to a database with Registration Editor. Although the text string sometimes wraps to the next line in this example, the lines should not include newline characters when they are added to the database.

HKEY_CLASSES_ROOT*class name* = *readable version of class name*
HKEY_CLASSES_ROOT\.*ext* = *class name*
HKEY_CLASSES_ROOT*class name*\protocol\StdFileEditing\server =
    executable file name
HKEY_CLASSES_ROOT*class name*\protocol\StdFileEditing\handler =
    dll name
HKEY_CLASSES_ROOT*class name*\protocol\StdFileEditing\verb\0 =
    primary verb
HKEY_CLASSES_ROOT*class name*\protocol\StdFileEditing\verb\1 =
    secondary verb

Servers that support the **OleExecute** function also add the following line to the database:

HKEY_CLASSES_ROOT*class name*\protocol\StdExecute\server =
    executable file name

An ampersand (&) can be used in the verb specification to indicate that the following character is an accelerator key. For example, if a verb is specified as &Edit, the E key is an accelerator key.

A server can register the entire path for its executable file, rather than registering only the filename and arguments. Registering only the filename fails if the application is installed in a directory that is not mentioned in the PATH environment variable. Usually, registering the path and filename is less ambiguous than registering only the filename.

Servers can register data formats that they accept on calls to the **OleSetData** function or that they can return when a client calls the **OleRequestData** function. Clients can use this information to initialize newly created objects (for example, from data selected in the client) or when using the server as an engine (for example, when sending data to a chart and getting a new picture back). Client applications should not depend on the requested data format, because the calls can be rejected by the server.

In the following example, *format* is the string name of the format as passed to the **RegisterClipboardFormat** function or is one of the system-defined clipboard formats (for example, CF_METAFILEPICT):

HKEY_CLASSES_ROOT*class name*\protocol\StdFileEditing
    \SetDataFormats = *format*[,*format*]

HKEY_CLASSES_ROOT*class name*\protocol\StdFileEditing
\RequestDataFormats = *format*[,*format*]

For compatibility with earlier applications, the system registration service also reads and writes registration information in the [embedding] section of the WIN.INI initialization file.

In the following example, the keyword **picture** indicates that the server can produce metafiles for use when rendering objects:

[embedding]
*classname=comment,textual class name,path/arguments,*picture

Version Control for Servers

Server applications should store version numbers in their Native data formats. New versions of servers that are intended to replace old versions should be capable of dealing with data in Native format that was created by older versions. It is sometimes important to give the user the option of saving the data in the old format, to support an environment with a mixture of new and old versions, or to permit data to be read by other applications that can interpret only the old format.

There can be only one application at a time (on one workstation) registered as a server for a given class name. The class name (which is stored with the Native data for objects) and the server application are associated in the registration database when the server application registers during installation.

If a new version of a server application allows the user to keep the old version available, a new class name should be allocated for the new server. A good way to do this is to append a version number to the class name. This allows the user to easily differentiate between the two versions when necessary. (The OLE libraries do not check these numbers.)

When the new version of the server is installed, the user should be given the option of either mapping the old objects to the new server (registering the new server as the server for both class names) or keeping them separate. When the user keeps them separate, the user will be aware of two kinds of object (for example, Graph1 and Graph2).

The user should be able to discard the old server version at a later time by remapping the registration database, typically with the help of the server setup program. To remap the database, the old and new objects are given the same value for *readable version of class name* (although their class names remain distinct). The OLE client library removes duplicate names when it produces the list in the Insert Object dialog box. When a client application produces a list by enumerating the registration database, the application must do this filtering itself.

Client User Interface

When a user opens a document that contains a linked or embedded object, the client application uses the OLE functions to communicate with OLECLI.DLL. This library assists the client application with such tasks as loading and drawing objects, updating objects (when necessary), and interacting with server applications.

New and Changed Commands

An OLE client application typically implements the following new or changed commands as part of its Edit menu. (Although this user interface is not mandatory, it is recommended for consistency with existing OLE applications.)

Command	Description
Copy	Copies an object from a document to the clipboard.
Cut	Removes an object from a document and places it on the clipboard.
Paste	Copies an object from the clipboard to a document.
Paste Link	Inserts a link between a document and the file that contains an object.

Class Name Object	Makes it possible for the user to activate the verbs for a linked or embedded object. The actual text used instead of the *Class Name* placeholder depends upon the selected object.
Links	Makes it possible for the user to change link updating options, update linked objects, cancel links, repair broken links, and activate the verbs associated with linked objects.
Insert Object	Starts the server application chosen by the user from a dialog box and embeds in a document the object produced by the server. This command is optional.
Paste Special	Transfers an object from the clipboard to a document or inserts a link to the object, using the data format chosen by the user from a dialog box. This command is optional.

In addition to the listed menu changes, client applications must also implement changes to their Copy and Cut commands. When a linked or embedded object is selected in the client application, the application can use the **OleCopyToClipboard** function to implement the Cut and Copy commands.

When the user chooses the Paste command, a client application should insert the contents of the clipboard at the current position in a document. If the clipboard contains an object, choosing this command typically embeds the object in the document.

When the user chooses the Paste Link command, the client library typically inserts a linked object at the current position in a document. The object is displayed in the document, but the Native data that defines that object is stored elsewhere.

If a user copies a linked object to the clipboard, other documents can use this object to produce a link to the original data.

The *Class Name* Object command allows the user to choose one of an object's verbs. If the selection in the document is an embedded object, the *Class Name* placeholder is typically replaced by the class and name of the object; for example, if a user selects an object that is a range of spreadsheet cells for Microsoft Excel, the text of the command might be "Microsoft Excel Worksheet Object." If an object supports only one verb, the name of the verb should precede the class name in the menu item; for example, if the only verb for a text object is Edit, the text of the command might be "Edit WPDocument Object." When an object supports more than one verb, choosing the *Class Name* Object command brings up a cascading menu listing each of the verbs.

For more information about verbs, see Verbs.

Choosing the Links command brings up a Links dialog box, which lists the selected links and their source documents and gives the user the opportunity to change how the links are updated, cancel the link, change the link, or activate the verbs for the link. A user can use this dialog box to repair links to objects that have been moved or renamed.

When the user chooses the Paste Special command, a client application should bring up a dialog box listing the data formats the client supports that are presently on the clipboard. The Paste Special dialog box makes if possible for the user to override the default behaviors of the Paste and Paste Link commands. For example, if the first format on the clipboard can be edited by the client application, the default behavior is for the client to copy the data into the document without making it into an object. The user could override this default behavior and create an object from such data by using the Paste Special command.

When the user chooses the Insert Object command, a client application should allow the user to insert an object of a specified class at the current position in a document. For example, to insert a range of spreadsheet cells in a text document, a user could choose the Insert Object command and select "Microsoft Excel Worksheet" from the dialog box. Selecting this item would start Microsoft Excel. The user would use Microsoft Excel to create the object to be embedded in the text document. When finished, the user would quit Microsoft Excel; the range of spreadsheet cells would automatically be embedded in the text document.

The Insert Object command is optional because a user could achieve the same results without it,

although the procedure is less convenient. To use the same example as that shown in the preceding paragraph, the user could leave the client application, start Microsoft Excel, and use the Microsoft Excel Cut or Copy command to transfer data to the clipboard. After returning to the client application, the user could choose the Paste command to move the data from the clipboard into the text document.

If the user chooses the Undo command after activating an object, all of the changes made since the object was last updated (or since the object was activated, if it has not been updated) are discarded and the object returns to its state prior to the update. The Undo command closes the connection to the server.

For more information about these commands, including illustrations of the dialog boxes, see *Microsoft Windows User Interface Guidelines.*

Using Packages

A package is an embedded graphical object that contains another object, which can be linked or embedded. For example, a user can package a file in an icon and embed the icon in an OLE document. Most of the packaging capabilities are provided by the dynamic-link library SHELL.DLL.

A user can put a package into an OLE document in a number of different ways:

- Copy a file from File Manager to the clipboard, and then choose the Paste or Paste Link command from the Edit menu in the client application.
- Drag a file from File Manager and drop it in the open window for a document in a client application.
- Select Package from the list of objects in the Insert Object dialog box. This starts Object Packager, with which the user can associate a file or data selection with an icon or graphic. Choosing Update and then Exit from Object Packager's File menu puts the package in the client document.
- Run Packager directly, following the steps outlined in the previous list item.

For information about how a client application should react when a user drops a file from File Manager in the client's window, see the description of the **OleCreateFromFile** function.

A user whose system does not include the Windows version 3.1 File Manager can follow these steps to create a package by using Object Packager:

- Copy to the clipboard the data to be packaged.
- Open Object Packager and paste the data into it. (At this point, the user could modify the default icon, the default label identifying the icon, or both.)
- Choose Copy Package from the Object Packager Edit menu to copy the package to the clipboard.
- Choose the Paste command from the Edit menu in the client application to embed the package.

For more information about Object Packager, see Packages, or *Microsoft Windows User Interface Guidelines.*

Server User Interface

A server for linked and embedded objects is any application that can be used to edit an object when the OLE libraries inform it that the user of a client application has activated the object. (Some servers can use verbs other than Edit to work with an object.) Although client applications implement many changes to the user interface to support OLE, the user interface does not change significantly for server applications.

OLE servers typically implement changes to the following commands in the Edit menu. (Although this user interface is not mandatory, it is recommended for consistency with existing OLE applications.)

Command	Description
Cut	Transfers data from the application to the clipboard, deleting the data from the source document. A client application can use this data to create an embedded object.
Copy	Transfers a copy of the data from the application to the clipboard. A client application can use this data to create an embedded object and may be able to establish a link to the source document.

Some menu items change names or behave differently when a server is started as part of activating an object from within a compound document. The exact behavior of the server depends on whether the server supports the multiple document interface (MDI).

Updating Objects from Multiple-Instance Servers

When an embedded object is edited or played by a multiple-instance server--that is, a server that does not support the multiple document interface (MDI), the Save command on the File menu should change to Update. (This change does not occur when a server starts for a linked object.) When the user chooses the Update command, the object in the client is updated but the focus remains with the server window. To close the server window, the user chooses the Exit command.

When the user chooses the Save As, New, or Open command, the application should display a warning message asking the user whether to update the object in the compound document before performing the action. The New and Open commands break the link between the client and server applications. The Save As command also breaks the link between the client and server if the server was editing an embedded object.

Updating Objects from Single-Instance Servers

The same rules for updating objects from multiple-instance servers apply to single-instance (MDI) servers, with the following differences:

- When the focus in an MDI server changes from a window in which an embedded object was activated to a window in which a document that does not contain an embedded object is being edited, the Update command should change back to Save.
- When the user chooses the New or Open command, the window containing the embedded object remains open. (This eliminates the need to prompt the user to update the object.)

Object Storage Formats

The presentation data in linked or embedded objects can be thought of as a presentation object. A presentation objects can be standard, generic, or NULL. A standard presentation object is used when the format is metafile, bitmap, or device-independent bitmap (DIB). The client library supports the presentation objects, including drawing them. Neither client applications nor object handlers can use the presentation objects; they are solely for the use of the client library.

The following list gives the storage format for strings in OLE. The items appear in the order listed.

Type	Description
LONG	Length of string, including terminating null character.
Variable	Null-terminated stream of bytes.

The following list gives the storage format for the standard presentation object used for linked and embedded objects. The items appear in the order listed.

Type	Description
LONG	OLE version number.
LONG	Format identifier. This value is 5.
Variable	Class string. For standard presentation objects, this string is **METAFILEPICT**, **BITMAP**, or DIB.
LONG	Width of object, in MM_HIMETRIC units.
LONG	Height of object, in MM_HIMETRIC units.
LONG	Size of presentation data, in bytes.
Variable	Presentation data.

The following list gives the storage format for the generic presentation object used for linked and embedded objects. Generic objects are used when the clipboard format is other than metafile, bitmap, or DIB. The items appear in the order listed.

Type	Description
LONG	OLE version number.
LONG	Format identifier. This value is 5.
Variable	Class string.
LONG	Clipboard format value. If this value exists, the next item in storage is the size of the presentation data.
LONG	Clipboard format name. This value exists only if the clipboard format value is NULL.
LONG	Size of presentation data, in bytes.
Variable	Presentation data.

The following list gives the storage format for embedded objects. The items appear in the order listed.

Type	Description
LONG	OLE version number.
LONG	Format identifier. This value is 2.
Variable	Class string.
Variable	Topic string.
Variable	Item string.
LONG	Size of Native data, in bytes.
Variable	Native data.
Variable	Presentation object (standard, generic, or NULL).

The following list gives the storage format for linked objects. The items appear in the order listed.

Type	Description
LONG	OLE version number.
LONG	Format identifier. This value is 1.
Variable	Class string.
Variable	Topic string.
Variable	Item string.
Variable	Network name string.
short	Network type.
short	Network driver version number.
LONG	Link update options.
Variable	Presentation object (standard, generic, or NULL).

The following list gives the storage format for static objects. The only difference between the format for static objects and the format for standard presentation objects is the value of the format identifier. The items appear in the order listed.

Type	Description
LONG	OLE version number.
LONG	Format identifier. This value is 3.
Variable	Class string. For static objects, this string is **METAFILEPICT**, **BITMAP**, or DIB.
LONG	Width of object, in MM_HIMETRIC units.
LONG	Height of object, in MM_HIMETRIC units.
LONG	Size of presentation data, in bytes.
Variable	Presentation data.

Client Applications

Client Applications

A client application uses a server application to activate and render an object contained by a compound document. A client application provides storage for embedded objects, such contextual information as the target printer and page position, and a means for the user to activate the object and the server application associated with that object. Client applications also provide ways of putting embedded and linked objects into a document and taking them out again.

Client applications must provide permanent storage for objects in the compound document's file. When an item being saved is an embedded object, the client library stores the object's Native data, the presentation data for the object (for example, a metafile), and the OwnerLink information. When the item being saved is a link to another document, the client library stores the presentation data and the ObjectLink format.

Client applications accommodate asynchronous operations by defining a callback function to which the library sends notifications about current operations. As long as the client continues to dispatch messages, it can react to the notifications being sent to the callback function and to input from the user. For more information about asynchronous operations, see Asynchronous Operations.

Starting a Client Application

When a client application starts, it should follow these steps:

1 Register the clipboard formats that it requires.

2 Allocate and initialize as many **OLECLIENT** structures as required.

3 Allocate and initialize an **OLESTREAM** structure.

A client application can register the clipboard formats by calling the **RegisterClipboardFormat** function for each format, specifying such formats as Native, OwnerLink, ObjectLink, and any other formats it requires.

A client application uses two structures to receive information from the client library: **OLECLIENT** and **OLESTREAM**.

The **OLECLIENT** structure points to an **OLECLIENTVTBL** structure, which in turn points to a callback function supplied by the client application. The OLE libraries use this callback function to notify the client of any changes to an object. The parameters for the callback function are a pointer to the client structure, a pointer to the relevant object, and a value giving the reason for the notification. Typically, an application creates one **OLECLIENT** structure for each **OLEOBJECT** structure. Having a separate **OLECLIENT** structure for each object allows an application to take object-specific action in response to the OLE_QUERY_PAINT callback notification.

The **OLECLIENT** structure can also point to data that describes the state of an object. This data, when present, is supplied and used only by the client application. The client application allocates a separate **OLECLIENT** structure for each object and stores state information about that object in the structure. Because one argument to the callback function is a pointer to the **OLECLIENT** structure, this is an efficient method of retrieving the object's state information when the callback function is called.

The **OLESTREAM** structure points to an **OLESTREAMVTBL** structure, which is a table of pointers to client-supplied functions for stream input and output. The client libraries use these functions when loading and saving objects. A client can customize functions for particular situations, and a client can make such changes as varying the permanent storage for an object; for example, a client could store an object in a database, instead of in a file with the rest of the document.

The client application should create a pointer to the callback function in the **OLECLIENTVTBL** structure and pointers to the functions in the **OLESTREAMVTBL** structure by using the **MakeProcInstance** function. Callback functions should be exported in the module-definition file.

Opening a Compound Document

To open a compound document, a client application should take the following steps:

1 Register the document with the client library.

2 Load the document data from a file.

3 For each object in the document, call the **OleLoadFromStream** function.

4 List any objects with manual links so that the user can update them. Automatically update any automatic links.

The **OleRegisterClientDoc** function registers a document with the client library and returns a handle that is used in object-creation functions and document-management functions. (This registration does not involve the registration database.)

A client application should call the **OleLoadFromStream** function for each object in the document that will be shown on the screen or otherwise activated. (It is often not necessary to load every object in a document immediately when the document is opened.) Parameters for this function include a pointer to the **OLECLIENT** structure, which is used to locate the client's callback function (and which is sometimes used by the client to store private state information for the object), and a pointer to the **OLESTREAM** structure. The library calls the **Get** function in the **OLESTREAMVTBL** structure to load the object.

Document Management

A client application should notify the library when it opens, closes, saves, or renames a document, or causes a document to revert to a previously saved state. A client application can use the following functions to accomplish these tasks:

Function	Description
OleRegisterClientDoc	Registers an opened document with the library.
OleRenameClientDoc	Informs the library that a document has been renamed.
OleRevertClientDoc	Informs the library that a document has reverted to a previously saved state.
OleRevokeClientDoc	Informs the library that a document should be closed or no longer exists.
OleSavedClientDoc	Informs the library that a document has been saved.

A client application should also maintain a persistent name for each object. This name should be unique within the scope of the client document and should be stored with the document. This name is specified when the object is created and should persist when the document is saved and reopened. When a client uses the **OleRename** function to change the name of an object, the new name must also be unique and must be stored with the document.

Saving a Document

A client application should follow these steps to save a document:

1 Save the data for the document in the document's file.

2 For each object in the document, call the **OleSaveToStream** function.

3 When the library confirms that all objects have been saved, call the **OleSavedClientDoc** function.

A client application can call the **OleQuerySize** function to determine the size of the buffer required to store an object before calling **OleSaveToStream**.

Closing a Document

A client application should follow these steps to close a document:

1 For each object in the document, call the **OleRelease** function.

2 Use either the **OleRevertClientDoc** or the **OleSavedClientDoc** function to register the current

state of the document with the library.

3 When the library confirms that all objects have been closed, call the **OleRevokeClientDoc** function.

Asynchronous Operations

When a client application calls a function that invokes a server application, actions taken by the client and server can be asynchronous. For example, the actions of updating a document and closing a server are asynchronous. Whenever an asynchronous operation begins, the client library returns OLE_WAIT_FOR_RELEASE. When a client application receives this notification, it must wait for the OLE_RELEASE notification before it quits. If the client cannot take further action until the asynchronous operation finishes, it should enter a message-dispatch loop and wait for OLE_RELEASE. Otherwise, it should allow the main message loop to continue dispatching messages so that processing can continue.

An application can run only one asynchronous operation at a time for an object; each asynchronous operation must end with the OLE_RELEASE notification before the next one begins. The client's callback function must receive OLE_RELEASE for all pending asynchronous operations before calling the **OleRevokeClientDoc** function.

Some of the object-creation functions return OLE_WAIT_FOR_RELEASE. The client application can continue to work with the document while waiting for OLE_RELEASE, but some functions (for example, **OleActivate**) cannot be called until the asynchronous operation has been completed.

If an application calls a function for an object before receiving OLE_RELEASE for that object, the function may return OLE_BUSY. The server also returns OLE_BUSY when processing a new request would interfere with the processing of a current request from a client application or user. When a function returns OLE_BUSY, the client application can display a message reporting the busy condition at this point or it can enter a loop to wait for the function to return OLE_OK. (The OLE_QUERY_RETRY notification is also sent to the client's callback function when the server is busy; when the callback function returns FALSE, the transaction with the server is ended.) Note that if the server uses the **OleBlockServer** function to postpone OLE activities, the OLE_QUERY_RETRY notification is not sent to the client.

The following example shows a message-dispatch loop that allows a client application to transact messages while waiting for the OLE_RELEASE notification:

```
while ((olestat = OleQueryReleaseStatus(lpObject)) == OLE_BUSY) {
    if (GetMessage(&msg, NULL, NULL, NULL)) {
        TranslateMessage(&msg);
        DispatchMessage(&msg);
    }
}
if (olestat == OLE_ERROR_OBJECT) {
    .
    .  /* The lpObject parameter is invalid. */
    .
}
else { /* if olestat == OLE_OK */
    .
    . /* The object is released, or the server has terminated. */
    .
}
```

A server application could end unexpectedly while a client is waiting for OLE_RELEASE. In this case, the client library recovers properly only if the client uses the **OleQueryReleaseStatus** function, as shown in the preceding example.

The following table shows which OLE functions can return the OLE_WAIT_FOR_RELEASE or

OLE_BUSY value to a client application:

Function	OLE_BUSY	OLE_WAIT_FOR_RELEASE
OleActivate	Yes	Yes
OleClose	Yes	Yes
OleCopyFromLink	Yes	Yes
OleCreate	No	Yes
OleCreateFromClip	No	Yes
OleCreateFromFile	No	Yes
OleCreateFromTemplate	No	Yes
OleCreateLinkFromClip	No	Yes
OleCreateLinkFromFile	No	Yes
OleDelete	Yes	Yes
OleExecute	Yes	Yes
OleLoadFromStream	No	Yes
OleObjectConvert	Yes	No
OleReconnect	Yes	Yes
OleRelease	Yes	Yes
OleRequestData	Yes	Yes
OleSetBounds	Yes	Yes
OleSetColorScheme	Yes	Yes
OleSetData	Yes	Yes
OleSetHostNames	Yes	Yes
OleSetLinkUpdateOptions	Yes	Yes
OleSetTargetDevice	Yes	Yes
OleUnlockServer	No	Yes
OleUpdate	Yes	Yes

Displaying and Printing Objects

When an object has been loaded and, if necessary, brought up to date, the object can be displayed or printed with the container document. To display an object, the client application should set up the device context and bounding rectangle (ensuring that they use the same mapping mode) and then call the **OleDraw** function. The client application can use the **OleQueryBounds** function to retrieve the size of the bounding rectangle on the target device.

An object handler can be used to draw an object. If an object handler exists for an object, the call to the **OleDraw** function is received and processed by the object handler. If there is no object handler, the client library uses the object's presentation data to display or print the object.

If the presentation data for an object is a metafile, the library periodically sends an OLE_QUERY_PAINT notification to the client's callback function while drawing the object. If the callback function returns FALSE, the **OleDraw** function returns immediately and the drawing is ended. A client could also use the OLE_QUERY_PAINT notification to take some actions within the callback function and then return TRUE to indicate that drawing should continue. Any actions the client takes at this time should not interfere with the drawing operation; for example, the client should not scroll the window.

If the target device for an object changes (for example, when the user changes printers), the client application should call the **OleSetTargetDevice** function. The client should also call **OleSetTargetDevice** whenever an object is created or loaded.

If the size of the presentation rectangle for the object changes (for example, through action by the

user) the client application should call the **OleSetBounds** function. After calling **OleSetBounds**, the client should call the **OleUpdate** function to update the object and then **OleDraw** to redisplay it.

Opening and Closing Objects

When the user requests the client application to activate an object, the client should check whether the object is busy by calling the **OleQueryReleaseStatus** function. If the object is busy, the client should either refuse the request to open the object or enter a message-dispatch loop, waiting for the OLE_RELEASE notification.

If the object to be activated is not busy, the client should call the **OleActivate** function. The library notifies the client when the server is open or when an error occurs.

The **OleActivate** function allows the client application to specify whether to display the activated object in a window of the server application. A client might hide the server window if an object is updated automatically.

A client application can use the **OleQueryOpen** function to determine whether a specified object is open. The **OleClose** function allows the client to close an open object. Closing an object terminates the connection with the server. To reestablish a terminated connection between a linked object and an open server, the client can use the **OleReconnect** function. To close an open object and release it from memory, a client application can call the **OleRelease** function.

The first time a client application activates a particular embedded object, the client should call the **OleSetHostNames** function, specifying the string the server window should display in its title bar. This string should be the name of the client document containing the object. The client does not need to call **OleSetHostNames** every time an embedded object is activated, because the library maintains a record of the specified names.

Deleting Objects

To permanently delete an object from a document, the client should call the **OleDelete** function. **OleDelete** closes the specified object, if necessary, before deleting it.

Client Cut and Copy Commands

A client application can copy an object to the clipboard by simply opening the clipboard, calling the **OleCopyToClipboard** function, and closing the clipboard again. If the client supports delayed rendering, however, it should follow these steps to cut or copy an object to the clipboard:

1 Open and empty the clipboard.

2 Put the preferred data formats on the clipboard.

3 Call the **OleEnumFormats** function to retrieve the formats for the object.

4 Call the **SetClipboardData** function to put the formats on the clipboard, specifying NULL for the handle of the data.

   If the call to the **OleEnumFormats** function retrieves the ObjectLink format, the client should call **SetClipboardData** with OwnerLink instead of ObjectLink format. (For more information, see the following description of the **OleCopyToClipboard** function.)

5 Put any additional presentation data formats on the clipboard.

6 Close the clipboard.

To support the Cut command on the Edit menu, an application can call **OleCopyToClipboard** and then delete the object by using the **OleDelete** function. (The client can put only one of the selected objects on the clipboard, even when the user has selected and cut or copied multiple objects. In this case, the client typically puts the first object in the selection onto the clipboard.)

The **OleCopyToClipboard** function always copies OwnerLink format, not ObjectLink format, to the clipboard. For embedded objects, Native data always precedes the OwnerLink format. If a linked object

uses Native data, OwnerLink format always precedes the Native data. If an application uses the **OleGetData** function to retrieve data from a linked object that has been copied by using **OleCopyToClipboard**, it should specify ObjectLink format, not OwnerLink format, even if OwnerLink format was put on the clipboard.

When an application that can act as both a client and server copies a selection to the clipboard that contains one or more objects, it should first allocate enough memory for the selection. To discover how much memory is required for each object, the application can call the **OleQuerySize** function. When memory has been allocated, the application should call the **OleRegisterClientDoc** function, specifying Clipboard for the document name. (In this case, the handle returned by the call to **OleRegisterClientDoc** identifies a document that is used only during the copy operation.) To save each object to memory, the application calls the **OleClone** function, calls the **OleSaveToStream** function for the cloned object, and then calls the **OleRelease** function to free the memory for the cloned object. When the selection has been saved to the stream, the application can call the **SetClipboardData** function. If **SetClipboardData** is successful, the application should call the **OleSavedClientDoc** function. The application then calls the **OleRevokeClientDoc** function, specifying the handle retrieved by the call to **OleRegisterClientDoc**.

For more information about the Cut and Copy commands, see Server Cut and Copy Commands.

Creating Objects

A client application can put linked and embedded objects in a document by pasting them from the clipboard, creating them from a file, copying them from other objects, or by starting a server application to create them directly.

Object-Creation Functions

Each of the following functions creates an embedded or linked object in a specified document:

Function	Description
OleClone	Creates an exact copy of an object.
OleCopyFromLink	Creates an embedded object that is a copy of a linked object.
OleCreate	Creates an embedded object of a specified class.
OleCreateFromClip	Creates an object from the clipboard. This function typically creates an embedded object.
OleCreateFromFile	Creates an object by using the contents of a file. This function typically creates an embedded object.
OleCreateFromTemplate	Creates an embedded object by using another object as a template.
OleCreateInvisible	Creates an object without displaying the server application to the user.
OleCreateLinkFromClip	Creates an object by using information on the clipboard. This function typically creates a linked object.
OleCreateLinkFromFile	Creates an object by using the contents of a file. This function typically creates a linked object.
OleObjectConvert	Creates an object that supports a specified protocol by converting an existing object.

Each of these functions requires a parameter that points to an **OLEOBJECT** structure when the function returns. Server applications often create an **OLEOBJECT** structure whenever an object is created; **OLEOBJECT** points to functions that describe how the server interacts with the object. Before the client library gives the client application a pointer to this structure, the library includes with the structure some internal information corresponding to the OwnerLink or ObjectLink data. This internal information allows the client library to identify the correct server when an OLE function such as **OleActivate** passes it a pointer to an **OLEOBJECT** structure. For more information about the **OLEOBJECT** structure, see Starting a Server Application.

Each new object must have a name that is unique to the client document. Although meaningful object

names can be helpful, some applications assign unique object names simply by incrementing a counter for each new object. For more information about object names, see Document Management.

If a client application implements the Insert Object command, it should use the registration database to find out what OLE servers are available and then list those servers for the user. When the user selects one of the servers and chooses the OK button, the client can use the **OleCreate** function to create an object at the current position.

The **OleCopyFromLink**, **OleCreate**, and **OleCreateFromTemplate** functions always create an embedded object. The other object-creation functions can create either an embedded object or a linked object, depending on the order and type of available data.

If a client application's callback function receives the OLE_RELEASE notification after the client calls the **OleCreate** or **OleCreateFromFile** function, the client should respond by calling the **OleQueryReleaseError** function. If **OleQueryReleaseError** shows that there was an error when the object was created, the client application should delete the object.

Whenever an object-creation function returns OLE_WAIT_FOR_RELEASE, the calling application should either wait for the OLE_RELEASE notification or notify the user that the object cannot be created. For more information, see Asynchronous Operations.

If a client application accepts files dropped from File Manager, it should respond to the **WM_DROPFILES** message by calling the **OleCreateFromFile** function and specifying Packager for the lpszClass parameter.

Paste and Paste Link Commands

A client application should follow these steps to create an embedded or linked object by pasting from the clipboard:

1. Call the **OleQueryCreateFromClip** function to determine whether to enable the Paste command. If this function fails when StdFileEditing is specified for the *lpszProtocol* parameter, call it again, specifying Static.
2. Call the **OleQueryLinkFromClip** function to determine whether to enable the Paste Link command.

- If the user chooses the Paste command, open the clipboard and call the **OleCreateFromClip** function.
- If the user chooses Paste Link, open the clipboard and call the **OleCreateLinkFromClip** function.

3. Close the clipboard.
4. Call the **OleQueryType** function to determine the kind of object created by the creation function. (Depending on the order of clipboard data, **OleCreateFromClip** can sometimes create a linked object and **OleCreateLinkFromClip** can sometimes create an embedded object.)

The client application should put the pasted data or object into the document at the current position. The client should select the object so that the user can work with it immediately. If both the **OleQueryCreateFromClip** and **OleQueryLinkFromClip** functions fail but there is data on the clipboard that the client can interpret, the client should enable the Paste command.

If the information on the clipboard is incomplete--for example, if Native data is not accompanied by the OwnerLink format--the Paste command should insert a static object into the document. (A static object consists of the presentation data for an object; it cannot be edited by using standard OLE techniques. Attempts to open static objects fail and generate no notifications.)

If the client application implements the Paste Special command, it should use the **EnumClipboardFormats** function to produce a list of data formats on the clipboard. The client should also check the registration database to find the full name of the server application. The Paste Link button in the Paste Special dialog box works in exactly the same way as the Paste Link command on the Edit menu.

If the DDE Link format is available on the clipboard instead of ObjectLink format, the client application

should perform the same link operation that it supported prior to the implementation of OLE.

Undo Command

A client application can use the **OleClone** function to support the Undo command. A cloned object is identical to the original except for connections to the server application; the cloned object is not automatically connected to the server. When the server is closed and the object is updated, the saved copy of the object gives the user the opportunity to undo all of the changes made in the server. Support for the Undo command is provided by the client application, because the server cannot maintain a record of the prior states of objects.

The Undo command restores an object to its condition prior to the last update from the server. To support this behavior, the client application must clone the object when it is first activated and then clone the updated object when an update occurs; the client must maintain two clones of the object. The clone of the original object must be maintained so that an updated object can be restored if the user chooses the Undo command. The clone of the updated object must be maintained to support the Undo command if the updated object is updated again. Because the data changes when the update occurs, the clone for supporting the Undo command must be made before any updates occur.

Because the client application cannot distinguish between different types of object activation, the client must clone an object for verbs that do not edit the object, even though no updates can occur in those cases.

Class Name Object Command

A client application can implement the *Class Name* Object command by using the **OleActivate** function. **OleActivate** includes a parameter that allows the client to specify the verb chosen by the user.

Links Command

When a user chooses the Links command, a dialog box appears listing every linked object in the document. The selected links are highlighted in the dialog box. The dialog box makes it possible for the user to invoke the verbs for an object, select whether link updating should be automatic or manual, update a link immediately, cancel a link, and repair broken links. For more information about this dialog box, see *Microsoft Windows User Interface Guidelines.*

The Links dialog box includes buttons that allow the user to activate the primary and secondary verbs for an object. A client application can implement these buttons by using the **OleActivate** function.

A client application can use the **OleGetLinkUpdateOptions** and **OleSetLinkUpdateOptions** functions to support the link-update radio buttons in the Links dialog box. The following are the three possible update options:

Option	Description
oleupdate_always	Update the linked object whenever possible. This option supports the Automatic link-update radio button in the Links dialog box.
oleupdate_onsave	Update the linked object when the source document is saved by the server.
oleupdate_oncall	Update the linked object only on request from the client application. This option supports the Manual link-update radio button in the Links dialog box.

These update options control when updates to the presentation of an object occur. The contents of the source document are used to update the presentation whenever the link is activated.

To support the Update Now button in the Links dialog box, an application can call the **OleUpdate** function. When a user chooses Update Now, the client application should update the links the user selected.

A user's choosing the Cancel Link button in the Links dialog box changes an object into a picture that an application cannot edit by using standard OLE techniques. An application can implement the Cancel Link button by using the **OleObjectConvert** function.

A client application should activate the Change Link button in the Links dialog box only if all the selected links are to the same source document. When the client has the correct information, it can repair the link by using the **OleGetData** and **OleSetData** functions. To retrieve the link information for an object, a client can call the **OleGetData** function, specifying the ObjectLink format. (The call to **OleGetData** fails if ObjectLink is specified and the object is not a link.) A client can retrieve class information by using **OleGetData** and specifying either the OwnerLink format (for embedded objects) or the ObjectLink format (for linked objects). The client can make it possible for the user to edit the link information and store it in the object by using the **OleSetData** function, specifying the ObjectLink format.

Closing a Client Application

A client application should use the **OleRelease** function to remove all objects from memory when it shuts down. If the library returns the OLE_WAIT_FOR_RELEASE value instead of OLE_OK, the client should not quit. The client can perform many cleanup tasks while waiting for the OLE_RELEASE notification--for example, it can close files, free memory, and hide windows.

The OLE_RELEASE notification to the client's callback function indicates that an operation has finished in a server application, but it does not identify the operation or indicate whether the operation was successful. A client application can call the **OleQueryReleaseStatus** function to determine whether an operation has been completed for a specified object. The **OleQueryReleaseMethod** function indicates the nature of the operation that has finished for a specified object. To discover the error value for the operation, the client can call the **OleQueryReleaseError** function.

If a client owns the clipboard when it quits, it should make sure that the data on the clipboard is complete and in the correct order.

Server Applications

Server Applications

An OLE server supplies functions that the server library calls when a user works with an object. The server library, OLESVR.DLL, uses DDE commands to communicate with the client library. When the client application calls one of the functions in the OLE API, the client library informs the server library and the server library routes the request to the appropriate function in the server-supplied list of function pointers.

In addition to the specialized functions that the server creates and which are called by the server library, there are ten OLE functions that allow a server to control the library's ability to gain access to the server and the documents and objects it controls:

Function	Description
OleBlockServer	Queues requests to the server until the server calls the **OleUnblockServer** function.
OleRegisterServer	Registers the specified server with the library. Information registered includes the class name and instance and whether the server supports single or multiple instances.
OleRegisterServerDoc	Registers a document with the server library.
OleRenameServerDoc	Renames the specified document.
OleRevertServerDoc	Restores a document to a previously saved state, without closing the document.
OleRevokeObject	Revokes access to the specified object.
OleRevokeServer	Revokes access to the specified server, closing any documents and ending communication with client applications.
OleRevokeServerDoc	Revokes access to the specified document.
OleSavedServerDoc	Informs the library that a document has been saved. Calling this function is equivalent to sending the OLE_SAVED notification.
OleUnblockServer	Processes a request from a queue created when the server application called the **OleBlockServer** function.

The **OleRevokeServer** and **OleRevokeServerDoc** functions can return OLE_WAIT_FOR_RELEASE. When a server application receives this error value, it should take the same action as a client application, dispatching messages until the server library calls the corresponding **Release** function.

Starting a Server Application

When a server application starts, it should follow these steps:

1. Register window classes and window procedures for the main window, documents, and objects.
2. Initialize the function tables for the **OLESERVERVTBL**, **OLESERVERDOCVTBL**, and **OLEOBJECTVTBL** structures.
3. Register the clipboard formats.
4. Allocate memory for the **OLESERVER** structure.
5. Register the server with the library by calling the **OleRegisterServer** function.
6. Check for the **/Embedding** and **/Embedding** *filename* options on the command line and act according to the following guidelines. (Applications should also check for **-Embedding** whenever they check for these options.)

- If neither **/Embedding** nor **/Embedding** *filename* is present, call the **OleRegisterServerDoc** function, specifying an untitled document.

- If the **/Embedding** option is present, do not register a document or display a window. (In this case, the server takes actions only in response to calls from the server library.)
- If the **/Embedding** *filename* option is present, do not display a window. Process the filename string and call the **OleRegisterServerDoc** function.

The **OLESERVERVTBL**, **OLESERVERDOCVTBL**, and **OLEOBJECTVTBL** structures are tables of function pointers. The server library uses these structures to route requests from the client application to the server. The server application should create the function pointers in these structures by using the **MakeProcInstance** function. The functions should also be exported in the application's module-definition file.

The **OLESERVER** structure contains a pointer to an **OLESERVERVTBL** structure. The **OLESERVERVTBL** structure contains pointers to functions that control such fundamental server tasks as opening files, creating objects, and terminating after an editing session. Several of the functions pointed to by the **OLESERVERVTBL** structure cause the server to allocate and initialize an **OLESERVERDOC** structure.

The **OLESERVERDOC** structure contains a pointer to an **OLESERVERDOCVTBL** structure. The **OLESERVERDOCVTBL** structure contains pointers to functions that control such tasks as saving or closing documents or setting document dimensions. The **OLESERVERDOCVTBL** structure also contains a function that causes the server to allocate and initialize an **OLEOBJECT** structure.

The **OLEOBJECT** structure contains a pointer to an **OLEOBJECTVTBL** structure. The **OLEOBJECTVTBL** structure contains pointers to functions that operate on objects. After the server application creates an **OLEOBJECT** structure, the server library gives information about the structure to the client library. The client library then creates a parallel **OLEOBJECT** structure (including internal information identifying the server application, the document, and the item for the object) and passes a pointer to that structure to the client application.

This hierarchy of structures--**OLESERVER**, **OLESERVERDOC**, and **OLEOBJECT**--makes it possible for a server to open as many documents as the library requests and for each document to contain as many objects as necessary.

A server application can register the clipboard formats by calling the **RegisterClipboardFormat** function for each format, specifying Native, OwnerLink, ObjectLink, and any other formats it requires.

When the server application starts, it creates an **OLESERVER** structure and then registers it with the library by calling the **OleRegisterServer** function. When this function returns, one of its parameters points to a server handle. The library uses this handle of refer to the server, and the server uses it in calls to the server-specific OLE functions.

If an OLE server application is also a DDE server, the class name specified in the call to the **OleRegisterServer** function cannot be the same as the name of the executable file for the application.

When a client working with a compound document opens a linked or embedded object for editing, the client library starts the server using the **/Embedding** command-line option. The server uses this option to determine whether the object has been opened directly by a user or as part of an editing session for linked and embedded objects. (If the object is a linked object, the **/Embedding** option is followed by a filename.) When a server is started for an embedded object with the **/Embedding** option, the server should not create a document or show a window. Instead, it should call the **OleRegisterServer** function and then enter a message-dispatch loop. (If the server is started with the **/Embedding** *filename* option, it should also call the **OleRegisterServerDoc** function.) The server then takes actions in response to calls from the library. The server should not make itself visible until the library calls the **Show** or **DoVerb** function in the **OLEOBJECTVTBL** structure. (Server applications should check for both -Embedding and /Embedding.)

By calling the **OleBlockServer** function, a server application can cause requests from the client library to be saved in a queue. When the server is ready for the server library to process the requests, it can call the **OleUnblockServer** function. It is best to use the **OleUnblockServer** function prior to the **GetMessage** function in a message loop, so that all blocked requests are unblocked before getting the next message. (Often a server returns OLE_BUSY instead of calling **OleBlockServer**. Returning

OLE_BUSY has two advantages: It allows the client to decide whether to retry the message or discontinue the operation, and it allows the server to choose which requests to process.)

When an error occurs in a server-supplied function, the server should return the **OLESTATUS** error value that best describes the error. The OLE libraries use these error values to help determine the appropriate behavior in error situations. However, the client application does not necessarily receive the error values the server returns; the OLE libraries may change error values before passing them to the client application.

Opening a Document or Object

Whenever the server library calls the **Open**, **Create**, **CreateFromTemplate**, or **Edit** function in the **OLESERVERVTBL** structure, the server creates an **OLESERVERDOC** structure. If the document is opened by a call from the server library, the server application returns the **OLESERVERDOC** structure to the library. If the document is opened directly by a user, however, the server should call the **OleRegisterServerDoc** function to register the document with the library. The library then uses the **GetObject** function in the **OLESERVERDOCVTBL** structure to request the server to create an **OLEOBJECT** structure for each object requested by the client application.

A new instance of the server application is typically started when the client activates a linked or embedded object. This new instance is unnecessary if the object is already open in an instance of the server or if the server is a single-instance (MDI) server that is already open. For more information about the rules for starting new instances of server applications, see *Microsoft Windows User Interface Guidelines.*

Whether the server library starts a new instance of a server to edit an embedded or linked object depends upon the value specified when the server calls the **OleRegisterServer** function.

Server Cut and Copy Commands

A server application should follow these steps to cut or copy onto the clipboard data that a client can then use to create an embedded or linked object:

1 Open and empty the clipboard.

2 Put the data formats that describe the selection on the clipboard, using the **SetClipboardData** function.

3 Close the clipboard.

If the server cuts data onto the clipboard, rather than copying it, the server typically does not offer ObjectLink or Link formats, because the source for the data has been removed from the document.

The server should put data on the clipboard in the order given in Clipboard Conventions.

Typically, the server puts server-specific formats, Native format, OwnerLink format, and presentation formats on the clipboard. If it can support links, the server also puts ObjectLink format and, when appropriate, Link format on the clipboard. The server must provide a presentation format (CF_METAFILE, CF_BITMAP, or CF_DIB) if the server does not have an object handler. Native data can be used as a presentation format only if the server has an object handler that can use the Native data.

If a user copies onto the clipboard a selection that includes an embedded object or a link, the data formats the server should copy depend upon whether the container document modifies the object or link. If the document does not modify the object or link, the best formats are the Native and OwnerLink formats from the original source of the object. If the document modifies the object or link--for example, by recoloring it--the best formats are the Native and OwnerLink formats from the container document.

If a server uses a metafile as the presentation format for an object, the mapping mode for that metafile must be MM_ANISOTROPIC. When a server application uses fonts in these metafiles, it can improve performance by using TrueType fonts. (Metafiles scale better when they use TrueType fonts.) To use TrueType fonts exclusively, the server should set bit 2 (04h) of the **lpPitchandFamily** member of the **LOGFONT** structure.

The OLE libraries express the size of every object in MM_HIMETRIC units. Neither the width nor height of an object should exceed 32,767 in MM_HIMETRIC units.

Update, Save As, and New Commands

When a server is started as part of editing an object from within a compound document, the server application should change the Save command on the File menu to Update. When the user chooses the Update command, the server should call the **OleSavedServerDoc** function.

When the user chooses the Save As, New, or Open command in a single-document server, the application should display a message asking the user whether to update the object in the compound document before performing the action. When the user chooses the Save As command, the server should call the **OleRenameServerDoc** function. If the user responds to the message by choosing to save changes in the object before renaming the document, the server should call the **OleSavedServerDoc** function before calling **OleRenameServerDoc**. For embedded objects, choosing the Save As command causes the connection with the client to be broken, because this command reassociates a document in memory with the specified new file. For linked objects, calling **OleRenameServerDoc** when the user chooses Save As makes it possible for the client to associate the link with the new file.

Most server applications maintain a "dirty" flag that records whether changes have been made to each open document in an instance. The following table shows the rules that apply to this flag when the server edits an embedded object. By following these rules, a server can ensure that this flag is TRUE when the document being edited in the server matches the embedded object in the client and that, otherwise, this flag is FALSE.

Flag	Condition
TRUE	Library calls the **Create** function in the **OLESERVERVTBL** structure.
TRUE	Library calls the **CreateFromTemplate** function in **OLESERVERVTBL**.
TRUE	Document is changed in server.
FALSE	Library calls the **Edit** function in **OLESERVERVTBL**.
FALSE	Library calls the **GetData** function in **OLEOBJECTVTBL** with the Native data format. (The flag should not change for any other formats.)

A server following these rules displays the message asking whether to update the object whenever it destroys a document that was editing an embedded object and the "dirty" flag is TRUE.

In an MDI server application, the New and Open commands on the File menu simply open a new window, and the connection with the client application remains unchanged. The user can continue to work with the server application after choosing one of these commands, but when the user exits the server application, the focus does not necessarily return to the client application.

Typically, a server can call the **OleSavedServerDoc** function whenever an object needs to be updated in the client document, including when the server closes the document. When the server closes the document and the object should be updated, the server sends the OLE_CLOSED notification. Client applications receive the OLE_CLOSED notification for embedded objects but not for linked objects, because the server library intercepts the notification for linked objects.

Closing a Server Application

The server library calls the **Exit** function in the **OLESERVERVTBL** structure when the server must quit. The server library calls the **Release** function to inform the server that it is safe to quit; the server does not necessarily stop when the library calls **Release**.

The server must exit when it is invisible and the library calls **Release**. (The only exception is when an application supports multiple servers; in this case, an invisible server is sometimes not revocable when the library calls **Release**.) If the server has no open documents and it was started with the **/Embedding** option (indicating that it was started by a client application), the server should exit when the library calls the **Release** function. If the user explicitly loads a document into a single-instance (MDI) server, however, the server should not exit when the library calls **Release**.

When the user closes a server that has edited an embedded object without updating changes to the client application, the server should display a message asking whether to save the changes. If the user chooses to save the changes, the server should send the OLE_CLOSED notification and call the **OleRevokeServerDoc** function. (Because sending OLE_CLOSED prompts the server library to send data to the client library, it is not necessary to send OLE_CHANGED or OLE_SAVED. If the user chooses not to save the changes, the server should simply call the **OleRevokeServerDoc** function (without sending OLE_CLOSED).

A server can use the **OleRevokeObject** function to revoke a client's access to an object--for example, if the user destroys the object. Similarly, the **OleRevokeServerDoc** function revokes a client's access to a document. (Because **OleRevokeServerDoc** revokes a client's access to all objects in a document, an application that uses **OleRevokeServerDoc** does not need to call the **OleRevokeObject** function for objects in that document.) To terminate all conversations with client applications, the server can call the **OleRevokeServer** function. These functions inform the server library that the specified items are no longer available.

A server application can receive OLE_WAIT_FOR_RELEASE--for example, the **OleRevokeServerDoc** function can return this value. Although a server can enter a message-dispatch loop and wait for the library to call the server's **Release** function, servers should never enter message-dispatch loops inside any of the server-supplied functions that are called by the server library.

The client application should not instruct the server to close the document or exit when the server is editing a linked object, unless the server is updating the link without displaying the object to the user. Because a linked object exists independently of the client, the user controls saving and closing the document by using the server application.

If a server application owns the clipboard when it closes, it should make sure that the data on the clipboard is complete and in the correct order. For example, any Native data should be accompanied by the OwnerLink format.

Object Handlers

Object Handlers

An application developer can use object handlers to introduce customized features into implementations of linked and embedded objects. When an object handler exists for a class of object, the object handler supplants some or all of the functionality that is usually provided by the client library and the server application. The object handler can take specialized action for any of the functions it intercepts. The object handler passes functions that it does not take action on to the client library, which then implements the default processing for that class.

An application might use an object handler to render Native data as the presentation data for an object, instead of using metafiles or bitmaps. Object handlers could also be used to implement special behavior when an object is opened.

Implementing Object Handlers

A server installing an object handler registers the handler with the registration database, using the keyword **handler**. Whenever a client application calls one of the object-creation functions, the client library uses the class name specified for the object and the **handler** keyword to search the registration database. If the library finds an object handler, the client library loads the handler and calls it to create the object. The handler can create an object for which all of the creation functions and methods are defined by the handler, or it can call default object-creation functions in the client library.

The client library exports the object-creation OLE functions with new names; in each case, the prefix "Ole" is changed to "Def" (for "default"). Object handlers can import any of these functions and use them when creating objects.

Object handlers must import the following functions:

OLE function	Name exported by client library
OleCreate	DefCreate
OleCreateFromClip	DefCreateFromClip
OleCreateFromFile	DefCreateFromFile
OleCreateFromTemplate	DefCreateFromTemplate
OleCreateLinkFromClip	DefCreateLinkFromClip
OleCreateLinkFromFile	DefCreateLinkFromFile
OleLoadFromStream	DefLoadFromStream

When an object handler defines a function that is to be called by the client application, it should use the same name as the corresponding OLE function the client calls, with the prefix "Ole" replaced by "Dll". For example, when an object handler uses the **DefCreate** function exported by the client library, the handler should use it inside a function named **DllCreate**. When the client library finds an object handler for a class of object, it calls handler-specific object-creation functions by specifying this "Dll" prefix.

When the handler calls one of the default object-creation functions, it receives a handle of an **OLEOBJECT** structure, which in turn points to the **OLEOBJECTVTBL** structure containing the current object-management functions. The object handler should copy this **OLEOBJECTVTBL** structure and customize the structure by replacing any function pointers in the structure with pointers to functions of its own. (If the object handler saves the pointers to the default functions, any of the replacement functions can also call the default functions in the table of function pointers.) When the object handler has finished customizing the structure, it should replace the pointer to the old **OLEOBJECTVTBL** structure with a pointer to the modified **OLEOBJECTVTBL** structure.

When the client makes a call to a function in the client library, the call is dispatched through the object handler's **OLEOBJECTVTBL** structure. If the object handler has replaced the function pointer, the call is routed to the function supplied by the handler. Otherwise, the call is routed to the client library.

Each **OLECLIENT**, **OLEOBJECT**, **OLESERVER**, **OLESERVERDOC**, or **OLESTREAM** structure contains a pointer to a structure that contains a table of function pointers. (Structures containing tables of function pointers are identified with the "VTBL" suffix.) Each of the structures containing a pointer to a "VTBL" structure can also contain extra instance-specific information. This information is meaningful only to the application that supplies it and should not be used by other applications; for example, an object handler should not attempt to use any instance-specific information in an **OLECLIENT** structure.

The object handler should use the "Def" and "Dll" renaming conventions when it defines specialized functions. For example, if an object handler modifies the **Draw** function from an object's **OLEOBJECTVTBL** structure, it should copy that **Draw** function to a function named **DefDraw** and replace the **Draw** function with a specialized function named **DllDraw**. Inside the **DllDraw** function, the object handler can call **DefDraw** if the default drawing operation is appropriate in a particular case.

The following example demonstrates this process of copying and replacing pointers to functions. Functions with the "Dll" prefix should be exported in the module-definition file.

```
/* Declare the DllDraw and DefDraw functions.            */

OLESTATUS FAR PASCAL DllDraw(LPOLEOBJECT, HDC, LPRECT, LPRECT, HDC);
OLESTATUS (FAR PASCAL *DefDraw)(LPOLEOBJECT, HDC, LPRECT, LPRECT, HDC);

/* Copy the Draw function from OLEOBJECTVTBL to DefDraw. */

    DefDraw             = lpobj->lpvtbl->Draw;

/* Copy DllDraw to OLEOBJECTVTBL.                        */

    *lpobj->lpvtbl->Draw = DllDraw;


OLESTATUS FAR PASCAL DllDraw(lpObject, hdc, lpBounds, lpWBounds,
        hdcFormat)
LPOLEOBJECT     lpObject;
HDC             hdc;
LPRECT          lpBounds;
LPRECT          lpWBounds;
HDC             hdcFormat;
{
    /* Return DefDraw if Native data is not available.   */

    if ((*lpobj->lpvtbl->GetData) (lpobj, cfNative, &hData) != OLE_OK)
        return (*DefDraw) (lpobj, hdc, lpBounds, lpWBounds, hdcFormat);
    .
    .
    .
}
```

Creating Objects in an Object Handler

Most of the object-creation functions in the OLE API work in exactly the same way when they are renamed and used by object-handler DLLs. Two functions are somewhat different, however: **OleCreateFromClip** and **OleLoadFromStream**.

DefCreateFromClip and DllCreateFromClip

When the client library calls the **DllCreateFromClip** function, the library includes a parameter that is not specified in the original call to the **OleCreateFromClip** function. This parameter, *objtype,* specifies whether the object being created is an embedded object or a link; its value can be either OT_LINK or OT_EMBEDDED.

The following syntax block shows the *objtype* parameter when an object handler uses the **DefCreateFromClip** function. The **DllCreateFromClip** function has exactly the same syntax as **DefCreateFromClip**. For a full description of all the parameters, see the description of the **OleCreateFromClip** function.

OLESTATUS DefCreateFromClip(lpszProtocol, lpclient, lhclientdoc, lpszObjname, lplpobject, renderopt, cfFormat, objtype);

```
LPSTR lpszProtocol;              /* address of string for protocol name */
LPOLECLIENT lpclient;            /* address of client structure         */
LHCLIENTDOC lhclientdoc;         /* long handle of client document      */
LPSTR lpszObjname;               /* string for object name              */
LPOLEOBJECT FAR * lplpobject;    /* address of pointer to object        */
OLEOPT_RENDER renderopt;         /* rendering options                   */
OLECLIPFORMAT cfFormat;          /* clipboard format                    */
LONG objtype;                    /* OT_LINKED or OT_EMBEDDED            */
```

If **DllCreateFromClip** calls **DefCreateFromClip**, **DllCreateFromClip** should pass it the *objtype* parameter along with the other parameters from the version of **DefCreateFromClip** that was exported by the client library. **DllCreateFromClip** can modify some of these parameters before passing them back to **DefCreateFromClip**. For example, the object handler could specify a different value for the *renderopt* parameter when it calls **DefCreateFromClip**. If the client calls this function with **olerender_draw** for *renderopt* and the handler performs the drawing with Native data, the handler could change **olerender_draw** to **olerender_none**. If the client calls this function with **olerender_draw** for *renderopt* and the handler calls the **GetData** function and performs the drawing based on a class-specific format, the handler could change **olerender_draw** to **olerender_format**. If the handler needed a different rendering format than the format specified by the client application, the object handler could also change the value of the *cfFormat* parameter in the call to **DefCreateFromClip**.

If an object handler uses Native data to render an embedded object, the handler can call the library and specify **olerender_none**. If a handler uses Native data to render a linked object, it can use **olerender_format** and specify Native data. When the handler's **Draw** function is called, the handler calls the **GetData** function, specifying Native data, to do the rendering. If a handler uses a private data format, the procedure is the same--except that the private format is specified with the **olerender_format** option and with the **GetData** function.

DefLoadFromStream and DllLoadFromStream

When the client library calls the **DllLoadFromStream** function, the library includes three parameters that are not specified in the original call to the **OleLoadFromStream** function. One of the additional parameters is *objtype,* as described for **DefCreateFromClip** and **DllCreateFromClip**. The other two parameters are *aClass,* which is an atom containing the class name for the object, and *cfFormat,* which specifies a private clipboard format that the object handler can use for rendering the object.

The following syntax block shows the *objtype, aClass,* and *cfFormat* parameters when an object handler uses the **DefLoadFromStream** function. The **DllLoadFromStream** function has exactly the same syntax as **DefLoadFromStream**. For a full description of all the parameters, see the description of the **OleLoadFromStream** function in the *Microsoft Windows Programmer's Reference, Volume 2.*

```
OLESTATUS DefLoadFromStream(lpstream, lpszProtocol, lpclient,
    lhclientdoc, lpszObjname, lplpobject, objtype, aClass, cfFormat);
LPOLESTREAM lpstream;          /* address of stream for object        */
LPSTR lpszProtocol;            /* address of string for protocol name */
LPOLECLIENT lpclient;          /* address of client structure         */
LHCLIENTDOC lhclientdoc;       /* long handle of client document      */
LPSTR lpszObjname;             /* string for object name              */
LPOLEOBJECT FAR * lplpobject; /* address of pointer to object        */
LONG objtype;                  /* OT_LINKED or OT_EMBEDDED            */
```

```
ATOM aClass;                    /* atom containing object's class name */
OLECLIPFORMAT cfFormat;         /* private data format for rendering   */
```

If **DllLoadFromStream** calls **DefLoadFromStream**, **DllLoadFromStream** should pass it the three additional parameters along with the other parameters from the version of **DefLoadFromStream** that was exported by the client library. **DllLoadFromStream** can modify some of these parameters before passing them back to **DefLoadFromStream**. For example, the object handler could modify the value of the *cfFormat* parameter to specify a private data format it would use to render the object.

When the client calls the object handler with **DefLoadFromStream**, the handler uses the **Get** function from the **OLESTREAMVTBL** structure to obtain the data for the object.

Direct Use of Dynamic Data Exchange

The OLE libraries, OLECLI.DLL and OLESVR.DLL, use DDE messages to communicate with each other. Although client and server applications can use DDE directly, without employing OLECLI.DLL or OLESVR.DLL, this method of implementing OLE is not recommended. Future enhancements to the OLE libraries will benefit applications that use the libraries but will not benefit applications that use DDE directly.

The following information about the DDE-based OLE protocol is provided for applications that must implement DDE directly, despite losing the ability to take advantage of future enhancements to the system.

Implementation of the OLE protocol requires implementation of the underlying DDE protocol. All the standard DDE rules and facilities apply. Applications that conform to this protocol must also conform to the DDE specification. Conforming to this specification implies supporting the System topic and the standard items in that topic.

Client Applications and Direct Use of Dynamic Data Exchange

When opening a link or an embedded document, the client application should look up the class name in the registration database, as described in Registration.

The following pseudocode illustrates the chain of events for a client implementing OLE through DDE. Whenever a client that attempts to establish a conversation with a server receives responses from more than one server, the client should accept the first server and reject the others.

Linked object:

```
WM_DDE_INITIATE class name, document name
if not found {
        WM_DDE_INITIATE class name, OLESystem
        if not found {
                WM_DDE_INITIATE class name, System
                if not found {
                        launch application name, /Embedding
                        fLaunched = true
                        WM_DDE_INITIATE class name, OLESystem
                        if not found {
                                WM_DDE_INITIATE class name, System
                                if not found
                                        return error
                        }
                }
        }

        /*
         * Now there is a conversation with the server on the System or
         * OLESystem topic.
         */

        WM_DDE_EXECUTE StdOpenDocument(DocumentName)
        WM_DDE_INITIATE class name, document name
        if not found {
                if(fLaunched) WM_DDE_EXECUTE StdExit /* clean up */
                        return error
        }
}
```

```
/*
 * Now there is a conversation with the correct document.
 */
```

Embedded object:

```
WM_DDE_INITIATE class name, OLESystem
if not found {
        WM_DDE_INITIATE class name, System
        if not found {
                launch application name, /Embedding
                fLaunched = true
                WM_DDE_INITIATE class name, OLESystem
                if not found {
                        WM_DDE_INITIATE class name, System
                        if not found
                                return error
                }
        }
}

/*
 * Now there is a conversation with the server on the system or
 * OLESystem topic.
 */

DDE_EXECUTE StdEditDocument(DocumentName)

/*
 * Or StdCreateDoc if this is an Insert Object command
 */

WM_DDE_INITIATE class name, document name
if not found {
        if(fLaunched) DDE_EXECUTE StdExit          /* clean up */
                return error
}

/* Now there is a conversation with the correct document. */
```

Server Applications and Direct Use of Dynamic Data Exchange

When a server receives the **/Embedding** command-line argument, it should not create a new default document. Instead, it should wait until the client sends either the **StdOpenDocument** command or the **StdEditDocument** command followed by the Native data and then instructs the server to show the window. The server can use the **StdHostNames** item to display the client's name in the window title.

The following pseudocode illustrates the chain of events for a server implementing OLE through DDE. The example shows two cases: one in which the server reuses a single instance for editing all objects (in MDI child windows), and another in which a new instance is used for each object. Applications that use a new instance for each object should reject requests to open or create a new document when they already have a document open.

MDI application:

```
case WM_DDE_INITIATE:
     if class name == this class {
```

```
        if (DocumentName == OLESystem || DocumentName == System)
            WM_DDE_ACK
        else if DocumentName == name of some open document
            WM_DDE_ACK
    }
```

Multiple-instance application:

```
case WM_DDE_INITIATE:
    if class name == this class {
        if (DocumentName == OLESystem || DocumentName == System) {
            if no documents are open
                WM_DDE_ACK
        }
        else if DocumentName == name of some open document
            WM_DDE_ACK
    }
```

Conversations

Document operations are performed during conversations with an application's OLESystem or System topic. The document's class name is used to establish the conversation.

Data transfer and negotiation operations are performed during conversations with the document (that is, the topic). The document name is used to establish the conversation.

Note that the topic name is used only in initiating conversations and is not fixed throughout the conversation; permitting the document to be renamed does not mean that there will be two names. Therefore, it is reasonable to tie the topic name to the document name.

Items for the System Topic

An application using DDE-based OLE can use three new items for the System topic: the Topics item, the Protocols item, and the Status item.

The Topics item returns a list of DDE topic names that the server application has open. Where topics correspond to documents, the topic name is the document name.

The Protocols item returns a list of protocol names supported by the application. The list is returned in tab-separated text format. A protocol is a defined set of DDE execute strings and item and format conventions that the application understands. The protocol currently defined for linked and embedded objects is the following:

Protocol: StdFileEditing *commands*/*items*/*formats*

For compatibility with client applications that were written before the implementation of the OLE protocol, server applications that use the DDE protocol directly should also include the string Embedding in the list of protocols.

The Status item is a text item that returns Ready if the server is prepared to respond to DDE requests; otherwise, it returns Busy. This item can be queried to determine if the client should offer such functions as one that gives the user an opportunity to update the object. Because it is possible that a server could reject or defer a request even if Status returns Ready, client applications should not depend solely on the Ready item.

Standard Item Names and Notification Control

Applications supporting OLE with direct DDE use four clipboard formats in addition to the regular data and picture formats. These are ObjectLink, OwnerLink, Native, and Binary. Binary format is a stream of bytes whose interpretation is implicit in the item; for example, the **EditEnvItems**, **StdTargetDevice**, and **StdHostNames** items are in Binary format. The ObjectLink, OwnerLink, and Native formats are

described in Clipboard Conventions.

New items available on each topic other than the System topic are defined for this protocol. These items are the following:

Item	Description
StdDocumentName	Contains the permanent document name associated with the topic. If no permanent storage is associated with the topic, this item is empty. This item supports both request and advise transactions and can be used to detect the renaming of open documents.
EditEnvItems	Returns a list in tab-separated text format of the items that contain environmental information supported by the server for its documents. Currently defined items are **StdHostNames**, **StdDocDimensions**, and **StdTargetDevice**. Applications can declare other items (and define their interpretations if Binary format is used) to permit clients that are informed of these items to provide more detailed information. Servers that cannot use particular items should omit their names from the EditEnvItems item. Clients should use the **WM_DDE_REQUEST** message with this item to find out which items the server can use and should supply the data through a **WM_DDE_POKE** message.

StdHostNames	Accepts information about the client application, in Binary format interpreted as the following structure:
	
	`struct {`
	`  WORD clientNameOffset;`
	`  WORD documentNameOffset;`
	`  BYTE data[];`
	`} StdHostNames;`
	
	The offsets are relative to the start of the data array. They indicate the starting point for the appropriate information in the array.

StdTargetDevice	Accepts information about the target device that the client is using. This information is in Binary format, interpreted as the following structure. Offsets are relative to the start of the data array.
	
	`typedef struct _OLETARGETDEVICE {`
	`  WORD otdDeviceNameOffset;`
	`  WORD otdDriverNameOffset;`
	`  WORD otdPortNameOffset;`
	`  WORD otdExtDevmodeOffset;`
	`  WORD otdExtDevmodeSize;`
	`  WORD otdEnvironmentOffset;`
	`  WORD otdEnvironmentSize;`
	`  BYTE otdData[];`
	`} OLETARGETDEVICE;`

StdDocDimensions	Accepts information about the size of a document. This information is in Binary format, interpreted as the following structure. These values are specified in MM_HIMETRIC units.
	
	`struct {`
	`  int iXContainer;`
	`  int iYContainer;`
	`} StdDocDimensions;`

StdColorScheme	Returns the colors that the server is currently using and accepts information about the colors that the client requests the server to use. This information is in Binary format, interpreted as a **LOGPALETTE** structure.

null	Specifies a request or advise transaction on all data contained in the topic. This item is a zero-length item name.

The update method used for advise transactions on items follows a convention in which an update specifier is appended to the actual item name. The item is encoded as follows:

*itemname***/***update type*

For backward compatibility, omitting the update type has the same result as specifying **/Change**. The *update type* placeholder may be filled with one of the following values:

Value	Meaning
/Change	Notify for each change.
/Close	Notify when document is closed.
/Save	Notify when document is saved.

DDE server applications are required to save each occurrence of a **WM_DDE_ADVISE** message that specifies a unique combination of *itemname, update type, format,* and *conversation.* A notification is disabled by a **WM_DDE_UNADVISE** message with corresponding parameters. If the WM_DDE_UNADVISE message does not specify a format, it disables the oldest notification in first in, first out (FIFO) rotation.

Standard Commands in DDE Execute Strings

The syntax for standard commands sent in execute strings is the same as for other DDE commands:

*command***(***argument1***,***argument2***,**...**)**[*command2***(***argument1***,***argument2***,**...**)**]

Commands without arguments do not require parentheses. String arguments must be enclosed in double quotes.

International Execute Commands

DDE execute strings are typically sent from a macro language in an external application and are typically localized. OLE execute commands, however, are sent by application programs for their own purposes, need not be localized, and must be commonly recognized.

The OLE standard execute commands should not be localized; the U.S. spelling and separator characters are used. Therefore, the following rules apply:

- Client applications and the client library send standard execute commands in U.S. form.
- The server library must receive the U.S. form for these commands.
- Servers written directly to the DDE-level protocol should parse the U.S. form, if they have no additional commands.
- Servers that support both OLE and localized DDE execute commands should first parse the string by using localized separators. If this fails, they should parse it again using the U.S. form and, if successful, should execute the command. Optionally, if the command is received in the U.S. form, the server can check that the command is one of the valid standard commands.

Required Commands

This section lists commands that must be supported by server applications.

The **StdNewDocument**, **StdNewFromTemplate**, **StdEditDocument**, and **StdOpenDocument** commands all make the document available for DDE conversations with the name *DocumentName.* They do not show any window associated with the document; the client must send the **StdShowItem** and **StdDoVerbItem** commands, or the **StdDoVerbItem** command alone to make the window visible. This enables the client to negotiate additional parameters with the server (for example, the **StdTargetDevice** item) without causing unnecessary repaints.

StdNewDocument(*ClassName***,** *DocumentName***)**

Creates a new, empty document of the given class, with the given name, but does not save it. The server should return an error value if the document name is already in use. When the client

receives this error, it should generate another name and try again.

The server should not show the window until it receives a **StdShowItem** command. Waiting for the client to send the **StdShowItem** and **StdDoVerbItem** commands makes it possible for the client to negotiate additional parameters (for example, by using **StdTargetDevice**) without forcing the window to repaint.

StdNewFromTemplate(*ClassName***,** *DocumentName***,** *TemplateName***)**
Creates a new document of the given class with the given document name, using the template with the given permanent name (that is, filename).

The server should not show the window until it receives a **StdShowItem** command. Waiting for the client to send a **StdShowItem** command makes it possible for the client to negotiate additional parameters (for example, by using **StdTargetDevice**) without forcing the window to repaint.

StdEditDocument(*DocumentName***)**
Creates a document with the given name and prepares to accept data that is poked into it with WM_DDE_POKE. The server should return an error if the document name is already in use. When the client receives this error, it should generate another name and try again.

The server should not show the window until it receives a **StdShowItem** command. Waiting for the client to send a **StdShowItem** command makes it possible for the client to negotiate additional parameters (for example, by using **StdTargetDevice**) without forcing the window to repaint.

StdOpenDocument(*DocumentName***)**
Sent to the System topic. This command opens an existing document with the given name.

The server should not show the window until it receives a **StdShowItem** command. Waiting for the client to send a **StdShowItem** command makes it possible for the client to negotiate additional parameters (for example, by using **StdTargetDevice**) without forcing the window to repaint.

StdCloseDocument(*DocumentName***)**
Sent to the System topic. This command closes the window associated with the document. Following acknowledgment, the server terminates any conversations associated with the document. The server should not activate the window while closing it.

StdShowItem(*DocumentName***,** *ItemName* [**,** *fDoNotTakeFocus*]**)**
Sent to the System topic. This command makes the window containing the named document visible and scrolls to show the named item (if any). The optional third argument indicates whether the server should take the focus and bring itself to the front. This argument should be TRUE if the server should not take the focus; otherwise, it should be FALSE. The default value is FALSE.

StdExit
Shuts down the server application. This command should be used only by the client application that launched the server. This command is available in the System topic only.

StdExit is sent to shut down an application if an error occurs during the startup phase or if the client started the server for an invisible update. If servers have unsaved data opened by the user, they should ignore this command.

Variants on Required Commands

The following variants of the above commands may be sent to the document topic rather than the System topic. This allows a client that already has a conversation with the document to avoid opening an additional conversation with the system. The document name is omitted from these commands because it is implied by the conversation topic and because it may have been changed by the server. This kind of name change does not invalidate the conversation. The client should not be forced to keep track of the name change unnecessarily. However, the server must be able to use the conversation information to identify the document on which to operate.

StdCloseDocument

Sent to the document conversation. This command closes the document associated with the conversation without activating it. This command causes a **WM_DDE_TERMINATE** message to be posted by the server window following the acknowledgment.

StdDoVerbItem(*ItemName***,** *iVerb***,** *fShow***,** *fDoNotTakeFocus***)**

Sent to the document conversation. This command is similar to the **StdShowItem** command, except that it includes an integer indicating which of the registered operations to perform and a flag indicating whether to show the window. The server can ignore the *fShow* flag, if necessary.

StdShowItem(*ItemName* [**,** *fDoNotTakeFocus*]**)**

Sent to the document conversation. This command shows the document window, scrolling if necessary to bring the item into view. If the item name is NULL, scrolling does not occur. The optional second argument indicates whether the server should take the focus and bring itself to the front. This argument should be TRUE if the server should not take the focus; otherwise, it should be FALSE. The default value is FALSE.

The Windows Shell Overview (3.1)

This topic describes features of the shell for the Microsoft Windows operating system. The following features are supported by the dynamic-link library SHELL.DLL:

Association Functions
Drag-Drop
Icon Extraction
Registration Database

Registration Database

The registration database is a systemwide source of information about applications. This information is used to support the integration of applications with Windows File Manager and is used by applications that support object linking and embedding (OLE).

An application can use the registration database to store the following information:

- The name of the executable file that is associated with a given filename extension
- The command line to execute--or dynamic data exchange (DDE) messages to send--when the user opens a file from Windows shell applications (File Manager or Program Manager)
- The command line to execute--or DDE messages to send--when the user prints a file from File Manager
- Details about the implementation of OLE if the application is an OLE server

The registration database is a standard part of Windows version 3.1. Any Windows version 3.0 application that supports OLE also uses the registration database. The registration database is not meant as a place for applications to store private data. Applications should use private initialization files for data that is not defined or that is not needed either by the Windows 3.1 shell applications or by OLE applications.

For most applications, the developer uses Microsoft Windows Registration Editor (REGEDIT.EXE) to edit the registration database and produce a registration (.REG) file that contains readable text strings corresponding to database entries. This .REG file can be merged into the user's registration database when the application is installed. For more information about merging text files with the database, see Format of Registration Files.

Structure of the Database

The registration database is stored in binary format in a file named REG.DAT. This file is saved in the user's Windows directory.

Data in the registration database is in the form of a hierarchically structured tree. Each node in the tree is identified by a key name. Each key name is a string from the set of printable ASCII characters (values 32 through 127). Key names cannot include a space, a backslash (\), or a wildcard (* or ?). Key names beginning with a period (.) are reserved.

Any key name can also be associated with a text string that provides further information about that key. The text string can contain any character from the set of printable ASCII characters. These text strings are also called values.

Each key name is unique with respect to the key that is immediately above it in the hierarchy. For example, the **open** and **print** keys are often subkeys of the key named **shell**. Both **open** and **print** might have subkeys named **command**, but **open** could not have two subkeys named **command**.

The system defines a standard entry for the root level of the database: **HKEY_CLASSES_ROOT**. Root-level key names that begin with a period are reserved by the system. Database entries that are subordinate to the **HKEY_CLASSES_ROOT** key define types (or classes) of documents and the properties that are associated with these classes. Information stored under **HKEY_CLASSES_ROOT** is used by Windows shell applications and by OLE applications.

The following table shows the structure of a typical REG.DAT file. In this table, bold characters designate reserved words and italic characters designate words or phrases that vary with the registering application.

HKEY_CLASSES_ROOT

.ext	*class name*
ClassName	*class description*
shell	
open	
command	*command line for opening application*
ddeexec	*DDE command used when opening document*

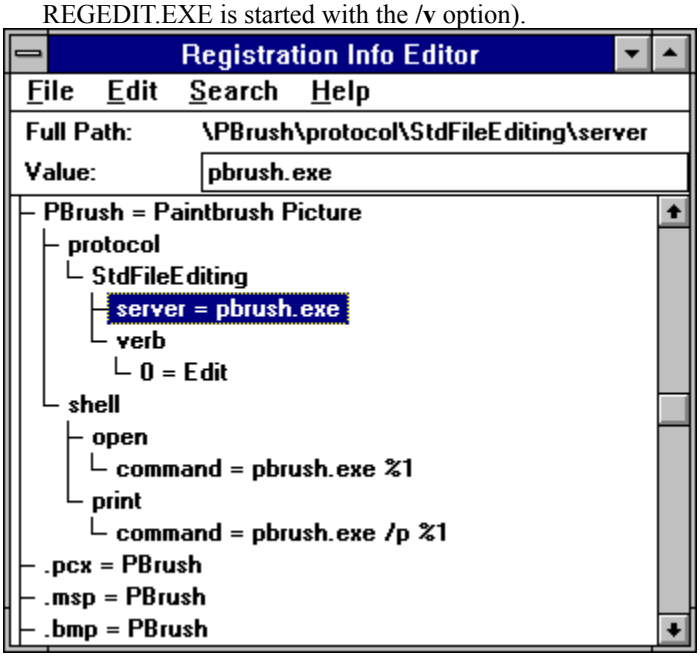
application *DDE app name for starting conversation*
topic *topic of the DDE conversation*
ifexec *DDE command if initiate fails*
print
command *command line for opening application*
ddeexec *DDE command used when printing document*
application *DDE app name for starting conversation*
topic *topic of the DDE conversation*
ifexec *DDE command if initiate fails*
protocol
StdFileEditing
server *command line for opening application*
handler *path and filename for handler DLL*
verb *play or edit*

Future versions of the database will include more reserved words. To avoid conflict with future versions, applications should record information that is not used by the Windows shell or OLE in private initialization files.

Standardized keys help an application navigate in the database. When an application has found the key for a feature, it typically uses the text string associated with that key. (As shown in the preceding list, however, not all keys have text strings.) For example, if an application needs to display the name of an application in a dialog box, the application might use the *ClassName* key to find the *class description* text string. The class name is often an abbreviated string, for application use only, whereas the class description is the full name of the application and is presented in the user interface.

Some standard entries to the database that are occasionally used by OLE server applications are not noted in the preceding list. For more information about these standard entries, see Object Linking and Embedding Overview.

The following illustration shows how Windows Paintbrush is registered in REG.DAT (as displayed when REGEDIT.EXE is started with the /**v** option).



Format of Registration Files

For most applications, the developer creates a registration (.REG) file that contains the database entries. Registration Editor (REGEDIT.EXE) can then be used to merge the .REG file into the user's REG.DAT file when the application is installed on the user's system.

The following example shows the format of a .REG file that would set up Microsoft Paintbrush with the entries

shown in Figure 7.1:

```
REGEDIT

This is a comment line.

HKEY_CLASSES_ROOT\PBrush = Paintbrush Picture
HKEY_CLASSES_ROOT\.bmp = PBrush
HKEY_CLASSES_ROOT\.msp = PBrush
HKEY_CLASSES_ROOT\.pcx = PBrush
HKEY_CLASSES_ROOT\PBrush\shell\print\command = pbrush.exe /p %1
HKEY_CLASSES_ROOT\PBrush\shell\open\command = pbrush.exe %1
HKEY_CLASSES_ROOT\PBrush\protocol\StdFileEditing\verb\0 = Edit
HKEY_CLASSES_ROOT\PBrush\protocol\StdFileEditing\server = pbrush.exe
```

The first line of the file must be REGEDIT, as shown. Any subsequent lines that do not begin with **HKEY_CLASSES_ROOT** are currently treated as comments by REGEDIT.EXE. For compatibility with future versions of the database, however, a comment should not begin with a backslash (\) character or with the string HKEY. Each line to be added to the database must begin with a full key name. To create a key with an associated text string, the key name must be followed by at least one space, an equal sign (=), another space, and the string. Characters following the equal sign and single space are treated as the value of the key.

When SHELL.DLL encounters the string %1 in a command, it replaces that string with the name of the document being opened or printed.

A .REG file cannot be larger than 64K.

The setup procedure for the registering application typically merges this file with the user's REG.DAT file by running REGEDIT.EXE with the ***/s*** option. (Applications that must update the database with Windows 3.0 can use REGLOAD.EXE instead of REGEDIT.EXE to merge the files. REGLOAD.EXE is smaller than REGEDIT.EXE and does not require the common dialog box dynamic-link library COMMDLG.DLL.)

Class Registration

Database entries that are one level below the **HKEY_CLASSES_ROOT** root-level entry are defined as classes of documents. The exception to this definition is the *.ext* class.

Database entries that are subordinate to the class-definition entries describe the properties of a class. The database can describe two kinds of document properties for each class of document: shell properties and protocol properties.

Registering Filename Extensions

The *.ext* key name defines all files with that extension as members of a specified class. The registering application specifies the document class for an extension in the text string associated with the *.ext* key name.

Unlike other second-level key names, the *.ext* key name is not a class definition. Instead, it helps associate a class with a specific filename extension. For example, a word processor application can define a .DOC filename extension with the text string wpdoc. Then, when the word processor uses wpdoc as the class name for its documents, the .DOC extension is associated with that class.

The class name is the same name used by an OLE server application when it registers itself. For example, if a voice-annotation application named TALK.EXE registered as an OLE server, the information would look like this:

```
HKEY_CLASSES_ROOT\.tlk = Talk
HKEY_CLASSES_ROOT\Talk = Talk Voice Annotation
```

Filename extensions are recorded both in the database and in the [extensions] section of WIN.INI when the user records a filename association in the Associate dialog box. The Associate dialog box is

displayed when the user chooses the Associate command from the File menu in File Manager. (Although File Manager automatically records the information in both places, SHELL.DLL does not. Applications that register filename extensions in the registration database should also record the information in WIN.INI, to provide compatibility with applications written before Windows 3.1.)

File Manager uses the filename associations recorded in WIN.INI if the information is not found in the registration database. If information is duplicated in the database and WIN.INI, File Manager uses the information in the database.

Shell Properties

Shell properties describe how a document of a given class interacts with Windows shell applications. There are two key names for shell properties: **open** and **print**. The **open** properties describe how the class responds to a request from a Windows shell application to open a document. The **print** properties describe how the class responds to a request from Print Manager to print a document.

Both the **open** and **print** key names must have the **command** subkey. The value assigned to **command** specifies the command line used to run the application. If appropriate, this value can include command-line options.

If an application supports DDE, it can also define the **ddeexec** subkey for either or both of the **open** and **print** key names. The text string given with the **ddeexec** key name is treated as a DDE command. Defining **ddeexec** is particularly useful if an application already supports DDE **open** and **print** commands. Using DDE messages can add flexibility, particularly for applications that support the multiple document interface (MDI), because a DDE message string can include more than one command.

The **ddeexec** key has three predefined subkeys: **application**, **topic**, and **ifexec**.

The text string given with the **application** key name specifies the application name to use in establishing the DDE conversation. If the registering application does not specify an **application** key, the shell uses the application name specified in the **command** key.

The text string given with the **topic** key name specifies the topic name of the DDE conversation. If the application does not register a **topic** key, the shell uses the System topic as the default topic name.

The text string given with the **ifexec** key name defines the DDE command to use when initiation of the DDE conversation fails (for example, if the application is not running). When the initiation fails, the command specified by the **command** key is carried out and then the string specified with the **ifexec** key is sent. (If an application does not specify a value for the **ifexec** key, the command specified by the **command** key is executed when initiation fails and the string specified with the **ddeexec** key is sent again.)

Opening Files

An application should open a file in a new instance of the associated application, even if the application supports MDI. If the user has already opened the file, applications typically give the focus to the window with the file instead of obtaining a new copy of the file.

If an MDI application does not use memory efficiently when multiple instances of the application are running, the application can open the file in the existing instance, as a new MDI window.

Printing Files

After opening the file as described in the preceding section, the application should carry out the **print** command. Whenever possible, applications should display the Print dialog box to give the user the opportunity to customize the print job. If this is not possible, the file should be printed immediately. Once the file is printed or the user chooses to cancel the print job, the application should close. (If the file was opened as a new MDI window, the application typically closes the window, rather than the entire application, when the print job has finished.)

Protocol Properties

A protocol is a convention for manipulating a document or some other collection of data. Database entries that are subordinate to the **protocol** key name describe the properties of a protocol. Although a class can support any number of protocols, currently only one is defined. This protocol, **StdFileEditing**, is used by documents that support OLE.

The **StdFileEditing** protocol has three subkeys: **server**, **handler**, and **verb**.

The text string given with the **server** key name is a command line that an OLE client application uses to start the server application for a linked or embedded object.

The text string given with the **handler** key name is the name of a dynamic-link library that acts as an object handler for OLE objects. For more information about object handlers, see **Object Linking and Embedding**.

The **verb** key name has subkeys that identify the kind of action a server should take when it opens an object. These subkeys are consecutive numbers, beginning with zero. The 0 subkey corresponds to the primary verb for the objects supported by the server. For example, 0 often means Edit and 1 often means Play. For more information about verbs, see **Object Linking and Embedding**.

For example, if an application named NewApp could not use REGEDIT.EXE to set up its **protocol** properties, it could set them up by using the following example:

```
HKEY hkProtocol;

if (RegCreateKey(HKEY_CLASSES_ROOT,             /* root               */
    "NewAppDocument\\protocol\\StdFileEditing", /* protocol string    */
    &hkProtocol) != ERROR_SUCCESS)             /* protocol key handle */
        return FALSE;

RegSetValue(hkProtocol,          /* handle to protocol key           */
    "server",                    /* name of subkey                   */
    REG_SZ,                      /* required                         */
    "newapp.exe",                /* command to activate server       */
    10);                         /* text string size                 */

RegSetValue(hkProtocol,          /* handle to protocol key           */
    "handler",                   /* name of subkey                   */
    REG_SZ,                      /* required                         */
    "nwappobj.dll",              /* name of object handler           */
    12);                         /* text string size                 */

RegSetValue(hkProtocol,          /* handle to protocol key           */
    "verb\\0",                   /* name of subkey                   */
    REG_SZ,                      /* required                         */
    "Edit",                      /* server should edit object        */
    4);                          /* text string size                 */

RegCloseKey(hkProtocol);         /* close protocol key and subkeys   */
```

Server Registration in WIN.INI

When an application creates a **server** protocol property and saves this key in REG.DAT, SHELL.DLL also puts this information into the WIN.INI initialization file. Some applications that use linked and embedded objects were developed before the implementation of the registration database. The information in WIN.INI allows such an application to find the command line that starts the server for an object. Server registration entries in WIN.INI are also written to the registration database whenever the user starts Windows.

The server registration entries in WIN.INI are in a section headed [embedding]. If an [embedding] section does not already exist when a registering application calls the **RegCloseKey** function for a

key, SHELL.DLL creates it. When an application calls **RegCloseKey**, every class-definition key in REG.DAT that is not already in the [embedding] section is added to WIN.INI, not simply the key for which **RegCloseKey** was called.

The server information in WIN.INI is recorded in the following form:

[embedding]
*ClassName=comment,textual class name,path/arguments,*Picture

The keyword Picture indicates that the server can produce metafiles for use when rendering objects. Because commas are used as field separators, none of the fields can contain a comma.

A server can register only the name and arguments for its executable file, rather than the entire path, if the application is always installed in a directory that is mentioned in the PATH environment variable. Usually, registering the path and filename is less ambiguous than registering only the filename.

When the database is opened, the shell library reads the [embedding] section of WIN.INI and updates the registration database with any new information it contains. If the [embedding] section contains information that conflicts with REG.DAT, the information in REG.DAT is overwritten. When the database is closed, the shell library writes the information in REG.DAT back into the [embedding] section of WIN.INI. This ensures that applications that depend on WIN.INI for information about linked and embedded objects retrieve current information and that new OLE applications can simply read from and write to REG.DAT.

Querying and Deleting Database Entries

An application can use the **RegCreateKey** and **RegSetValue** functions to add keys to the registration database and the **RegCloseKey** function to indicate that a key is no longer needed by the application. Other registration functions allow an application to query the contents of the database and delete keys.

An application can use the **RegEnumKey** function to determine the subkeys of a specified key. Because the first parameter of **RegEnumKey** must be the handle of an open key, this function is typically preceded by a call to the **RegOpenKey** function and followed by a call to **RegCloseKey**. (Because the **HKEY_CLASSES_ROOT** key is always open, bracketing **RegEnumKey** with **RegOpenKey** and **RegCloseKey** is not strictly necessary when **HKEY_CLASSES_ROOT** is specified as the first parameter of **RegEnumKey**. Using **RegOpenKey** and **RegCloseKey** is a time optimization in this case, however.) The **RegQueryValue** function retrieves the text string that has been associated with a key name.

The following example uses the **RegEnumKey** function to put the values associated with top-level keys into a list box:

```
HKEY hkRoot;
char szBuff[80], szValue[80];
static DWORD dwIndex;
LONG cb;

if (RegOpenKey(HKEY_CLASSES_ROOT, NULL, &hkRoot) == ERROR_SUCCESS) {
    for (dwIndex = 0; RegEnumKey(hkRoot, dwIndex, szBuff,
              sizeof(szBuff)) == ERROR_SUCCESS; ++dwIndex) {
        if (*szBuff == '.')
            continue;
        cb = sizeof(szValue);
        if (RegQueryValue(hkRoot, (LPSTR) szBuff, szValue,
                &cb) == ERROR_SUCCESS)
            SendDlgItemMessage(hDlg, ID_ENUMLIST, LB_ADDSTRING, 0,
                (LONG) (LPSTR) szValue);
    }
    RegCloseKey(hkRoot);
```

```
}
```

The following example uses the **RegQueryValue** function to retrieve the name of an object handler and then calls the **RegDeleteKey** function to delete the key if its value is nwappobj.dll:

```
char szBuff[80];
LONG cb;
HKEY hkStdFileEditing;

if (RegOpenKey(HKEY_CLASSES_ROOT,
        "NewAppDocument\\protocol\\StdFileEditing",
        &hkStdFileEditing) == ERROR_SUCCESS) {

    cb = sizeof(szBuff);
    if (RegQueryValue(hkStdFileEditing,
            "handler",
            szBuff,
            &cb) == ERROR_SUCCESS
            && lstrcmpi("nwappobj.dll", szBuff) == 0)
        RegDeleteKey(hkStdFileEditing, "handler");
    RegCloseKey(hkStdFileEditing);
}
```

Drag-Drop Feature

When an application implements the drag-drop feature, a user can select one or more files in File Manager, drag them to an open application, and drop them there. The application in which the files were dropped receives a message it can use to retrieve the filenames and the coordinates of the point at which the files were dropped.

The drag-drop feature depends upon SHELL.DLL. The drag-drop feature does not depend in any way on the registration database, however.

An application that can accept dropped files from File Manager calls the **DragAcceptFiles** function for one or more of its windows. Then, when the user releases the mouse button to drop a file or files in the window specified in the call to **DragAcceptFiles**, File Manager sends the application a **WM_DROPFILES** message. (File Manager does not send the WM_DROPFILES message to an application unless the application calls **DragAcceptFiles**.) WM_DROPFILES contains a handle of an internal data structure the application can query to retrieve the name of the dropped file and the coordinates of the position at which the cursor was located when the file was dropped. The application can use the **DragQueryFile** function to retrieve the number of files that were dropped and their names. The **DragQueryPoint** function returns the window coordinates of the cursor when the user released the mouse button.

To free the memory allocated by the system for the **WM_DROPFILES** message, an application should call the **DragFinish** function when it is finished.

For example, an application can call the **DragAcceptFiles** function when it starts and call a drag-drop function when it receives a **WM_DROPFILES** message, as shown in the following example:

```
case WM_CREATE:
    DragAcceptFiles(hwnd, TRUE);
    break;

case WM_DROPFILES:
    DragFunc(hwnd, wParam);
    break;

case WM_DESTROY:
    DragAcceptFiles(hwnd, FALSE);
    break;
```

The following example uses the **DragQueryPoint** function to determine where to begin to write text. The first call to the **DragQueryFile** function determines the number of dropped files. The loop writes the name of each file, beginning at the point returned by **DragQueryPoint**.

```
POINT pt;
WORD cFiles, a;
char szFile[80];

DragQueryPoint((HANDLE) wParam, &pt);

cFiles = DragQueryFile((HANDLE) wParam, 0xFFFF, (LPSTR) NULL, 0);
for(a = 0; a < cFiles; pt.y += 20, a++) {
    DragQueryFile((HANDLE) wParam, a, szFile, sizeof(szFile));
    TextOut(hdc, pt.x, pt.y, szFile, strlen(szFile));
}

DragFinish((HANDLE) wParam);
```

Association Functions

File Manager includes an Associate dialog box that makes it possible for users to associate a filename extension with a specific application. File Manager stores these associations in the registration database and the WIN.INI initialization file. If a file has a filename extension that has been associated with an application, that application starts automatically whenever a user double-clicks that file in File Manager.

Using the **FindExecutable** and **ShellExecute** functions, applications can take advantage of such associations to find and start applications or open and print files.

An application can use the **FindExecutable** function to retrieve the name and handle of the executable file that is associated with a specified filename. The **ShellExecute** function either opens or prints a specified file, depending on the value of its *lpszOp* parameter. To open a document file, the function relies on the association of the filename extension.

Extracting Icons from Executable Files

An application can use the **ExtractIcon** function to retrieve the handle of an icon from a specified executable file, dynamic-link library, or icon file. The following example uses the **DragQueryPoint** function to retrieve the coordinates of the point where a file was dropped, the **DragQueryFile** function to retrieve the filename of a dropped file, and the **ExtractIcon** function to retrieve the handle of the first icon in the file, if any:

```
HDC hdc;
HANDLE hCurrentInst, hicon;
POINT pt;
char szFile[80];

hCurrentInst = (HANDLE) GetWindowWord(hwnd, GWW_HINSTANCE);

DragQueryPoint((HANDLE) wParam, &pt);

DragQueryFile((HANDLE) wParam, 0, szFile, sizeof(szFile));
hicon = ExtractIcon(hCurrentInst, szFile, 0);
if (hicon == NULL)
    TextOut(hdc, pt.x, pt.y, "No icons found.", 15);
else if (hicon = (HICON) 1)
    TextOut(hdc, pt.x, pt.y,
        "File must be .EXE, .ICO, or .DLL.", 33);
else
    DrawIcon(hdc, pt.x, pt.y, hicon);
```

Tool Helper Library Overview (3.1)

The tool helper library (TOOLHELP.DLL) makes it easier for developers who work with the Microsoft Windows 3.1 operating system to obtain system information and control system activity. This dynamic-link library was designed to streamline the creation of Windows-hosted tools, specifically Windows-hosted debugging applications. TOOLHELP.DLL is available to applications running with Windows versions 3.0 and later.

To use the elements of TOOLHELP.DLL in an application, you must include the TOOLHELP.H header file in the application source files, link the application with TOOLHELP.LIB, and ensure that TOOLHELP.DLL is in the system path.

The following topics are related to the information in this topic:

- Debugging
- Memory management
- Windows classes
- Task management
- Interrupts

Calling Tool Helper Functions

Most of the functions in TOOLHELP.DLL use structures to return information. The first member in each of these structures is a doubleword value named **dwSize**. This value must be initialized before an application calls the function that uses the structure; otherwise, the function fails.

The **dwSize** member enables new versions of TOOLHELP.DLL to include additional features without breaking code written for structures in Windows versions earlier than 3.1.

The THSAMPLE.C sample program demonstrates how to use some of the functions in TOOLHELP.DLL.

Accessing Internal Windows Lists

TOOLHELP.DLL includes functions that enable you to retrieve information from the internal Windows lists. These lists include the class list, module list, and task queue.

Walking the Windows Class List

The **ClassFirst** function fills a **CLASSENTRY** structure with information about the first class on the Windows class list. This information includes the name of the class and the instance handle of the task that owns the class.

You use **ClassFirst** to begin a walk through the Windows class list. The **ClassNext** function continues the walk by filling a **CLASSENTRY** structure with information about the next class on the Windows class list.

You use the **GetClassInfo** function to obtain more specific class information. **GetClassInfo** requires the instance handle provided by **ClassFirst** or **ClassNext** in the **CLASSENTRY** structure.

Walking the Windows Module List

The **ModuleFirst** function fills a **MODULEENTRY** structure with information about the first module on the list of all currently loaded modules. This information includes the module name, handle, reference count, path to the executable file, and so on.

You use **ModuleFirst** to begin a walk through the Windows module list. The **ModuleNext** function continues the walk by filling a **MODULEENTRY** structure with information about the next module on the list.

The **ModuleFindHandle** function fills a **MODULEENTRY** structure with information about a module whose handle is known. The **ModuleFindName** function fills a **MODULEENTRY** structure with information about a module whose name is known. You use **ModuleFindHandle** or **ModuleFindName**, rather than **ModuleFirst**, to begin a walk through the Windows module list at a

specific module, rather than at the first module on the list.

Walking the Windows Task Queue

The **TaskFirst** function fills a **TASKENTRY** structure with information about the first task in the Windows task queue. This information includes the task handle, SS register value, SP register value, stack dimensions, number of pending events, PSP offset, and so on.

You use **TaskFirst** to begin a walk through the Windows task queue. The **TaskNext** function continues the walk by filling a **TASKENTRY** structure with information about the next task in the task queue.

The **TaskFindHandle** function fills a **TASKENTRY** structure with information about a task whose handle is known. You use **TaskFindHandle**, rather than **TaskFirst**, to begin a walk through the Windows task queue at a specific task, rather than at the first task in the queue.

Obtaining Advisory Information

To simplify system analysis, TOOLHELP.DLL includes functions that retrieve general information about the USER heap, GDI heap, memory manager, and virtual timer.

The **SystemHeapInfo** function fills a **SYSHEAPINFO** structure with information about the USER and GDI heaps. This information includes the percentage of free space and the segment handle for each heap.

The **MemManInfo** function fills a **MEMMANINFO** structure with status and performance information about the memory manager. This information includes the size of the largest free memory object, the maximum number of pages available, the maximum number of lockable pages, total linear space, total unlocked pages, number of pages in the system swap file, and so on.

The **TimerCount** function fills a **TIMERINFO** structure with the execution times of the current task and virtual machine (VM).

Walking the Global and Local Heaps

TOOLHELP.DLL includes functions that enable a developer to examine objects on the global and local heaps.

Walking the Global Heap

The **GlobalInfo** function fills a **GLOBALINFO** structure with information about the global heap. This information includes the total number of items, the number of free items, and the number of "least recently used" (LRU) items on the global heap. The information enables the application to determine how much memory to allocate for a global-heap walk. The application must allocate the memory before starting the walk. If the application allocates any memory after starting the walk, the results of the heap walk will be corrupt.

The **GlobalFirst** function fills a **GLOBALENTRY** structure with information about the first object on the global heap. This information includes the structure size, the size and address of the object, the lock count, and so on.

You use **GlobalFirst** to begin a walk through the global heap. The **GlobalNext** function continues the walk by filling a **GLOBALENTRY** structure with information about the next object on the global heap.

The **GlobalEntryHandle** function fills a **GLOBALENTRY** structure with information about a global object whose handle or selector is known. The **GlobalEntryModule** function fills a **GLOBALENTRY** structure with information about a specific segment in a module. You use **GlobalEntryHandle** or **GlobalEntryModule**, rather than **GlobalFirst**, to begin a walk through the global heap at a specific object, rather than at the first object on the global heap.

Walking the Local Heap

The **LocalInfo** function fills a **LOCALINFO** structure with the total number of items on the local heap. This information enables the application to determine how much memory to allocate for a local-heap walk. The application must allocate the memory before starting the walk. If the application allocates

any memory after starting the walk, the results of the heap walk will be corrupt.

The **LocalFirst** function fills a **LOCALENTRY** structure with information about the first object on the local heap. This information includes the structure size; the handle, address, and size of the object; the lock count; and so on.

You can use **LocalFirst** to begin a walk through the local heap. The **LocalNext** function continues the walk by filling a **LOCALENTRY** structure with information about the next object on the local heap.

Tracing the Windows Stack

The **StackTraceFirst** function fills a **STACKTRACEENTRY** structure with information about the first stack frame for an inactive task. This information includes the stack-frame module handle, segment number, register contents, frame type, and so on.

You use **StackTraceFirst** to begin a stack trace of an inactive task. The **StackTraceNext** function continues the stack trace by filling a **STACKTRACEENTRY** structure with information about the task's next stack frame.

The **StackTraceCSIPFirst** function fills a **STACKTRACEENTRY** structure with information about a stack frame whose SS:BP and CS:IP values are known. You should use **StackTraceCSIPFirst**, rather than **StackTraceFirst**, to begin a stack trace of an active task.

Examining and Modifying Memory Contents

TOOLHELP.DLL includes functions that enable you to examine and modify global memory contents without consideration for selector tiling and aliasing or read-write attributes.

The **MemoryRead** function reads global memory at a specific selector and offset. The **MemoryWrite** function writes to global memory at a specific selector and offset.

The **GlobalHandleToSel** function converts a global memory handle to a selector.

Installing Callback Functions

TOOLHELP.DLL includes functions that enable you to trap an application's interrupts and notifications.

The **InterruptRegister** function installs a callback function that handles all system interrupts. The callback function must be reentrant and must explicitly preserve all register values. The **InterruptUnRegister** function restores the default processing.

The **NotifyRegister** function installs a notification callback function for a specific task. Typically, the notification callback function cannot use any Windows functions except the TOOLHELP.DLL functions and the **PostMessage** function. The **NotifyUnRegister** function restores the default processing.

The exit code returned by a non-Windows application may reflect an error encountered by Windows when it attempted to start the application, rather than a value returned by the application itself. These error values are as follows:

Error value	Cause
0x81	Could not start the application because of a file-access problem. This problem originated either in the application or its PIF file. Following are likely reasons for this error value: File not found Path not found No file handles Invalid drive Access denied Sharing violation Invalid executable format
0x82	Could not start the application, because of insufficient memory or disk space.

0x83	Abnormal termination.
0x84	Could not start the application, because of incorrect version.
0x85	Could not start the application, because MS-DOS Interrupt 21h Function 4B00h (Load and Execute Program) failed.
0x86	Could not start the application, because the TOOLHELP.DLL task-switching functions prevented it from starting.

Controlling Process Execution

TOOLHELP.DLL includes four functions you can use to control process execution: **TaskGetCSIP**, **TaskSetCSIP**, **TaskSwitch**, and **TerminateApp**. These functions are designed for use exclusively in Windows-hosted debuggers.

When an inactive task is activated, it begins execution at the location specified by its CS:IP value. The **TaskSetCSIP** function sets this value, and the **TaskGetCSIP** function returns the value.

The **TaskSwitch** function activates a specific task beginning at a specified CS:IP value.

The **TerminateApp** function terminates an application as if a general protection (GP) fault had occurred.

LZExpand Overview (3.1)

The Microsoft Windows operating system includes the dynamic-link library LZEXPAND.DLL. Typically, an application calls functions in LZEXPAND.DLL to decompress data previously compressed by Microsoft File Compression Utility (COMPRESS.EXE).

A version of LZEXPAND.DLL was shipped with Windows version 3.0. That version of LZEXPAND.DLL does not contain the full set of functions that is included with the Windows 3.1 version. Applications that could be installed on a system running Windows 3.0 should always check the version number of the library to ensure that the correct version is being used. For more information about checking version numbers, see the **File Installation Library**.

This topic describes important concepts relating to data compression and describes the decompression functions in LZEXPAND.DLL.

Data Compression

Data compression is an operation that reduces the size of a file by minimizing redundant data. In a file that contains text, redundant data could be frequently occurring characters, such as the space character, or common vowels, such as the letters *e* and *a;* it could also be frequently occurring character strings. Data compression operations create a compressed version of a file by minimizing this redundant data.

Each of the many types of data-compression operations minimizes redundant data in a unique manner. For example, the Huffman encoding algorithm assigns a code to characters in a file based on how frequently those characters occur. Another compression algorithm, called run-length encoding, generates a two-part value for repeated characters: The first part specifies the number of times the character is repeated, and the second part identifies the character. Another compression algorithm, known as the Lempel-Ziv algorithm, converts variable-length strings into fixed-length codes, which consume less space than the original strings.

To compress large applications or data files, you can run COMPRESS.EXE from the Microsoft MS-DOS® command line. COMPRESS.EXE uses the Lempel-Ziv compression algorithm.

Data Decompression

Applications can call the functions in LZEXPAND.DLL to decompress files compressed with COMPRESS.EXE. The functions can also process uncompressed files without attempting to decompress them. To use these functions, include the LZEXPAND.H header file. To use the static-link libraries, define LIB before including LZEXPAND.H.

For a list of functions contained in LZEXPAND.DLL, see the **Lempel-Ziv Encoding Functions** topic.

Decompressing a Single File

An application can decompress a single compressed file by performing the following tasks:

1 Open the compressed file by calling the **LZOpenFile** function or a combination of the **OpenFile** and **LZInit** functions.

2 Open the destination file by calling the **LZOpenFile** or **OpenFile** function.

3 Copy the source file to the destination file by calling the **LZCopy** function and passing the handles returned by **LZOpenFile** (or **LZInit**).

4 Close the files by calling the **LZClose** function.

Decompressing Multiple Files

An application can decompress multiple files by performing the following tasks:

1 Open the source file by calling the **LZOpenFile** function or a combination of the **OpenFile** and **LZInit** functions.

2 Open the destination file by calling the **LZOpenFile** or **OpenFile** function.

3 Allocate memory for the copy operation by calling the **LZStart** function.

4 Copy the source files to the destination files by calling the **CopyLZFile** function.

5 Release the allocated memory by calling the **LZDone** function.

6 Close the files by calling the **LZClose** function.

Reading Bytes from Compressed Files

In addition to decompressing a complete file at a time, an application can decompress compressed files a portion at a time by using the **LZSeek** and **LZRead** functions. These functions are particularly useful when it is necessary to extract parts of large files. For example, a font manufacturer may have compressed files containing font metrics in addition to character data. To use the information in these files, an application would need to decompress the file; however, most applications would use only part of the file at any particular time. When the user queried the font metrics, the application would extract data from the header. When the user rendered text output, the application would reposition the file pointer by calling **LZSeek** and extract the character data.

Stress Library (3.1)

The system resources stress-testing library (STRESS.DLL) is a dynamic-link library that artificially consumes system resources, enabling developers to observe how an application behaves in scarce-resource conditions. This library was designed to make scarce-resource testing easier and more realistic. It is used by the STRESS.EXE utility.

System Resources Stress-Testing Library Functions

Following are the system resources affected by STRESS.DLL, with the functions that consume and release each resource:

Resource	Allocation function	Release function
Global memory	**AllocMem**	**FreeAllMem**
GDI heap memory	**AllocGDIMem**	**FreeAllGDIMem**
User heap memory	**AllocUserMem**	**FreeAllUserMem**
Disk space	**AllocDiskSpace**	**UnAllocDiskSpace**
File handles	**AllocFileHandles**	**UnAllocFileHandles**

File Installation Overview (3.1)

The file installation library in the Microsoft Windows version 3.1 operating system makes it easier for applications to install files properly and enables utility programs to analyze files that are currently installed.

This overview is divided into three parts:

File Installation Concepts
Creating an Installation Program
Adding Version Information to a File

File Installation Concepts

The file installation library includes functions that determine where a file should be installed, identify conflicts with currently installed files, and perform the installation process. These functions enable installation programs to avoid the following problems:

- Installing older versions of components over newer versions
- Changing the language in a mixed-language system without notification
- Installing multiple copies of a library in different directories
- Copying files to network directories shared by multiple users

The file installation library also includes functions that enable applications to query a version resource for information about a file and present the information to the user in a clear format. This information includes the file's purpose, author, version number, and so on. (For more information about version resources, see Adding Version Information to a File).

The file installation library is available for Windows and non-Windows applications. Windows applications should use the dynamic-link library VER.DLL and the header file VER.H. Non-Windows applications should use one of the following static-link libraries: VERS.LIB, VERC.LIB, VERM.LIB, or VERL.LIB. Applications that use the static-link libraries should use the following line before including VER.H:

```
#define LIB
```

Creating an Installation Program

An installation program typically has the following goals:

- To place files in the correct location
- To notify the user if the installation program is replacing an existing file with a version that is significantly different--for example, replacing a German file with an English file, or replacing a newer file with an older file

When writing the installation program, you must have the following information for each file on the installation disk(s):

- The name and location of the file (referred to as the source file).
- The name of the equivalent file on the user's hard disk (referred to as the destination file). This name is usually the same as the filename on the installation disk.
- The sharing status of the file--that is, whether the file is private to the application being installed or could be shared by multiple applications.

For each file on the installation disk(s), the installation program must, at least, call the **VerFindFile** and **VerInstallFile** functions. These functions are described briefly in the rest of this section.

You use the **VerFindFile** function with the destination-file name to determine where the file should be copied to on the disk. This function also enables you to specify whether the file is private to the application or can be shared. If a problem occurs in finding the file, **VerFindFile** returns an error value. For example, if Windows is using the destination file, **VerFindFile** returns VFF_FILEINUSE. The installation program must notify the user of the problem and respond to the user's decision to continue or end the installation.

The **VerInstallFile** function copies the source file to a temporary file in the directory specified by **VerFindFile**. If necessary, **VerInstallFile** expands the file by using the functions in the data decompression library, LZEXPAND.DLL.

VerInstallFile compares the version information of the temporary file to that of the destination file. If they differ, **VerInstallFile** returns one or more error values. For example, it returns VIF_SRCOLD if the temporary file is older than the destination file and VIF_DIFFLANG if the files have different language identifiers or code-page values. The installation program must notify the user of the problem and respond to the user's decision to continue or end the installation.

Some **VerInstallFile** errors are recoverable. That is, the installation program can call **VerInstallFile** again, specifying the VIFF_FORCEINSTALL option, to install the file regardless of the version conflict. If **VerInstallFile** returns VIF_TEMPFILE and the user chooses not to force the installation, the installation program should delete the temporary file.

VerInstallFile could encounter a nonrecoverable error when attempting to force installation, even though the error did not exist previously. For example, the file could be locked by another user before the installation program tried to force installation. If an installation program attempts to force installation after a nonrecoverable error, **VerInstallFile** fails. The installation program must deal with this situation.

The recommended solution is to display a common dialog box with the buttons Install, Skip, and Install All for all errors. The Install All button should prevent the installation program from prompting the user about similar errors by including the VIFF_FORCEINSTALL option in all subsequent uses of **VerInstallFile**. For nonrecoverable errors, the Install and Install All buttons should be disabled.

To display a useful error message to the user, the installation program usually must retrieve information from the version resources of the conflicting files. The file installation library provides four functions the installation program can use for this purpose: **GetFileVersionInfoSize**, **GetFileVersionInfo**, **VerQueryValue**, and **VerLanguageName**. The **GetFileVersionInfoSize** function returns the size of the version information. The **GetFileVersionInfo** function then uses information retrieved by **GetFileVersionInfoSize** to retrieve a structure that contains the information. The **VerQueryValue** function retrieves a specific member from that structure.

For example, if **VerInstallFile** returns the VIF_DIFFTYPE error, the installation program should use **GetFileVersionInfoSize**, **GetFileVersionInfo**, and **VerQueryValue** on the temporary and destination

files to obtain the general type of each file. If the languages of the files conflict, the installation program should also use the **VerLanguageName** function to translate the binary language identifier into a text representation of the language. (For example, 0x040C translates to the string French.)

If **VerInstallFile** returns a file error, such as VIF_ACCESSVIOLATION, the installation program should use MS-DOS Interrupt 21h Function 59h (Get Extended Error) to obtain the most recent error value. The program should translate this value into an informative message to display to the user. The program must not yield control between calling **VerInstallFile** and calling Get Extended Error. If it does, the MS-DOS error value could reflect a later error. (An error could also occur while the program is making the MS-DOS call.)

Adding Version Information to a File

Version information can be added to any Windows file that can have Windows resources, such as a dynamic-link library, an executable file, or a font file. To add the information, you must create a version resource and add the resource to the file by using RC.

32-Bit Memory Management Library

One of the significant features of 80386 and 80486 processors is the availability of 32-bit registers for the manipulation of code and data. Applications written to use these registers can avoid the segmented memory model of earlier CPUs and instead use a flat memory model in which memory is viewed as a single, contiguous block.

Although the Microsoft Windows operating system continues to adhere to a segmented 16-bit memory model, Windows does provide a set of functions that allow an application to make use of the 32-bit memory-addressing capabilities of the 80386 and 80486 processors. These functions are available to an application through a dynamic-link library (DLL) named WINMEM32.DLL.

Your application's installation program should use the file installation library (VER.DLL) to ensure that it does not install an older version of WINMEM32.DLL over a newer version. For more information about VER.DLL, see File Installation Overview.

This topic introduces the functions contained in WINMEM32.DLL and explains how to use these functions in the context of a Windows application. It covers the following information:

- Some of the differences between a segmented memory model and a flat memory model
- Use of WINMEM32.DLL to take advantage of the 32-bit memory-addressing capabilities of 80386 and 80486 processors
- Programming considerations for use of 32-bit memory in a Windows application
- Use of 32-bit memory in a Windows application
- A directory of WINMEM32.DLL functions
- Assembly-language examples illustrating how to use WINMEM32.DLL functions

You should be thoroughly familiar with the following information about 80386 and 80486 processors that is not covered in this topic:

- Terminology and concepts relating to the architecture
- Code-management features
- Memory-management features

Only developers with experience writing Windows applications and assembly language code should attempt to use these functions in an application.

Segmented and Flat Memory Models

The family of processors that includes 80286, 80386, and 80486 processors implements a segmented memory model in which system memory is divided into 64K segments. In the real mode of these processors, the address of any byte consists of two 16-bit values: a segment address and an offset. (Windows version 3.1 does not support real mode.) In the protected mode of the 80286, 80386, and 80486 processors, the segment address is replaced by a selector value that the processor uses to access the 64K segment. In either mode, a memory object larger than 64K occupies all or part of several segments. An application cannot access such an object as though it consisted of a single contiguous block simply by incrementing a pointer to the memory. Instead, the application can increment only the offset portion of the address, taking care not to exceed the 64K boundary of the segment.

The 80386 processor introduced 32-bit registers that parallel the 16-bit registers of older processors. These registers make it possible for the first time to access memory in segments larger than 64K. In fact, the maximum segment size is potentially so large (2^32 bytes) that a flat memory model utilizing a single segment is now feasible. In this model, an application's code, data, or both occupy a single segment. The application can manipulate the 32-bit offset portion of the memory as though it were a simple pointer. The application can increment and decrement the offset portion of the memory throughout the address space without having to deal with multiple segment boundaries.

To a certain extent, the flat memory model most closely resembles the tiny memory model, in which both code and data occupy a single segment; of course, the segment is much larger than the 64K limit imposed by the segmented memory model. As in the tiny memory model, the beginning of the segment of the flat memory model can appear anywhere in memory. In other words, the segment-

descriptor portion of the address can refer to virtually any location in memory. As the application moves through memory, the segment descriptor never changes. Only the offset is incremented and decremented to point to different locations in memory.

The flat memory model makes it possible for you to ignore segments and segment registers. The segment registers are loaded at the start of the 32-bit code and are then left alone. The rest of the application runs in this purely 32-bit offset mode--all pointers are near pointers.

It is not possible to implement a Windows application by using an exclusively flat memory model. Because Windows itself relies on the 16-bit segmented memory model, any application that interacts with Windows must implement at least one 16-bit code segment. Despite this limitation, it is possible for a Windows application to reside largely in one or more 32-bit code segments and to use 32-bit data segments. The WINMEM32.DLL library makes this possible in a way that ensures the application cooperates fully with Windows and similar platforms. For more information, see Flat Memory Model Limitations.

Using the WINMEM32.DLL Library

Although you could directly implement code for a flat memory model in your Windows application, this implementation would necessarily be unique to your application. As a result, your application might not run with future versions of Windows or with other compatible platforms.

WINMEM32.DLL supplies a standard method for implementing a flat memory model that is guaranteed to run with future versions of Windows and other compatible platforms. It gives your application access to services for allocating, reallocating, and freeing 32-bit memory objects; for translating 32-bit pointers to 16-bit pointers that can be used by Windows and MS-DOS functions; and for aliasing a data segment to a code segment so you can execute code loaded into a 32-bit segment.

Your application can load WINMEM32.DLL when Windows is running in standard or 386 enhanced mode. However, because the 32-bit registers of the 80386 or 80486 processor are available only when Windows is in 386 enhanced mode, WINMEM32.DLL is enabled only in that mode. If your application runs in standard mode, you must design your application so that it can access 16-bit memory instead of 32-bit memory. You can find out which mode Windows is running in by calling the **GetWinFlags** function.

WINMEM32.DLL contains eight functions that enable your application to access 32-bit memory. The following table summarizes each of these functions:

Function	Description
GetWinMem32Version	Returns the version number of the WINMEM32.DLL application programming interface (API).
Global16PointerAlloc	Converts a 32-bit pointer to a 16-bit pointer.
Global16PointerFree	Frees a pointer alias created by the **Global16PointerAlloc** function.
Global32Alloc	Allocates a 32-bit memory object.
Global32CodeAlias	Creates a code-segment alias for a 32-bit memory object, allowing code in the object to be executed.
Global32CodeAliasFree	Frees a code-segment alias created by the **Global32CodeAlias** function.
Global32Free	Frees a 32-bit memory object.
Global32Realloc	Changes the size of a 32-bit memory object.

A directory listing of these functions appears later in this topic.

Because WINMEM32.DLL is a standard Windows DLL, your application loads it as it would any other DLL. Your application should be linked so that the case of the DLL entry point names is ignored.

The WINMEM32.DLL functions use the same calling conventions as other Windows functions. The DLL entry points are external **FAR PASCAL** procedures. They preserve the SS, BP, DS, SI, and DI registers, and they return values in AX register or DX:AX register pair.

Considerations for Using 32-Bit Memory

As previously noted, Windows adheres to the segmented memory model. That is, all far pointers are in the form 16:16 consisting of a 16-bit segment selector, combined with a 16-bit offset within the segment. An application using the 32-bit registers of the 80386 or 80486 processor cannot directly call the Windows functions, because its far pointers are in the form 16:32 and Windows cannot work with the extra 16 bits in the offset portion of the address.

Because of this conflict, a Windows application cannot reside exclusively in a 32-bit segment. It must contain at least one 16-bit helper code segment through which it interacts with Windows (including WINMEM32.DLL). In other words, all calls to Windows functions must be made in the helper code segment. The helper segment contains the code that converts the 16:32 pointers in the 32-bit segment to the 16:16 pointers used by Windows functions. This segment also performs the same tasks for the application when the application makes calls to MS-DOS, to other DLLs, or to any other code that uses 16:16 pointers exclusively.

An important limitation on this helper segment is that it must not be discardable (although it can be movable). If the segment is discarded and a 32-bit segment attempts to access the segment, an indirect call into the Windows kernel module to reload the segment results. Because the source of this indirect call is not a 16-bit segment, the system might crash.

Another important consideration is that in writing your application you must not assume anything about the state of the 32-bit registers around 16:16 function calls. For instance, the Windows function calls preserve SI and DI registers, but they presently do not preserve ESI and EDI registers. If the application needs to preserve 32-bit registers around 16:16 function calls, it must explicitly push and pop the register values around the calls. If the 32-bit code segment that calls a Windows function (by means of the helper segment) needs ESI and EDI registers to be preserved when the Windows function returns, the helper segment must explicitly save the registers before making the actual Windows function call. The helper segment must then restore the registers when the Windows function returns.

This rule also applies to return values when a 32-bit segment indirectly calls a Windows function and the caller requires a 32-bit return value. The helper segment must explicitly set the high-order 16 bits of the return value when it moves it into the EAX register, as shown in the following examples:

```
movzx    eax,ax      ; unsigned return

movsx    eax,ax      ; signed return
```

All these considerations apply equally to calls to Windows DLLs, MS-DOS, and other 16-bit functions.

Flat Memory Model Limitations

In the Windows environment, system memory is a shared resource that Windows manages on behalf of all applications. For this reason, a true flat memory model is not possible in the Windows environment. When an application allocates 32-bit memory in Windows, the memory that Windows gives the application can be located anywhere in physical memory. The memory to which the selector refers is specific to the application and does not include systemwide memory locations. In other words, the selector that the application receives does not refer to linear address 0. This means that offset 400h for the selector does not point to the MS-DOS ROM BIOS data area, for example.

Windows applications do not need to address these systemwide memory locations directly, so there is no need to map these locations in the 32-bit memory objects.

The Application Stack

Windows cannot operate in an environment of mixed segment types (including both 16:16 and 16:32 segments). As a result, the stack selector size must match the corresponding code selector size. When the processor is executing code in a 16:32 (USE32) code segment, the selector in the SS register must contain a 16:32 selector. When the processor is executing code in a 16:16 (USE16) segment, the SS register must contain a 16:16 selector.

When the 80386 or 80486 processor is executing on a USE16 stack segment, it uses the low-order 16 bits of the ESP register as the SP register. Because only the low-order 16 bits are of use when the processor is running on a USE16 stack segment, the processor does not control how the high-order 16 bits of the ESP register are set. As a result, the high-order 16 bits are set at random. When an application switches to a USE32 stack segment, the ESP register contains a corrupted pointer unless the high-order 16 bits of ESP are set properly.

Suppose that a Windows application has a USE32 code segment and a USE16 helper segment, but (improperly) only a USE32 stack. When the application calls from its USE32 code into the USE16 segment, the application continues to use its USE32 stack. The USE16 code segment calls a Windows function, which changes the selector in the SS register to a USE16 selector. Because the stack is now USE16, the high-order 16 bits of the ESP register are set at random. The code that originally switched stacks then restores the original selector in SS and, lacking the information that the selector referred to a USE32 stack, restores the 16-bit SP register instead of the full 32 bits of the ESP register. As a result, the USE32 stack now has an invalid pointer in the ESP register.

There are a number of ways to deal with this problem. One solution is for an application to maintain two separate stacks, one USE16 and the other USE32. Maintaining separate stacks requires you to include extra code --for example, you must copy parameters for stack-calling conventions such as that used in C. Another solution is to maintain one stack but two stack selectors, one USE16 and the other USE32, both of which point to the same memory. This requires the USE32 stack to be restricted to ESP values less than or equal to FFFFh.

In either case, the USE16 code segment must switch to the USE32 stack immediately before calling into a USE32 code segment. When control returns from the USE32 code segment to the USE16 code segment, the USE16 segment must switch back to the USE16 stack before doing anything else.

Because the problem with stack switching is the corruption of the high 16 bits of ESP, a Windows application with 16:32 code must make sure that it sets the high 16 bits of ESP when it is switching to the USE32 stack selector. It sets these bits by placing the selector into the SS register, as shown in the following example:

```
mov    ss,word ptr [Use32StackSel]
mov    esp,dword ptr [Use32StackOffset]

mov    ss,word ptr [Use32StackSel]
movzx  esp,word ptr [Use32StackOffset]

mov    ss,word ptr [Use32StackSel]
movzx  esp,sp
```

Interrupt-Time Code

A 32-bit code segment in a Windows application must not contain code that is executed at interrupt time. Also, it must not contain data that is accessed at interrupt time. Any code executed at interrupt time must be in a USE16 code segment. The code must use a USE16 stack. Data used at interrupt time must be USE16 data. This rule also applies to processor exceptions (such as the coprocessor exception) because they are handled as interrupts are handled. Note, however, that it is acceptable for a 32-bit code segment to access data in a USE16 data segment.

Programming Languages

The helper segment has to perform very low-level tasks to manage transitions between USE16 and USE32 stacks and between USE16 and USE32 code. For this reason, it is difficult to use a high-level language such as C to write the helper segment code. Even if you write the helper segment in C, you must add assembly-language support for the more difficult tasks. In most cases, it is easier and more efficient to write the entire helper segment in assembly language.

Using 32-Bit Memory in a Windows Application

There are three common uses for 32-bit memory in a Windows application. In increasing order of complexity, they are:

- Using 32-bit data objects in 16-bit code
- Using 32-bit code and data in a subroutine library
- Using 32-bit code and data for the main program

The remaining topics in this section briefly describe these uses.

Using 32-Bit Data Objects

The simplest use of 32-bit memory is to store data that is used exclusively by USE16 code segments. In this case, the application does not require a dedicated helper segment because it contains no USE32 code segments. Instead, each of its code segments performs the necessary tasks of allocating, reallocating, and freeing the 32-bit memory. If data from the 32-bit memory is to be passed to Windows functions or other 16-bit functions, the application calls the **Global16PointerAlloc** function so that the application's USE16 code segment can perform the aliasing of 32-bit pointers to the 16-bit pointers.

Using 32-Bit Code and Data in a Subroutine Library

Using 32-bit segments for code and data can simplify porting an application from a 32-bit platform to the Windows environment when portions of the application can be isolated as a subroutine library. This subroutine library serves as a low-level engine but does not call Windows or MS-DOS functions.

As when the 32-bit memory is used exclusively for data storage, the USE16 code segment retains control of the program. Typically, the USE16 segment allocates the 32-bit memory, creating one or more objects for code and data. In addition to the data-management tasks described in Considerations for Using 32-Bit Memory, the USE16 segment also loads the subroutine code into one of the 32-bit segments, fixes up the pointers in the code as required, and creates a code-segment alias to permit the code to be executed. The USE16 code segment is responsible for maintaining control of the program flow, calling into the USE32 code segment when it requires the low-level services of the subroutine library.

Using 32-Bit Code and Data for the Main Program

The most complex use of 32-bit memory involves placing the primary control of the program in a 32-bit code segment. In this type of application, the USE16 segment is reduced to helper status exclusively. During initialization, the USE16 segment allocates the 32-bit memory for code and data, loads the code into the USE32 segment, creates a code-segment alias for the USE32 segment, and then calls the main entry point in the USE32 segment.

From then on, the USE32 segment takes control of the program, calling into the USE16 helper segment only when the application needs to call Windows or MS-DOS functions. The USE32 segment continues to control the flow of the program until the application is ready to close. Only then does it return control to the USE16 segment so the USE16 segment can free the 32-bit memory and perform other cleanup tasks before the application quits.

Error Values

This section describes error values returned by the functions that applications can use for 32-bit memory management. Most of these functions return zero to indicate success. The following table describes each error value:

Value	Meaning
WM32_Insufficient_Mem	Insufficient memory. There is not enough memory to satisfy the requested allocation or reallocation.
WM32_Insufficient_Sels	Selector not available. There is not enough room in the descriptor table(s) to allocate the required selector(s). It may be necessary to advise the user to close other Windows applications.
WM32_Invalid_Arg	Invalid parameter. One of the parameters was invalid. For example, a size

	parameter might be out of range.
WM32_Invalid_Flags	Invalid flag. The *wFlags* parameter contained at least one invalid bit setting. The *wFlags* parameter currently is not used and must be set to zero.
WM32_Invalid_Func	Invalid function. The current Windows mode does not support this function. Windows supports the 32-bit memory functions only in 386 enhanced mode.

WM32_Insufficient_Mem

Insufficient memory. There is not enough memory to satisfy the requested allocation or reallocation.

WM32_Insufficient_Sels

Selector not available. There is not enough room in the descriptor table(s) to allocate the required selector(s). It may be necessary to advise the user to close other Windows applications.

WM32_Invalid_Arg

Invalid parameter. One of the parameters was invalid. For example, a size parameter might be out of range.

WM32_Invalid_Flags

Invalid flag. The *wFlags* parameter contained at least one invalid bit setting. The *wFlags* parameter currently is not used and must be set to zero.

WM32_Invalid_Func

Invalid function. The current Windows mode does not support this function. Windows supports the 32-bit memory functions only in 386 enhanced mode.

Screen Saver Library

The Microsoft Windows operating system provides special applications called screen savers that start when the mouse and keyboard have been idle for a period of time. Screen savers exist for two main reasons:

- To avoid phosphor burn caused by static images on a screen
- To conceal sensitive information left on a screen

Clearing a screen addresses both goals, but screen savers are not restricted to this simple use. They can also display animated sequences such as a fish tank or fireworks. Animated sequences avoid phosphor burn by continually changing the image.

Windows provides a screen saver application that monitors the mouse and keyboard and starts the screen saver after a period of inactivity. The Desktop section of Windows Control Panel makes it possible for users to select from a series of screen savers, specify how much time should elapse before the screen saver is started, configure screen savers, and preview screen savers.

This topic describes how to create a custom screen saver and add it to the library of screen savers users can select by using Control Panel.

About Screen Savers

Screen savers are Windows applications that contain specific variable declarations, exported functions, and resource definitions. The static-link library SCRNSAVE.LIB contains the **WinMain** function and other startup code required for a screen saver. To create a screen saver, you create a source module containing specific function and variable definitions and link it with SCRNSAVE.LIB. Your screen saver module is responsible only for configuring itself and for providing visual effects.

Screen savers are loaded automatically when Windows starts or when a user activates the screen saver feature by using Control Panel. Windows monitors keystrokes and mouse movements and starts the screen saver after a period of inactivity specified by the user.

Windows does not start the screen saver if any of the following conditions exists:

- The active application is not a Windows application.
- A computer-based training (CBT) window is present.
- The active application returns a nonzero value in response to the **WM_SYSCOMMAND** message sent with the SC_SCREENSAVE identifier.

When your screen saver starts, the startup code in SCRNSAVE.LIB creates a full-screen window. The window class for the screen saver window is declared as follows:

```
WNDCLASS cls;

cls.hCursor        = NULL;
cls.hIcon          = LoadIcon(hInst, MAKEINTATOM(ID_APP));
cls.lpszMenuName   = NULL;
cls.lpszClassName  = "WindowsScreenSaverClass";
cls.hbrBackground  = GetStockObject(BLACK_BRUSH);
cls.hInstance      = hInst;
cls.style          = CS_VREDRAW | CS_HREDRAW
                   | CS_SAVEBITS | CS_DBLCLKS;
cls.lpfnWndProc    = ScreenSaverProc;
cls.cbWndExtra     = 0;
cls.cbClsExtra     = 0;
```

Your source module provides the **ScreenSaverProc** window procedure. Your resource-definition file supplies the icon identified by **ID_APP**. This icon is visible only when your screen saver is run as a stand-alone application. (To be run by Control Panel, a screen saver must have the .SCR filename extension; to be run as a stand-alone application, it must have the .EXE filename extension.)

Creating a Screen Saver

The SCRNSAVE.H header file defines the function prototypes for the screen saver functions in SCRNSAVE.LIB. You must include this header file in your source module.

You must also define the **idsAppName** string. The **idsAppName** string should contain a screen saver name of the form **Screen Saver**.*Name,* where *Name* is a unique name for your screen saver. For example, a screen saver named Bouncer would include the following line in the **STRINGTABLE** statement in its resource-definition file:

```
STRINGTABLE PRELOAD
BEGIN
    idsAppName          "Screen Saver.Bouncer"
    .
    .  /* other strings */
    .
END
```

If your screen saver stores configuration information, it should use the **idsAppName** string as the application heading for the configuration block in the CONTROL.INI file. For more information about storing screen saver configuration information, see Providing a Configuration Routine.

Your application should declare the following global variables, which are defined in SCRNSAVE.LIB:

```
extern HINSTANCE hMainInstance;
extern HWND      hMainWindow;
```

The **hMainInstance** variable contains the instance handle of your application. The **hMainWindow** variable contains the window handle of the screen saver window.

Processing Screen Saver Messages

Your screen saver module must include a **ScreenSaverProc** window procedure to receive and process messages for the screen saver window. The **ScreenSaverProc** window procedure must pass unprocessed messages to the **DefScreenSaverProc** function rather than to the **DefWindowProc** function.

Your **ScreenSaverProc** window procedure can substitute its own actions for the message handling performed by **DefScreenSaverProc**.

The **ScreenSaverProc** window procedure must be exported by including it in the **EXPORTS** section of your module-definition (.DEF) file.

Providing a Configuration Routine

When the user chooses the Setup button, Windows uses the **/c** or **-c** command-line option to start the screen saver. To start the screen saver without displaying the configuration dialog box, Windows uses the **/s** or **-s** command-line option. When no command-line option is used, Windows displays the configuration dialog box, just as if **/c** had been specified.

If your screen saver supports configuration by the user, your source module must provide the following functions and dialog box resource to handle configuration:

Name	Description
ScreenSaverConfigureDialog	Dialog box procedure for a configuration dialog box.
RegisterDialogClasses	Function that registers any special or nonstandard window classes needed for a configuration dialog box.
DLG_SCRNSAVECONFIGURE	Dialog box template for a configuration dialog box.

When Windows starts your screen saver with the configuration option (**/c**), the **WinMain** function in SCRNSAVE.LIB calls the **RegisterDialogClasses** function and then displays the configuration dialog box.

Define the **ScreenSaverConfigureDialog** function as you would any dialog box procedure.

Your screen saver should save its configuration settings in the CONTROL.INI file. SCRNSAVE.LIB uses the application name stored in the **idsAppName STRINGTABLE** statement as the CONTROL.INI application heading. Your application can use the **LoadString** function to retrieve the name of the heading from CONTROL.INI and then use the **WritePrivateProfileString** and **WritePrivateProfileInt** functions to store the configuration information.

The *hInst* parameter of the **RegisterDialogClasses** function contains the instance handle for the screen saver. This is the same value contained in the **hMainInstance** global variable. If your configuration routine does not require any special window classes, your **RegisterDialogClasses** function can simply return TRUE.

Creating Module-Definition and Resource-Definition Files

Be sure to export the **ScreenSaverProc** function and, if it is present, the **ScreenSaverConfigureDialog** function. The **RegisterDialogClasses** function should not be exported.

The **DESCRIPTION** statement in your module-definition file must use the following format:

DESCRIPTION 'SCRNSAVE : *description***'**

If your screen saver includes a configuration routine, you should include a dialog box template with the **DLG_SCRNSAVECONFIGURE** identifier.

Installing New Screen Savers

Control Panel searches the Windows startup directory for files with the .SCR extension when compiling the list of available screen savers. (Screen saver applications are standard Windows executable files. Simply rename the compiled screen saver so that its extension is .SCR.)

A Sample Screen Saver

The remainder of this topic discusses the implementation of a screen saver application.

General-Purpose Declarations

Screen savers must use the string identifier **idsAppName** to identify themselves for other routines in SCRNSAVE.LIB:

```
STRINGTABLE PRELOAD
BEGIN
    idsAppName          "Screen Saver.ScreenSaverName"
    .
    .  /* other strings */
    .
END
```

The **idsAppName** string contains the name of the screen saver. The name to the right of the period is a unique name for the screen saver. The screen saver application can retrieve this string by calling the **LoadString** function.

Screen savers must also declare the following external variables:

```
HINSTANCE hMainInstance;
HWND      hMainWindow;
```

These external variables are defined in SCRNSAVE.LIB. They contain handles to the application instance and main window.

Message Handling

The following **ScreenSaverProc** function processes the **WM_CREATE**, **WM_TIMER**,

WM_DESTROY, and **WM_ERASEBKGND** messages before calling the **DefScreenSaverProc** function:

```
LONG CALLBACK ScreenSaverProc(HWND hwnd, UINT msg, WPARAM wParam,
    LPARAM lParam)
{
    RECT rc;
    static UINT cBottom;

    switch (msg) {
        case WM_CREATE:
            GetIniEntries();   /* load strings from STRINGTABLE */
            GetIniSettings();  /* load initialization settings  */

            /* Load DIB image. */

            hbmImage = LoadBitmap(hMainInstance, szDIBName);

            /* Create a timer to move the image. */

            idTimer = SetTimer(hwnd, ID_TIMER, wElapse, NULL);

            xPos = xPosInit;
            yPos = yPosInit;

            break;

        case WM_TIMER:

            if (fPause && fBottom) {
                if (++cBottom == 10) {
                    cBottom = 0;
                    fBottom = FALSE;
                }
                break;
            }

            MoveImage(hwnd);   /* move the image slightly */

            break;

        case WM_DESTROY:

            if (hbmImage)
                DeleteObject(hbmImage);
            if (idTimer == 0)
                KillTimer(hwnd, ID_TIMER);

            break;

        case WM_ERASEBKGND:
            GetClientRect(hwnd, &rc);
            FillRect((HDC) wParam, &rc,
                (HBRUSH) GetStockObject(BLACK_BRUSH));
            return 0;

        default:
```

```
            break;
    }

    return DefScreenSaverProc(hwnd, msg, wParam, lParam);
}
```

If your window procedure traps the **WM_DESTROY** message, it must use one of the following methods to properly end the screen saver:

- After processing the message, pass it to the **DefScreenSaverProc** function.
- In the **WM_DESTROY** case of the message handler, call the **PostQuitMessage** function.

Configuration Dialog Box

A screen saver uses the **ScreenSaverConfigureDialog** function to process messages sent to the configuration dialog box. (A screen saver's resource-definition file includes the dialog box template.) The configuration dialog box is displayed when the user selects the Setup button from Desktop section of Control Panel.

The **ScreenSaverConfigureDialog** function saves its configuration information in the CONTROL.INI file. This configuration information is largely specific to the screen saver and may include such settings as speed, color, number of objects, and position.

The configuration information may also include password protection. When a screen saver is password protected, the user cannot deactivate it and return to the Windows session without typing the password in a dialog box. Adding password protection to a screen saver requires three dialog boxes: one for setting or changing the password, one for typing the password after the screen saver has been activated, and one for informing the user when the password is incorrect. These dialog boxes can be defined as follows:

```
#define ID_OLDTEXT      100
#define ID_NEWTEXT      101
#define ID_AGAIN        102
#define ID_PASSWORD     103
#define ID_ETOLD        104
#define ID_ETNEW        105
#define ID_ETAGAIN      106
#define ID_ETPASSWORD   107
#define ID_ICON         108
#define ID_PASSWORDHELP 109

<>#ifdef RC_INVOKED

DLG_CHANGEPASSWORD    DIALOG       8,16,174,79
FONT 8, "MS Sans Serif"
STYLE WS_POPUP | DS_MODALFRAME | WS_CAPTION | WS_SYSMENU
CAPTION "Change Password"
BEGIN
 LTEXT "&Old Password:",        ID_OLDTEXT,  4, 3,80,14
 EDITTEXT                       ID_ETOLD,   84, 3,80,14, ES_PASSWORD
 LTEXT "&New Password:",        ID_NEWTEXT,  4,21,80,14
 EDITTEXT                       ID_ETNEW,   84,21,80,14, ES_PASSWORD
 LTEXT "&Retype New Password:", ID_AGAIN,    4,39,80,14
 EDITTEXT                       ID_ETAGAIN, 84,39,80,14, ES_PASSWORD
 DEFPUSHBUTTON "OK",            IDOK,        4,59,40,14
 PUSHBUTTON "&Help",            ID_PASSWORDHELP, 64,59,40,14
 PUSHBUTTON "Cancel",           IDCANCEL,  124,59,40,14
END
```

```
DLG_ENTERPASSWORD     DIALOG       250,175,170,96
FONT 8, "MS Sans Serif"
STYLE WS_POPUP | DS_MODALFRAME | WS_CAPTION | WS_SYSMENU
CAPTION "<name of screen saver>"
BEGIN
 LTEXT "The screen saver you are using is password protected.
     You must type the screen saver password
     to turn off the screen saver.", -1, 31,3,140,40
 LTEXT "Password:",    ID_PASSWORD,    31,45,40,14
 EDITTEXT              ID_ETPASSWORD, 71,45,80,14, ES_PASSWORD
 DEFPUSHBUTTON "OK",   IDOK,           31,66,40,14
 PUSHBUTTON "Cancel", IDCANCEL,      111,66,40,14
 ICON "",              ID_ICON,         3, 3,32,32
END

DLG_INVALIDPASSWORD DIALOG  8,16,174, 79
FONT 8, "MS Sans Serif"
STYLE WS_POPUP | DS_MODALFRAME | WS_CAPTION | WS_SYSMENU
CAPTION "<name of screen saver>"
BEGIN
 ICON "", ID_ICON,                          3, 3, 0, 0
 LTEXT "Incorrect password;\n\nCheck your screen saver password,
     and try again.", -1, 40,3,130,40
 DEFPUSHBUTTON "OK", IDOK,                 70,50,40,14
END
<>#endif
```

The preceding example wraps several long lines in the DLG_ENTERPASSWORD and DLG_INVALIDPASSWORD dialog boxes. These lines should not wrap in your resource-definition file.

The **ScreenSaverConfigureDialog** function typically processes a message from a check box that specifies whether the screen saver is password protected and a message specifying that the user has chosen the button to set the password, as shown in the following example:

```
case ID_SETPASSWORD: {
    DLGPROC fpDialog;

    if ((fpDialog = (DLGPROC) MakeProcInstance((FARPROC) DlgChangePassword,
            hMainInstance)) == NULL)
        return FALSE;
    DialogBox(hMainInstance, MAKEINTRESOURCE(DLG_CHANGEPASSWORD),
            hwndDlg, fpDialog);
    FreeProcInstance((FARPROC) fpDialog);
    SendMessage(hwndDlg, WM_NEXTDLGCTL, (WPARAM) hwndOK, 1l);
    break;
}

case ID_PASSWORDPROTECTED:
    bPassword ^= 1;
    CheckDlgButton(hwndDlg, wParam, bPassword);
    EnableWindow(hwndSetPassword, bPassword);
    break;
```

The **DlgChangePassword** function displays the DLG_CHANGEPASSWORD dialog box.

Adding Help

The configuration and password dialog boxes for screen savers typically include a Help button. Screen saver applications can check for the Help-button identifier and call the **WinHelp** function in the same

way Help is provided in other Windows applications. In addition, SCRNSAVE.LIB includes **HelpMessageFilterHookFunction**, which posts the MyHelpMessage message whenever the user presses the F1 key while using a screen saver dialog box. A screen saver can check for this message in the **ScreenSaverConfigureDialog** function, as follows:

```
switch (msg) {
    .
    . /* process messages */
    .

    default:
        if (msg==MyHelpMessage)
            DoLocalHelpFunc();
}
```

Exporting Functions

A typical module-definition file for a screen saver application might look like this:

```
NAME        BOUNCER

DESCRIPTION 'SCRNSAVE : Bounce a bitmap'

STUB        'WINSTUB.EXE'
EXETYPE     WINDOWS

CODE        MOVEABLE DISCARDABLE PRELOAD
DATA        MOVEABLE MULTIPLE PRELOAD

HEAPSIZE    1024
STACKSIZE   4096

EXPORTS
        ScreenSaverProc                 @1
        ScreenSaverConfigureDialog      @2
        DlgChangePassword               @3
        DlgGetPassword                  @4
        DlgInvalidPassword              @5
        HelpMessageFilterHookFunction   @6
```

The **ScreenSaverProc**, **ScreenSaverConfigureDialog**, **DlgChangePassword**, and **HelpMessageFilterHookFunction** functions have been discussed earlier in this topic. The screen saver module typically does not make explicit calls to the **HelpMessageFilterHookFunction**, **DlgGetPassword**, or **DlgInvalidPassword** function.

Functions

This section describes the functions that applications can use to create a screen saver.

Windows Debugging Version

The debugging version of the Microsoft Windows operating system generates diagnostic messages whenever it encounters an error that would otherwise cause the system to fail. You use the debugging version by itself or in conjunction with a debugger to debug Windows applications and dynamic-link libraries (DLLs). The debugging functions described in this appendix are not available in the retail version of the system: The API elements exist, but they have no effect. However, the retail version of Windows version 3.1 contains parameter-validation capabilities that an application can use with the Tool Helper library (TOOLHELP.DLL) to retrieve system errors and information about invalid parameters. For more information about the Tool Helper library, see **Tool Helper Library**.

The following topics discuss the use of the debugging version of the Windows:

Debugging Introduction

The debugging version of Windows consists of the executable and symbol files for the GDI, KERNEL, and USER modules. These modules are identical to those provided with standard Windows except that they contain extra code that checks for errors and then reports them.

The best way to use the debugging version of Windows is to install it on a computer you use for testing and debugging and use a second computer for development. Output from the debugging system and debugger can be directed to a debugging terminal.

Developers who write and debug applications on a single computer often place copies of the standard and debugging versions of Windows in separate directories. When they need to switch from one system to the other, they use batch files to copy the appropriate files to the Windows system directory. (Switching between systems is a good idea because the standard Windows system is faster that the debugging version--it is a better environment for compilers and editors.) You can use the installation program supplied for the Microsoft Windows Software Development Kit (SDK) to set up this two-directory system and then use the batch files D2N.BAT and N2D.BAT to switch between the debugging and standard versions of Windows.

Introduction

The Microsoft Windows System Debugging Log Application (DBWIN.EXE) allows you to see messages produced by the debugging version of Windows even if you are not using a debugging terminal or debugging application. DBWIN.EXE allows you to control the kinds of messages that are displayed and to save your preferences in the WIN.INI file. DBWIN.EXE also provides a feature that allows you to test the performance of your application during out-of-memory failures.

The Microsoft Windows Dr. Watson application detects system and application failures and can store information in a disk file. This program can help you find and fix problems in your applications. For more information about it, see Object Linking and Embedding Overview.

Logging Debugging Messages

You can log messages to the DBWIN window, to a debugging monitor, or to the device attached to the COM1 port. The Options menu allows you to change the destination of debugging messages.

Settings Command

Choosing the Settings command from the Options menu produces a dialog box that allows you to control the display of debugging messages produced by the debugging system. This dialog box contains the following check boxes:

Check box	Description
Break	Controls whether and how a message causes a break to the debugger with a stack trace.
Trace	Controls whether certain kinds of informational messages are produced.
Debugging	Controls the kind of debugging features enabled in the system. Following is a selected list of debugging options:

Option	Meaning
Validate Heap	Check the consistency of global and local heaps before every call to a memory-management function. This option affects the global heap only when it is one of the default start-up settings (that is, when it is saved by choosing the Save Settings command from the File menu). This option affects local heaps only if it is set before the application is started.
Check Free Blocks	Ensure that freed local blocks are not written into. The value 0xFB is written into free blocks and when the heap is validated, a check is performed to ensure that the blocks are still filled with this value. This option works only with local heaps. It must be used with the Validate Heap option.
Buffer Fill	Fill buffers that are passed to Windows functions with the value 0xF9. This option ensures that all of the supplied buffer is writable and helps detect overwrite problems that can occur when the buffer is too small.
Break with INT 3	Break to the debugger with an **int 3** instruction, instead of a fatal exit. This option does not display a stack back-trace.

Note: Some applications will not run when the Buffer Fill option is turned on. If the supplied buffer is smaller than the size specified in the *count* parameter of the calling function, the application data is overwritten.

Alloc Break Command

The Alloc Break command on the Options menu ensures that an application deals properly with out-of-memory conditions. This command displays a dialog box into which you can enter the module name of your application and the number of memory allocations you want to succeed before subsequent

allocations fail.

The system counts each global or local memory allocation performed by your application. When the number of allocations reaches the allocation break count, that allocation and all subsequent allocations fail. Because memory allocations made by the system fail once the break count is reached, calls to certain functions (such as **CreateWindow**, **CreateBrush**, and **SelectObject**) will fail as well. Only allocations made within the context of the application you specify are affected by the allocation break count.

The module name is limited to 8 characters. In some cases the module name may be different from the filename. (The module name is specified in the module-definition file for the application.) You cannot specify the module name of a DLL.

If you set the break count to zero, no allocation break is set, but the system counts allocations made by the specified application. You can choose the Show Count button to display the current allocation count.

You can set an allocation break before the named application is run. The allocation count is then set to zero and allocations are counted as soon as the application starts. If you run more than one instance of an application, the allocation break applies only to the most recent instance.

The allocation count is also reset to zero when you choose the Set command or the Inc & Set command. You can set an allocation break before performing an operation, to ensure that your application handles the problem effectively, and then choose Inc & Set and repeat the operation, to ensure that the next allocation failure is also handled properly.

Interpreting Debugging Messages

Windows debugging messages are the primary feature of the debugging version of Windows. These messages identify errors caused by applications and report the type of each error and the information you need to locate the error in your application.

Windows debugging messages have the following form:

FatalExit Code = *fatalexit-code*

Stack trace:
*module-name***!***segment-name***:**[*function-name***+**]*address*

.
.
.

Abort, Break or Ignore?

The *fatalexit-code* parameter identifies the type of error. For a complete set of possible error codes, see Error Values.

The stack trace consists of one or more addresses representing a chain of return addresses from the function that detected the error to the application that made the original function call.

Windows displays the "Abort, Break or Ignore?" prompt at the end of each debugging message.

The following variables are found in Windows debugging messages:

Variable	Description
fatalexit-code	Identifies the type of error (a hexadecimal value).
module-name	Specifies the name of the application or of a Windows module (such as USER, GDI, or KERNEL).
segment-name	Specifies the name of a segment in the application or module.
function-name	Specifies the name of a function in the segment.

Note: The segment and function names are available only if a symbol file (.SYM extension) exists for

the given module. Otherwise, Windows displays addresses instead of names.

The following example shows a typical debugging message:

```
FatalExit Code = 0x6040

Stack trace:
USER!_FFFE:SHOWCURSOR+0389
USER!_MSGBOX:08D7
USER!_FFFE:922D
MYAPP!_TEXT:WINMAIN+001B
MYAPP!_TEXT:__astart+0060

Abort, Break or Ignore?
```

In this example, the stack trace shows that the **ShowCursor** function in the USER module (USER.EXE) detected the error. The error type is 0x6040. This value is associated with the **ERR_BAD_HWND** constant; it means that the window handle passed to the function is not valid. The MYAPP application initially called the USER module at the address WINMAIN+001B in its _TEXT segment. A check of the application code at that location will probably reveal the error.

The "Abort, Break or Ignore?" prompt gives you the opportunity to terminate Windows, pass control to the debugger, or ignore the error. When you receive this prompt, you must type one of the following responses:

Response	Action
A	Terminates Windows, returning control to the MS-DOS prompt or to the debugger (if one was running).
B	Generates a breakpoint interrupt. If no debugger is running, this response terminates Windows as if you had typed **A**. If a debugger is running, control passes to the debugger as if you had set a breakpoint in the application. In this case, the CS:IP registers point to an **int 3** instruction. To continue execution or to enable single-stepping, you must change the IP register to the address of the next instruction.
I	Ignores the error and continues running the application that caused the error.
SPACE or NEWLINE	Directs Windows to redisplay the debugging message. This is helpful if the stack trace for the message is exceptionally long.

Note: Not all debuggers support the same type of stack trace that Windows displays. If you use the **B** response to enter a debugger that does not support stack tracing, there is no way to regenerate the trace.

Debugging API Elements

Applications can use the **DebugOutput** function to display information on either the debugging terminal or the current debugging computer. The function is especially useful for displaying the full details of calls to functions that generate debugging messages.

DebugOutput includes formatting and message-filtering features that are not available with the **OutputDebugString** function.

Debugging-system options and filters are provided in the **WINDEBUGINFO** structure. The **WINDEBUGINFO** structure has the following form:

```
typedef struct tagWINDEBUGINFO {
    UINT    flags;              /* valid WINDEBUGINFO members      */
    DWORD   dwOptions;          /* debugging options               */
    DWORD   dwFilter;           /* filter  for trace messages      */
    char    achAllocModule[8]; /* module for alloc break          */
    DWORD   dwAllocBreak;       /* allocs to succeed before break  */
    DWORD   dwAllocCount;       /* number of successful allocs     */
} WINDEBUGINFO;
```

The values in **WINDEBUGINFO** can be set and retrieved by using the **SetWinDebugInfo** and **GetWinDebugInfo** functions.

You can generate your own debugging messages by using the **FatalExit** function. This function displays a message that has the same form as a debugging message generated by Windows, using the error value supplied as its only parameter. This function is especially useful for debugging DLLs.

In general, you should remove calls to debugging functions when compiling the final version of your application or library.

WIN.INI Debugging Options

Applications use the **GetWinDebugInfo** and **SetWinDebugInfo** functions to retrieve or set debugging options or filter values at run time. To control the same options and filter values in a system-wide, persistent manner, you can use two entries in the **[WINDOWS]** section of the WIN.INI file. These entries are **DebugOptions** and **DebugFilter**. They have the following form:

[WINDOWS]
DebugOptions = *hexadecimal value*
DebugFilter = *hexadecimal value*

The setting for the **DebugOptions** entry corresponds to the values for the **dwOptions** member of the **WINDEBUGINFO** structure. The setting for the **DebugFilter** entry corresponds to the values for the **dwFilter** member of **WINDEBUGINFO**. To determine the proper hexadecimal value for a setting, add the values of the options to be set. For example, to specify **DBO_CHECKHEAP** and DBO_FREEFILL, the setting for the **DebugOptions** entry would be 0x0021 (0x0001 + 0x0020). For information about the possible values for these options and a full description of the **WINDEBUGINFO** structure, see the *Microsoft Windows Programmer's Reference, Volume 3.*

Error Values

The following table gives the possible error values in a Windows debugging message:

Value	Constant	Meaning
0x0001	ERR_GALLOC	**GlobalAlloc** failed. This error value is sent by KERNEL.
0x0002	ERR_GREALLOC	**GlobalReAlloc** failed. This error value is sent by KERNEL.
0x0003	ERR_GLOCK	**GlobalLock** failed. This error value is sent by KERNEL.
0x0004	ERR_LALLOC	**LocalAlloc** failed. This error value is sent by KERNEL.
0x0005	ERR_LREALLOC	**LocalReAlloc** failed. This error value is sent by KERNEL.
0x0006	ERR_LLOCK	**LocalLock** failed. This error value is sent by KERNEL.
0x0007	ERR_ALLOCRES	**AllocResource** failed. This error value is sent by KERNEL.
0x0008	ERR_LOCKRES	**LockResource** failed. This error value is sent by KERNEL.
0x0009	ERR_LOADMODULE	**LoadModule** failed. This error value is sent by KERNEL.
0x0040	ERR_CREATEDLG	Dialog box could not be created because **LoadMenu** failed. This error value is sent by USER.
0x0041	ERR_CREATEDLG2	Dialog box could not be created because **CreateWindow** failed. This error value is sent by USER.
0x0042	ERR_REGISTERCLASS	**RegisterClass** failed because the class is already registered. This error value is sent by USER.
0x0043	ERR_DCBUSY	Device-context cache is full. This error value is sent by USER.
0x0044	ERR_CREATEWND	Window could not be created because the class was not found. This error value is sent by USER.
0x0045	ERR_STRUCEXTRA	Program is using unallocated space. This error value is sent by USER.
0x0046	ERR_LOADSTR	**LoadString** failed. This error value is sent by USER.
0x0047	ERR_LOADMENU	**LoadMenu** failed. This error value is sent by USER.
0x0048	ERR_NESTEDBEGINPAINT	Program contains nested **BeginPaint** functions. This error value is sent by USER.
0x0049	ERR_BADINDEX	Index to **GetClassLong**, **GetClassWord**, **GetWindowLong**, **GetWindowWord**, **SetClassLong**, **SetClassWord**, **SetWindowLong**, or **SetWindowWord** is invalid. This error value is sent by USER.
0x004A	ERR_CREATEMENU	Menu could not be created. This error value is sent by USER.
0x0080	ERR_CREATEDC	**CreateCompatibleDC**, **CreateDC**, or **CreateIC** failed. This error value is sent by GDI.
0x0081	ERR_CREATEMETA	**CreateMetaFile** failed. This error value is sent by GDI.
0x0082	ERR_DELOBJSELECTED	Program is trying to delete a bitmap that is selected into the device context. This error value is sent by GDI.

0x0083	ERR_SELBITMAP	Program is trying to select a bitmap that is already selected. This error value is sent by GDI.
0x6001	ERR_BAD_VALUE	A 16-bit signed or unsigned value is invalid.
0x6002	ERR_BAD_FLAGS	One or more bit flags are invalid.
0x6003	ERR_BAD_INDEX	Index is invalid or out of range.
0x6009	ERR_BAD_SELECTOR	Selector is invalid.
0x600B	ERR_BAD_HANDLE	Generic handle is invalid.
0x6020	ERR_BAD_HINSTANCE	Instance handle is invalid. This error value is sent by KERNEL.
0x6021	ERR_BAD_HMODULE	Module handle is invalid. This error value is sent by KERNEL.
0x6022	ERR_BAD_GLOBAL_HANDLE	Global handle is invalid. This error value is sent by KERNEL.
0x6023	ERR_BAD_LOCAL_HANDLE	Local handle is invalid. This error value is sent by KERNEL.
0x6024	ERR_BAD_ATOM	Atom is invalid. This error value is sent by KERNEL.
0x6025	ERR_BAD_HFILE	File handle is invalid. This error value is sent by KERNEL.
0x6040	ERR_BAD_HWND	Window handle is invalid. This error value is sent by USER.
0x6041	ERR_BAD_HMENU	Menu handle is invalid. This error value is sent by USER.
0x6042	ERR_BAD_HCURSOR	Cursor handle is invalid. This error value is sent by USER.
0x6043	ERR_BAD_HICON	Icon handle is invalid. This error value is sent by USER.
0x6044	ERR_BAD_HDWP	Handle to a window-position structure is invalid. This error value is sent by USER.
0x6045	ERR_BAD_CID	Communications identifier (CID) is invalid. This error value is sent by USER.
0x6046	ERR_BAD_HDRVR	Installable-driver handle is invalid. This error value is sent by USER.
0x6061	ERR_BAD_GDI_OBJECT	GDI object is invalid. This error value is sent by GDI.
0x6062	ERR_BAD_HDC	Device-context handle is invalid. This error value is sent by GDI.
0x6063	ERR_BAD_HPEN	Pen handle is invalid. This error value is sent by GDI.
0x6064	ERR_BAD_HFONT	Font handle is invalid. This error value is sent by GDI.
0x6065	ERR_BAD_HBRUSH	Brush handle is invalid. This error value is sent by GDI.
0x6066	ERR_BAD_HBITMAP	Bitmap handle is invalid. This error value is sent by GDI.
0x6067	ERR_BAD_HRGN	Region handle is invalid. This error value is sent by GDI.
0x6068	ERR_BAD_HPALETTE	Palette handle is invalid. This error value is sent by GDI.
0x6069	ERR_BAD_HMETAFILE	Metafile handle is invalid. This error value is sent by GDI.
0x7004	ERR_BAD_DVALUE	A 32-bit signed or unsigned value is invalid.
0x7005	ERR_BAD_DFLAGS	One or more 32-bit flags are invalid.
0x7006	ERR_BAD_DINDEX	A 32-bit index is invalid or out of range.

0x7007	ERR_BAD_PTR	Pointer is invalid.
0x7008	ERR_BAD_FUNC_PTR	Function pointer is invalid.
0x700A	ERR_BAD_STRING_PTR	Zero-terminated string pointer is invalid.
0x7060	ERR_BAD_COORDS	X- and y-coordinates are invalid. This error value is sent by GDI.

The following error values may have been combined with other values in the preceding table to identify the type of error:

Value	Constant	Meaning
0x4000	ERR_PARAM	Parameter is invalid. This flag is always set for parameter-validation error messages.
0x8000	ERR_WARNING	Nonfatal error occurred. An invalid parameter was detected, but the error was not serious enough to cause the function to fail. The invalid parameter is reported, but the function executes as usual.

To determine the size of an invalid parameter, you can combine **ERR_SIZE_MASK** (0x3000) with other error values by using the AND operator. The following table gives the possible results of this operation:

Value	Constant	Meaning
0x1000	ERR_BYTE	An 8-bit parameter is invalid.
0x2000	ERR_WORD	A 16-bit parameter is invalid.
0x3000	ERR_DWORD	A 32-bit parameter is invalid.

Debugging Messages

The following table gives the strings that are displayed as Windows debugging messages:

Activation failed: system modal window is present
: Windows may not be activated by another application while a system modal window is present. This warning message is sent by the USER module.

Alloc break: Failing allocation
: All further memory allocations will fail; this supports the Alloc Break debugging setting. This error message is sent by the KERNEL module.

AllocResource failed
: The **AllocResource** function failed, probably due to insufficient memory. This warning message is sent by the KERNEL module.

App not initialized
: A function was called before the application was properly initialized. This error message is sent by the USER module.

application-name Automatic Data Segment larger than 64K.
: The application's automatic data segment, combined with the heap and stack, must be less than 64K. This error message is sent by the KERNEL module.

application-name Compacting heap, discarding segments
: An application has specified a negative value in a call to the **GlobalCompact** function, forcing the system to free all of the code segments that have been loaded from disk. Instead, applications should simply allocate any needed memory and allow the system to compact memory as required. This trace message is sent by the KERNEL module to help applications optimize memory management.

application-name failed implicit link to *module-name*
: When an application calls the address specified by this warning, the system forces a call to the **FatalAppExit** function. This warning occurs when the application starts. An application will sometimes call the specified address after verifying that all entry points are valid. (For example, an application might verify the Windows version before calling functions that exist only in Windows 3.1.) This warning message is sent by the KERNEL module.

application-name: reading resource *value1 value2*
: The system is reading resources from disk. This trace message is sent by the KERNEL module to help applications optimize loading and execution.

Attempt to activate destroyed window
: A window was activated during processing of the **WM_DESTROY** or **WM_NCDESTROY** message. No active window is produced. This error message is sent by the USER module.

Attempt to delete object still selected in SaveDC stack
: An application attempted to delete an object that was still in use because of an earlier call to the **SaveDC** function. Deleting an object that is still saved can cause the system to crash. Applications must call the **RestoreDC** function and select the object out of the device context before deleting the object. This error message is sent by the GDI module.

Bad GWW_/GWL_/GCW_ index value
: An invalid negative index was used in a call to the **GetWindowWord**, **SetWindowWord**, **GetClassWord**, or **SetClassWord** function. This warning can occur in the retail version of Windows. The **LogError** constant is ERR_BADINDEX. This warning message is sent by the USER module.

Beginning app termination cleanup...
: The system application-termination routine has begun. This trace message is sent by the USER module.

BOOT: unable to load *filename*
: A startup error occurred. This error message is sent by the KERNEL module.

BS_USERBUTTON no longer supported

The BS_USERBUTTON style is no longer supported in Windows 3.1. Use **BS_OWNERDRAW** instead. This warning message is sent by the USER module.

Can't change WS_EX_TOPMOST with SetWindowLong
: An attempt was made to change the **WS_EX_TOPMOST** style by using the **SetWindowLong** function. The style bit is not changed. Use the **SetWindowPos** function's **HWND_TOPMOST** or **HWND_NOTOPMOST** values to change this flag. This error message is sent by the USER module.

Can't find *filename*
: A startup error occurred. This error message is sent by the KERNEL module.

Can't load segment.
: A disk or link error occurred. This error message is sent by the KERNEL module.

Can't post system error dialog: app not initialized
: A system error occurred before an application was initialized. This sometimes happens because of an error during the initialization of a DLL. This warning message is sent by the USER module.

Clipboard already open
: The **OpenClipboard** function was called when the clipboard was already open. This error message is sent by the USER module.

CreateDialog() failed: couldn't create control
: The creation of a dialog box from a dialog-box template failed because a control could not be created. This warning can occur in the retail version of Windows. The **LogError** constant is ERR_CREATEDLG. This warning message is sent by the USER module.

CreateDialog() failed: couldn't create window
: The creation of a dialog box from a dialog-box template failed because the dialog box could not be created. This warning can occur in the retail version of Windows. The **LogError** constant is ERR_CREATEDLG2. This warning message is sent by the USER module.

CreateDialog() failed: couldn't load menu
: The creation of a dialog box from a dialog-box template failed because the menu resource in the template could not be created. This warning can occur in the retail version of Windows. The **LogError** constant is ERR_CREATEDLG. This warning message is sent by the USER module.

CreateMenu failed
: The **CreateMenu** function failed because of a memory shortage. This warning can occur in the retail version of Windows. The **LogError** constant is ERR_CREATEMENU. This warning message is sent by the USER module.

CreateWindow failed: Out of memory
: The **CreateWindow** function failed because of a memory shortage. This warning can occur in the retail version of Windows. The **LogError** constant is ERR_CREATEWND. This warning message is sent by the USER module.

CreateWindow failed: Window class not found
: The **CreateWindow** function was called with a nonexistent window class name. This error can occur in the retail version of Windows. The **LogError** constant is ERR_CREATEWND. This error message is sent by the USER module.

CreateWindow(): Invalid parent hwnd
: A child window was created without a valid parent window handle. This error can occur in the retail version of Windows. The **LogError** constant is ERR_CREATEWND. This error message is sent by the USER module.

CreateWindow(): NULL instance handle
: The **CreateWindow** function was called with a NULL instance handle. This error can occur in the retail version of Windows. The **LogError** constant is ERR_CREATEWND. This error message is sent by the USER module.

CreateWindow: Out of memory
: The **WM_NCCREATE** message returned FALSE, preventing the window from being destroyed. This warning message is sent by the USER module.

Data Segment *N* of *module-name* can't be discardable

Certain segments of an application or DLL must be preloaded. If an application sets the switch incorrectly, the system corrects the setting. However, the application will load faster if it sets the switch properly. The following segments must be preloaded: **DATA** segments, **FIXED CODE** segments, and **CODE** segments that are **MOVEABLE** but not **DISCARDABLE**. This warning message is sent by the KERNEL module.

DC Cache full: Too many GetDC() calls

More than five nested calls to the **GetDC** function were made without subsequent calls to the **ReleaseDC** function. This situation can cause system deadlock; device contexts must be released before further calls to **GetDC**. This error can occur in the retail version of Windows. The **LogError** constant is ERR_DCBUSY. This error message is sent by the USER module.

DecExeUsage(*application-name*) not DLL

A low-memory situation can cause this error. This error message is sent by the KERNEL module.

Default Data Segment of *module-name* must be preload

Certain segments of an application or DLL must be preloaded. If an application sets the switch incorrectly, the system corrects the setting. However, the application will load faster if it sets the switch properly. The following segments must be preloaded: **DATA** segments, **FIXED CODE** segments, and **CODE** segments that are **MOVEABLE** but not **DISCARDABLE**. This warning message is sent by the KERNEL module.

DeferWindowPos: All windows must share same parent

All windows positioned by using the **DeferWindowPos** function must be siblings. This error message is sent by the USER module.

DefMDIChildProc called on a non-MDIChild window

The **DefMDIChildProc** function was called with a window that is not a proper MDI child window. This error message is sent by the USER module.

Demand load *module-name*(*N*) on *application-name*

The system is demand-loading the specified segment of the specified module. If an application loads many segments when starting, the application should probably add these segments to the FastLoad block. (To add a segment to the FastLoad block, give the segment the **PRELOAD** attribute.) This change does not affect total memory requirements. If there is not enough memory to load all the **PRELOAD** segments, they won't be preloaded. This trace message is sent by the KERNEL module to help applications optimize loading and execution.

DestroyCursor: Destroying current cursor

The **DestroyCursor** function was called with the currently-selected cursor. The arrow cursor was selected in its place. This error message is sent by the USER module.

DestroyWindow: hwnd not created by the current task

The **DestroyWindow** function was called with a window created by another application. An application cannot destroy windows created by other applications. This error message is sent by the USER module.

DestroyWindow: System menu handle no longer valid

A window's system menu window was destroyed. Normally, applications should never destroy the system menu handle; this handle is automatically destroyed when the window is destroyed. This warning message is sent by the USER module.

DestroyWindow: Unremoved window property

A window was destroyed without removing all of its properties. Properties should be removed before the window is destroyed or during the processing of the **WM_DESTROY** message. This warning message is sent by the USER module.

DestroyWindow: Window menu no longer valid

A window menu was destroyed without clearing the handle by calling the **SetMenu** function with NULL as the second parameter. The menu associated with a window is destroyed when the window is destroyed. If you destroy the menu separately, always use **SetMenu** to clear the handle. This warning message is sent by the USER module.

Dialog class registered with cbWndExtra < DLGWINDOWEXTRA

The **DefDlgProc** function was called with a window whose class was not registered with the proper value for the **cbWndExtra** member of the **WNDCLASS** structure. Windows, when used with the dialog manager, must use the DLGWINDOWEXTRA constant for this member. This error message is sent by the USER module.

Dialog control id not found

An invalid dialog-control identifier was passed to one of the dialog-box functions that take a dialog-box handle and control identifier (for example, the **SetDlgItemText** function). This warning message is sent by the USER module.

Dialog should be dismissed with EndDialog, not DestroyWindow

The dialog window was destroyed during the processing loop for dialog messages. The **EndDialog** function should be used instead. This error message is sent by the USER module.

Dialog window destroyed in dialog callback

The dialog window was destroyed by the dialog function. The **EndDialog** function should be used to destroy a dialog window. This error message is sent by the USER module.

Dialog window owner destroyed while dialog still valid

The owner of a dialog box window was destroyed before the dialog box was destroyed. This can be avoided by calling the **SetWindowWord** function with **GWW_HWNDPARENT** set to NULL. This warning message is sent by the USER module.

Discardable temp buffer busy

An internal error has corrupted the internal state of GDI. (This error should never occur.) This error message is sent by the GDI module.

Divide by zero or divide overflow error: break and trace till IRET

A divide-by-zero or divide-overflow fault has occurred. To find the fault, trace with your debugger to the **IRET** instruction: one more trace will take you to the instruction that caused the error. This fatal error message is sent by the USER module.

DlgDirList: id not a list box or combo box

The **DlgDirList** function was called with a control identifier specifying a control other than a list-box or combo-box class window. This error message is sent by the USER module.

DlgDirList: list box or combo box id not found

The **DlgDirList** function was called with a control identifier specifying a nonexistent control. This error message is sent by the USER module.

Edit SetText: 3.0 compat AnsiUpper being done on source text

The application is using the **AnsiUpper** function unnecessarily. For single-line edit controls with the **ES_UPPERCASE** style, the string that is passed to **WM_SETTEXT** and other messages is not typically modified by edit control code, but is converted to uppercase internally. This corresponds to the WIN.INI [Compatibility] section, value 0x0080. This error message is sent by the USER module.

End of app termination cleanup

The system-application termination routine has finished. This trace message is sent by the USER module.

Error reading relocation records from *module-name*

I/O error loading a segment. This error message is sent by the KERNEL module.

Error *value* loading *filename*

The **LoadModule** function failed. The message displays the **LoadModule** return value and the name of the file being loaded. This warning message is sent by the KERNEL module.

ES_READONLY not supported in 3.0 edit ctls: use EM_SETREADONLY

The **ES_READONLY** edit control style was specified by a 3.0 application. Use **EM_SETREADONLY** instead. This error message is sent by the USER module.

Exiting menu mode: another window activated

A menu was canceled because another window in the system was being activated. This warning can occur if a dialog box or message box is brought up while a menu is displayed. This warning message is sent by the USER module.

FastLoad area ignored due to incorrect segment flags

If the system must change the **PRELOAD** flag of a segment, it invalidates the FastLoad block and the application is loaded relatively slowly. This warning message is sent by the KERNEL module.

Fault detected - handled by *module-name segment:offset*

A general-protection fault occurred in a **WEP** (Windows exit procedure). The system continues operations with the next step. This error message is sent by the KERNEL module.

Fault in SegReloc *value1 value2*

A disk or link error occurred. This error message is sent by the KERNEL module.

GDI: %s not deleted: %04X

An application has neglected to delete certain GDI objects upon termination. These objects are not deleted by GDI; in order to avoid using up system resources, an application must delete all GDI objects that it creates. This message can also occur with certain objects that an application uses that were created by a DLL. When a DLL creates an object to share among multiple applications, this message may result when the first application that uses the DLL terminates, even though the object should not be deleted at that time. This warning message is sent by the GDI module.

GDI: Attempt to delete object owned by system

An application attempted to delete an object that is owned by the system. For example, this error occurs when a window class brush is deleted by the application after the class has been registered. This error also occurs when an application reuses a deleted object handle. This error message is sent by the GDI module.

GDI: DeleteObject:%s(%04X) selection count incorrect

The internal state of GDI has been corrupted and the system may be in an unstable state. This warning can occur because of writing through uninitialized pointers or other programming errors and is usually a symptom of a more serious problem elsewhere. This warning message is sent by the GDI module.

GDI: DeleteObject:%s(%04X) still selected in DC(s)

An application attempted to delete an object that was still selected in a device context. Applications must always deselect objects before deleting them. If an application deletes an object that is selected into a device context and then attempts to draw in the device context, the system may be left in an indeterminate state. This warning message is sent by the GDI module.

GDI: Unable to deselect %04X

The internal state of GDI has been corrupted and the system may be in an unstable state. This warning can occur because of writing through uninitialized pointers or other programming errors and is usually a symptom of a more serious problem elsewhere. This warning message is sent by the GDI module.

Get file offset failed

A disk or link error occurred. This error message is sent by the KERNEL module.

GetAtomName(*0xNNNN,*...) Can't find atom

An atom was not found in a call to the **GetAtomName** function. This warning message is sent by the KERNEL module.

GetDC without ReleaseDC

A window was destroyed before calling the **ReleaseDC** function. This error message is sent by the USER module.

GetDCEx: Can't find permanent DC

The **GetDCEx** function was called for a window that does not have the **CS_OWNDC** or **CS_CLASSDC** style without setting the **DCX_CACHE** flag. This warning message is sent by the USER module.

GetMenu: Window menu no longer valid

A window's menu was previously destroyed, and the menu returned by the **GetMenu** function is no longer valid. If a window menu is destroyed, the **SetMenu** function should be called with the second parameter set to NULL to clear the handle stored in the window. This warning message is sent by the USER module.

GetNextDriver: Invalid starting driver handle

The **GetNextDriver** function was called with an invalid driver handle. This error message is sent by the USER module.

Global class freed with existent class windows!
A global class registered by a DLL is being freed while windows of that class still exist. This serious error is usually caused by the incorrect termination of an application's DLL. This error message is sent by the USER module.

GlobalAlloc failed
The **GlobalAlloc** function failed, probably due to insufficient memory. This warning message is sent by the KERNEL module.

GlobalAlloc(*0xNNNNNNN*) failed for *application-name*
A call to the **GlobalAlloc** function failed. This typically happens because the requested memory is too large. This trace message is sent by the KERNEL module to help applications optimize memory management.

GlobalReAlloc failed
The **GlobalReAlloc** function failed, probably due to insufficient memory. This warning message is sent by the KERNEL module.

GlobalWire(*N* of *module-name*) (try GlobalLock)
Applications should generally use the **GlobalLock** function to lock memory instead of the **GlobalWire** function. **GlobalWire** should not be used in Windows 3.1. This warning message is sent by the KERNEL module.

GP fault in _hread/_hwrite at *value1 value2*
A general-protection fault occurred while reading or writing a huge file. This is a user error. This error message is sent by the KERNEL module.

GP fault in LStrNCpy
A general-protection fault occurred when copying a string. This error message is sent by the KERNEL module.

greserve doesn't fit
Memory is low. This error message is sent by the KERNEL module.

greserve: *0xNNNNNN* bytes
Memory has been reserved by the system for discardable segments. This trace message is sent by the KERNEL module to help applications optimize memory management.

GrowHeap: *0xNNNNNN* allocated
Memory has been allocated from a **DPMI** server (Win386 or DOS*X*). This trace message is sent by the KERNEL module to help applications optimize memory management.

hMemCopy: Copy past end of segment
A general-protection fault occurred while copying a huge memory block. This is a user error. This error message is sent by the KERNEL module.

Hook Not Allowed
An application attempted to install a task-specific hook when only a system hook was allowed, such as **WH_JOURNALRECORD**, **WH_JOURNALPLAYBACK**, or WH_SYSMSGFILTER. This error message is sent by the USER module.

IncExeUsage(*application-name*) not DLL
A low-memory situation can cause this error. This error message is sent by the KERNEL module.

IncExeUsage: ne_usage overflow
An internal error occurred. This fatal error message is sent by the KERNEL module.

Intertask SendMessage() during app termination
An inter-application call to the **SendMessage** function occurred during application termination. Usually this means that an application failed to destroy all of its windows before terminating. This warning message is sent by the USER module.

Intertask SendMessage() not allowed: Tasks locked
An inter-application call to the **SendMessage** function was attempted while a system modal dialog box was displayed, or the system has locked all but the current task. Using **SendMessage** to send

messages to other applications is not allowed while a system modal dialog box is displayed. This error message is sent by the USER module.

Intertask SendMessage: Sleeping since unreplied SendMessage pending
An application attempted to send a message to another application before the second application processed an earlier inter-application call to the **SendMessage** function. This warning indicates that there may be a hung application in the system. This warning message is sent by the USER module.

Invalid button style
An invalid button class style was supplied. This error message is sent by the USER module.

Invalid clipboard metafile
An invalid metafile handle was placed in the clipboard by using the **SetClipboardData** function. This error message is sent by the USER module.

Invalid color index.
An invalid color index was specified in a call to the **SetSysColors** function. This error message is sent by the USER module.

Invalid driver entry proc address
An installable driver entry procedure was not declared with the **PASCAL** keyword or was otherwise improperly implemented. The driver will not be installed. This error message is sent by the USER module.

Invalid EXE file *filename*
A startup error occurred. This error message is sent by the KERNEL module.

Invalid function called: System state potentially trashed
The edit control window procedure is being called by an application. Applications should always use the **CallWindowProc** function and the previous window procedure address returned either from a call to the **GetClassInfo** function or a call to the **GetWindowLong** function using the **GWL_WNDPROC** constant. This error message is sent by the USER module.

Invalid HBRUSH returned by WM_CTLCOLOR message
An invalid brush handle was returned by the **WM_CTLCOLOR** message. This error message is sent by the USER module.

Invalid Hook Code
An invalid negative hook code value was passed to the **DefHookProc** or **DefHookProcEx** function. This error message is sent by the USER module.

Invalid Hook Handle
An invalid hook handle was passed to the **DefHookProcEx** or **UnhookWindowsHookEx** function. This error message is sent by the USER module.

Invalid Hook ID
An invalid hook identifier was passed to the **SetWindowsHook** or **SetWindowsHookEx** function. This error message is sent by the USER module.

Invalid Hook Instance
An invalid hook instance handle was passed to the **SetWindowsHookEx** function. This error message is sent by the USER module.

Invalid Hook Proc Addr
The hook function address specified in a call to the **SetWindowsHook** function is invalid. This error message is sent by the USER module.

Invalid ordinal reference (#*NNN*) to *application-name*
When an application calls the address specified by this warning, the system forces a call to the **FatalAppExit** function. This warning occurs when the application starts. An application will sometimes call the specified address after verifying that all entry points are valid. (For example, an application might verify the Windows version before calling functions that exist only in Windows 3.1.) This warning message is sent by the KERNEL module.

Invalid protect mode EXE file *filename*
A startup error occurred. This error message is sent by the KERNEL module.

Invalid segment in fixup.

A disk or link error occurred. This error message is sent by the KERNEL module.

Invalid ShowWindow command

An invalid command was specified in a call to the **ShowWindow** function. This error message is sent by the USER module.

Invalid size for DRIVERINFOSTRUCT

The **length** member of the **DRIVERINFOSTRUCT** structure was not properly initialized when the structure was passed to the **GetDriverInfo** function. This member should be set to the size of the **DRIVERINFOSTRUCT** structure. This error message is sent by the USER module.

Invalid SPI_* parameter

The **SystemParametersInfo** function was called with an invalid *uAction* parameter. This error message is sent by the USER module.

Invalid task handle

An invalid task handle was passed to the **SetWindowsHookEx** function. This error message is sent by the USER module.

Invalidation with fErase==FALSE prevents WM_ERASEBKGND

In Windows 3.1, a call to the **InvalidateRect** function does not prevent pending **WM_ERASEBKGND** messages from being sent. In Windows 3.0, if **InvalidateRect** was called with the *lprc* parameter equal to NULL and the *fErase* parameter equal to FALSE, any pending WM_ERASEBKGND messages were validated and were not sent. This warning message is sent by the USER module.

KReboot: Trying to look up *application-name*

The system disables the local reboot capability for known modules. This informational trace message is sent by the KERNEL module.

Loading *filename*

The name of the application, DLL, or driver is now being loaded. This informational trace message is sent by the KERNEL module.

Loading *module-name* Nonresident name table

The system loads the nonresident-name table when an application specifies a name in a call to the **GetProcAddress** function and the DLL does not have the name in the resident-name table. When a name is not in the resident-name table, it is either in the nonresident-name table or the name does not exist. This message demonstrates the performance decrease that occurs whenever the nonresident-name table is loaded. This trace message is sent by the KERNEL module to help applications optimize loading and execution.

LoadString() failed

The **LoadString** function failed because a resource could not be found. This warning can occur in the retail version of Windows. The **LogError** constant is ERR_LOADSTR. This warning message is sent by the USER module.

Local free memory overwritten at *segment:offset*

The local heap has been corrupted. This fatal error message is sent by the KERNEL module.

LocalAlloc failed

The **LocalAlloc** function failed, probably due to insufficient memory. This warning message is sent by the KERNEL module.

LocalLock failed

The **LocalLock** function failed, probably due to an invalid handle or a corrupted heap. This warning message is sent by the KERNEL module.

LocalReAlloc failed

The **LocalReAlloc** function failed, probably due to insufficient memory. This warning message is sent by the KERNEL module.

LockInput called with input already unlocked

The **LockInput** function was called to unlock input when the input was already unlocked. This error message is sent by the USER module.

LockInput() called when already locked

The **LockInput** function was called when the input was already locked by a previous call to **LockInput**. This error message is sent by the USER module.

LockResource failed

The **LockResource** function failed, probably due to an invalid resource handle or insufficient memory. This warning message is sent by the KERNEL module.

looking for *entry-name*

The system loads the nonresident-name table when an application specifies a name in a call to the **GetProcAddress** function and the DLL does not have the name in the resident-name table. When a name is not in the resident-name table, it is either in the nonresident-name table or the name does not exist. This message demonstrates the performance decrease that occurs whenever the nonresident-name table is loaded. This trace message is sent by the KERNEL module to help applications optimize loading and execution.

MakeProcInstance failed. Did you check return values?

A call to the **MakeProcInstance** function failed. This error message is sent by the KERNEL module.

Menu destroyed unexpectedly by WM_INITMENU

The **DestroyMenu** function was called unexpectedly during processing of the **WM_INITMENU** message. This error message is sent by the USER module.

Menu destroyed unexpectedly by WM_INITMENUPOPUP

The **DestroyMenu** function was called unexpectedly during processing of the **WM_INITMENUPOPUP** message. This error message is sent by the USER module.

MessageBox failed: app not initialized

The **MessageBox** function was called (or an error occurred) before an application was properly initialized. This error sometimes happens during the initialization of a DLL. This error message is sent by the USER module.

Metafile has incorrect size

The data contained in a metafile is invalid. This warning message is sent by the GDI module.

Metafile is not terminated properly

The data contained in a metafile is invalid. This warning message is sent by the GDI module.

Missing BeginPaint() or GetUpdateRect/Rgn(fErase == TRUE) in WM_PAINT

A **WM_PAINT** message was handled incorrectly. In order to ensure that all necessary **WM_NCPAINT** messages are sent properly, a window that processes a WM_PAINT message must call the **BeginPaint** function or call either the **GetUpdateRect** or **GetUpdateRgn** function with the *fErase* parameter equal to TRUE. This warning message is sent by the USER module.

Module Name *module-name* (*application-name*) too long

The names of application modules are limited to 8 bytes. This warning message is sent by the KERNEL module.

Module unloaded with windows still subclassed

A DLL was terminated or unloaded while a window in the system was subclassed with a function defined in that DLL. This is a serious error. In general, DLLs that contain subclassed functions must not be freed unless all windows that may have been subclassed with that function are destroyed. This error message is sent by the USER module.

module-name has invalid relocation record

A disk or link error occurred. This error message is sent by the KERNEL module.

module-name I/O error reading segment

An I/O error in loading a segment occurred. This error message is sent by the KERNEL module.

module-name MakeProcInstance only for current instance.

An application is calling the **MakeProcInstance** function incorrectly. This fatal error message is sent by the KERNEL module.

module-name segment:offset called undefined dynalink

The specified module attempted to link to a function exported by a DLL, but the system could not

find the function. The application attempted to call the entry point even though the function was not found. This fatal error message is sent by the KERNEL module.

Multiple properties removed during enumerate
: More than one window property was removed during a property-enumeration callback function; there may be improper property enumeration. Generally, only the enumerated window property may be removed during the enumeration callback function. This warning message is sent by the USER module.

MyOpenFile not reentrant
: An internal error occurred. This error message is sent by the KERNEL module.

Nested BeginPaint() calls
: The **BeginPaint** function was called a second time for a window before the **EndPaint** function was called. This warning usually occurs when an application calls a function such as **UpdateWindow** during the processing of a **WM_PAINT** message. This should be avoided because it may cause incorrect clipping regions in the device context after a call to **EndPaint**. This warning can occur in the retail version of Windows. The **LogError** constant is ERR_NESTEDBEGINPAINT. This warning message is sent by the USER module.

not enough stack space for DX array. String truncated.
: An application has called the **TextOut** or **ExtTextOut** function with a very long string (> 2048 characters); there was not enough stack space for temporary storage. This problem is typically solved by breaking the string up into shorter strings, although an application with insufficient stack space may encounter this warning with smaller strings. This warning message is sent by the GDI module.

NULL handle.
: A disk or link error occurred. This error message is sent by the KERNEL module.

NULL segment in fixup.
: A disk or link error occurred. This error message is sent by the KERNEL module.

Obsolete function ControlPanelInfo() called
: The obsolete **ControlPanelInfo** function was called. Use the **SystemParametersInfo** function instead. This error message is sent by the USER module.

Obsolete function GetInternalWindowPos() called
: The obsolete **GetInternalWindowPos** function was called. Use the **GetWindowPlacement** function instead. This error message is sent by the USER module.

Obsolete function SetDeskPattern called: use SystemParametersInfo
: The obsolete **SetDeskPattern** function was called. Use the **SystemParametersInfo** function instead. This error message is sent by the USER module.

Obsolete function SetDeskWallPaper() called
: The obsolete **SetDeskWallPaper** function was called. Use the **SystemParametersInfo** function instead. This error message is sent by the USER module.

Obsolete function SetInternalWindowPos() called
: The obsolete **SetInternalWindowPos** function was called. Use the **SetWindowPlacement** function instead. This error message is sent by the USER module.

Out of files (set FILES=30 in CONFIG.SYS) *filename*
: A startup error occurred. This error message is sent by the KERNEL module.

Out of mem loading seg *module-name*
: This internal error should never occur. This error message is sent by the KERNEL module.

Popup menu incorrectly activated by application
: The **ActivateWindow** function was called with the handle of a pop-up menu. The system will activate the owner of the pop-up window instead. This error message is sent by the USER module.

Read record failed
: A disk or link error occurred. This error message is sent by the KERNEL module.

Read *value* bytes, expecting *value.*
: A disk or link error occurred. This error message is sent by the KERNEL module.

Reentrant application termination

The system application-termination routine was reentered; that is, two applications were terminating at the same time. This situation can occur if an application is terminated by another when it is processing activation messages, during DLL **WEP** function processing or installable driver **DRV_EXITAPPLICATION** message processing. This reentrancy situation can result in timing errors that are difficult to debug. This warning message is sent by the USER module.

RegisterClass failed: class already exists

A window class was registered with a name that has already been registered. This warning can occur in the retail version of Windows. The **LogError** constant is ERR_REGISTERCLASS. This warning message is sent by the USER module.

RegisterClass failed: global class already exists

A global window class was registered with a name that already has been registered. This error message is sent by the USER module.

RegisterClass failed: out of memory

The **RegisterClass** function failed because of a memory shortage. This error message is sent by the USER module.

RegisterClass: HACK! Fixing up bogus cbWndExtra and cbClsExtra

An extra 4 bytes of window and class word space is added to all window classes created by this application. This addition fixes a serious problem in some applications using unallocated window words. This corresponds to the WIN.INI [Compatibility] section, value 0x0100. This error message is sent by the USER module.

RegisterClass: Invalid class brush

The **hbrBackground** member of the **WNDCLASS** structure is invalid. This error message is sent by the USER module.

RegisterClass: Invalid class style

The **style** member of the **WNDCLASS** structure is invalid. This error message is sent by the USER module.

RegisterClass: Invalid HINSTANCE

The **hInstance** member of the **WNDCLASS** structure was NULL or otherwise invalid. This error message is sent by the USER module.

RegisterClass: Negative cbClsExtra

The **cbClsExtra** member of the **WNDCLASS** structure contains a negative number. This error message is sent by the USER module.

RegisterClass: Negative cbWndExtra

The **cbWndExtra** member of the **WNDCLASS** structure contains a negative number. This error message is sent by the USER module.

RegisterClass: NULL window proc

The **lpfnWndProc** member of the **WNDCLASS** structure does not contain a valid function pointer. This error message is sent by the USER module.

RegisterClass: Unusually large cbClsExtra (> 40)

The **cbClsExtra** member of the **WNDCLASS** structure contains a number that is too large. This value should be less than 40. This is an error message if the application is running with Windows 3.1; otherwise, it is a warning message. It is sent by the USER module.

RegisterClass: Unusually large cbWndExtra (> 40)

The **cbWndExtra** member of the **WNDCLASS** structure contains a number that is too large. In order to avoid using system resources, applications should limit the number of extra window words to less than 40 bytes, and preferably to less than 10 bytes. It is usually best to store a single pointer to a private data structure that is allocated elsewhere. This is an error message if the application is running with Windows 3.1; otherwise, it is a warning message. It is sent by the USER module.

RegisterClass: Window proc not exported

The **lpfnWndProc** member of the **WNDCLASS** structure contains a pointer a function that is not properly exported. This error message is sent by the USER module.

ReleaseDC: DC already released

A redundant call to the **ReleaseDC** function was detected. This error may be caused by incorrect window or device-context parameters. This error message is sent by the USER module.

ReleaseDC: hwnd not same as for GetDC

The device context or window parameter to the **ReleaseDC** function is incorrect. The window or device context is not the same as was passed to (or returned from) the **GetDC** function. This error message is sent by the USER module.

ReleaseDC: Passed DC not a window DC

The device context supplied to the **ReleaseDC** function was not obtained by using the **GetDC** function. This error is often caused by attempting to release printer or memory device contexts. This error message is sent by the USER module.

Resources *N*% - this tests your error handling code

The debugging kernel allows applications to load even with very low system resources. This allows the application developer to test how their code handles allocation failure. This warning demonstrates the different behaviour of the debugging kernel and retail kernel. This warning message is sent by the KERNEL module.

Seek failed.

A disk or link error occurred. This error message is sent by the KERNEL module.

Segment *N* of *module-name* must be preload

Certain segments of an application or DLL must be preloaded. If an application sets the switch incorrectly, the system corrects the setting. However, the application will load faster if it sets the switch properly. The following segments must be preloaded: **DATA** segments, **FIXED CODE** segments, and **CODE** segments that are **MOVEABLE** but not **DISCARDABLE**. This warning message is sent by the KERNEL module.

Segment *N* of *module-name* was discardable under Win 3.0

In Windows 3.1, the **DISCARDABLE** bit is not necessarily set for DLL segments that are marked **MOVEABLE**. In Windows 3.0, DLL segments marked **MOVEABLE** were also made **DISCARDABLE**. In general, if a DLL segment is **MOVEABLE**, it can also be **DISCARDABLE**. This warning message is sent by the KERNEL module.

SetClassWord: Invalid class brush

The **SetClassWord** function was called with an invalid brush handle. This error message is sent by the USER module.

SetSysModalWindow failed: another app's window already sys modal

The **SetSysModalWindow** function failed because another application was already displaying a system modal window. This warning message is sent by the USER module.

SetWindowLong/SetClassLong of NULL window procedure

An attempt was made to subclass a window by using a NULL or invalid window procedure address. This warning message is sent by the USER module.

SetWindowPos: Invalid hwndInsertAfter

The *hwndInsertAfter* parameter to the **SetWindowPos** or **DeferWindowPos** function is invalid. This error may occur because a window was destroyed between the call to the **DeferWindowPos** function and the call to the **EndDeferWindowPos** function. This error message is sent by the USER module.

SetWindowPos: Invalid window handle

An invalid window handle was passed to the **SetWindowPos** or **DeferWindowPos** function. This error may occur because a window was destroyed between the call to the **DeferWindowPos** function and the call to the **EndDeferWindowPos** function. This error message is sent by the USER module.

SetWindowPos: WS_EX_TOPMOST window positioned incorrectly

The **WS_EX_TOPMOST** windows have been corrupted. This internal error message is sent by the USER module.

SetWindowsHook called to unhook: use UnhookWindowsHook

The **SetWindowsHook** function was called with the window hook address returned from a

previous call to **SetWindowsHook**. This can result in unhooking more than one hook from the hook chain. The **UnhookWindowsHook** function should always be used to unhook hooks. This warning message is sent by the USER module.

SetWindowsHook: HookProc must be in a DLL

Hook functions with system scope that are installed by using the **SetWindowsHookEx** function or hook functions installed by using the **SetWindowsHook** function (other than **WH_MSGFILTER** hooks) must be defined in a DLL. Task hooks and WH_MSGFILTER hooks can be defined in a standard executable file. This warning message is sent by the USER module.

Starting Code Segment of *module-name* must be preload

Certain segments of an application or DLL must be preloaded. If an application sets the switch incorrectly, the system corrects the setting. However, the application will load faster if it sets the switch properly. The following segments must be preloaded: **DATA** segments, **FIXED CODE** segments, and **CODE** segments that are **MOVEABLE** but not **DISCARDABLE**. This warning message is sent by the KERNEL module.

System message box already up

An internal error occurred that caused a system modal message box to be displayed when there was already one displayed. This error message is sent by the USER module.

Too many windows positioned with tasks locked

An internal buffer has overflowed. This internal fatal error message is sent by the USER module.

TrueType font width mismatch

There is a possible error in the selected TrueType font. This warning message is sent by the GDI module.

Unable to load *filename* (*number*)

A startup error occurred. This error message is sent by the KERNEL module.

Unallocated extra window/class word index used

An invalid index was used in a call to the **GetWindowWord**, **SetWindowWord**, **GetClassWord**, or **SetClassWord** function. This warning can occur when these functions are called with windows created by other applications or other parts of the application. An application should not call these functions unless it is guaranteed that the window class supports the extra window words. This warning also can occur if insufficient window or class words are allocated when the window class is registered. This warning can occur in the retail version of Windows. The **LogError** constant is ERR_STRUCEXTRA. This warning message is sent by the USER module.

Unknown fixup *N*

A disk or link error occurred. This error message is sent by the KERNEL module.

UnlinkWin386Block: releasing *0xNNNNNN* bytes

Memory is being returned to a **DPMI** server (Win386 or DOS*X*). This trace message is sent by the KERNEL module to help applications optimize memory management.

UnregisterClass failed: called from wrong app

The **UnregisterClass** function must be called from same application that called the **RegisterClass** function. This error message is sent by the USER module.

UnregisterClass failed: class doesn't exist

The **UnregisterClass** function failed because the specified class does not exist. This error message is sent by the USER module.

UnregisterClass failed: class windows still exist

The **UnregisterClass** function failed because windows for the specified window class have not been destroyed. This error message is sent by the USER module.

Use of DC after ReleaseDC or EndPaint

Drawing occurred in a device context after it was released with the **ReleaseDC** or **EndPaint** function. This is a serious error; it can cause drawing to occur in other application windows. This error is often caused by an application neglecting to set global HDC variables to NULL after releasing the device context. This error message is sent by the USER module.

USER: Menu not destroyed: 0x1234

The specified menu handle was not destroyed by an application before terminating. This warning

message is sent by the USER module.

USER: Window not destroyed: 0x1234
: The specified window handle was not destroyed by an application before terminating. This warning message is sent by the USER module.

Warning: Yield() during application termination
: An application yielded during application termination. This message can help track down timing problems that occur while the application is terminating and are otherwise difficult to debug. This warning message is sent by the USER module.

Window class freed with existent class windows!
: An internal error occurred when the system was destroying the windows created by an application while terminating the application. This error message is sent by the USER module.

Window class reference count overflow
: The internal system data structures may have been damaged. This error could be caused by writing through an uninitialized pointer or performing other kinds of incorrect memory handling. This error message is sent by the USER module.

Window class reference count underflow
: The internal system data structures may have been damaged. This error could be caused by writing through an uninitialized pointer or performing other kinds of incorrect memory handling. This error message is sent by the USER module.

Window destroyed itself during WM_DESTROY processing
: The **DestroyWindow** function was called a second time while the window was processing the **WM_DESTROY** message. This error message is sent by the USER module.

Window destroyed unexpectedly by callback
: A window was destroyed unexpectedly while it was processing a message. This warning message is sent by the USER module.

Windows will delete class brushes
: A class brush is invalid when the application exits. When an application is terminating, all classes it registered are destroyed. The class brush handles are also deleted. If an application deletes its class brush before terminating, this message will be generated. This warning message is sent by the USER module.

WM_NCACTIVATE FALSE return ignored during WM_MDIACTIVATE
: In Windows version 3.0, the return value of the **WM_NCACTIVATE** message is ignored when the message is sent to a MDI child window. In Windows 3.1, the activation is prevented (just as with top-level windows) if FALSE is returned. This error message is provided for applications that depend on compatibility with Windows 3.0 to indicate that a FALSE return value is ignored in an application for Windows 3.0. This error message is sent by the USER module.

WM_NCACTIVATE FALSE return ignored: activating sys modal window
: Returning FALSE after processing the **WM_NCACTIVATE** message does not prevent a window from being deactivated if a system modal window is activated. This warning message is sent by the USER module.

WS_CLIPCHILDREN overridden by CS_PARENTDC
: In Windows 3.1, the **WS_CLIPCHILDREN** style works correctly when a window is created with the **CS_PARENTDC** style. In Windows 3.0, the WS_CLIPCHILDREN style has no effect in this situation. This warning message is sent by the USER module.

WS_CLIPSIBLINGS overridden by CS_PARENTDC
: In Windows 3.1, the **WS_CLIPSIBLINGS** style works correctly when a window is created with the **CS_PARENTDC** style. In Windows 3.0, the WS_CLIPSIBLINGS style has no effect in this situation. This warning message is sent by the USER module.

wsprintf: Invalid char sequence follows '%'
: An improper format string was passed to the **wsprintf** function. This warning message is sent by the USER module.

Zero import module.
: A disk or link error occurred. This error message is sent by the KERNEL module.

Common Programming Errors

The following list describes programming errors that sometimes appear in Windows applications:

- Passing invalid parameters.
- Accessing nonexistent window words. (In Windows 3.0, a call to the **SetWindowWord** or **SetWindowLong** function past the end of the allocated window words, as defined by the **RegisterClass** function, would damage internal window-management structures.)
- Using handles after they have been deleted or destroyed.
- Using a device context after it has been released.
- Deleting GDI objects before they are selected out of a device context.
- Neglecting to delete GDI or USER objects when an application terminates.
- Writing past the end of an allocated memory block.
- Reading or writing using a memory pointer after it has been freed.
- Neglecting to export window procedures and other callback functions.
- Neglecting to use the **MakeProcInstance** function with dialog procedures and other callback functions.

Many of these programming errors can cause unrecoverable application errors in Windows version 3.0. The debugging system can help you locate these types of problems.

Compatibility Issues

Although every effort has been made to ensure that the many enhancements and improvements to the Windows operating system, version 3.1, are compatible with Windows 3.0 applications, some enhancements may affect application operation. This is especially true if an application uses features in an undocumented fashion or relies on invalid assumptions about the behavior of Windows.

The following Help topics discuss categories of compatibility issues:

Window Management
TrueType
Undocumented Windows 3.0 Features

Window Management Compatibility Issues

The window management (USER module) enhancements may affect Windows 3.0 applications. To test this, you need to perform as many operations as possible that cause your application windows to be moved, sized, scrolled, and repainted. The following sections identify a few basic methods to try, but you should try as many other methods as possible.

In some cases, Windows 3.1 ensures compatibility with existing Windows 3.0 applications by supporting both the Windows 3.0 and the new Windows 3.1 implementations. If an application's Windows version as set by Microsoft Windows Resource Compiler (RC) is 3.0, Windows 3.1 carries out the Windows 3.0 implementation, meaning that the Windows 3.1 enhancement has no impact on an existing Windows 3.0 application. However, if a Windows 3.0 application's Windows version is changed to 3.1 without corresponding changes to the application code, the application may encounter problems whenever Windows 3.1 carries out the 3.1 implementation.

Moving and Sizing

MoveWindow

A call to the **MoveWindow** function is equivalent to a call to **SetWindowPos** with the **SWP_NOZORDER** and **SWP_NOACTIVATE** flags set. If the **MoveWindow** *fRedraw* parameter is FALSE, the **SWP_NOREDRAW** flag is also set. For Windows 3.0 applications, when **MoveWindow** is called for a top-level window with *fRedraw* set to FALSE, Windows calls **SetWindowPos** without setting the SWP_NOREDRAW flag and then calls the **ValidateRect** function to prevent the client area from being repainted. However, **WM_NCPAINT** and **WM_ERASEBKGND** messages will have been sent, even though *fRedraw* was FALSE. For Windows 3.1 applications, **MoveWindow** no longer sends these messages in this special case.

For Windows 3.0 applications, Windows always completely redraws a window's frame when the window is moved or sized. For Windows 3.1 applications, Windows no longer completely redraws a window's frame in all cases. For example, the following code sequence does not redraw the window border:

```
MoveWindow(hwnd, ..., FALSE);
     .
     .
     .
InvalidateRect(hwnd, NULL, TRUE);
```

SetWindowPos

For Windows 3.0 applications, the **SetWindowPos** function assumes that **SWP_NOMOVE** and **SWP_NOSIZE** are set if **SWP_HIDEWINDOW** or **SWP_SHOWWINDOW** is set. This means it is not possible in an atomic operation both to hide or show a window and to change its size or position. For Windows 3.1 applications, this limitation does not exist.

For Windows 3.0 applications, when the window is already visible, a call to **SetWindowPos** with the **SWP_SHOWWINDOW** flag set always causes the entire window to be redrawn. This also affects the operation of the **ShowWindow** function. For Windows 3.1 applications, when the window is already visible, a call to **SetWindowPos** with SWP_SHOWWINDOW sets does not cause the window to be redrawn (unless another area must be updated as a result of a size, move, or z-order operation specified in addition to SWP_SHOWWINDOW).

WM_NCCALCSIZE

In Windows 3.0, the **WM_NCCALCSIZE** message is always sent to a window whenever the window is moved or sized. For Windows 3.1, the WM_NCCALCSIZE message is sent only if the size of the window actually changes.

Painting

Window management has been substantially optimized to avoid unnecessary redrawing and flashing.

Applications that depend in subtle ways on when (and if) **WM_NCPAINT**, **WM_ERASEBKGND**, and **WM_PAINT** messages are sent may have incompatibilities. Windows 3.0 frequently sent these messages redundantly to windows and sometimes sent them to windows that were not visible. One of the visual results of the Windows 3.1 optimizations is that a window's nonclient area is not always completely repainted when a window is sized or moved. Some attempt has been made to ensure compatibility, but there are some differences that cannot be backward-compatible and still achieve the significant performance and visual advantages.

BeginPaint and **GetDC**

For Windows 3.0 applications, if the **BeginPaint** function is called on a window that has a class icon, the function returns a window device context (DC); in contrast, the **GetDC** function returns a client DC with no visible region. For Windows 3.1 applications, **BeginPaint** and **GetDC** both return a client DC with no visible region.

BS_USERBUTTON Style

The BS_USERBUTTON style is not valid for Windows 3.1.

CS_PARENTDC Class Style

For Windows 3.0, a window with the **CS_PARENTDC** class style whose parent window does not have the **WS_CLIPCHILDREN** style receives the device context of the parent window, even when the child window has the **WS_CLIPSIBLINGS** or WS_CLIPCHILDREN style. For Windows 3.1, a window with the CS_PARENTDC class style does not receive the parent device context if the window style is either WS_CLIPSIBLINGS or WS_CLIPCHILDREN. Windows 3.1 consistently favors the window-style specifications over the class style.

GetUpdateRect

For Windows 3.0 applications, calling the **GetUpdateRect** function for a window that has the **CS_OWNDC** class style and a mapping mode other than MM_TEXT sometimes retrieves the update rectangle in device coordinates instead of logical coordinates. For Windows 3.1 applications, the result is always in logical coordinates for this class style and mapping mode.

InvalidateRect and **InvalidateRgn**

For Windows 3.0 applications, when the **InvalidateRect** or **InvalidateRgn** function is called with the *lprc* parameter set to NULL to invalidate the entire window, all child windows are also completely invalidated--regardless of whether the child window is outside the parent's client area (that is, invisible). This results in **WM_PAINT** messages being sent to windows that don't require them. For Windows 3.1 applications, only windows that are actually visible within a parent's client area receive update regions and therefore receive WM_PAINT messages.

InvalidateRect and **RedrawWindow**

A minimized Windows 3.0 application could call the **InvalidateRect** function to invalidate its icon. For a Windows 3.1 application to invalidate its icon, it must call the **RedrawWindow** function and specify **RDW_FRAME** for the *fuRedraw* parameter.

Multicolumn List Boxes

A multicolumn list box in Windows 3.0 always received two paint messages when being created. For Windows 3.1, a multicolumn list box receives only one paint message.

UpdateWindow

In Windows 3.0, the various controls call the **UpdateWindow** function at inappropriate times, such as when receiving a **WM_SETFOCUS** message and at other times when changing the internal state. Some controls may not be redrawn properly if they are moved or hidden before they are able to process a **WM_PAINT** message. In Windows 3.1, the controls do not call **UpdateWindow** as often, resulting in faster window repainting and improved appearance.

WM_DRAWITEM

For list boxes in Windows 3.0, the *wParam* parameter of the **WM_DRAWITEM** message is always zero. In Windows 3.1, the *wParam* parameter specifies the identifier of the control that sent the message.

WM_ERASEBKGND

For Windows 3.0 applications, if an application responds with FALSE to a **WM_ERASEBKGND** message sent during any operation other than **BeginPaint** (such as **SetWindowPos**), another

WM_ERASEBKGND message is sent when the application calls **BeginPaint**. For Windows 3.1 applications, if an application responds with FALSE, no second WM_ERASEBKGND message is sent but **BeginPaint** sets the **fErase** member of the **PAINTSTRUCT** structure to TRUE.

For Windows 3.0 applications, calls to the **InvalidateRect** function with the *fErase* parameter equal to FALSE always prevented the window from receiving a **WM_ERASEBKGND** message, even if the message was already pending before the call to **InvalidateRect** was made. For Windows 3.1, pending WM_ERASEBKGND messages are received by the application.

WM_SETREDRAW

For Windows 3.0 applications, sending the **WM_SETREDRAW** message with the *wParam* parameter set to FALSE to a window that has an update area does not validate the window. The update area is still present after a WM_SETREDRAW message with *wParam* set to TRUE. For Windows 3.1 applications, sending WM_SETREDRAW with *wParam* set to FALSE does validate the window completely to ensure that the window does not receive any **WM_PAINT** messages while it is invisible. This does not apply to edit controls, list boxes, and combo boxes, because their WM_SETREDRAW messages are handled differently.

WM_SETVISIBLE

For Windows 3.0 applications, Windows sends a WM_SETVISIBLE message immediately after sending the **WM_SHOWWINDOW** message. For Windows 3.1 applications, Windows does not send the WM_SETVISIBLE message-- WM_SETVISIBLE is obsolete for Windows 3.1.

Scrolling

For Windows 3.0 applications, the **ScrollWindow** function has a number of bugs associated with scrolling a window that had any invalid area. Frequently, the update region resulting from the scrolling operation is not properly calculated. For Windows 3.1 applications, **ScrollWindow** calculates the update region correctly.

Multiple Document Interface (MDI)

Multiple document interface (MDI) is completely compatible with Windows 3.0 applications. For Windows 3.1 applications, MDI has been enhanced. In particular, specifying the low-order style bit (MDIS_ALLCHILDSTYLES) when creating an MDICLIENT window enables the new Windows 3.1 MDI capabilities for that window. This gives applications control over all MDI child window styles and allows for hidden windows.

Windows Hooks

Hook Chain

In Windows 3.0, an application or dynamic-link library (DLL) that installs a hook is responsible for maintaining the hook chain. In Windows 3.1, Windows maintains the hook chain. Consequently, there are subtle changes in the interface that may affect Windows 3.0 applications. Furthermore, Windows 3.1 no longer allows applications and DLLs to enumerate all the functions in a hook chain. In particular, Windows 3.1 no longer supports the HC_GETLPLPFN, HC_LPLPFNNEXT, and HC_LPFNNEXT values for the **DefHookProc** function.

Negative Hook Values

In Windows 3.0, Windows passes a negative hook value to a hook function when unhooking a hook. This negative value is for Windows internal use only. In Windows 3.1, Windows does not pass a negative hook value to a hook function; it uses another method to unhook a hook.

SetWindowsHook

In Windows 3.0, the **SetWindowsHook** function returns a pointer to the next hook function. In Windows 3.1, **SetWindowsHook** does not return a pointer; instead, it returns a 32-bit value that identifies the next hook function. An application that attempts to call the hook function by using the return value from **SetWindowsHook** as a function address causes a general protection (GP) fault.

In Windows 3.0, an application can unhook a hook function by passing the address of the next hook function to the **SetWindowsHook** function. In Windows 3.1, passing the address of the next

hook function causes a system debugging error (RIP) in the Windows 3.1 debugging version.

SetWindowsHookEx, **UnhookWindowsHookEx**, and **CallNextHookEx**

In Windows 3.0, three hook functions are available: **SetWindowsHook**, **UnhookWindowsHook**, and **DefHookProc**. In Windows 3.1, these functions are replaced with three more powerful functions: **SetWindowsHookEx**, **UnhookWindowsHookEx**, and **CallNextHookEx**. Windows 3.1 applications should use the new functions. The old functions are still supported for backward compatibility.

Parameter Validation

Windows strictly checks parameters passed to its functions before using them. For Windows 3.0 applications, there are many validation errors that Windows works around and lets the function or application continue to function. For Windows 3.1 applications, many of these errors cause the functions to fail and it is up to you to ensure that structures and parameters are passed correctly.

For example, in Windows 3.0, if an application passes NULL as the *hInstance* parameter to **CreateWindowEx**, Windows maps the handle to the stack segment. In Windows 3.1, the function returns an error value.

Undeleted Object Notifications

In Windows 3.1, any GDI or USER object left allocated when an application terminates results in a warning to the debug terminal. Windows 3.1 does not automatically free these objects--your application must free them. These warnings usually imply a memory leakage, in which case running and terminating an offending application eventually uses all available memory.

Sometimes an object is intended to last longer than the application or DLL that created it. This occurs frequently in shared DLLs that share GDI objects such as bitmaps and brushes among its many clients. In such cases, the warnings at the debug terminal can be ignored.

Menu Implementation

SendMessage and **PostMessage**

For Windows 3.0 applications, Windows uses the **SendMessage** function to send a **WM_COMMAND** message. For Windows 3.1 applications, Windows uses the **PostMessage** function to send the message, preventing stack overflow when the application is working with pop-up menus.

TrackPopupMenu

Menu management has been enhanced for Windows 3.1. In particular, the **TrackPopupMenu** function now allows additional parameters, and Windows now stores application menu data in a separate heap, expanding the number of windows that can exist.

RegisterClass

In Windows 3.0, Windows fails to properly free the window-class background brush when deleting the class. In Windows 3.1, Windows frees the brush when either a Windows 3.0 or 3.1 application terminates.

Topmost Window

A new window attribute allows a window to be placed on top of all other windows, even when the owning application is not active. If multiple applications have topmost windows, the topmost windows will have the same order as their owning applications.

Also, a topmost window, its owners, and all the windows it owns will stay together as windows are moved around. This means that if you bring an owned dialog window to the top, its owner will also be brought forward so that it stays immediately below the dialog box.

An application that depends on being able to have a window of another application between its main window and a dialog box may encounter problems. For example, a setup program that starts Windows Notepad and then brings up a dialog box causes Notepad to be positioned behind the dialog box

owner. The solution in this case is to create the dialog box without an owner (a window cannot be owned by a window of another application).

Any application that relies on having an unobstructed client area when the application is active may encounter problems, because it is not possible to guarantee that the active window is on top. This means the active window may not have a rectangular clipping region, because a topmost window may be on top of it. Calling the **BitBlt** function with a window or screen DC as the source (which is not recommended in any case) may copy bits belonging to the topmost window.

TrueType Compatibility Issues

TrueType Compatibility Issues

Although Windows 3.1 includes support that seamlessly integrates TrueType fonts into existing applications, problems with fonts can occur for Windows 3.0 applications that assume bitmap fonts are always available, that Helv and Tms Rmn font are always available, and that font sizes are limited. Be sure to thoroughly check fonts in your application, including files and dialog boxes. Also, because TrueType provides more fonts in more styles, Windows 3.1 may consume both printer and global memory faster than Windows 3.0. You should check your applications with systems and printers that have limited memory.

Helv and Tms Rmn Fonts

Helv and Tms Rmn fonts are no longer available. The fonts that replace these are MS Sans Serif and MS Serif, respectively. To support Windows 3.0 applications that use the Helv and Tms Rmn fonts, the [FontSubstitutes] section in the WIN.INI file maps Helv to MS Sans Serif and Tms Rmn to MS Serif by default. It also maps Times® to the Times New Roman TrueType font and Helvetica® to the Arial TrueType font.

Applications that search explicitly for "Helv" or "Tms Rmn" may encounter difficulties when these fonts are not found.

Font Enumeration

Applications should test to ensure that TrueType fonts are enumerated correctly. Applications should also ensure that they encounter no unexpected font mapping. (When a TrueType font substitutes for another font, line spacing, paragraph breaks, or page breaks could change.)

Windows 3.0 applications sometimes create multiple instances of a single font or font family. In particular, some applications use different handling for fonts that are enumerated by a nonraster printer than they use for fonts enumerated for the screen, even if these fonts have the same names. With TrueType fonts, fonts with the same name are identical, regardless of the output device. Some Windows 3.0 applications assume that scalable fonts can not be available on nonscaling devices. In such cases, the applications intentionally enumerate a single size for every TrueType font even though other sizes are available. Furthermore, some applications assume that bold, italic, and bold italic are always simulated from regular fonts. This is not true with TrueType fonts.

An application can create multiple instances of the same font.

Windows continues to support and is fully backward-compatible with Adobe Type Manager (ATM), Facelift, and Intellifont for Windows. Applications using these font technologies should encounter no problems.

TrueType Only

Windows 3.0 applications may behave unexpectedly if the user has used Control Panel to check the Show Only TrueType Fonts in Applications check box. An application may fail to locate any fonts if only TrueType fonts are present.

Font Sizes

TrueType supports a wide variety of sizes for all TrueType fonts. In Windows 3.1, if an application requests a very small or very large font, it usually gets the requested size.

An application that checks for the smallest or largest font by setting the *nHeight* parameter in the **CreateFont** function to an extreme value will not get the expected results.

Font Substitutions

The [FontSubstitutes] section may cause the **GetTextFace** function to return a typeface name that is not enumerated by the **EnumFontFamilies** function. This ensures that an application gets the

typeface name it requests. For example, an application that requests Helv (and expects Helv) gets a typeface named Helv.

An application that expects matching facenames from **EnumFontFamilies** and **GetTextFace** may encounter mismatches.

ABC Spacing

ABC-spaced fonts can lead to misplaced cursors, highlights that do not encompass all the text on a line, pieces of characters left behind after screen updates, and unexpected clipping of fonts on printers (when a character goes outside the printable area).

Third-Party Font Manager Problems

Be sure to try your application with ATM, Facelift, or Intellifont for Windows fonts installed. Do not install more that one of these font managers at a time. Skip this test if your application does not work with these font managers under Windows 3.0.

Mixing Device, Bitmap, and TrueType Fonts

In Windows 3.1, some fonts, such as the Symbol font, may be supported by a TrueType font, a GDI bitmap font, and a device-specific font. Applications can get unexpected results if they specify the name of the font without specifying the font technology; for example, the Symbol bitmap font could be mixed with the Symbol TrueType font in a print job.

Printing may mix device, bitmap, and TrueType fonts, causing unacceptable output.

Desktop Publishing and International Characters

Windows 3.1 includes 22 new international and desktop publishing characters. Unfortunately, these new characters appear only in TrueType fonts; the bitmap fonts do not have them.

Changing to a bitmap font causes the new characters to be displayed as the default character for the current font. Some applications may perform their own remapping in the ASCII character range 128 through 159.

Note: The desktop publishing characters are not be available to dialog boxes that use bitmap fonts exclusively (such as the Find and Replace dialog boxes).

Text Rotation

Although Windows 3.0 can rotate vector and device fonts, under certain mapping modes it rotates these fonts differently. For compatibility, Windows 3.1 also rotates fonts differently. However, an application can override this default behavior and direct Windows 3.1 to use the same convention to rotate all fonts by setting the CLIP_LH_ANGLES bit in the **lfClipPrecision** member of the **LOGFONT** structure. When this bit is set, Windows 3.1 rotates all fonts using the same rules used by Windows 3.0 to rotate device fonts.

Other TrueType Considerations

Some applications do not request point sizes correctly. For bitmap fonts, the results are acceptable because only these fonts have a limited range of sizes available. For TrueType fonts, output can be unacceptable because any size requested is available.

Windows 3.0 applications sometimes set the **tmAveCharWidth** member of the **TEXTMETRIC** structure to request a specific font. With Windows 3.1, the widths of TrueType characters are changed to match the requested width.

With TrueType, Windows now adds at least 13 fonts to the default list. Some applications may fail because they do not have test cases that account for the additional fonts.

Printing

You can evaluate the effects of most of the printing changes by printing documents from your

application in Windows 3.0 and Windows 3.1 and comparing the output. Although you should test as many printers as possible, you must test the following four printer types:

- PostScript
- LaserJet II
- LaserJet III
- Dot matrix

Some printers have been renamed. This could cause problems in your application if your application or documents make specific references to a certain printer. Note that renaming the printer does not affect soft fonts.

Other TrueType Enhancements

The font enhancements implemented by TrueType do not cause problems for applications unless the applications depend upon internal structures or internal operations. TrueType enhancements can cause problems in the following situations:

- When an application depends upon internal data structures, which may have changed.
- When an application relies on real mode, which is no longer supported.
- When an application builds its own selectors. KERNEL now runs at ring 3 (instead of ring 1, as in Windows 3.0) to prevent ill-behaved applications from relying on the relationship between handles and selectors.

Undocumented Windows 3.0 Features

Undocumented Windows 3.0 Features

Windows 3.0 applications that call undocumented Windows 3.0 functions or structures may fail when run with Windows 3.1. Most of the undocumented functions are internal USER, GDI, and KERNEL functions that Windows 3.0 must export to support movable data segments in real mode. Windows 3.1 supports only protected mode. Therefore, Windows 3.1 does not export these internal functions, and applications that attempt to link with them will fail.

The undocumented structures are internal structures used by Windows to store information about Windows objects, such as windows and device contexts. To support parameter validation, Windows 3.1 has changed the number and meaning of the members in these structures. Windows 3.0 applications that directly access these structures will eventually fail.

To determine whether your application will fail, run it with the debugging version of Windows 3.1. The debugging version displays an error message if the application contains undocumented functions that are no longer supported. Windows closes the application when the unsupported function is actually called.

Creating Windows Applications

This topic explains what elements are needed to build applications for the Microsoft Windows operating system versions 3.0 and 3.1. It also provides guidelines for writing robust applications and for debugging applications.

Writing Compatible Windows Applications

The Microsoft Windows 3.1 Software Development Kit (SDK) allows you to create applications for either Windows 3.0 or 3.1. If you write your application carefully, you can create a single application that is compatible with Windows 3.0 but also takes advantage of newer features when running with Windows 3.1.

Windows 3.1 Applications

The Windows 3.1 SDK tools, header files, and libraries create Windows 3.1 applications by default. No special procedures are required to create executable files that run with Windows 3.1. If you create Windows Help files for your applications, use Microsoft Help Compiler version 3.1 (HC31.EXE) to compile your files so that they have access to the latest features of Windows Help.

Applications that call Windows 3.1 functions depend on Windows 3.1 and cannot be run with Windows 3.0.

Windows 3.0 Applications

You can use the Windows 3.1 SDK to create a Windows 3.0 application by following these steps:

1 Set the WINVER define variable to 0x300 to enable the WINDOWS.H file for Windows 3.0 compilation. Place the following statement immediately before the include statement for the header file:

```
#define WINVER 0x300
```

2 Link your application object files with the LIBW.LIB library provided with the Windows 3.1 SDK. Except for the functions that are new to Windows 3.1, all functions defined in this import library are compatible with Windows 3.0.

3 Mark your application as a Windows 3.0-only executable by using the **/30** option with Windows Resource Compiler (RC). The **/30** option cannot be used with the **/r** option.

4 If you create Windows Help files for your application, use Help Compiler version 3.0 (HC30.EXE) to compile your files.

By default, Resource Compiler marks applications for 3.1, so it is important to use the **/30** option mentioned in the preceding steps.

All Windows 3.0 applications can use Windows extensions, such as common dialog boxes and object linking and embedding. If you use these features, you must ship the corresponding dynamic-link libraries (DLLs) and related files with your application. They should be installed along with the application.

Combined Windows 3.0 and 3.1 Applications

You can create Windows applications that run with Windows 3.0 but also take advantage of newer features when running with Windows 3.1. Such applications consist primarily of Windows 3.0 function calls but conditionally link to and use Windows 3.1 functions.

To build a combined application, mark your application as a Windows 3.0 only executable by using the **/30** option with Resource Compiler, but do not set the WINVER define variable to 0x300. You must use the **GetVersion** function to determine the version of Windows that is running before using any Windows 3.1 functions.

The following example demonstrates how to set a flag if the current system is Windows 3.1:

```
extern BOOL fWin31;

UINT version;

fWin31 = FALSE;

version = LOWORD(GetVersion());
if (((LOBYTE(version) << 8) | HIBYTE(version)) >= 0x030a) {
    fWin31 = TRUE;
}
```

For information about interpreting the return value of the **GetVersion** function, see the *Microsoft Windows Programmer's Reference, Volume 2.*

Your application can call Windows 3.1 functions directly as long as you link it with the 3.1 version of LIBW.LIB. (It is not necessary to call the **GetProcAddress** function.) However, you must ensure that Windows 3.1 functions are not called when your application is running with Windows 3.0. The following example demonstrates how this can be done, using the fWin31 flag that was set in the preceding example:

```
extern BOOL fWin31;

if (fWin31) {
    ScrollWindowEx(hwnd, ...);  /* new for Windows 3.1  */
}
else {
    ScrollWindow(hwnd, ...);    /* Windows 3.0 function */
}
```

If you create Windows Help files for your application, either use Help Compiler version 3.0 (HC30.EXE) to compile your files, or create a help file for Windows 3.1 and release your help file with the redistributable Windows 3.1 versions of the WINHELP.EXE and WINHELP.HLP files.

If you run a combined application using the debugging version of Windows 3.0, a call to an undefined function causes a warning. The application, however, continues to load and run successfully, as long as the function is not actually called.

Creating Robust Applications

Windows 3.1 includes a number of features and enhancements designed to make running Windows applications much more reliable. Efforts to make Windows 3.1 more reliable have focused primarily on three areas:

- Improving how the system handles errors if and when they occur.
- Avoiding errors in system code by ensuring the validity of all handles, pointers, structures, indices, and flags passed to the system.
- Providing better diagnostics, tools, and header files for finding and fixing bugs more efficiently during development.

The two key components improving reliability are the parameter validation built into the Windows operating system and the STRICT type-checking of the WINDOWS.H file. Also useful are the new features of WINDOWSX.H, which include macros, message crackers, and control functions.

Parameter Validation

Windows 3.1 contains code to validate parameters passed to Windows functions and messages. These features are included in both the retail and debugging versions of the system. The debugging version of the system includes some additional features and parameter checking that is not included in the retail product.

Invalid Parameter Error Messages

The system validates handles, pointers, structures, indices, and flags. In most cases, an invalid parameter causes a function to return an error value. In other cases, such as when a flag is invalid, the function executes as usual, but an appropriate warning message is displayed.

When Windows encounters an invalid parameter error, it displays the message on your debugging terminal or window. The message has the following form:

err *AppName function*:*address*: *message*:*parameter-value*

Following are the message parameters:

AppName	Identifies the application or DLL that caused the error.
function	Identifies the number of the function that was passed the invalid parameter.
address	Identifies the address of the function that was passed the invalid parameter.
message	Specifies the string identifying the error.
parameter-value	Specifies the value of the invalid parameter.

For example, a message could have the following form:

```
err FONTSAMP 011F:056A: Invalid local handle: 1D50
```

If the address is not near the address of a Windows function you recognize, the window message parameter is probably invalid. Functions that take messages, such as **SendMessage**, **DispatchMessage** and **SendDlgItemMessage**, show an address within the message validation code. Parameter values for invalid parameters begin with the PV prefix (for example, PV_WM_COMMAND).

By default, invalid parameter messages display a stack trace and an "Abort, Break, or Ignore?" prompt. You can change the default by setting options in the System Debug Options box of the Systems Debugging Log Application (DBWIN.EXE). This dialog box is displayed when you choose the Settings command on the Options menu.

You can also log invalid parameter errors by using Dr. Watson, just as you would log general-protection (GP) faults by using Dr. Watson. By default, this feature is turned off.

Buffer Overflow Errors

A common application error is to allocate too little space for a buffer that is passed to and filled by Windows. These errors are especially difficult to track if the buffers are allocated on the stack. Windows can help you find these errors by filling buffers before information is copied into them. If the operation overflows the buffer, Windows detects and reports the error.

By default, this feature is disabled. You can enable the feature by choosing the Settings command on the Options menu of DBWIN.EXE and then selecting the Fill Buffers check box. When you select this check box, Windows displays a stack trace and an "Abort, Break, or Ignore?" prompt with some warning messages.

This feature is available in the Windows debugging version only.

Interpreting Invalid Parameters

Possible reasons for getting invalid parameter errors follow.

Invalid Handles

A handle is invalid under the following circumstances:

- Using NULL or -1 when it is not allowed
- Reusing a destroyed or deleted handle
- Using an uninitialized stack variable
- Using a device context handle created by the **CreateIC** or **CreateMetaFile** function in a function that does not allow the handle
- Passing one type of handle in place of another, such as passing a device-context handle in place of an window handle

Invalid Pointers

A pointer is invalid under the following circumstances:

- Using a NULL pointer when it is not allowed
- Pointing to a buffer that is too small
- Using a function pointer without properly exporting it or properly creating a procedure-instance address
- Pointing to a string that does not have a null-terminating character
- Pointing to a structure that contains an invalid member (for example, if you call the **RegisterClass** function with a invalid window procedure in the **CREATESTRUCT** structure, Windows reports an invalid pointer)
- Using an uninitialized stack variable
- Passing a read-only pointer when a read-write pointer is required

Invalid Flags or Value

A flag or value is invalid under the following circumstances:

- Passing meaningless flags
- Passing an out-of-range index
- Using a value that is otherwise illegal

You can use pointer-validation functions (such as **IsBadCodePtr**) to help you check for and debug your application's use of pointers.

Strict Type-Checking

The Windows 3.1 header file (WINDOWS.H) includes various features for detecting problems when compiling an application. These features, which are provided by the STRICT option, make application development faster and easier.

You define STRICT before the include statement for the header file. STRICT causes the various types and function prototypes in WINDOWS.H to be declared with very strict type-checking. For example, once STRICT is defined, it is impossible to pass a window handle to a function that requires a device-context handle without generating a compiler error.

Features of the STRICT Option

Specific features provided by the STRICT option include:

- Strict handle type-checking
- Proper declaration of certain parameter and return value types
- Fully prototyped type definitions for callback function types
- Proper declaration of polymorphic parameters and return values (for example, *wParam* and *lParam* message parameters)
- Proper use of the **const** keyword for pointer parameters and structure members when the pointer is read-only

Type declarations for many of the Windows functions and callback functions have changed. Nonetheless, unless you define STRICT, the new declarations for Windows 3.1 are fully compatible with the old declarations for Windows 3.0. WINDOWS.H for Windows 3.1 can, therefore, be used to compile Windows 3.0 applications without modifications.

Compiling with the STRICT Option

In general, the STRICT option is most useful with newly developed code or with code that is being maintained or changed regularly. Code that has already been written and tested, and is not changing very much over time, will generally not benefit as much from STRICT. If you find that stable code generates lots of run-time parameter validation errors when run with Windows 3.1, you will find STRICT very valuable as you go through the code to clean up those errors.

The following procedures will ensure that your application conforms to STRICT type-checking:

- Use new handle and parameter types. In particular, replace **HANDLE** with appropriate handle

types and use **WPARAM** and **LPARAM** with all message parameters.

- Use new return type and parameter types for windows and dialog box procedures and callback functions.
- Declare all your functions with full prototypes. Place these prototypes in a include file and include it with each source file.
- Cast function pointers to the proper type rather than to **FARPROC** type. This is especially important with the **MakeProcInstance** function.
- Take special care with **HMODULE** and **HINSTANCE** types. There are a few Windows functions that return or accept only **HMODULE** types.
- Use the **MAKELPARAM** macro instead of the **MAKELONG** macro when building **LPARAM** parameters out of two words. Also, use the **MAKELRESULT** macro instead of **MAKELONG** when building **LRESULT** return values.
- Cast the handle or near pointer to a **WORD** type in order to prevent getting the data segment value in the high word of the value when casting a handle or near pointer value to **LRESULT** or **LPARAM**.
- Cast a far pointer, **LPARAM** or **LRESULT**, to a **DWORD** type and then to the desired type when you cast the far pointer to a handle or near pointer. This prevents "segment lost in conversion" warnings.
- Make sure you have the following lines, in the given order, in each source file:

```
#define STRICT
#include <windows.h>
```

- Compile your source to use the highest level of error checking. Treat any warnings as errors and correct your sources to eliminate the warning messages.
- Link and run the application to ensure that it executes without errors.

Testing and Debugging Your Application in Windows

One of the advantages of an operating system such as Windows is its ability to run more than one application at a time. However, this advantage can also create hazards when you are testing and debugging an application.

Windows is a robust operating system. When Windows is running in protected (standard or 386 enhanced) mode, it can usually terminate an application that encounters a fatal error (such as an invalid handle) without affecting other applications. A fatal error or even a GP fault in an application very rarely causes the entire system to crash. However, it is possible to cause system failure in other ways when you are testing and debugging an application.

Because of the risk of system failure, you should always save all file buffers to disk before testing and debugging your application. You should also avoid running other applications while testing and debugging your application if a general system failure would cause problems for the other applications.

Using Different Windows Versions

The Windows 3.1 SDK provides two environments for debugging or testing your Windows applications: a debugging version of the retail Windows product and a nondebugging version of the retail Windows product.

The SDK installation program creates two directories to contain the debugging and nondebugging versions of the core DLLs. Unless you specify different paths, Install places the debugging versions of the Windows core libraries in the \WINDEV\DEBUG directory and the nondebugging versions in the \WINDEV\NODEBUG directory. Install copies the nondebugging version of the Windows core libraries from your Windows system directory to the \WINDEV\NODEBUG directory.

You can conveniently switch between the debugging and nondebugging versions of Windows by running one of two batch files that Install places in the Windows development directory (named \WINDEV by default). The N2D.BAT file switches from the nondebugging to the debugging version, and D2N.BAT switches from the debugging to the nondebugging version.

These batch files either copy files from your \WINDEV\DEBUG and \WINDEV\NODEBUG directories or rename files in your Windows system directory. When you install the SDK files, Install asks if you

want to keep a duplicate set of the libraries and symbol files in your Windows system directory. If you answer Yes, N2D.BAT and D2N.BAT quickly rename the duplicate files. Otherwise, the batch files copy the DLLs to your Windows system directory from the appropriate directory.

If you choose to retain a duplicate set of files, the DLLs and symbol files for the two versions of Windows appear in your Windows system directory with the same names as the core libraries and symbol files, but with the letter *N* (nondebugging) or *D* (debugging) appended to the name. For example, in addition to the GDI.EXE file, your system directory will contain the GDID.EXE and GDIN.EXE files.

Debugging Version

The debugging version of Windows consists of a set of DLLs that replace the Windows core DLLs of the retail product. The replaced DLLs are KRNL286.EXE, KRNL386.EXE, USER.EXE, GDI.EXE, and MMSYSTEM.DLL. Accompanying these DLLs is a set of symbol (.SYM) files.

The debugging versions of the core DLLs provide error checking and diagnostic messages that help you debug a Windows application. The symbol-file information helps you track calls into Windows when using the Microsoft Windows 80386 Debugger (WDEB386.EXE). In addition, the debugging versions of these DLLs contain Microsoft® CodeView® symbol information for tracking calls into Windows when using Microsoft® CodeView® for Windows™ (CVW).

A special setting is available in the [386Enh] section of SYSTEM.INI for the debugging version of Windows. The form of this setting follows:

```
DebugPhysAddrs = {TRUE|FALSE}
```

By default, Windows makes the entire base physical linear memory region available when a debugger is loaded. Setting the DebugPhysAddrs option to FALSE overrides this default when the debugger is loaded. Although the FALSE setting prevents you from being able to examine all memory, it creates a memory environment more like the nondebugging version of Windows, which can help you spot problems with pointers more quickly. The default value for DebugPhysAddrs is TRUE.

Nondebugging Version

During application development, you should use the debugging version of Windows. However, use the nondebugging version of Windows whenever you want to do the following:

- Test the final version of your application
- Test the performance of your application without the performance disadvantages of the debugging version of Windows

Use the nondebugging version of Windows with the core DLLs supplied by the retail version of Windows. The Windows 3.1 SDK also provides symbol files for the nondebugging version of Windows. The retail Windows core libraries do not contain CodeView symbol information, however.

Using the System Debugging Log Application

The System Debugging Log Application (DBWIN.EXE) allows you to display messages produced by the debugging version of Windows even if you are not running a debugger and do not have a debugging terminal. DBWIN.EXE allows you to control the output of specific types of messages. It also includes a feature that forces memory-allocation errors when testing the robustness of an application.

Note: DBWIN.EXE can provide useful debugging messages with the retail version of Windows as well. When you run DBWIN.EXE with the retail version of Windows, the Settings and Alloc Break commands are disabled in the Options menu, and you will only see a limited subset of debugging messages.

System Debugging Output

The default system debugging output goes to AUX. DBWIN.EXE can also send debugging messages to COM1 or COM2. Sending debugging output to COM1 or COM2 improves the performance of your debugging system when you have redirected system debugging output to NUL, or if DBWIN.EXE is

not running.

To disable AUX as the default, add the following setting to the [Debug] section of SYSTEM.INI:

```
OutputTo=NUL
```

To disable the default kernel output and to send output to COM1 or COM2, set the MS-DOS COM port baud rates to match the baud rates of your debugging terminal by using the MS-DOS **mode** command. To ensure that the settings are always correct, use the **mode** command in your AUTOEXEC.BAT file.

You can log messages to the system debugging window, to a monochrome screen, or to the COM1 or COM2 devices. The default destination for messages is to a window.

You can choose different destinations for debugging messages from the Options menu. These settings stay in effect the next time you run DBWIN.EXE.

System Debug Options Dialog Box

When you choose the Settings command on the Options menu, a System Debug Options dialog box appears. This dialog box allows you to control the output of debugging messages produced by the debugging version of Windows.

The System Debug Options dialog box works only when you are running the debugging version of Windows. There are three groups of check boxes, described as follows:

Break Options	Control whether and how a message will cause a break and stack trace to the debugger.
Debug Options	Control the kind of debugging features that are enabled in the system.
Trace Options	Control whether or not certain kinds of informational messages are produced.

The check boxes for Break Options and Trace Options are self-explanatory. The following list explains the check boxes for the Debug Options:

Option	Description
Validate Heap	Checks the consistency of global and local heaps before every call to a memory-management function. This option affects the global heap only when it is one of the default startup settings (that is, when it is saved by choosing the Save Settings command on the File menu). This option affects local heaps only if it is set before the application is started.
Check Free Blocks	Ensures that freed local blocks are not written into. The value 0xFB is written into free blocks, and when the heap is validated, a check is performed to ensure that the blocks are still filled with this value. This option works only with local heaps. This option must be used with the Validate Heap option.
Buffer Fill	Fills buffers that are passed to Windows functions with the value 0xF9. This option ensures that all of the supplied buffer is writable and helps detect overwrite problems that can occur when the buffer is too small.
Break with INT 3	Breaks to the debugger with an **int 3** instruction, instead of a fatal exit. This option does not display a stack trace.
Don't trap faults	Prevents the system from hooking GP and stack overflow faults. (Many faults that result from choosing this option would normally be handled by the system. Choosing this option results in faults that would not occur otherwise.)

Alloc Break Command

The Alloc Break command on the Options menu ensures that an application deals properly with out-of-memory conditions. This command displays a dialog box into which you can enter the module name of your application and the number of memory allocations you want to succeed before subsequent allocations fail.

The system counts each global or local memory allocation performed by your application. When the

number of allocations reaches the allocation break count, that allocation and all subsequent allocations fail. Because memory allocations made by the system fail once the break count is reached, calls to certain functions (such as **CreateWindow** and **SelectObject**) fail as well. Only allocations made within the context of the application you specify are affected by the allocation break count.

The module name is limited to 8 characters. In some cases the module name may be different from the filename; the module name is specified in the module-definition (.DEF) file for the application. You cannot specify the module name of a DLL.

If you set the break count to zero, no allocation break is set, but the system counts allocations made by the specified application. You can choose the Show Count button to display the current allocation count.

You can set an allocation break before an application is run. The allocation count is then set to zero and allocations are counted as soon as the application starts. If you run more than one instance of an application, the allocation break applies only to the most recent instance.

The allocation count is also reset to zero when you choose the Set or the Inc & Set button. You can set an allocation break before performing an operation to ensure that your application handles the problem effectively. Then you can choose Inc & Set and repeat the operation to ensure that the next allocation failure is also handled properly.

Control Panel Applications

This topic describes Control Panel (CONTROL.EXE) for the Microsoft Windows operating system. It explains how to create a Control Panel application and then add the application to Control Panel.

Control Panel provides a window for running applications. These applications are used to configure the Windows environment. A number of standard applications are included with Windows. However, additional ones can be created and added to Control Panel. This capability is useful for modifying environmental factors unique to specific hardware and software.

An application is contained in a dynamic-link library (DLL). A DLL can support more than one Control Panel application.

Control Panel loads Control Panel application libraries in this order:

1. The library containing the standard Control Panel applications
2. Libraries specified in the [MMCPL] section of the CONTROL.INI file
3. Libraries with the .CPL filename extension residing in the same directory as the CONTROL.EXE file
4. Libraries with the .CPL filename extension residing in the Windows SYSTEM directory

Starting a Control Panel Application

There are three ways to start a Control Panel application:

- The user can open Control Panel and start an application by double-clicking the application icon.
- The user or an application can open Control Panel by using a command-line argument that specifies the name of the application to start. When the Control Panel application closes, Control Panel automatically closes.
- An application can send a WM_CPL_LAUNCH message to Control Panel while Control Panel is running. When the Control Panel application closes, Control Panel sends back a WM_CPL_LAUNCHED confirmation message.

The following example shows how an application can start Control Panel and the Printers application from the command line by using the **WinExec** function:

```
WinExec("control.exe printers", SW_SHOWNORMAL)
```

When Control Panel starts, it immediately displays the Printers application. After the Printers application finishes, Control Panel ends.

The following example shows a function that starts a Control Panel application by using the WM_CPL_LAUNCH message:

```
BOOL StartApplet(LPSTR lpszName, HWND hwndMine)
{
    HGLOBAL hglbAppletName;    /* global-object handle for app name   */
    HWND hwndCPL;              /* handle of Control Panel window      */
    LPSTR lpszAppletName;      /* name of the application             */
    BOOL  fStartedCPL = FALSE; /* application started by CONTROL.EXE? */

    /*
     * Allocate a global, shareable memory block to hold the
     * application-name string.
     */

    hglbAppletName = GlobalAlloc(GMEM_MOVEABLE, lstrlen(lpszName) + 1);
    if(hglbAppletName == NULL)
        return FALSE;
```

```
    lpszAppletName = GlobalLock(hglbAppletName);
    lstrcpy(lpszAppletName, lpszName);
    GlobalUnlock(hglbAppletName);

    /*
     * Get the Control Panel window handle and start Control Panel, if
     * necessary.
     */

    if((hwndCPL = FindWindow("CtlPanelClass",
            "Control Panel")) == NULL) {
        WinExec("control.exe", SW_SHOWNA);
        hwndCPL = FindWindow("CtlPanelClass", "Control Panel");
        if(hwndCPL == NULL) {
            GlobalFree(hglbAppletName);
            return FALSE;
        }
        fStartedCPL = TRUE;
    }

    /* Start the application and end Control Panel, if started. */

    SendMessage(hwndCPL, WM_CPL_LAUNCH, (WPARAM) hwndMine,
        (LPARAM) lpszAppletName);
    if (fStartedCPL)
        SendMessage(hwndCPL, WM_CLOSE, 0, 0);
    GlobalFree(hglbAppletName);
    return TRUE;
}
```

Creating a Control Panel Application

A Control Panel application must reside in a DLL that includes a standard entry-point function named **CPlApplet**. The application must include the CPL.H header file for the definition of the Control Panel messages. Control Panel communicates with the DLL by sending the following CPL messages to the **CPlApplet** function:

Message	Description
CPL_DBLCLK	Sent when the user double-clicks an application icon. In response to this message, the DLL should start its configuration process, usually displaying a dialog box.
CPL_EXIT	Sent after the last CPL_STOP message and immediately before Control Panel calls the **FreeLibrary** function for the DLL. In response to this message, the DLL should free any remaining memory and prepare to exit.
CPL_GETCOUNT	Sent after the CPL_INIT message, to prompt the DLL to return a number indicating how many applications it services.
CPL_INIT	Sent immediately after the DLL is loaded, to prompt the DLL to perform initialization procedures, including memory allocation.
CPL_INQUIRE	Sent after the CPL_GETCOUNT message, to prompt the DLL to provide information about each application. The handler for this message is a good place to include any initialization required by individual applications.
CPL_NEWINQUIRE	Sent to a Control Panel DLL to request information about an application that the DLL supports. The CPL_NEWINQUIRE message is the same as the CPL_INQUIRE message except that its second parameter (*lParam2*) is a pointer to a **NEWCPLINFO** structure instead of a **CPLINFO** structure. New applications should use CPL_NEWINQUIRE instead of CPL_INQUIRE.

CPL_SELECT	Sent when the user selects an application icon.
CPL_STOP	Sent once for each application before Control Panel ends. In response to this message, the DLL should free any memory associated with the individual application for which the message is sent.

Creating the Entry-Point Function

Control Panel communicates with an application DLL through the **CPlApplet** function. Be sure to export this function by listing it in the **EXPORTS** statement of your module-definition (.DEF) file. The **CPlApplet** function handles the messages listed previously, performing three main tasks:

Task	Result
Initializing the application (CPL_INIT, CPL_INQUIRE)	Allocates any memory needed and gives Control Panel the information needed to display the application icon.
Running the application (CPL_DBLCLK)	Passes control to a dialog box and its associated message processor.
Closing the application (CPL_STOP, CPL_EXIT)	Frees any memory allocated and prepares to exit.

The **CPlApplet** function has the following format:

LONG CALLBACK* CPlApplet(*hwndCPL***, *msg*, *lParam1*, *lParam2*)**

The *hwndCPL* parameter contains the handle of the Control Panel window. The *msg* parameter contains one of the CPL messages listed previously. The *lParam1* and *lParam2* parameters contain message-dependent values.

Initializing the Application

To initialize a Control Panel application, Control Panel sends the CPL_INIT message first to the **CPlApplet** function, which prompts the application DLL to perform initialization procedures. If initialization succeeds, **CPlApplet** returns nonzero.

If **CPlApplet** returns zero in response to the CPL_INIT message, Control Panel calls the **FreeLibrary** function and ends communication with the application DLL. This is the only way an application can notify Control Panel of initialization problems and prevent the application from being loaded.

If initialization is successful, Control Panel sends the CPL_GETCOUNT message. The **CPlApplet** function responds by returning the number of applications serviced by the application DLL. This number determines how many icons Control Panel displays for the DLL.

Once Control Panel finds out the number of applications serviced by the DLL, it sends the CPL_NEWINQUIRE message once for each application. The *lParam1* parameter specifies the application number, which is zero for the first application and CPL_GETCOUNT minus 1 for the last application.

Control Panel passes a far pointer to a **NEWCPLINFO** structure in the *lParam2* parameter. The **NEWCPLINFO** structure has the following form:

```
typedef struct tagNEWCPLINFO /* ncpli */
{
    DWORD dwSize;          /* length of structure, in bytes     */
    DWORD dwFlags;         /* setup flags                       */
    DWORD dwHelpContext;   /* help-context number               */
    LONG  lData;           /* application-defined data          */
    HICON hIcon;           /* handle of icon (owned by CPL.EXE) */
    char  szName[32];      /* short-name string                 */
    char  szInfo[64];      /* description string (status line)  */
    char  szHelpFile[128]; /* path to help file                 */
```

```
} NEWCPLINFO;
```

The **CPlApplet** function must fill in the **NEWCPLINFO** structure. The function must assign values for the **dwSize**, **hIcon**, **szName**, and **szInfo** members for the structure size, application icon, short name, and description. To add an accelerator key for the application, precede the selected accelerator character in the **szName** string with an ampersand. If the application DLL supports context-sensitive Help, the **CPlApplet** function should also assign the values for the **dwHelpContext** and **szHelpFile** members. The **lData** member can be used for application-defined data.

Note: The CPL_NEWINQUIRE message and **NEWCPLINFO** structure replace the CPL_INQUIRE message and **CPLINFO** structure. The latter have been kept for backward compatibility with Windows version 3.0. If the application DLL does not respond to the CPL_NEWINQUIRE message, Control Panel sends it the CPL_INQUIRE message. Then the *lParam2* parameter points to a **CPLINFO** structure rather than to a **NEWCPLINFO** structure.

Responding to User Actions

Control Panel sends the CPL_SELECT and CPL_DBLCLK messages when the user selects (single-clicks) or double-clicks an application icon. For each message, Control Panel passes the application number in *lParam1* and the **lData** value in *lParam2.*

Typically, an application DLL responds to the CPL_SELECT message by doing nothing. When it receives the CPL_DBLCLK message, it transfers control to the appropriate dialog box.

Exiting the Application and the DLL

Before exiting, Control Panel sends the CPL_STOP message once for each application in the DLL. The *lParam1* and *lParam2* parameters sent with the CPL_STOP message correspond to the application number and the **lData** value. After Control Panel sends the last CPL_STOP message, it sends a CPL_EXIT message and then calls the **FreeLibrary** function to free the DLL.

When the CPL_STOP and CPL_EXIT cases in the switch statement are executed, the DLL frees memory that it allocated. Typically, the DLL frees memory associated with individual applications when the CPL_STOP case is executed and frees any other allocated memory when the CPL_EXIT case is executed.

Example of a Control Panel Application

The following example shows the **CPlApplet** function for a DLL containing three Control Panel applications that set preferences for a component stereo system attached to the computer.

The example uses a programmer-defined StereoApplets array that contains three structures, each corresponding to one of the Control Panel applications. Each structure contains all the information required by the CPL_INQUIRE message, as well as the dialog box template and dialog box procedure required by the CPL_DBLCLK message. The following example fills the structures in the StereoApplets array:

```
#define NUM_APPLETS 3

typedef struct tagApplets
{
    int icon;         /* icon-resource identifier                */
    int namestring;   /* name-string resource identifier         */
    int descstring;   /* description-string resource identifier  */
    int dlgtemplate;  /* dialog box template resource identifier */
    DLGPROC dlgfn;    /* dialog box procedure                    */
} APPLETS;

APPLETS StereoApplets[NUM_APPLETS] =
{
    AMP_ICON, AMP_NAME, AMP_DESC, AMP_DLG, AmpDlgProc,
```

```
    TUNER_ICON, TUNER_NAME, TUNER_DESC, TUNER_DLG, TunerDlgProc,
    TAPE_ICON, TAPE_NAME, TAPE_DESC, TAPE_DLG, TapeDlgProc,
};
```

This code defines the **CPlApplet** function for the preceding example:

```
LONG CALLBACK CPlApplet(hwndCPL, msg, lParam1, lParam2)
HWND hwndCPL;       /* handle of Control Panel window */
UINT msg;           /* message                        */
LPARAM lParam1;     /* first message parameter        */
LPARAM lParam2;     /* second message parameter       */
{
    int i;
    LPCPLINFO lpCPlInfo;

    i = (int) lParam1;

    switch (msg) {
        case CPL_INIT: /* first message, sent once */
            return TRUE;

        case CPL_GETCOUNT: /* second message, sent once */
            return NUM_APPLETS;
            break;

        case CPL_INQUIRE: /* third message, sent once per app */
            lpCPlInfo = (LPCPLINFO) lParam2;

            lpCPlInfo->idIcon = StereoApplets[i].icon;
            lpCPlInfo->idName = StereoApplets[i].namestring;
            lpCPlInfo->idInfo = StereoApplets[i].descstring;
            lpCPlInfo->lData  = 0;

            break;

        case CPL_SELECT: /* application selected */
            break;

        case CPL_DBLCLK: /* application double-clicked */
            DialogBox(hinst,
                MAKEINTRESOURCE(StereoApplets[i].dlgtemplate),
                hwndCPL, StereoApplets[i].dlgfn);
            break;

        case CPL_STOP: /* sent once per app before CPL_EXIT */
            break;

        case CPL_EXIT: /* sent once before FreeLibrary called */
            break;

        default:
            break;
    }
    return 0;
}
```

Installing a New Application

There are three ways to register an application DLL with Control Panel:

- List the DLL in the [MMCPL] section of the CONTROL.INI file. Use this method when the DLL is part of a system library and handles more than just messages from Control Panel. The following is a sample CONTROL.INI entry:

```
[MMCPL]
myapplets=mydll.dll
```

- Assign the DLL a .CPL filename extension and install it in the directory that contains the CONTROL.INI file.
- Assign the DLL a .CPL filename extension and install it in the Windows SYSTEM directory.

See Also

CPlApplet

File Manager Extensions (3.1)

This topic describes how to create and install extensions for File Manager in the Microsoft Windows operating system. A File Manager extension is a dynamic-link library (DLL) that adds a menu to File Manager.

File Manager maintains a list of extensions in an initialization file and loads the extentsions when starting. An extension DLL contains an entry point that processes menu commands and notification messages sent by File Manager. Up to five extension DLLs can be installed at any one time.

Creating a File Manager Extension

A File Manager extension must reside in a DLL that includes a standard entry point, the **FMExtensionProc** function. It must include the WFEXT.H header file that defines File Manager messages and structures. File Manager communicates with the extension DLL by sending the following messages to the DLL's **FMExtensionProc** function:

Message	Meaning
1 through 99	User has selected an item from the extension-supplied menu. The value is the identifier of the selected menu item.
FMEVENT_INITMENU	User has selected the extension's menu. The extension should initialize items in the menu.
FMEVENT_LOAD	File Manager is loading the extension DLL and prompts the DLL for information about the menu that the DLL supplies.
FMEVENT_SELCHANGE	Selection in the File Manager directory window or Search Results window has changed.
FMEVENT_UNLOAD	Extension DLL is being unloaded.
FMEVENT_USER_REFRESH	User has chosen the Refresh command from the Window menu. The extension should update items in the menu, if necessary.

Creating the Entry-Point Function

File Manager communicates with an extension DLL through the **FMExtensionProc** function. Be sure to export this function by listing it in an **EXPORTS** statement of your module-definition (.DEF) file. The **FMExtensionProc** function handles the messages listed in the previous section, performing the following tasks:

Task Action

Initializing the extension (FMEVENT_LOAD)
: Provides File Manager with the name and handle of the menu and saves the menu-item delta value.

Initializing the menu (FMEVENT_INITMENU)
: Initializes all top-level menu items and the items in any submenus.

Processing menu selections
: Carries out commands that the user chooses from the extension's menu.

Processing file selections (FMEVENT_SELCHANGE)
: Queries File Manager for information about the file that the user has selected from the directory window or Search Results window.

Updating items in the menu (FMEVENT_USER_REFRESH)
: Modifies the menu as appropriate when the user chooses File Manager's Refresh command from the Window menu.

Quitting the extension DLL (FMEVENT_UNLOAD)
: Frees any memory allocated and prepares to exit.

The **FMExtensionProc** function is defined as follows:

```
HMENU CALLBACK FMExtensionProc(hwnd, msg, lParam)
```

```
HWND hwnd;
UINT msg;
LPARAM lParam;
```

The *hwnd* parameter identifies the File Manager window. An extension should use this window handle to specify the parent window for any dialog boxes or message boxes it needs to display. It should also use this handle to send query messages to File Manager. The *msg* parameter contains one of the File Manager messages listed previously. The *lParam* parameter contains a message-dependent value. The return value from the **FMExtensionProc** function depends on the value of the *msg* parameter.

The menu added to File Manager may be a hierarchical (cascaded) menu and may contain grayed, disabled, or checked menu items in addition to command items. Menu items should be text only; owner-drawn menus and bitmap menus are not supported. Changing the check-mark bitmap is not supported.

Whenever File Manager calls the **FMExtensionProc** function, it waits to refresh its directory windows (for changes in the file system) until after the function returns. This allows the extension to perform large numbers of file operations without excessive repainting on the part of File Manager. The extension does not need to send the **FM_REFRESH_WINDOWS** message to notify File Manager to repaint its directory windows.

Loading the Extension

File Manager sends, first, the **FMEVENT_LOAD** message to the **FMExtensionProc** function. The *lParam* parameter that accompanies the FMEVENT_LOAD message points to an **FMS_LOAD** structure that File Manager uses to obtain information about the extension-supplied menu, including the menu name and menu handle.

File Manager also uses the **FMS_LOAD** structure to pass the menu-item delta value to the extension. To avoid conflicts with its own menu-item identifiers, File Manager renumbers the menu-item identifiers in an extension-supplied menu by adding the delta value to each identifier. If an extension DLL needs to modify its menu after File Manager has loaded it, it must use the delta value. For example, to delete a menu item, the extension DLL finds the sum of the delta value and the menu item's identifier and then passes the sum as the *idItem* parameter to the **DeleteMenu** function.

Processing Menu Selections

The menu resource that you define for your extension's menu must use menu-item identifiers in the range 1 through 99. When the user selects an item, the extension receives a command notification, which is the actual identifier of the selected item as defined in the resource-definition file (which has the .RC filename extension). The command notification is not the sum of the delta value and the identifier. An extension DLL's **FMExtensionProc** function carries out commands by processing command notifications.

Initializing the Extension Menu

Whenever the user selects the extension's main menu item from File Manager's menu bar, File Manager sends the **FMEVENT_INITMENU** message to the extension DLL. An extension can use this message to initialize its menu items. For example, an extension can add check marks, disable items, or gray items during this message.

When the user selects submenus within the extension's menu, File Manager does not send the **FMEVENT_INITMENU** message. An extension DLL must initialize all items at the same time, including those in submenus.

Updating the Extension Menu

When the user chooses the Refresh command from the Window menu, File Manager sends an **FMEVENT_USER_REFRESH** message to an extension DLL. An extension can use this opportunity to update its menu items.

Processing File Selections

When the user selects a filename in the directory window or in the Search Results window, File Manager sends the **FMEVENT_SELCHANGE** message to an extension DLL. An extension can use this opportunity to send a query message to File Manager to obtain more information about the user's selection. For more information, see Extension Messages.

Because the user can change the selection often, the extension should return promptly after processing the **FMEVENT_SELCHANGE** message to avoid slowing the user's selection process.

Quitting the Extension DLL

When File Manager quits, it sends the **FMEVENT_UNLOAD** message to each extension DLL and then calls the **FreeLibrary** function to free the DLLs. Each DLL should free any memory that it has allocated.

Installing Extensions

File Manager installs extensions that have settings in the [AddOns] section of the WINFILE.INI initialization file. Each setting contains an entry and a value. An entry consists of a string that represents the name of an extension. The value assigned to the entry consists of a string that specifies the path to the extension DLL. An application can use the **WritePrivateProfileString** function to add a setting to WINFILE.INI. The following example shows a setting in WINFILE.INI:

```
[AddOns]
My File Manager Extension=c:\win\system\rfmine.dll
```

File Manager does not display an error message if it cannot find an extension DLL, so an extension DLL can be deleted in order to uninstall it. Even so, an application that installs an extension DLL should provide an uninstall option to remove the extension's setting from the WINFILE.INI file.

Extension Messages

An extension can send the following window messages to retrieve relevant information from File Manager. File Manager is only guaranteed to respond correctly to messages sent from the **FMExtensionProc** function.

Message	Description
FM_GETDRIVEINFO	File Manager returns drive information from the active window. An extension provides a pointer to an **FMS_GETDRIVEINFO** structure; File Manager fills the structure with drive information.
FM_GETFILESEL	File Manager returns information about a selected file from the active File Manager window (either the directory window or the Search Results window). An extension provides a pointer to an **FMS_GETFILESEL** structure; File Manager fills the structure with file information.
FM_GETFILESELLFN	Same as the **FM_GETFILESEL** message except that the selected file may have a long filename.
FM_GETFOCUS	File Manager returns a value that identifies the type of window with input focus.
FM_GETSELCOUNT	File Manager returns the count of selected files in the directory and Search Results windows.
FM_GETSELCOUNTLFN	Same as the **FM_GETSELCOUNT** message except that the count includes files with long filenames.
FM_REFRESH_WINDOWS	File Manager repaints either its active window or all of its windows. This message is similar to File Manager's Refresh command on the Window menu.
FM_RELOAD_EXTENSIONS	File Manager reloads all extensions. First File Manager unloads all extensions, sending an **FMEVENT_UNLOAD** message to each extension. Then it reloads the extensions, sending an

FMEVENT_LOAD message to each extension. The **FM_RELOAD_EXTENSIONS** message allows an extension to uninstall itself by removing its setting from the WINFILE.INI file; this action causes File Manager to reload the remaining extensions. Other applications (for example, installation programs) can also post this message by calling the **PostMessage** function.

File Manager Extension Example

The following example shows the **FMExtensionProc** function for a sample extension DLL. It demonstrates how an extension processes the menu commands and notification messages sent by File Manager.

```
HINSTANCE hinst;
HMENU hmenu;
WORD wMenuDelta;
BOOL fMultiple = FALSE;
BOOL fLFN = FALSE;

DWORD FAR PASCAL FMExtensionProc(hwnd, wMsg, lParam)
HWND hwnd;
WORD wMsg;
LONG lParam;
{
    char szBuf[200];
    int count;

    switch (wMsg) {
        case FMEVENT_LOAD:

            #define lpload  ((LPFMS_LOAD)lParam)

            /* Save the menu-item delta value. */

            wMenuDelta = lpload->wMenuDelta;

            /* Fill the FMS_LOAD structure. */

            lpload->dwSize = sizeof(FMS_LOAD);
            lstrcpy(lpload->szMenuName, "&Extension");

            /* Return the handle of the menu. */

            return (DWORD) (lpload->hMenu = LoadMenu(hinst,
                MAKEINTRESOURCE(MYMENU)));
            break;

        case FMEVENT_UNLOAD:

            /* Perform any cleanup procedures here. */

            break;

        case FMEVENT_INITMENU:

            /* Copy the menu-item delta value and menu handle. */
```

```
    wMenuDelta = LOWORD(lParam);
    hmenu = (HMENU) HIWORD(lParam);

    /*
     * Add check marks to menu items as appropriate. Add menu-
     * item delta values to menu-item identifiers to specify the
     * menu items to check.
     */

    CheckMenuItem(hmenu, wMenuDelta + MULTIPLE,
        fMultiple ? MF_BYCOMMAND | MF_CHECKED :
                    MF_BYCOMMAND | MF_UNCHECKED);
    CheckMenuItem(hmenu, wMenuDelta + LFN,
        fLFN ? MF_BYCOMMAND | MF_CHECKED :
               MF_BYCOMMAND | MF_UNCHECKED);
    break;

case FMEVENT_USER_REFRESH:
    MessageBox(hwnd, "User refresh event", "Hey!", MB_OK);
    break;

case FMEVENT_SELCHANGE:
    OutputDebugString("Sel change\r\n");
    break;

/*
 * The following messages are generated when the user chooses
 * items from the extension menu.
 */

case GETFOCUS:
    wsprintf(szBuf, "Focus %d", (int)SendMessage(hwnd,
        FM_GETFOCUS, 0, 0L));
    MessageBox(hwnd, szBuf, "Focus", MB_OK);
    break;

case GETCOUNT:
    count = (int)SendMessage(hwnd,
        fLFN ? FM_GETSELCOUNTLFN : FM_GETSELCOUNT, 0, 0L);

    wsprintf(szBuf, "%d files selected", count);
    MessageBox(hwnd, szBuf, "Selection Count", MB_OK);
    break;

case GETFILE:
{
    FMS_GETFILESEL file;

    count = (int) SendMessage(hwnd,
        fLFN ? FM_GETSELCOUNTLFN : FM_GETSELCOUNT,
        FMFOCUS_DIR, 0L);

    while (count >= 1) {

        /* Selection indices are zero-based (0 is first). */

        count--;
```

```
                SendMessage(hwnd, FM_GETFILESEL, count,
                    (LONG) (LPFMS_GETFILESEL)&file);
                OemToAnsi(file.szName, file.szName);
                wsprintf(szBuf, "file %s\nSize %ld",
                    (LPSTR)file.szName, file.dwSize);
                MessageBox(hwnd, szBuf, "File Information", MB_OK);

                if (!fMultiple)
                        break;
            }
            break;
        }

        case GETDRIVE:
        {
            FMS_GETDRIVEINFO drive;

            SendMessage(hwnd, FM_GETDRIVEINFO, 0,
                (LONG) (LPFMS_GETDRIVEINFO)&drive);

            OemToAnsi(drive.szVolume, drive.szVolume);
            OemToAnsi(drive.szShare, drive.szShare);

            wsprintf(szBuf,
        "%s\nFree Space %ld\nTotal Space %ld\nVolume %s\nShare %s",
                (LPSTR) drive.szPath, drive.dwFreeSpace,
                drive.dwTotalSpace, (LPSTR) drive.szVolume,
                (LPSTR) drive.szShare);
            MessageBox(hwnd, szBuf, "Drive Info", MB_OK);
            break;
        }

        case LFN:
            fLFN = !fLFN;
            break;

        case MULTIPLE:
            fMultiple = !fMultiple;
            break;

        case REFRESH:
        case REFRESHALL:
            SendMessage(hwnd, FM_REFRESH_WINDOWS,
                wMsg == REFRESHALL, 0L);
            break;

        case RELOAD:
            PostMessage(hwnd, FM_RELOAD_EXTENSIONS, 0, 0L);
            break;
    }
    return NULL;
}
```

Adding the Undelete Command

File Manager supports a hook for adding an Undelete command to the File menu (below the Delete command). If an undelete dynamic-link library is specified in the WINFILE.INI file, File Manager adds

the Undelete command to the File menu when it starts. When the user chooses the Undelete command, File Manager calls the DLL.

The [settings] section of the WINFILE.INI file should include a reference to the undelete DLL, as follows:

```
[settings]
UNDELETE.DLL=C:\MYDIR\OTHER.DLL
```

An undelete DLL must include a standard entry point, the **UndeleteFile** function. This function must be exported by specifying the name of the function in the **EXPORTS** statement of the DLL's module-definition (.DEF) file.

The **UndeleteFile** function is defined as follows:

```
int CALLBACK UndeleteFile(hwndParent, lpszDir)
HWND hwndParent;
LPSTR lpszDir;
```

The *hwndParent* parameter identifies the parent window for any dialog boxes that the DLL creates. The *lpszDir* parameter specifies the initial directory to be used (for example, C:\TEMP).

See Also

File Manager Extension Functions, **File Manager Extension Messages**, File Manager Extension Structures

Shell Dynamic-Data Exchange Interface Overview (3.1)

This topic describes the dynamic data exchange (DDE) interface of Windows Program Manager (PROGMAN.EXE). Program Manager is an application that lets users group, start, and otherwise control other applications for the Microsoft Windows operating system. Program Manager starts automatically when the user starts Windows and continues to run as long as Windows is in use. Upon starting, Program Manager displays one or more windows within its main window. Each window contains icons that correspond to logically related Windows applications. For example, the Main window contains an icon for the File Manager, Control Panel, Print Manager, Clipboard, MS-DOS Prompt, and Windows Setup applications.

The following topics are related to the information in this topic:

- Atoms
- Dynamic data exchange (DDE)
- Registration database

PROGMAN.INI File

When Program Manager starts, it searches its initialization file for a list of group files. The windows that appear in Program Manager's main window correspond to group files. From the user's perspective, a group file is a collection of icons that represent logically related applications, but from the programmer's perspective, a group file is actually a collection of data. This data includes the color information for the icons (their AND and XOR masks), an offset to the resource header for each icon, the ideal resolution for displaying each icon, the name of the executable file that contains the application, and so on.

Group files are identified in the Program Manager initialization file (PROGMAN.INI). This initialization file has the following form:

```
[Settings]
Window=64 48 576 384 1
Order= 3 4 5 6 8 7 2 1 9
AutoArrange=1
SaveSettings=1
MinOnRun=1
Startup=
display.drv=v776816.drv

[Groups]
Group1=C:\WINDOWS\MAIN.GRP
Group2=C:\WINDOWS\ACCESSOR.GRP
Group3=C:\WINDOWS\GAMES.GRP
Group4=C:\WINDOWS\STARTUP.GRP
Group5=C:\WINDOWS\LZEXPAND.GRP
Group6=C:\WINDOWS\COMDLG.GRP
Group7=C:\WINDOWS\GDI.GRP
Group8=C:\WINDOWS\WINPROJ.GRP
Group9=C:\WINDOWS\MICROSOF.GRP

[Restrictions]
NoRun=1
NoClose=1
NoSaveSettings=0
NoFileMenu=0
EditLevel=3
```

The following three sections describe the contents of the PROGMAN.INI file.

Settings Section

The first section of the initialization file, [Settings], controls attributes of the Program Manager environment. The following entries appear in the [Settings] section:

Entry	Meaning
Window=	Specifies the location and dimensions of Program Manager's main window.
Order=	Specifies the order in which the groups listed in the [Groups] section appear in Program Manager's main window.
AutoArrange=	Specifies whether Program Manager should automatically arrange icons within groups.
SaveSettings=	Specifies whether to save the position of Program Manager's main window when exiting Program Manager.
MinOnRun=	Specifies whether to minimize Program Manager when an application is started.
Startup=	Specifies the name of the startup group. Program Manager automatically starts the applications in the startup group whenever it starts. If the startup group has a name other than "Startup", that name must be specified by the Startup= entry.
display.drv=	Specifies the display driver that was in use when Program Manager last ended. When Program Manager starts, it compares this value to the string in the SYSTEM.INI file. If they are different, Program Manager reextracts the application icons.

Groups Section

The second section of the initialization file, [Groups], identifies the names of the group files for which Program Manager should display unique windows or icons. The groups must be numbered, but they need not be listed in any particular order. Program Manager never changes the number of an existing group, so if an application other than Program Manager constructs a PROGMAN.INI file, it can assign meaningful numbers to groups, if necessary.

Restrictions Section

The third section of the initialization file, [Restrictions], disables some capabilities of the Program Manager environment. The following entries can appear in the [Restrictions] section:

Entry	Meaning
NoRun=	Specifies whether to disable the Run command on the File menu. If this entry is set to 1, the command is disabled. If this entry is set to 0, the Run command is enabled. The default is 0 (enabled) if no value is specified.
NoClose=	Specifies whether to prevent the user from exiting Program Manager through the File menu, the System menu, the ALT+F4 accelerator, or the Task List. If this entry is set to 1, exiting is prevented. If this entry is set to 0, exiting is allowed. The default is 0 (allowing exiting) if no value is specified.
NoSaveSettings=	Specifies whether to disable the Save Settings on Exit command on the Options menu. If this entry is set to 1, the Save Settings on Exit command is disabled. If this entry is set to 0, the command is enabled. The default is 0 (enabled) if no value is specified.
NoFileMenu=	Specifies whether to disable the File menu and all of its commands. If this entry is set to 1, the File menu is disabled. If this entry is set to 0, the menu is enabled. The default setting is 0 (enabled) if no value is specified.
EditLevel=	Controls the extent to which the user can modify read-write groups. (Shared, read-only groups cannot be modified.) This entry may be set to one of the following values:

Value	Meaning
0	Allows any modifications to the group. This is the default.
1	Prevents the user from creating, deleting, or renaming groups.
2	Prevents the user from creating, deleting, or renaming groups and

from creating or deleting items in a group.

3	Prevents the user from creating, deleting, or renaming groups; from creating or deleting items in a group; and from changing command lines for items in a group.
4	Prevents the user from changing any property of an item in a group; from creating, deleting, or renaming groups; from creating or deleting items in a group; and from changing command lines for items in a group.

Setting NoRun to 1 and EditLevel to 3 prevents a user from using Program Manager to run any applications that are not already in a program group.

Command-String Interface

Program Manager has a DDE command-string interface that allows other applications to create, display, delete and reload groups; add items to groups; replace items in groups; delete items from groups; and to close Program Manager. The following commands perform these actions:

AddItem	**ExitProgman**
CreateGroup	**Reload** (Windows 3.1 only)
DeleteGroup	**ReplaceItem** (Windows 3.1 only)
DeleteItem (Windows version 3.1 only)	**ShowGroup**

The setup program for an application can use these commands, for example, to instruct Program Manager to install the application's icon in a group.

Multiple commands may be concatenated; each command must be contained in square brackets, and parameters must be contained in parentheses and separated by commas. Quotation marks must be used to delimit arguments that contain spaces, brackets, or parentheses. For example, the following set of commands adds WINAPP.EXE to the Windows Applications group:

```
[CreateGroup("Windows Applications")]
[ShowGroup("MYGROUP.GRP",1)]
[AddItem(winapp.exe,Win App,winapp.exe,2)]
```

To use these commands, an application must first initiate a conversation with Program Manager. The application and topic names for the conversation are both PROGMAN. Then the application sends the **WM_DDE_EXECUTE** message, specifying the appropriate command and its parameters.

Note: The user can configure Windows to use a shell other than Program Manager as the default. As a result, you should not design an application assuming that Program Manager will be available for a DDE conversation.

The following sections describe Program Manager DDE command strings in detail. In the syntax blocks in the following sections, brackets enclose optional arguments.

CreateGroup

The syntax for the **CreateGroup** command has this form:

CreateGroup(*GroupName*[,*GroupPath*])

The **CreateGroup** command instructs Program Manager to create a new group or activate the window of an existing group.

Following are the parameters for this command:

GroupName	Identifies the group to be created. This parameter is a string. If a group already exists with the name specified by *GroupName,* **CreateGroup** activates the group window.
GroupPath	Specifies the path of the group file. If your application does not supply this parameter, Windows uses a default filename for the group in the Windows directory.

ShowGroup

The syntax for the **ShowGroup** command has this form:

ShowGroup(*GroupName,ShowCommand*)

The **ShowGroup** command instructs Program Manager to minimize, maximize, or restore the window of an existing group.

Following are the parameters for this command:

GroupName Identifies the group window to be minimized, maximized, or restored.

ShowCommand Specifies the action that Program Manager is to perform on the group window. This parameter is an integer. It must have one of the following values:

Value	Meaning
1	Activates and displays the group window. If the window is minimized or maximized, Windows restores it to its original size and position.
2	Activates the group window and displays it as an icon.
3	Activates the group window and displays it as a maximized window.
4	Displays the group window in its most recent size and position. The window that is currently active remains active.
5	Activates the group window and displays it in its current size and position.
6	Minimizes the group window.
7	Displays the group window as an icon. The window that is currently active remains active.
8	Displays the group window in its current state. The window that is currently active remains active.

DeleteGroup

The syntax for the **DeleteGroup** command has this form:

DeleteGroup(*GroupName*)

The **DeleteGroup** command instructs Program Manager to delete an existing group.

Following is the parameter for this command:

GroupName Identifies the group to be deleted.

Reload

The syntax for the **Reload** command has this form:

Reload(*GroupName*)

The **ReloadGroup** command instructs Program Manager to remove and reload an existing group. An application that modifies group files can use this command to cause Program Manager to update the groups when it has finished making modifications.

Following is the parameter for this command:

GroupName Identifies the group to be removed and reloaded. If the *GroupName* parameter is not specified, Program Manager unloads all groups and reloads the [Group] section of PROGMAN.INI. The [Settings] and [Restrictions] sections are not reread.

AddItem

The syntax for the **AddItem** command has this form:

AddItem(*CmdLine*[,
Name[,*IconPath*[,*IconIndex*[,*xPos, yPos*[,*DefDir*[,

HotKey,[,*fMinimize*]]]]]])

The **AddItem** command instructs Program Manager to add an icon to an existing group.

Following are the parameters for this command:

CmdLine	Specifies the full command line required to execute the application. This parameter is a string. At a minimum, this string is the name of the executable file for the application. It can also include the full path of the application and any parameters required by the application.
Name	Specifies the title that is displayed below the icon in the group window.
IconPath	Identifies the filename for the icon to be displayed in the group window. This parameter is a string. This file can be either a Windows executable file or an icon file. If the *IconPath* parameter is not specified, Program Manager uses the first icon in the file specified by the *CmdLine* parameter if that file is an executable file. If *CmdLine* specifies an associated file, Program Manager uses the first icon of the associated executable file. The association is taken from the registration database. (For more information about the registration database, see The Windows Shell Overview.) If *CmdLine* specifies neither an executable file nor an associated executable file, Program Manager uses a default icon.
IconIndex	Specifies the index of the icon in the file identified by the *IconPath* parameter. The *IconIndex* parameter is an integer. PROGMAN.EXE contains five built-in icons that can be used for non-Windows programs.
xPos	Specifies the horizontal position of the icon in the group window. This parameter is an integer. You must use both the *xPos* and *yPos* parameters to specify the position of the icon. If you do not specify the position, Program Manager places the icon in the next available space.
yPos	Specifies the vertical position of the icon in the group window. This parameter is an integer. You must use both the *xPos* and *yPos* parameters to specify the position of the icon. If you do not specify the position, Program Manager places the icon in the next available space.
DefDir	Specifies the name of the default (or working) directory. This parameter is a string.
HotKey	Identifies a hot (or shortcut) key that is specified by the user.
fMinimize	Specifies whether an application window should be minimized when it is first displayed.

ReplaceItem

The syntax for the **ReplaceItem** command has this form:

ReplaceItem(*ItemName*)

The **ReplaceItem** command instructs Program Manager to delete an item and record the position of the deleted item. Program Manager will add a new item (specified by the next **AddItem** command) at this recorded position.

Following is the parameter for this command:

ItemName	Specifies the item to be deleted. Its position is recorded by Program Manager.

DeleteItem

The syntax for the **DeleteItem** command has this form:

DeleteItem(*ItemName*)

The **DeleteItem** command instructs Program Manager to delete an item from the currently active group.

Following is the parameter for this command:

ItemName	Specifies the item to be deleted from the currently active group.

ExitProgman

The syntax for the **ExitProgman** command has this form:

ExitProgman(*bSaveGroups*)

If Program Manager was started by another application, the **ExitProgman** command instructs Program Manager to exit and, optionally, save its group information.

Following is the parameter for this command:

bSaveGroups Specifies a Boolean value that, if nonzero, causes Program Manager to save its group information before closing. If *bSaveGroups* is zero, Program Manager does not save its group information.

Requesting Group Information

Program Manager can provide information about its groups to an application. Applications can request this information from Program Manager by using the PROGMAN topic.

An application can obtain a list of Program Manager groups by issuing a request for the Group item. Program Manager provides the list in CF_TEXT format. The list consists of group-name strings separated by carriage returns.

An application can use a group name as an item name to request information about the group. Program Manager provides this information in CF_TEXT format. The fields of group information are separated by commas. The first line of the information contains the group name (in quotation marks), the path of the group file, and the number of items in the group. Each subsequent line contains information about an item in the group, including the command line (in quotation marks), the default directory, the icon path, the position in the group, the icon index, the shortcut key (in numeric form), and the minimize flag.

Dynamic Data Exchange Interface for Replacement Shells

You may choose to write an application that replaces the Windows shell. This replacement shell must be able to provide property information to the application that starts non-Windows programs in an MS-DOS window. (This application is known as WinOldApp.) This section discusses how a replacement shell can provide property information for WinOldApp. Applications other than WinOldApp do not need this information. The DDE protocol described in this section may not be supported in future versions of Windows.

Properties

A replacement shell should maintain several pieces of information, called properties, for each application that WinOldApp might start. These are the same properties that appear in the Program Item Properties dialog box of Program Manager. These properties include:

- Description (title)
- Command line
- Working directory
- Shortcut key
- Icon

The shell must provide a DDE interface that allows WinOldApp to obtain three of these properties: description, working directory, and icon.

To obtain its properties from the shell, WinOldApp must accomplish the following tasks:

1 Establish a DDE conversation with the shell.

2 Request a property from the shell.

3 Receive a property from the shell.

4 Terminate the DDE conversation.

Establishing a DDE Conversation

WinOldApp requests property data from the shell by using the **SendMessage** function to broadcast the **WM_DDE_INITIATE** message. The *wParam* parameter of the **SendMessage** function is the handle of WinOldApp's DDE window. The low-order word of the *lParam* parameter is an atom that represents the name of the shell application: "Shell". The high-order word is an atom that represents the name of the properties topic: "AppProperties".

A "Shell" DDE server that supports the "AppProperties" topic responds to the **WM_DDE_INITIATE** message by sending a **WM_DDE_ACK** message. The server should send the following parameters with the WM_DDE_ACK message:

Parameter	Description
hwnd	Specifies the handle of WinOldApp's DDE window. The shell should use the handle that WinOldApp specified as the *wParam* parameter in the **WM_DDE_INITIATE** message.
message	Specifies the **WM_DDE_ACK** message.
wParam	Specifies the handle of the "Shell" server's DDE window.
HIWORD(*lParam***)**	Specifies an atom that represents the name of the shell application: "Shell".
LOWORD(*lParam***)**	Specifies an atom that represents the name of the properties topic: "AppProperties".

It is not necessary to free the atoms used in a conversation with WinOldApp. It is WinOldApp's responsibility to create and free the atoms.

Providing Property Data

After the DDE server that provides a replacement shell responds with a **WM_DDE_ACK** message to the **WM_DDE_INITIATE** from WinOldApp, WinOldApp sends a **WM_DDE_REQUEST** message to request property data. The server can respond to the WM_DDE_REQUEST message by posting a **WM_DDE_DATA** message.

The Windows shell associates an item name with each of the application properties that it provides. The item names are described in the following table:

Item name	Description
"GetDescription"	The shell provides an application's description (title) property.
"GetWorkingDIR"	The shell provides an application's working-directory property.
"GetIcon"	The shell provides an application's icon property.

WinOldApp requests properties by obtaining an atom for each of the item-name strings and passing the atoms to the shell in a sequence of **WM_DDE_REQUEST** messages (one message for each property). WinOldApp also passes the handle of the application's instance as the low-order word of the *lParam* parameter in the WM_DDE_REQUEST message. The shell should use this instance handle to find the properties associated with the application.

If a "Shell" DDE server does not recognize the application's instance handle, the server does not support properties for the application instance. In this case, the server should respond by sending a negative **WM_DDE_ACK** message. The parameters passed with the negative WM_DDE_ACK message are as follows:

Parameter	Description
hwnd	Specifies the handle of WinOldApp's DDE window. The shell should use the handle that WinOldApp specified as the *wParam* parameter in the **WM_DDE_REQUEST** message.
message	Specifies the **WM_DDE_ACK** message.
wParam	Specifies the handle of the "Shell" server's DDE window.
LOWORD(*lParam***)**	Specifies zero. The "Shell" DDE server does not support properties for the

	specified application instance.
HIWORD(*lParam***)**	Specifies an atom that represents the item name of the requested property. Depending on the type of property requested, the atom should identify one of the following strings: "GetDescription", "GetWorkingDIR", or "GetIcon".

When WinOldApp receives a negative **WM_DDE_ACK** message, it terminates the conversation with the "Shell" DDE server.

If a "Shell" DDE server recognizes the application's instance handle and the requested property is available, it should allocate a global memory object and copy the property data to the object. Then it should post a **WM_DDE_DATA** message to WinOldApp. The WM_DDE_DATA message should contain the handle of the global memory object.

The contents of the global memory object allocated by the shell depend on the type of property WinOldApp requested. The following three sections describe the description, working-directory, and icon properties.

Providing the Description Property

If the shell is responding to a request for the "GetDescription" property, the shell should pass the following parameters with the **WM_DDE_DATA** message:

Parameter	Description
hwnd	Specifies the handle of WinOldApp's DDE window. The shell should use the handle that WinOldApp specified as the *wParam* parameter in the **WM_DDE_REQUEST** message.
message	Specifies the **WM_DDE_DATA** message.
wParam	Specifies the handle of the shell's DDE window.
LOWORD(*lParam***)**	Specifies a handle to a global memory object that contains a **DDEDATA** structure. A description of the contents of the **DDEDATA** structure follows this table. To report an error, the server should use one of the error values listed with the **WinExec** function.
HIWORD(*lParam***)**	Specifies an atom that represents the string, "GetDescription".

The low-order word of the *lParam* parameter should be a handle to a global memory object that contains a **DDEDATA** structure (defined in the DDE.H header file). The contents of the **DDEDATA** structure are as follows:

```
#include <dde.h>

typedef struct tagDDEDATA {   /* ddedat */
    WORD    unused:12,
            fResponse:1,
            fRelease:1,
            reserved:1,
            fAckReq:1;
    short   cfFormat;
    BYTE    Value[1];
} DDEDATA;
```

The **Value** member should contain the description property, in the form of a null-terminated string of characters from the Windows character set. The string can be any size but typically contains fewer than 30 characters.

If the server sets the **fAckReq** bit, WinOldApp responds to the **WM_DDE_DATA** message by posting a **WM_DDE_ACK** message after processing the data.

If the server sets the **fRelease** bit, WinOldApp frees the global memory object after copying the description string. Otherwise, WinOldApp does not free the memory object.

Providing the Working-Directory Property

If the shell is responding to WinOldApp's request for the "GetWorkingDIR" property, the shell passes the following parameters with the **WM_DDE_DATA** message:

Parameter	Description
hwnd	Specifies the handle of WinOldApp's DDE window. The shell should use the handle that WinOldApp specified as the *wParam* parameter in the **WM_DDE_REQUEST** message.
message	Specifies the **WM_DDE_DATA** message.
wParam	Specifies the handle of the shell's DDE window.
LOWORD(*lParam***)**	Specifies a handle to a global memory object that contains a **DDEDATA** structure. A description of the contents of the **DDEDATA** structure follows this table. To report an error, the server should use one of the error values listed with the **WinExec** function.
HIWORD(*lParam***)**	Specifies an atom that represents the string, "GetWorkingDIR".

The low-order word of the *lParam* parameter is a handle to a global memory object that contains a **DDEDATA** structure. The contents of the **DDEDATA** structure are as follows:

```
#include <dde.h>

typedef struct tagDDEDATA {    /* ddedat */
    WORD    unused:12,
            fResponse:1,
            fRelease:1,
            reserved:1,
            fAckReq:1;
    short   cfFormat;
    BYTE    Value[1];
} DDEDATA;
```

The **Value** member should specify the location (drive and path) of the application's executable file, in the form of a null-terminated string of characters from the Windows character set. The character string has a maximum size of 128 characters (including the terminating null character).

If the server sets the **fAckReq** bit, WinOldApp responds to the **WM_DDE_DATA** message by posting a **WM_DDE_ACK** message after processing the working-directory property.

If the server sets the **fRelease** bit, WinOldApp frees the global memory object after copying the working-directory string. Otherwise, WinOldApp does not free the memory object.

Providing the Icon Property

If the shell is responding to WinOldApp's request for "GetIcon" property, the shell passes the following parameters with the **WM_DDE_DATA** message:

Parameter	Description
hwnd	Specifies the handle of WinOldApp's DDE window. The shell should use the handle that WinOldApp specified as the *wParam* parameter in the **WM_DDE_REQUEST** message.
message	Specifies the **WM_DDE_DATA** message.
wParam	Specifies the handle of the shell's DDE window.
LOWORD(*lParam***)**	Specifies a handle to a global memory object that contains a **DDEDATA** structure. A description of the contents of the **DDEDATA** structure follows this table. To report an error, the server should use one of the error values listed with the **WinExec** function.
HIWORD(*lParam***)**	Specifies an atom that represents the string, "GetIcon".

The low-order word of the *lParam* parameter is a handle to a global memory object that contains icon-property data. The icon data should be in the following form:

```
typedef struct tagICONPROPS { /* ip */

    unsigned reserved:12,   /* reserved                          */
             fResponse:1,   /* always 1                          */
             fRelease:1,    /* 1 if app. frees object, else 0    */
             reserved:1,    /* reserved                          */
             fAckReq:1;     /* 1 if app. should respond, else 0  */
    int      cfFormat;      /* clipboard format (not used)       */
    int      nWidth;        /* width, in pixels, of the icon     */
    int      nHeight;       /* height, in pixels, of the icon    */
    BYTE     nPlanes;       /* number of planes in XOR mask      */
    BYTE     nBitsPixel;    /* number of bits/pixel in XOR mask  */
    LPBYTE   lpANDbits;     /* points to AND mask array          */
    LPBYTE   lpXORbits;     /* points to XOR mask array          */
} ICONPROPS;
```

If the server sets the **fAckReq** bit, WinOldApp responds to the **WM_DDE_DATA** message with a **WM_DDE_ACK** message after processing the data.

If the server sets the **fRelease** bit, WinOldApp frees the global memory object after copying the working-directory string. Otherwise, WinOldApp does not free the memory object.

The **lpANDbits** and **lpXORbits** pointers may be either near or far. If the pointers are near (that is, the segment selector portion of the pointers is zero), the bits are part of the global memory object. The offset portion of the pointers is a near offset from byte zero of the object.

Because the bits are part of the global memory object, they are freed along with the object. The combined size of the **ICONPROPS** structure together with the bits pointed to by the **lpANDbits** and **lpXORbits** members must be no more than 64K.

If the server needs to use far pointers for the **lpANDbits** and **lpXORbits** members, the bits must be part of a separate memory object. This object is not freed automatically when the global memory object is freed.

Terminating the DDE Conversation

The shell may terminate the conversation at any time by posting a **WM_DDE_TERMINATE** message. After WinOldApp has obtained its properties from the shell, it terminates the DDE conversation by posting a WM_DDE_TERMINATE message.

International Applications

The Microsoft Windows operating system provides means for making applications country- and language-independent. This topic describes how to design Windows applications so that they can be readily adapted to international markets. The following topics are related to the information in this topic:

- File version library
- Resources and Resource Compiler (RC)
- Initialization files

Creating an International Application

To reach worldwide audiences, you need to design Windows applications so that they can be marketed in more than one country and modified for new markets. International applications must be country- and language-independent and easy to localize.

A Windows application, regardless of the language used in its interface, should be able to handle data from different countries and in different languages. For example, a database developed primarily for the English-speaking market should accept French and German input. The application should also support different currency symbols and date and time formats. Furthermore, it should permit complex operations, such as sorting, in any language selected by the user.

A Windows application should be developed so that localization can be easily accomplished. Localization is the process of adapting an application for a market other than the one for which it was originally designed. Adapting an application involves translating the product, adding new features when required, and modifying the product to meet local needs.

Achieving Country and Language Independence

Windows provides resources for writing applications that are country- and language-independent. These resources consist of international information stored in the WIN.INI file and in certain Windows functions. By using the resources described in this section, you can correctly produce international applications.

International Information in WIN.INI

The [Intl] section of the WIN.INI file contains the current country settings for Windows. The user can modify these settings through Control Panel. An application has access to the current country settings through the **GetProfileInt** and **GetProfileString** functions and can modify them through the **WriteProfileString** function. An application should read the required country settings at startup and should monitor the **WM_WININICHANGE** message to update its country settings in case the country settings in WIN.INI have changed.

Following are the country settings stored in WIN.INI:

iCountry Country code. This value is based on the telephone country code. The only exception is Canada, which has 2 instead of 1 (1 is used by the United States). This setting controls country-dependent features not supported by Windows.

sCountry String defining the selected country name.

sLanguage National language code selected by the user. The International dialog box in Control Panel changes the language of the installed language-dependent module. Following are some of the language codes that Windows currently supports:

Code	Language
DAN	Danish
DEU	German
ENG	U.K. English
ENU	U.S. English
ESN	Modern Spanish
ESP	Castilian Spanish

FIN	Finnish
FRA	French
FRC	Canadian French
ISL	Icelandic
ITA	Italian
NLD	Dutch
NOR	Norwegian
PTG	Portuguese
SVE	Swedish

sList List separator. This character separates elements in a list. The list separator must be different from the decimal separator to avoid conflicts with lists of numbers.

iMeasure Measurement system selected by the user, where 0 equals metric and 1 equals English. This setting controls measurement-dependent features of an application.

iTime Time format. This setting defines the time format: 12 hours or 24 hours, where 0 equals the 12-hour clock and 1 equals the 24-hour clock.

sTime Time separator. This character is displayed between hours and minutes and between minutes and seconds.

s1159 Trailing string (A.M., for example) used in some countries for times between 00:00 and 11:59.

s2359 Trailing string (P.M., for example) for times between 12:00 and 23:59 when in 12-hour clock format or trailing string (GMT, for example) for any time when in 24-hour clock format.

iTLZero Value specifying whether the hours displayed should have a leading zero, where 0 equals no leading zero (9:15, for example) and 1 equals a leading zero (09:15, for example).

iDate Date format. Kept for compatibility with Windows 2.*x.* The values for this setting are: 0 equals Month-Day-Year, 1 equals Day-Month-Year, and 2 equals Year-Month-Day. The **sShortDate** setting should be used instead.

sDate Date separator. Kept for compatibility with Windows 2.*x.* The **sShortDate** setting should be used instead.

sShortDate Date picture of the short date format. The **sShortDate** setting accepts only the values m, mm, d, dd, yy and yyyy. For information about these values and the format of date pictures, see the **sLongDate** setting.

sLongDate Date picture of the long date format, which is similar to the **sShortDate** setting, except it can also contain strings. Following are formats for different month (m), day (d), and year (y) values:

Value	Format
m	1-12
mm	01-12
mmm	Jan-Dec
mmmm	January-December
d	1-31
dd	01-31
ddd	Mon-Sun
dddd	Monday-Sunday
yy	00-99
yyyy	1900-2040

Following are examples of different date pictures:

Date picture	Example

d mmmm, yyyy	9 January, 1989
dddd, mmmm d, yyyy	Friday, February 7, 1992
m/d/yy	3/18/89
dd-mm-yyyy	18-03-1989
d "of" mmmm, yyyy	9 of January, 1992

sCurrency Currency symbol of a given country. Use of this setting requires care. If the currency symbol is changed through Control Panel, do not make global replacements of currency amounts in your application. Once the user has entered an amount using a particular currency, that currency should stay the same. This setting also requires special attention when files are shared among users or applications.

iCurrency Currency format. The values for this setting are as follows:

Value	Meaning
0	Currency symbol prefix with no separation ($1, for example)
1	Currency symbol suffix with no separation (1$, for example)
2	Currency symbol prefix with one character separation ($ 1, for example)
3	Currency symbol suffix with one character separation (1 $, for example)

iCurrDigits Number of digits used for the fractional part of a currency amount.

iNegCurr Negative currency format. The values for this setting are:

Value	Negative format
0	($1)
1	-$1
2	$-1
3	$1–
4	(1$)
5	-1$
6	1–$
7	1$–
8	-1 $
9	-$ 1
10	$ 1–

Note: The dollar symbol represents any currency symbol defined by the **sCurrency** setting.

sThousand Symbol used to separate thousands in numbers with more than three digits.

sDecimal Character used to separate the integer part from the fractional part of a number.

iDigits Value defining the number of decimal digits that should be used in a number.

iLzero Value specifying whether a decimal value less than 1.0 (and greater than -1.0) should contain a leading zero, as follows:

Value	Meaning
0	Do not use a leading zero (.7, for example).
1	Use a leading zero (0.7, for example).

International Information in Windows Functions

Windows includes provisions for specifying a national language. Language, in conjunction with the specification of a country, allows Windows to describe more precisely the characteristics of a given geographical location (for example, Swiss-German as opposed to Swiss-French). The following Windows functions behave differently depending on the language that is selected:

AnsiLower **IsCharAlpha**

AnsiLowerBuff **IsCharAlphaNumeric**

AnsiNext	**IsCharLower**
AnsiPrev	**IsCharUpper**
AnsiUpper	**lstrcmp**
AnsiUpperBuff	**lstrcmpi**

Comparing and Sorting Strings

The **lstrcmp** and **lstrcmpi** functions allow applications to compare and sort strings based on the language specified by the user. These functions take into account different alphabetic orderings, diacritical marks, and special cases that require character compression or expansion. Note that the **lstrcmp** and **lstrcmpi** functions do not act the same way as the C run-time functions **strcmp** and **strcmpi**.

The comparison done by **lstrcmp** and **lstrcmpi** is based on a primary value and a secondary value (see the following illustration). Each character has a primary and a secondary value.

When performing the comparison of two strings, the primary value takes precedence over the secondary value. That is, the secondary value is ignored unless a comparison based on primary value shows the strings as equivalent.

The following examples show the effect of primary and secondary values on string comparisons:

Comparison	Result
A = A	Primary values equal
A < a	Primary values equal, secondary values unequal (A < a)
Ab < ab	Primary values equal, secondary values unequal (A < a)
ab < Ac	Primary values unequal (b < c)

The **lstrcmpi** function ignores the effect of case in determining secondary value. That is, when **lstrcmpi** is called to compare AB and ab, the two strings are equivalent. However, **lstrcmpi** does not ignore diacritical marks, so Ab precedes äb regardless of whether the comparison is performed by the **lstrcmp** or **lstrcmpi** function.

When strings of different lengths are compared, length takes precedence over secondary values. That is, the shorter string always precedes the longer string as long as the primary values in the shorter string equal the primary values for equivalent characters in the longer string. For example, ab precedes **ABC**, but ABC precedes AD.

Depending on the language module installed, some characters are treated differently. For example, if the German language module is installed, the β character expands to *ss.* If the Spanish language module is installed, the characters *ch* are treated as a single character that sorts between *c* and *d.*

Case Conversions

Use of the case conversion functions, **AnsiLower**, **AnsiLowerBuff**, **AnsiUpper**, and **AnsiUpperBuff**, varies depending on the language module installed. The **IsCharAlpha**, **IsCharAlphaNumeric**, **IsCharLower** and **IsCharUpper** functions are also language-dependent. Different languages treat case conversions differently.

Note: Do not use the C-language case-conversion functions; they do not handle characters with values greater than 128 properly.

Handling Character Sets

If you are writing international Windows applications, you will handle different character sets. It is especially important in this case to understand the difference between the Windows and OEM character sets.

The Windows character set is essentially equivalent to the ANSI character set.

The OEM character set is defined by the Windows operating system as the character set used by MS-

DOS. The term OEM does not refer to a specific character set; instead, it refers to any of the different character sets (code pages) that can be installed and used by MS-DOS.

Because Windows runs on top of MS-DOS, there must be a layer between Windows and MS-DOS that performs translations between Windows and OEM characters. When Windows is first installed, the Windows Setup program looks at the character set that has been installed by MS-DOS and then installs the correct translation tables and Windows OEM fonts.

Windows applications should use the Windows **AnsiToOem** and **OemToAnsi** functions when transferring information to and from MS-DOS. Also, applications should use the correct character set when creating filenames. For more information about handling filenames, see the following section.

There is no one-to-one mapping between the Windows and OEM character sets. Applying the **AnsiToOem** function and then the **OemToAnsi** function to a given string does not always result in the original string.

Because the Windows and OEM character sets are 8-bit character sets, always use unsigned char values instead of signed char values. Bugs that result from using signed char values are very hard to track.

Handling Filenames

Applications do file handling differently depending on factors such as speed, size, and programming style. This section describes the most common methods for handling filenames.

The easiest way of handling filenames in Windows is to use the Windows character set for all filenames and to use the **_lcreat**, **_lopen**, and **OpenFile** functions to deal with differences between the MS-DOS and the OEM character sets.

Another way to handle filenames is to use the **OpenFile** function to obtain a full path, by using the **szPathName** member from the **OFSTRUCT** structure. The **szPathName** member contains characters from the OEM character set and must first be converted to the Windows character set before it is used as a parameter for the **OpenFile** function, for other Windows functions, or in a dialog box.

The following example shows this conversion:

```
if (OpenFile("myfile.txt", &of, OF_EXISTS) == -1) {
    OemToAnsi(of.szPathName, szAnsiPath);
    OpenFile(szAnsiPath, &of, OF_CREATE);
}
```

The third, and maybe most complicated, way of handling files is to call MS-DOS directly (by using the **DOS3Call** function or an Interrupt 21h instruction). You must ensure that your application always passes OEM characters to MS-DOS.

Differences between the Windows and OEM character sets complicate the handling of filenames. Problems can occur when applications try to create filenames using the Windows character set that have no equivalent characters in the OEM set. For example, the character Ê does not exist in code page 437 (437 is the standard U.S. extended ASCII character set). If the application tries to save the file named Ê.TXT, Windows converts Ê.TXT into E.TXT (by using the **AnsiToOem** function) and then passes it to MS-DOS.

You can prevent confusion about filenames by using the **ES_OEMCONVERT** and **CBS_OEMCONVERT** control styles. These styles (the first for edit controls and the second for combo boxes) read the user's input and convert the typed character to a valid character (one that exists in the OEM character set). This way, the user sees on the screen the actual filename that will be stored at the MS-DOS level.

Handling the Keyboard

The most important keyboard issue for international applications is the use of the VK_OEM keys for user input because the locations of these keys change depending on the keyboard layout chosen by the user.

The **VkKeyScan** function is used to translate characters from the Windows character set into a virtual-key code plus a shift state. This function can be also used when one application has to send text to another application by simulating keyboard input.

Some other useful keyboard functions are the following:

Function	Purpose
ToAscii	Converts a virtual-key code plus a shift state to a character in the Windows character set. This function is the opposite of the **VkKeyScan** function.
GetKeyNameText	Retrieves a string that contains the name of a key (the SHIFT key or the ENTER key, for example). The string is in the language associated with the keyboard. For example, for a French keyboard layout the names of the keys are in French.
GetKBCodePage	Returns the code page (OEM character set) that was running at the MS-DOS level at the time Windows was installed. Note that there is no real relationship between the keyboard and the code page installed.

To type characters that are not on your keyboard, use the ALT key and the numeric keypad. For characters in the Windows character set, hold down ALT and then, using the numeric keypad, type 0 and the three-digit code of the character you want. For an OEM character, type the three-digit code for the character.

Handling Initialization Files

The WIN.INI and SYSTEM.INI files use the Windows character set. Usually, however, applications do not access SYSTEM.INI. For WIN.INI as well as for private initialization files, applications should use the following functions:

GetPrivateProfileInt	**GetProfileString**
GetPrivateProfileString	**WritePrivateProfileString**
GetProfileInt	**WriteProfileString**.

The Windows character set should always be used with these functions.

The section names and setting names in WIN.INI and in private initialization files should be independent of the language of the application. Usually, all of these names remain in English. For example, in WIN.INI the section name [Desktop] and the setting name Wallpaper should always remain in English so that applications in different languages can access the same information.

International Uses of the File Version Library

If your application includes a Windows version resource, you can use the functions in the file version library (VER.DLL) in your installation program. A Windows version resource includes the language, code page, version number, and so on for a file. The functions in VER.DLL retrieve information from a file's version resource and install files based on this information. For example, if an installation program tries to replace an existing copy of an application with a new copy in a different language, the **VerInstallFile** function returns an error that indicates a language conflict. Then the installation program queries the user about whether to overwrite the old file, install the new copy in another location, or exit.

For more information about the contents of a version resource and about using version functions, see File Installation Overview.

Achieving Easy Localization

Creating applications that are easy to localize is not difficult if you follow a few basic rules.

Isolation of Localizable Information

The most important rule for localization is to never mix functional code with strings, messages, or any other information that has to be modified to localize your application.

Hard-coded strings (strings mixed with functional code) make localization more difficult. In most Windows applications, all menus, strings and messages should be placed in the resource-definition (.RC) file. All the dialog box information should be placed in the dialog box script (.DLG) file. If you do this, you just need to run the Resource Compiler (RC) to obtain a new, localized version of the product instead of recompiling the executable file.

Strings that are not meant to be modified (filenames, WIN.INI setting names, and so on) can be placed in the .RC file, but the file should contain comments documenting that the names are permanent and should not be modified. It is a good idea also to mark what should be translated (explaining limitations, if any). The better you make the documentation, the easier the localization will be.

The .RC files and .DLG files should contain anything that can be a localization item. It is better to have extra information in these files than to have too little. In cases where an .RC or a .DLG file cannot be used, place all the information in a file, such as an include file, that is separate from any functional code.

Allocating Extra Space for Strings

Many languages are more verbose than English and require more space to hold strings or to display dialog boxes. There are cases, as with menus, where the space allocation is done dynamically, but in most cases the application has to provide the space. The following table shows the percentage of additional space that an application should allocate for non-English strings of various lengths.

Length in characters	Additional space required
1-10	200%
11-20	100%
21-30	80%
31-50	60%
51-70	40%
70+	30%

In the English version of your application avoid creating dense menus where most of the available space (all except one line, for example) is used. Dialog boxes should be designed so that items can be moved freely, allowing reorganization of the contents as translation demands. Do not crowd status bars with information. Even abbreviations are often longer in other languages.

Handling Foreign Languages

Never make assumptions about language usage when dealing with foreign languages. The ordering of words can be different, and the number of words required is often greater than in English.

Keep in mind the following grammatical points when preparing an application for localizing:

- Avoid using the same word in more than one message. Some words, such as *none,* can have different translations (different gender and number) depending on the context.
- Do not create plurals of words by adding *s.* Keep two strings, one for the singular and one for the plural.
- Avoid using slang, abbreviations, or jargon, because they are difficult to translate.

Keep also these syntactical considerations in mind when localizing:

- Avoid parsing text to obtain information. Parsing normally assumes specific syntax.
- Do not create a long string from several short strings. The long string may not make sense in another language, because the order of parts of speech varies in different languages.

Incorporate graphic objects such as bitmaps, cursors, and icons with these considerations in mind:

- Avoid the use of embedded text in graphics. Text is difficult to modify when in graphical form. If you cannot avoid this, leave enough space for translation and try to create tools to simplify the modification.
- Look for graphic objects that represent international concepts, because graphic objects are also language dependent.

Keep in mind the following points when planning screen elements:

- Do not hard-code the position or size of any element on the screen, because an item changes position and size as it gets translated. In cases where you need to define the size or position of certain object, place this definition in the resource-definition (.RC) file.
- Use the **CreateWindow** function carefully. The *lpClassName* parameter should be constant and independent from localization, but the *lpWindowName* parameter, which is the string that appears in the title bar, should be localized. The string used for *lpWindowName* should be taken from the resources.

All messages should be self-contained, not dynamically assembled. In cases where messages have variables added to them at run time, do not make any assumptions about the position of the variable in the message. Handle variables in messages in the following manner:

1 Place the string containing the variable in the resource-definition (.RC) file:

```
CannotOpen,       "The application could not open the file %s"
```

2 Use the **wsprintf** function to incorporate the variable into the string:

```
LoadString(hInst, CannotOpen, lpFormat, MaxLen);
wsprintf(FinalString, lpFormat, FileName);
```

Developing Network Applications

As local area networks (LANs) become increasingly common, application developers need to ensure that their applications run properly in a network environment. To do this, they should consider the behavior of applications shared by multiple users and the compatibility of applications that access network software directly with protected (standard or 386 enhanced) mode.

Sharing by Multiple Users

Many corporations choose to have their computer users share a single copy of an application that resides on a network server. The Microsoft Windows operating system, version 3.0 and later, can be run this way. The **/n** (network) option used in Windows Setup configures the user's system so that most Windows files are used directly off the network, but the user's personal files and configuration information are stored in a private Windows directory.

If you intend to allow shared copies of your application, you must ensure that two users running the same application do not interfere with each other. The following sections present guidelines for preparing an application for network support.

Sharing Directories

Many applications store configuration files in the same directory as the executable file for the application. This method does not work for multiple users, however, because the application stores each user's information in the same directory, overwriting the other users' information in the process.

Instead of using configuration files, an application should use the Windows profile functions to store user-specific information in initialization (.INI) files. The profile functions create initialization files in a user's private Windows directory, unless the application specifies a different directory.

Windows profile functions, such as **WriteProfileString**, usually store profile and configuration information in .INI files. Profile functions fall into two categories: those that access WIN.INI and those that access another .INI file specified by the program.

The functions that access WIN.INI are **GetProfileString**, **GetProfileInt**, and **WriteProfileString**. Because each user has a unique copy of WIN.INI, these functions can be used safely, even when the application is being shared by more than one user.

The functions that access other .INI files are **GetPrivateProfileString**, **GetPrivateProfileInt**, and **WritePrivateProfileString**. These functions behave similarly to the functions that access WIN.INI, except that the application specifies the name of the private initialization file. When using these functions, you should specify the name of the file, but not a complete path (for example, MYAPP.INI instead of C:\MYAPP\MYAPP.INI). By default, the file will be located in the user's private Windows directory; specifying a full path could give multiple users access to the same file.

The exception to the preceding rule are initialization files that need to be shared by all users. Make sure that those files cannot be left in an inconsistent state if multiple users update them simultaneously.

Sharing Temporary Storage

When creating temporary files, use the **GetTempFileName** function to determine a unique name and location for the file. This function ensures that temporary filenames do not conflict, even if multiple users share the same temporary storage directory.

Sharing Files

A network manages file sharing as if the SHARE utility were loaded. Each file that can be accessed on the network should use a sharing mode to ensure data integrity. Applications should also be designed to handle sharing violations.

A sharing violation occurs when one process (or machine) attempts to access a file after a different process has requested the server to block access to the file. If an application opens the file in

compatibility mode, a sharing violation results in a critical error. Therefore, unless the application uses the **SetErrorMode** function to set the error mode so that it always fails, Windows displays the standard sharing violation message.

Sharing Devices

Windows 3.1 includes three functions that an application can use to manage its network connections: **WNetAddConnection**, **WNetCancelConnection**, and **WNetGetConnection**. The **WNetAddConnection** function redirects a local device (either a disk drive or a printer port) to a shared device on a remote server. The **WNetCancelConnection** function cancels a redirection to a shared device. The **WNetGetConnection** function returns the name of the network resource associated with a redirected local device.

Calling Network Software in Protected Mode

Windows applications running in protected mode require special support whenever they make a call to real-mode software. This includes calls to MS-DOS, the BIOS, or a network. Non-Windows applications running with Windows do not require this special support, however, because they always run in real or virtual-8086 mode.

Windows applications running in protected mode require application programming interface (API) mapping. If the arguments to the calling function include pointers to data, that data should be copied into the first 1 megabyte of address space so that the real-mode software can access it. The processor is then switched into real or virtual-8086 mode so that the real-mode software can process the function. Finally, when the function returns, any data it modified is copied back to the caller's protected-mode address.

Fortunately, most applications interact with the network only indirectly, by using MS-DOS functions to manipulate files on redirected drives or by using MS-DOS or BIOS functions to print to a remote printer using redirected printer ports. Windows applications can continue to perform these functions as usual, because Windows automatically maps standard MS-DOS and BIOS functions.

Some applications, however, need to use functions that are specific to a particular network or networking protocol. Some part of the software must map these functions, and, in some cases, this may require special procedures on the part of the programmer.

The remainder of this topic describes programming considerations for designing Windows applications that use the following networking protocols and networks: Microsoft Networks and MS-DOS network functions, NetBIOS functions, Microsoft LAN Manager–based networks, Novell NetWare, Ungermann-Bass Net/One, and Banyan VINES.

Microsoft Networks and MS-DOS Network Functions

Many networks on the market today are based on the Microsoft Networks standard, also known as MS-NET. These networks support a set of standard MS-DOS functions that perform network activities, such as redirecting drive letters.

Current versions of Windows automatically handle these MS-DOS functions. However, in order to maintain compatibility with future Windows products, your application should not make MS-DOS calls by using Interrupt 21h. Instead, it should set up all the registers for Interrupt 21h and then make a far call to the Windows **DOS3Call** function.

NetBIOS Functions

NetBIOS is the most widely used networking API. The functions in this API are normally called by using Interrupt 5Ch. Current versions of Windows handle most NetBIOS functions. However, in order to maintain compatibility with future Windows products, the application should not make the NetBIOS call by using Interrupt 5Ch. Instead, it should set up all the registers for Interrupt 5Ch and then make a far call to the Windows **NetBIOSCall** function.

Windows does not support the following rarely used NetBIOS functions:

Function number	Function name
71h	**Send.No.Ack**
72h	**Chain.Send.No.Ack**
73h	**Lan.Status.Alert**
78h	**Find.Name**
79h	**Trace**

LAN Manager Networks

Networks based on Microsoft LAN Manager can be installed in either basic or enhanced versions. All versions of LAN Manager support MS-NET and NetBIOS functions. However, if you are running the enhanced version of LAN Manager with the API option, your applications can also use a powerful set of networking functions.

Non-Windows applications can call networking functions by linking with DOSNET.LIB, a static-link library provided with the network software. Windows applications, however, must use two dynamic-link libraries (DLLs), NETAPI.DLL and PMSPL.DLL, distributed on every workstation with the enhanced version of LAN Manager 2.0. (These DLLs do not run with LAN Manager 1.*x* or with the basic version of LAN Manager 2.0.)

For more details on writing Windows applications for LAN Manager, see the *Microsoft LAN Manager Programmer's Reference.*

Novell NetWare

Novell NetWare supports MS-NET and, optionally, NetBIOS functions, which are described earlier in this topic. Novell NetWare also supports the NetWare and IPX/SPX APIs, both based on Interrupt 21h.

Windows applications cannot make NetWare calls by using Interrupt 21h directly, because this method is not supported in all Windows operating modes. Instead, the Interrupt 21h instruction should be replaced by a far call to the **NetWareRequest** function. This function is exported by name from the NetWare DLL and should be imported to the module-definition (.DEF) file as NetWare.NetWareRequest.

Windows applications cannot make IPX/SPX calls at this time, although Novell plans to make this support available in a future release. For more information, contact Novell product support.

Ungermann-Bass Net/One

Ungermann-Bass Net/One is based on the Microsoft Networks standard. It supports standard MS-NET functions and most NetBIOS functions described earlier in this topic.

Net/One also supports private extensions to the NetBIOS function set (Interrupt 5Ch Functions 72h–7Dh). These functions are supported by Windows. You can call these functions as you would standard NetBIOS functions by making a far call to the **NetBIOSCall** function.

Banyan VINES

Banyan VINES supports the standard MS-NET functions and, optionally, NetBIOS functions. A toolkit is available for applications that write directly to the VINES API.

Windows applications can call the MS-NET and NetBIOS functions as previously described.

VINES version 4.0 does not support Windows applications that call the VINES API directly, but Banyan intends to make this support available in VINES 4.1. For more information, contact Banyan product support.

Windows Applications with MS-DOS Functions

This topic describes the support in the Microsoft Windows operating system version 3.0 and later for Windows and non-Windows applications using DOS Protected-Mode Interface (**DPMI**) version 1.0 functions, MS-DOS interrupts and functions in protected mode, and the NetBIOS in protected mode.

DPMI enables MS-DOS applications to access the extended memory of PC-architecture computers while maintaining system protection. It also defines a new interface, through Interrupt 31h, that protected-mode applications use for such tasks as allocating memory, modifying descriptors, and calling real-mode software.

According to the **DPMI** specification, the term real-mode software refers to code that runs in the low 1-megabyte address space and uses segment:offset addressing. With Windows 3.0 and later in protected mode, so-called real-mode software is actually run in virtual-8086 mode. However, because virtual-8086 mode is a close approximation of real mode, both are referred to as real mode in this topic.

For more information about the **DPMI** specification, contact Intel Corporation product support, or submit a service request through Microsoft OnLine.

Using DOS Protected-Mode Interface Functions

Windows 3.0 and later in 386 enhanced mode supports **DPMI** version 1.0. Windows 3.0 and later in standard mode supports a subset of DPMI that enables applications to call terminate-and-stay-resident (TSR) programs and device drivers running in real (or virtual-8086) mode. To ease the porting of an application to other operating environments, all code that calls DPMI functions directly should reside in a dynamic-link library (DLL).

Windows Kernel

Windows applications should not use the MS-DOS memory management functions for DPMI. The Windows 3.0 and later kernel has two functions, **GlobalDOSAlloc** and **GlobalDOSFree**, that should be used by Windows applications and DLLs for allocating and freeing MS-DOS addressable memory.

Because the Windows kernel provides functions for allocating memory, manipulating descriptors, and locking memory, no **DPMI** functions other than the following are required for Windows applications:

Interrupt 21h function	Description
0200h	Get Real Mode Interrupt Vector
0201h	Set Real Mode Interrupt Vector
0300h	Simulate Real Mode Interrupt
0301h	Call Real Mode Procedure with Far Return Frame
0302h	Call Real Mode Procedure with Interrupt Return Frame
0303h	Allocate Real Mode Callback Address
0304h	Free Real Mode Callback Address

Non-Windows applications running in 386 enhanced mode can use all **DPMI** functions, because those functions are not restricted by the kernel.

Other Application Programming Interfaces

In general, any software-interrupt function that passes parameters in the EAX, EBX, ECX, EDX, ESI, EDI, and EBP registers works as long as none of the registers contains a selector value. In other words, if a software-interrupt function is completely register-based without any pointers, segment registers, or stack parameters, that function should work with Windows running in protected mode.

More complex software interrupt functions require the calling function to use the **DPMI** translation functions.

Support for MS-DOS Interrupts

This section discusses support for MS-DOS interrupts and functions when Windows runs in protected mode with MS-DOS version 3.0 and later.

All MS-DOS interrupts and functions that are not mentioned in this section should work exactly as documented in *The MS-DOS Encyclopedia* (Redmond, Washington: Microsoft Press, 1988).

Unsupported MS-DOS Interrupts and Functions

The following MS-DOS interrupts are not supported in protected mode and will fail if called:

Interrupt	Description
20h	Terminate Program
25h	Absolute Disk Read
26h	Absolute Disk Write
27h	Terminate and Stay Resident

The following MS-DOS Interrupt 21h functions are also not supported in protected mode:

Function	Description
00h	Terminate Process
0Fh	Open File with FCB
10h	Close File with FCB
14h	Sequential Read
15h	Sequential Write
16h	Create File with FCB
21h	Random Read
22h	Random Write
23h	Get File Size
24h	Set Random Record Number
27h	Random Block Read
28h	Random Block Write

Partially Supported MS-DOS Interrupt 21h Functions

The following MS-DOS Interrupt 21h functions behave differently in protected mode than they do in real mode. To use these functions, an application might require additional code:

Function	Description
25h	Set Interrupt Vector
35h	Get Interrupt Vector
38h	Get/Set Current Country Information
4402-4405h	Send/Receive Control Data
440Ch	Generic IOCTL for Character Devices
6501-6506h	Get Extended Country Information

Functions 25h and 35h set and get the protected-mode interrupt vector. They can be used to hook hardware interrupts, such as the timer or keyboard interrupt, as well as to hook software interrupts. (Except for Interrupts 23h, 24h, and 1Ch, software interrupts that are issued in real mode are not passed to protected-mode interrupt handlers. However, all hardware interrupts are passed to protected-mode interrupt handlers before being passed to real mode).

Function 38h returns a 34-byte buffer containing a doubleword real-mode address. The address at offset 12h is used for case mapping. To call the case-mapping function, use the **DPMI** translation function to simulate a real-mode FAR call.

Functions 4402h, 4403h, 4404h, and 4405h are used to receive data from a device or send data to a

device. Because it is not possible to break the transfers automatically into small pieces, the calling program should assume that a transfer of greater than 4K will fail unless the address of the buffer is in the low 1 megabyte.

Only certain extensions of Function 440Ch (Minor Codes 45h and 65h) are supported for protected mode. The extensions of Function 440Ch that are used for code-page switching (Minor Codes 4Ah, 4Ch, 4Dh, 6Ah, and 6Bh) are not supported for protected-mode programs. To use 440Ch to switch code pages, you must use the **DPMI** translation functions.

Functions 6501h, 6502h, 6503h, 6504h, 6505h, and 6506h are supported for protected-mode programs. However, all doubleword parameters returned will contain real-mode addresses (that is, the case-conversion procedure address and all the pointers to tables will contain real-mode segment:offset addresses). To call the case-conversion procedure in real mode, you must use the **DPMI** translation functions.

NetBIOS Support

Windows supports standard NetBIOS (Interrupt 5Ch) functions in protected mode. All network control blocks (NCBs) and buffers must reside in fixed memory that is page-locked. To ease the porting of the application to other operating systems, all code that calls NetBIOS functions directly should reside in a DLL.

For more information about developing applications for networks, see Developing Network Applications.

Windows Prologs and Epilogs

This topic describes the prolog and epilog used with far functions in applications and dynamic-link libraries (DLLs) for the Microsoft Windows operating system. Compiler vendors can use this information to enable their compilers to generate prolog and epilog code that is suitable for Windows.

In Windows version 3.0 and earlier, the prolog and epilog for far functions must include instructions to mark the stack frame, indicating that the frame belongs to a far function. This makes it possible for real-mode Windows to locate segment addresses on the stack and update those addresses when it moves or discards the corresponding segments. Marking stack frames for far functions also allows debugging applications, such as Microsoft CodeView® for Windows (CVW) and Microsoft Windows 80386 Debugger (WDEB386.EXE), to display meaningful information about the contents of an application's stack.

Marking stack frames for far functions is optional for Windows 3.1 applications. Old debugging applications that do not access TOOLHELP.DLL, however, still need marking. Debugging applications that use TOOLHELP.DLL do not require stack frames for far functions to be marked.

Data-Segment Initialization

The Windows prolog and epilog contain instructions that initialize the DS register, setting the register to the segment address of the application or DLL. Windows requires callback functions, such as window, dialog box, and enumeration procedures, to initialize the DS register whenever they are called by Windows or an application. This guarantees that the function accesses its own data segment rather than the data segment of the caller.

Exported Far Functions

The Windows prolog used with exported far functions, such as dialog box and enumeration procedures, ensures that the DS register receives the data segment address for the application when Windows or an application calls the exported function. In Windows version 3.0 and earlier, the prolog and epilog for exported far functions have the following form:

```
push    ds          ; put DS in AX, take 3 bytes to do it,
pop     ax          ;   so the code can be rewritten as
nop                 ;   MOV AX, IMM when appropriate

inc     bp          ; push odd BP to indicate this stack
push    bp          ;   frame corresponds to a far CALL

mov     bp, sp      ; set up BP to access arguments and
                    ;   local variables

push    ds          ; save DS
mov     ds, ax      ; set DS to proper data segment
sub     sp, const   ; allocate local storage (optional)

 ...

sub     bp, 2       ; restore registers
mov     sp, bp
pop     ds
pop     bp
dec     bp
retf
```

Because Windows 3.1 does not support real mode, the **inc bp** and **dec bp** instructions are not required. Also, a variety of other changes can be made to the prolog and epilog to improve speed and reduce the size of the code. If a far function is part of an application (not part of a DLL), the SS register is already

the proper value for the DS register, so calling the **MakeProcInstance** function is not necessary. The prolog and epilog can be modified as follows:

```
push    bp          ; set up stack frame (optional)
mov     bp, sp

push    ds          ; save calling function's DS

push    ss          ; move SS to DS
pop     ds

 ...

pop     ds          ; restore registers
pop     bp

retf
```

An alternative form of the prolog and epilog for far functions follows:

```
push    bp          ; set up stack frame (optional)
mov     bp, sp

push    ds          ; save calling function's DS

mov     ax, ss      ; move SS to DS
mov     ds, ax

sub     sp, const   ; (optional) allocate local storage

 ...

mov     ds, [bp-2]  ; restore registers
leave

retf
```

Each of the variations of prolog and epilog code discussed previously works whether or not a far function is exported. The code can be called by an application or DLL as well as by the system.

If an application copies the contents of the SS register to the DS register, it doesn't need to call the **MakeProcInstance** function to obtain a procedure-instance address before calling an exported far function. Similarly, if a DLL moves the DGROUP data segment to the DS register through the AX register, the DLL doesn't need to call **MakeProcInstance** before calling an exported far function.

Although window procedures for an application require this same prolog, Windows loads the AX register before calling these procedures. An application, therefore, never needs to create a procedure-instance address for its window procedures.

Nonexported Far Functions

Although not required, nonexported far functions can also include prolog code that initializes the DS register. In this case, it is assumed that the function is never called by Windows or an application and that the DS register contains the correct segment address when the function is called. The prolog for a nonexported function has the following form:

```
mov     ax, ds      ; copy DS to AX
nop
```

```
push    bp          ; set up stack frame (optional)
mov     bp, sp

push    ds          ; save calling function's DS
mov     ds, ax      ; move same value back to DS

 ...

pop     ds          ; pop same value back to DS
pop     bp
retf
```

An alternative form of the prolog for a nonexported function follows:

```
push    ds          ; copy DS to AX
pop     ax
nop

push    bp          ; set up stack frame (optional)
mov     bp, sp

push    ds          ; save calling function's DS

mov     ds, ax      ; move same value back to DS

 ...

pop     ds          ; pop same value back to DS
pop     bp
retf
```

A compiler should not generate the preceding code by default because it reloads the DS register with the same value two times per far call. Loading segment registers is a slow operation in protected mode and should be avoided as much as possible.

Exported Far Functions in a Dynamic-Link Library

Exported far functions in DLLs also require a prolog. The prolog code in a DLL must generate a reference to the DGROUP data segment. The SS register cannot be used because execution occurs on the calling function's stack. Exported far functions cannot use this method because fixups to DGROUP are illegal for a multiple instance application.

The prolog and epilog for exported far functions in a DLL has the following form:

```
mov     ax, DGROUP      ; get DGROUP value

push    bp              ; set up stack frame (optional)
mov     bp, sp

push    ds              ; save calling function's DS
mov     ds, ax          ; move DGROUP to DS

 ...

pop     ds              ; restore registers
pop     bp

retf
```

Following is an alternative form of the prolog for exported far functions in a DLL:

```
mov     ax, DGROUP      ; get DGROUP value

push    bp              ; set up stack frame (optional)
mov     bp, sp

push    ds              ; save calling function's DS
mov     ds, ax          ; move DGROUP to DS

sub     sp, const       ; allocate local storage (optional)

 ...

mov     ds, [bp-2]      ; restore registers

leave
```

Windows inserts the current data segment address as the second operand (DGROUP) of the initial **mov** instruction.

Prologs in Real Mode

When Windows 3.0 and earlier is running in real mode, Windows must walk each application stack whenever it moves or discards segments. In particular, it must check each stack for any segment addresses that may have been affected by the segment operations.

To help Windows locate segment addresses associated with the stack frames of far functions, the Windows prolog increments the old frame pointer, contained in the BP register, before saving it on the stack. Because all stack offsets, including frame pointers, are expected to be word-aligned, incrementing the BP register gives Windows a quick way to locate all far function stack frames.

Windows only walks the stack in real mode. In protected mode, selector values do not change even though Windows may move and discard segments. Therefore, functions in protected mode do not need to increment the BP register when they save it. However, some debugging programs, such as CVW and WDEB386.EXE, use the incremented BP register to determine which stack frames correspond to far functions and give meaningless stack backtraces if the BP register is not incremented before it is saved.

Prologs in Protected Mode

Although exported functions in protected-mode, single-instance applications need to set the DS register, these functions do not require the exported prolog described in the previous section. Instead, they can use code similar to that generated by the **_loadds** keyword of the Microsoft C Optimizing Compiler (CL) to set the DS register.

The code generated by **_loadds** copies the data segment selector to the DS register whenever the function is called. Because a selector does not change value when the corresponding segment is moved, there is no need to set the AX register to the appropriate data segment address before calling the function (or to mark the stack frame). The function can, therefore, be called directly rather than through a procedure-instance address. The **_loadds** code has the following form:

```
push    bp
mov     bp,sp
push    ds
mov     ax, CONSTANT
mov     ds, ax
```

Functions that use the **_loadds** code can be used as callback functions. Because no prolog code is required, the functions do not need to be exported when used in an application. Functions in DLLs can

also use the _**loadds** code. However, the functions must be exported to ensure that other applications can link dynamically to them.

In multiple-instance applications, the Windows prolog is needed only for far functions called by Windows. For these functions, procedure-instance addresses are required. The _**loadds** code cannot be used in multiple-instance applications. Instead, applications should copy the SS register to the DS register.

Windows Application Startup

This topic describes the startup requirements of applications for the Microsoft Windows operating system. It also discusses the steps needed to initialize an application before its entry-point function, **WinMain**, can be called.

Startup Requirements

When Windows starts an application, it calls a startup routine supplied with the application rather than the application's **WinMain** function. The startup routine is responsible for initializing the application, calling **WinMain**, and exiting the application when **WinMain** returns control.

When Windows first calls the startup routine, the processor registers have the following values:

Register	Value
AX	Contains zero.
BX	Specifies the size, in bytes, of the stack.
CX	Specifies the size, in bytes, of the heap.
DI	Contains a handle identifying the new application instance.
SI	Contains a handle identifying the previous application instance.
BP	Contains zero.
ES	Contains the segment address of the program segment prefix (PSP).
DS	Contains the segment address of the automatic data segment for the application.
SS	Same as the DS register.
SP	Contains the offset to the first byte of the application stack.

To initialize and exit a Windows application, the startup routine must follow these steps:

1 Initialize the task by using the **InitTask** function. **InitTask** also returns values that the startup routine passes to the **WinMain** function.

2 Clear the event that started the task by calling the **WaitEvent** function.

3 Initialize the queue and support routines for the application by calling the **InitApp** function with the instance handle returned by the **InitTask** function.

4 Call the entry point for the application, the **WinMain** function.

5 Exit the application by calling the MS-DOS End Program function (Interrupt 21h Function 4Ch) when **WinMain** returns.

Although the startup routine is essentially the same for all Windows applications, a variety of startup routines may need to be developed to accommodate the different memory models and high-level language run-time libraries used by Windows applications. If a Windows application uses functions and variables provided by run-time libraries, the startup routine may need to be customized to initialize the library at the same time as the application. Customizing the startup routine for run-time library initialization is entirely dependent on the library and is, therefore, beyond the scope of this topic.

Example of a Startup Routine

A startup routine initializes and exits a Windows application. The routine in the following example, the __astart function, shows the code needed for startup, which includes Cmacros defined in the CMACROS.INC header file. When assembled, this code is suitable for small-model Windows applications that do not use run-time libraries:

```
.xlist
memS = 1     ; small memory model
?DF = 1      ; Do not generate default segment definitions.
?PLM = 1;
```

```
?WIN = 1;
include cmacros.inc
.list

STACKSLOP = 256

createSeg   _TEXT,CODE,PARA,PUBLIC,CODE
createSeg NULL, NULL, PARA,PUBLIC,BEGDATA,DGROUP
createSeg _DATA,DATA, PARA,PUBLIC,DATA,   DGROUP
defGrp      DGROUP,DATA

assumes DS,DATA

sBegin      NULL
            DD  0
labelW      <PUBLIC,rsrvptrs>
maxRsrvPtrs = 5
            DW  maxRsrvPtrs
            DW  maxRsrvPtrs DUP (0)
sEnd        NULL

sBegin  DATA
staticW hPrev,0             ; Save WinMain parameters.
staticW hInstance,0
staticD lpszCmdline,0
staticW cmdShow,0
sEnd    DATA

externFP   <INITTASK>
externFP   <WAITEVENT>
externFP   <INITAPP>
externFP   <DOS3CALL>
externP    <WINMAIN>

sBegin  CODE
assumes CS,CODE

labelNP <PUBLIC,__astart>

        xor     bp,bp                   ; zero bp
        push    bp

        cCall   INITTASK                ; Initialize the task.
        or      ax,ax
        jz      noinit

        add     cx,STACKSLOP            ; Add in stack slop space.
        jc      noinit                  ; If overflow, return error.

        mov     hPrev,si
        mov     hInstance,di
        mov     word ptr lpszCmdline,bx
        mov     word ptr lpszCmdline+2,es
        mov     cmdShow,dx

        xor     ax,ax                   ; Clear initial event that
        cCall   WAITEVENT,<ax>          ;   started this task.
```

```
        cCall   INITAPP,<hInstance>     ; Initialize the queue.
        or      ax,ax
        jz      noinit

        cCall   WINMAIN,<hInstance,hPrev,lpszCmdline,cmdShow>
ix:
        mov     ah,4Ch
        cCall   DOS3CALL                ; Exit with return code from app.
noinit:
        mov     al,0FFh                 ; Exit with error code.
        jmp short ix
sEnd     CODE

        end __astart                    ; start address
```

Windows requires the null segment (containing the rsrvptrs array), which is defined at the beginning of this sample. The **InitTask** function copies the top, minimum, and bottom address offsets of the stack into the third, fourth, and fifth elements of the rsrvptrs array. Applications can use these offsets to check the amount of space available on the stack. The debugging version of Windows also uses these offsets to check the stack. Applications must, therefore, not change these offsets, since doing so can cause a system debugging error (RIP).

Self-Loading Windows Applications Overview (3.1)

This topic describes the contents of a unique segment that is found only in self-loading applications for the Microsoft Windows operating system. This segment contains six functions: three that the application developer supplies and three that the Windows kernel supplies. The segment also contains a table of pointers to these functions and loader code.

This topic contains references to the Windows (new-style) header and the data tables in a Windows executable file.

Loader Functions

The Windows kernel provides a loader function that places applications into memory and passes execution to a specified entry point. Some Windows applications, however, must bypass this kernel function and load themselves in order to be executed correctly. For example, a compiler for Windows might contain two floating-point modules: one requiring a math coprocessor and one emulating the coprocessor. The standard loader function in the Windows kernel does not provide a method of specifying that code in one module should be loaded in place of code in another; this means that the compiler needs to load the appropriate code itself in order to run efficiently and correctly. Likewise, the code for a Windows application might be compressed with a special compression algorithm in order to fit on a certain number of disks, but the standard loader function does not provide a method for dealing with a compressed file format. The application, therefore, must load itself in order to be executed correctly.

To indicate that a Windows application is self-loading, the 16-bit flag value in the executable file's Windows header must contain the value 0x0800 (that is, bit 11 must be set). Otherwise, Windows ignores the private loader code and installs the application by using the standard loader functions in the Windows kernel.

Loader Data Table

In addition to the loader functions, the first segment of a self-loading Windows application contains a loader data table with far pointers to each of the loader functions. The format of this table follows:

Location	Description
0x00	Specifies the version number (this value must be 0xA0).
0x02	Reserved.
0x04	Points to a startup procedure, which the application developer provides.
0x08	Points to a reloading procedure, which the application developer provides.
0x0C	Reserved.
0x10	Points to a memory-allocation procedure, which the kernel provides.
0x14	Points to an entry-number procedure, which the kernel provides.
0x18	Points to an exit procedure, which the application developer provides.
0x1C	Reserved.
0x1E	Reserved.
0x20	Reserved.
0x22	Reserved.
0x24	Points to a set-owner procedure, which the kernel provides.

All of the pointers in this table must point to locations within the first segment. There can be no fixups outside this segment.

After the segment table for an executable file is loaded into memory, each entry contains an additional 16-bit value. This value is a segment selector (or handle) that the loader created.

Loader Code

The first segment of a self-loading Windows application contains loader code for the six required loader functions. The code loads and reloads segments and resets hardware.

Loading Segments

The kernel calls the **BootApp** function supplied by the application developer, instead of loading the application in the normal manner, if the 16-bit value in the information block for the Windows header contains the value 0x0800 (that is, bit 11 is set). The **BootApp** function allocates memory for all segments by calling the kernel-supplied **MyAlloc** function. If the segment is identified as a **PRELOAD** or **FIXED** type, **BootApp** also calls the **LoadAppSeg** function (another function supplied by the application developer). The **BootApp** function also calls **SetOwner**, a kernel-supplied function, to associate the correct information block with each segment handle.

The first segment that the **BootApp** function should allocate is the application's automatic data segment. This data segment contains the application's stack. The automatic data segment must be allocated before the **BootApp** function calls the Windows **PatchCodeHandle** function. For more information about the **PatchCodeHandle** function, see the *Microsoft Windows Programmer's Reference, Volume 2*.

Reloading Segments

In addition to loading segments, the **LoadAppSeg** function reloads segments that the Windows kernel has discarded. Because the **LoadAppSeg** function is responsible for reloading segments, it must update bits 1 and 2 of the 16-bit flag value in the segment table. (Only self-loading applications should alter the Windows header or the data tables that follow it.) Bit 1 specifies whether memory is allocated for the segment, and bit 2 specifies whether the segment is currently loaded. For a complete description of the segment table, see **Executable-File Format.**

If the loader allocates memory for a segment but the segment is not loaded (that is, bit 1 is set and bit 2 is not), the **LoadAppSeg** function should call the Windows **GlobalHandle** function to determine whether memory is allocated for the segment. If memory is not allocated, the **LoadAppSeg** function should call the Windows **GlobalReAlloc** function to reallocate memory for the segment.

Once memory is allocated, the **LoadAppSeg** function should read the segment from the executable file and call the **PatchCodeHandle** function to correct each function prolog that occurs in the segment. Once the function prologs are altered, the **LoadAppSeg** function should resolve any far pointers that occur in the segment. If the pointer is specified by an ordinal value, the **LoadAppSeg** function should call the kernel-supplied **EntryAddrProc** function to resolve the address.

Resetting Hardware

When closing a self-loading application, the kernel calls the **ExitProc** function, supplied by the application developer, to reset any hardware that a dynamic-link library may have accessed. However, the **ExitProc** function does not need to free memory or close files.

Function Reference

This section provides information about the functions supplied by the application developer and by the kernel for self-loading Windows applications.

See Also
BootApp, **EntryAddrProc**, **ExitProc**, **MyAlloc**, **PatchCodeHandle**, **LoadAppSeg**, **SetOwner**

Graphics File Formats

This topic describes the graphics-file formats used by the Microsoft Windows operating system. Graphics files include bitmap files, icon-resource files, and cursor-resource files.

Bitmap-File Formats

Windows bitmap files are stored in a device-independent bitmap (DIB) format that allows Windows to display the bitmap on any type of display device. The term "device independent" means that the bitmap specifies pixel color in a form independent of the method used by a display to represent color. The default filename extension of a Windows DIB file is .BMP.

Bitmap-File Structures

Each bitmap file contains a bitmap-file header, a bitmap-information header, a color table, and an array of bytes that defines the bitmap bits. The file has the following form:

```
BITMAPFILEHEADER bmfh;
BITMAPINFOHEADER bmih;
RGBQUAD          aColors[];
BYTE             aBitmapBits[];
```

The bitmap-file header contains information about the type, size, and layout of a device-independent bitmap file. The header is defined as a **BITMAPFILEHEADER** structure.

The bitmap-information header, defined as a **BITMAPINFOHEADER** structure, specifies the dimensions, compression type, and color format for the bitmap.

The color table, defined as an array of **RGBQUAD** structures, contains as many elements as there are colors in the bitmap. The color table is not present for bitmaps with 24 color bits because each pixel is represented by 24-bit red-green-blue (**RGB**) values in the actual bitmap data area. The colors in the table should appear in order of importance. This helps a display driver render a bitmap on a device that cannot display as many colors as there are in the bitmap. If the DIB is in Windows version 3.0 or later format, the driver can use the **biClrImportant** member of the **BITMAPINFOHEADER** structure to determine which colors are important.

The **BITMAPINFO** structure can be used to represent a combined bitmap-information header and color table.

The bitmap bits, immediately following the color table, consist of an array of **BYTE** values representing consecutive rows, or "scan lines," of the bitmap. Each scan line consists of consecutive bytes representing the pixels in the scan line, in left-to-right order. The number of bytes representing a scan line depends on the color format and the width, in pixels, of the bitmap. If necessary, a scan line must be zero-padded to end on a 32-bit boundary. However, segment boundaries can appear anywhere in the bitmap. The scan lines in the bitmap are stored from bottom up. This means that the first byte in the array represents the pixels in the lower-left corner of the bitmap and the last byte represents the pixels in the upper-right corner.

The **biBitCount** member of the **BITMAPINFOHEADER** structure determines the number of bits that define each pixel and the maximum number of colors in the bitmap. These members can have any of the following values:

Value	Meaning
1	Bitmap is monochrome and the color table contains two entries. Each bit in the bitmap array represents a pixel. If the bit is clear, the pixel is displayed with the color of the first entry in the color table. If the bit is set, the pixel has the color of the second entry in the table.
4	Bitmap has a maximum of 16 colors. Each pixel in the bitmap is represented by a 4-bit index into the color table. For example, if the first byte in the bitmap is 0x1F, the byte represents two pixels. The first pixel contains the color in the second table entry, and the second pixel contains the color in the sixteenth table entry.

8	Bitmap has a maximum of 256 colors. Each pixel in the bitmap is represented by a 1-byte index into the color table. For example, if the first byte in the bitmap is 0x1F, the first pixel has the color of the thirty-second table entry.
24	Bitmap has a maximum of 2^24 colors. The **bmiColors** (or **bmciColors**) member is NULL, and each 3-byte sequence in the bitmap array represents the relative intensities of red, green, and blue, respectively, for a pixel.

The **biClrUsed** member of the **BITMAPINFOHEADER** structure specifies the number of color indexes in the color table actually used by the bitmap. If the **biClrUsed** member is set to zero, the bitmap uses the maximum number of colors corresponding to the value of the **biBitCount** member.

An alternative form of bitmap file uses the **BITMAPCOREINFO**, **BITMAPCOREHEADER**, and **RGBTRIPLE** structures.

Bitmap Compression

Windows versions 3.0 and later support run-length encoded (RLE) formats for compressing bitmaps that use 4 bits per pixel and 8 bits per pixel. Compression reduces the disk and memory storage required for a bitmap.

Compression of 8-Bits-per-Pixel Bitmaps

When the **biCompression** member of the **BITMAPINFOHEADER** structure is set to BI_RLE8, the DIB is compressed using a run-length encoded format for a 256-color bitmap. This format uses two modes: encoded mode and absolute mode. Both modes can occur anywhere throughout a single bitmap.

Encoded Mode

A unit of information in encoded mode consists of two bytes. The first byte specifies the number of consecutive pixels to be drawn using the color index contained in the second byte.

The first byte of the pair can be set to zero to indicate an escape that denotes the end of a line, the end of the bitmap, or a delta. The interpretation of the escape depends on the value of the second byte of the pair, which must be in the range 0x00 through 0x02. Following are the meanings of the escape values that can be used in the second byte:

Second byte	Meaning
0	End of line.
1	End of bitmap.
2	Delta. The two bytes following the escape contain unsigned values indicating the horizontal and vertical offsets of the next pixel from the current position.

Absolute Mode

Absolute mode is signaled by the first byte in the pair being set to zero and the second byte to a value between 0x03 and 0xFF. The second byte represents the number of bytes that follow, each of which contains the color index of a single pixel. Each run must be aligned on a word boundary.

Following is an example of an 8-bit RLE bitmap (the two-digit hexadecimal values in the second column represent a color index for a single pixel):

Compressed data	Expanded data
03 04	04 04 04
05 06	06 06 06 06 06
00 03 45 56 67 00	45 56 67
02 78	78 78
00 02 05 01	Move 5 right and 1 down
02 78	78 78

00 00	End of line
09 1E	1E 1E 1E 1E 1E 1E 1E 1E 1E
00 01	End of RLE bitmap

Compression of 4-Bits-per-Pixel Bitmaps

When the **biCompression** member of the **BITMAPINFOHEADER** structure is set to BI_RLE4, the DIB is compressed using a run-length encoded format for a 16-color bitmap. This format uses two modes: encoded mode and absolute mode.

Encoded Mode

A unit of information in encoded mode consists of two bytes. The first byte of the pair contains the number of pixels to be drawn using the color indexes in the second byte.

The second byte contains two color indexes, one in its high-order nibble (that is, its low-order 4 bits) and one in its low-order nibble. The first pixel is drawn using the color specified by the high-order nibble, the second is drawn using the color in the low-order nibble, the third is drawn with the color in the high-order nibble, and so on, until all the pixels specified by the first byte have been drawn.

The first byte of the pair can be set to zero to indicate an escape that denotes the end of a line, the end of the bitmap, or a delta. The interpretation of the escape depends on the value of the second byte of the pair. In encoded mode, the second byte has a value in the range 0x00 through 0x02. The meaning of these values is the same as for a DIB with 8 bits per pixel.

Absolute Mode

In absolute mode, the first byte contains zero, the second byte contains the number of color indexes that follow, and subsequent bytes contain color indexes in their high- and low-order nibbles, one color index for each pixel. Each run must be aligned on a word boundary.

Following is an example of a 4-bit RLE bitmap (the one-digit hexadecimal values in the second column represent a color index for a single pixel):

Compressed data	Expanded data
03 04	0 4 0
05 06	0 6 0 6 0
00 06 45 56 67 00	4 5 5 6 6 7
04 78	7 8 7 8
00 02 05 01	Move 5 right and 1 down
04 78	7 8 7 8
00 00	End of line
09 1E	1 E 1 E 1 E 1 E 1
00 01	End of RLE bitmap

Bitmap Example

The following example is a text dump of a 16-color bitmap (4 bits per pixel):

```
Win3DIBFile
              BitmapFileHeader
                  Type       19778
                  Size       3118
                  Reserved1  0
                  Reserved2  0
                  OffsetBits 118
              BitmapInfoHeader
                  Size            40
```

```
                Width           80
                Height          75
                Planes          1
                BitCount        4
                Compression     0
                SizeImage       3000
                XPelsPerMeter   0
                YPelsPerMeter   0
                ColorsUsed      16
                ColorsImportant 16
            Win3ColorTable
                Blue  Green  Red  Unused
[00000000]      84    252    84   0
[00000001]      252   252    84   0
[00000002]      84    84     252  0
[00000003]      252   84     252  0
[00000004]      84    252    252  0
[00000005]      252   252    252  0
[00000006]      0     0      0    0
[00000007]      168   0      0    0
[00000008]      0     168    0    0
[00000009]      168   168    0    0
[0000000A]      0     0      168  0
[0000000B]      168   0      168  0
[0000000C]      0     168    168  0
[0000000D]      168   168    168  0
[0000000E]      84    84     84   0
[0000000F]      252   84     84   0
            Image
    .
    .                                           Bitmap data
    .
```

Icon-Resource File Format

An icon-resource file contains image data for icons used by Windows applications. The file consists of an icon directory identifying the number and types of icon images in the file, plus one or more icon images. The default filename extension for an icon-resource file is .ICO.

Icon Directory

Each icon-resource file starts with an icon directory. The icon directory, defined as an **ICONDIR** structure, specifies the number of icons in the resource and the dimensions and color format of each icon image. The **ICONDIR** structure has the following form:

```
typedef struct ICONDIR {
    WORD          idReserved;
    WORD          idType;
    WORD          idCount;
    ICONDIRENTRY  idEntries[1];
} ICONHEADER;
```

Following are the members in the **ICONDIR** structure:

idReserved Reserved; must be zero.

idType Specifies the resource type. This member is set to 1.

idCount Specifies the number of entries in the directory.

idEntries Specifies an array of **ICONDIRENTRY** structures containing information about

individual icons. The **idCount** member specifies the number of structures in the array.

The **ICONDIRENTRY** structure specifies the dimensions and color format for an icon. The structure has the following form:

```
struct IconDirectoryEntry {
    BYTE  bWidth;
    BYTE  bHeight;
    BYTE  bColorCount;
    BYTE  bReserved;
    WORD  wPlanes;
    WORD  wBitCount;
    DWORD dwBytesInRes;
    DWORD dwImageOffset;
};
```

Following are the members in the **ICONDIRENTRY** structure:

bWidth	Specifies the width of the icon, in pixels. Acceptable values are 16, 32, and 64.
bHeight	Specifies the height of the icon, in pixels. Acceptable values are 16, 32, and 64.
bColorCount	Specifies the number of colors in the icon. Acceptable values are 2, 8, and 16.
bReserved	Reserved; must be zero.
wPlanes	Specifies the number of color planes in the icon bitmap.
wBitCount	Specifies the number of bits in the icon bitmap.
dwBytesInRes	Specifies the size of the resource, in bytes.
dwImageOffset	Specifies the offset, in bytes, from the beginning of the file to the icon image.

Icon Image

Each icon-resource file contains one icon image for each image identified in the icon directory. An icon image consists of an icon-image header, a color table, an XOR mask, and an AND mask. The icon image has the following form:

```
BITMAPINFOHEADER    icHeader;
RGBQUAD             icColors[];
BYTE                icXOR[];
BYTE                icAND[];
```

The icon-image header, defined as a **BITMAPINFOHEADER** structure, specifies the dimensions and color format of the icon bitmap. Only the **biSize** through **biBitCount** members and the **biSizeImage** member are used. All other members (such as **biCompression** and **biClrImportant**) must be set to zero.

The color table, defined as an array of **RGBQUAD** structures, specifies the colors used in the XOR mask. As with the color table in a bitmap file, the **biBitCount** member in the icon-image header determines the number of elements in the array. For more information about the color table, see Section 1.1, "Bitmap-File Formats."

The XOR mask, immediately following the color table, is an array of **BYTE** values representing consecutive rows of a bitmap. The bitmap defines the basic shape and color of the icon image. As with the bitmap bits in a bitmap file, the bitmap data in an icon-resource file is organized in scan lines, with each byte representing one or more pixels, as defined by the color format. For more information about these bitmap bits, see Section 1.1, "Bitmap-File Formats."

The AND mask, immediately following the XOR mask, is an array of **BYTE** values, representing a monochrome bitmap with the same width and height as the XOR mask. The array is organized in scan lines, with each byte representing 8 pixels.

When Windows draws an icon, it uses the AND and XOR masks to combine the icon image with the

pixels already on the display surface. Windows first applies the AND mask by using a bitwise AND operation; this preserves or removes existing pixel color. Windows then applies the XOR mask by using a bitwise XOR operation. This sets the final color for each pixel.

The following illustration shows the XOR and AND masks that create a monochrome icon (measuring 8 pixels by 8 pixels) in the form of an uppercase K:

Windows Icon Selection

Windows detects the resolution of the current display and matches it against the width and height specified for each version of the icon image. If Windows determines that there is an exact match between an icon image and the current device, it uses the matching image. Otherwise, it selects the closest match and stretches the image to the proper size.

If an icon-resource file contains more than one image for a particular resolution, Windows uses the icon image that most closely matches the color capabilities of the current display. If no image matches the device capabilities exactly, Windows selects the image that has the greatest number of colors without exceeding the number of display colors. If all images exceed the color capabilities of the current display, Windows uses the icon image with the least number of colors.

Cursor-Resource File Format

A cursor-resource file contains image data for cursors used by Windows applications. The file consists of a cursor directory identifying the number and types of cursor images in the file, plus one or more cursor images. The default filename extension for a cursor-resource file is .CUR.

Cursor Directory

Each cursor-resource file starts with a cursor directory. The cursor directory, defined as a **CURSORDIR** structure, specifies the number of cursors in the file and the dimensions and color format of each cursor image. The **CURSORDIR** structure has the following form:

```
typedef struct _CURSORDIR {
    WORD           cdReserved;
    WORD           cdType;
    WORD           cdCount;
    CURSORDIRENTRY cdEntries[];
} CURSORDIR;
```

Following are the members in the **CURSORDIR** structure:

cdReserved	Reserved; must be zero.
cdType	Specifies the resource type. This member must be set to 2.
cdCount	Specifies the number of cursors in the file.
cdEntries	Specifies an array of **CURSORDIRENTRY** structures containing information about individual cursors. The **cdCount** member specifies the number of structures in the array.

A **CURSORDIRENTRY** structure specifies the dimensions and color format of a cursor image. The structure has the following form:

```
typedef struct _CURSORDIRENTRY {
    BYTE  bWidth;
    BYTE  bHeight;
    BYTE  bColorCount;
    BYTE  bReserved;
    WORD  wXHotspot;
    WORD  wYHotspot;
    DWORD lBytesInRes;
    DWORD dwImageOffset;
```

```
} CURSORDIRENTRY;
```

Following are the members in the **CURSORDIRENTRY** structure:

bWidth	Specifies the width of the cursor, in pixels.
bHeight	Specifies the height of the cursor, in pixels.
bColorCount	Reserved; must be zero.
bReserved	Reserved; must be zero.
wXHotspot	Specifies the x-coordinate, in pixels, of the hot spot.
wYHotspot	Specifies the y-coordinate, in pixels, of the hot spot.
lBytesInRes	Specifies the size of the resource, in bytes.
dwImageOffset	Specifies the offset, in bytes, from the start of the file to the cursor image.

Cursor Image

Each cursor-resource file contains one cursor image for each image identified in the cursor directory. A cursor image consists of a cursor-image header, a color table, an XOR mask, and an AND mask. The cursor image has the following form:

```
BITMAPINFOHEADER    crHeader;
RGBQUAD             crColors[];
BYTE                crXOR[];
BYTE                crAND[];
```

The cursor hot spot is a single pixel in the cursor bitmap that Windows uses to track the cursor. The **crXHotspot** and **crYHotspot** members specify the x- and y-coordinates of the cursor hot spot. These coordinates are 16-bit integers.

The cursor-image header, defined as a **BITMAPINFOHEADER** structure, specifies the dimensions and color format of the cursor bitmap. Only the **biSize** through **biBitCount** members and the **biSizeImage** member are used. The **biHeight** member specifies the combined height of the XOR and AND masks for the cursor. This value is twice the height of the XOR mask. The **biPlanes** and **biBitCount** members must be 1. All other members (such as **biCompression** and **biClrImportant**) must be set to zero.

The color table, defined as an array of **RGBQUAD** structures, specifies the colors used in the XOR mask. For a cursor image, the table contains exactly two structures, since the **biBitCount** member in the cursor-image header is always 1.

The XOR mask, immediately following the color table, is an array of **BYTE** values representing consecutive rows of a bitmap. The bitmap defines the basic shape and color of the cursor image. As with the bitmap bits in a bitmap file, the bitmap data in a cursor-resource file is organized in scan lines, with each byte representing one or more pixels, as defined by the color format. For more information about these bitmap bits, see Section 1.1, "Bitmap-File Formats."

The AND mask, immediately following the XOR mask, is an array of **BYTE** values representing a monochrome bitmap with the same width and height as the XOR mask. The array is organized in scan lines, with each byte representing 8 pixels.

When Windows draws a cursor, it uses the AND and XOR masks to combine the cursor image with the pixels already on the display surface. Windows first applies the AND mask by using a bitwise AND operation; this preserves or removes existing pixel color. Window then applies the XOR mask by using a bitwise XOR operation. This sets the final color for each pixel.

The following illustration shows the XOR and the AND masks that create a cursor (measuring 8 pixels by 8 pixels) in the form of an arrow:

Following are the bit-mask values necessary to produce black, white, inverted, and transparent results:

Pixel result	AND mask	XOR mask
Black	0	0

White	0	1
Transparent	1	0
Inverted	1	1

Windows Cursor Selection

If a cursor-resource file contains more than one cursor image, Windows determines the best match for a particular display by examining the width and height of the cursor images.

Clipboard File Format

Microsoft Windows Clipboard (CLIPBRD.EXE) saves and reads its data in files with the .CLP extension. A .CLP file contains a value identifying it as a Clipboard data file; one or more structures defining the format, size, and location of the data; and one or more blocks of actual data.

Clipboard-File Header

The Clipboard data file begins with a header consisting of two members. Following are the members in this header:

FileIdentifier Identifies the file as a Clipboard data file. This member must be set to CLP_ID. This is a 2-byte value.

FormatCount Specifies the number of clipboard formats contained in the file. This is a 2-byte value.

Clipboard-File Structure

The header is followed by one or more structures, each of which identifies the format, size, and offset of a block containing clipboard data. Following are the members in this structure:

FormatID Specifies the clipboard-format identifier of the clipboard data. For a description of the various formats that are available, see the description of **SetClipboardData**. This is 2-byte value.

LenData Specifies the length, in bytes, of the clipboard data. This is a 4-byte value.

OffData Specifies the offset, in bytes, of the clipboard-data block. The offset is from the beginning of the file. This is a 4-byte value.

Name Identifies a 79-character array specifying the format name of a private clipboard format.

The first block of clipboard data follows the last of these structures. For bitmaps and metafiles, the bits follow immediately after the bitmap header and the **METAFILEPICT** structures.

See Also

SetClipboardData, **METAFILEPICT**

Metafile Format

A metafile for the Microsoft Windows operating system consists of a collection of graphics device interface (GDI) functions that describe an image. Because metafiles take up less space and are more device-independent than bitmaps, they provide convenient storage for images that appear repeatedly in an application or need to be moved from one application to another.

To generate a metafile, a Windows application creates a special device context that sends GDI commands to a file or memory for storage. The application can later play back the metafile and display the image.

During playback, Windows breaks the metafile down into records and identifies each object with an index to a handle table. When a META_DELETEOBJECT record is encountered during playback, the associated object is deleted from the handle table. The entry is then reused by the next object that the metafile creates. To ensure compatibility, an application that explicitly manipulates records or builds its own metafile should manage the handle table in the same way. For more information on the format of the handle table, see the **HANDLETABLE** structure.

In some cases, there are two variants of a metafile record, one representing the record created by Windows versions before 3.0 and the second representing the record created by Windows versions 3.0 and later. Windows versions 3.0 and later play all metafile versions but store only 3.0 and later versions. Windows versions earlier than 3.0 do not play metafiles recorded by Windows versions 3.0 and later.

A metafile consists of two parts: a header and a list of records. The header and records are described in the remainder of this topic. For a list of function-specific records, see **Metafile Records**.

Metafile Header

The metafile header contains a description of the size of the metafile and the number of drawing objects it uses. The drawing objects can be pens, brushes, bitmaps, or fonts.

The metafile header has the following form:

```
typedef struct tagMETAHEADER {
    WORD  mtType;
    WORD  mtHeaderSize;
    WORD  mtVersion;
    DWORD mtSize;
    WORD  mtNoObjects;
    DWORD mtMaxRecord;
    WORD  mtNoParameters;
} METAHEADER;
```

Following are the members in the metafile header:

mtType Specifies whether the metafile is stored in memory or recorded in a file. This member has one of the following values:

Value	Meaning
0	Metafile is in memory.
1	Metafile is in a file.

mtHeaderSize Specifies the size, in words, of the metafile header.

mtVersion Specifies the Windows version number. The version number for Windows version 3.0 and later is 0x300.

mtSize Specifies the size, in words, of the file.

mtNoObjects Specifies the maximum number of objects that can exist in the metafile at the same time.

mtMaxRecord Specifies the size, in words, of the largest record in the metafile.

mtNoParameters Not used.

Typical Metafile Record

The graphics device interface stores most of the GDI functions that an application can use to create metafiles in typical records.

A typical metafile record has the following form:

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Following are the members in a typical metafile record:

rdSize Specifies the size, in words, of the record.

rdFunction Specifies the function number. This value may be the number of any function in the table at the end of this section.

rdParm Identifies an array of words containing the function parameters (listed in the reverse order in which they are passed to the function).

Following are the GDI functions found in typical records, along with their hexadecimal values:

GDI function	Value
Arc	0x0817
Chord	0x0830
Ellipse	0x0418
ExcludeClipRect	0x0415
FloodFill	0x0419
IntersectClipRect	0x0416
LineTo	0x0213
MoveTo	0x0214
OffsetClipRgn	0x0220
OffsetViewportOrg	0x0211
OffsetWindowOrg	0x020F
PatBlt	0x061D
Pie	0x081A
RealizePalette (3.0 and later)	0x0035
Rectangle	0x041B
ResizePalette (3.0 and later)	0x0139
RestoreDC	0x0127
RoundRect	0x061C
SaveDC	0x001E
ScaleViewportExt	0x0412
ScaleWindowExt	0x0400
SetBkColor	0x0201
SetBkMode	0x0102
SetMapMode	0x0103
SetMapperFlags	0x0231
SetPixel	0x041F
SetPolyFillMode	0x0106
SetROP2	0x0104

SetStretchBltMode	0x0107
SetTextAlign	0x012E
SetTextCharacterExtra	0x0108
SetTextColor	0x0209
SetTextJustification	0x020A
SetViewportExt	0x020E
SetViewportOrg	0x020D
SetWindowExt	0x020C
SetWindowOrg	0x020B

Placeable Windows Metafiles

A placeable Windows metafile is a standard Windows metafile that has an additional 22-byte header. The header contains information about the aspect ratio and original size of the metafile, permitting applications to display the metafile in its intended form.

The header for a placeable Windows metafile has the following form:

```
typedef struct {
    DWORD   key;
    HANDLE  hmf;
    RECT    bbox;
    WORD    inch;
    DWORD   reserved;
    WORD    checksum;
} METAFILEHEADER;
```

Following are the members of a placeable metafile header:

key	Specifies the binary key that uniquely identifies this file type. This member must be set to 0x9AC6CDD7L.
hmf	Unused; must be zero.
bbox	Specifies the coordinates of the smallest rectangle that encloses the picture. The coordinates are in metafile units as defined by the **inch** member.
inch	Specifies the number of metafile units to the inch. To avoid numeric overflow, this value should be less than 1440. Most applications use 576 or 1000.
reserved	Unused; must be zero.
checksum	Specifies the checksum. It is the sum (using the XOR operator) of the first 10 words of the header.

The actual content of the Windows metafile immediately follows the header. The format for this content is identical to that for standard Windows metafiles. For some applications, a placeable Windows metafile must not exceed 64K.

Note: Placeable Windows metafiles are not compatible with the **GetMetaFile** function. Applications that intend to use the metafile functions to read and play placeable Windows metafiles must read the file by using an input function (such as **_lread**), strip the 22-byte header, and create a standard Windows metafile by using the remaining bytes and the **SetMetaFileBits** function.

Guidelines for Windows Metafiles

To ensure that metafiles can be transported between different computers and applications, any application that creates a metafile should make sure the metafile is device-independent and sizable.

The following guidelines ensure that every metafile can be accepted and manipulated by other applications:

- Set a mapping mode as one of the first records. Many applications, including OLE applications, only accept metafiles that are in MM_ANISOTROPIC mode.

- Call the **SetWindowOrg** and **SetWindowExt** functions. Do not call the **SetViewportExt** or **SetViewportOrg** functions if the user will be able to resize or change the dimensions of the object.
- Use the **MFCOMMENT** printer escape to add comments to the metafile.
- Rely primarily on the functions listed in Typical Metafile Record. Observe the following limitations on the functions you use:
- Do not use functions that retrieve data (for example, **GetActiveWindow** or **EnumFontFamilies**).
- Do not use any of the region functions (because they are device dependent).
- Use **StretchBlt** or **StretchDIB** instead of **BitBlt**.

Sample of Metafile Program Output

This section describes a sample program and the metafile that it creates. The sample program creates a small metafile that draws a purple rectangle with a green border and writes the words "Hello People" in the rectangle.

```
MakeAMetaFile(hDC)
HDC hDC;
{
    HPEN     hMetaGreenPen;
    HBRUSH   hMetaVioletBrush;
    HDC      hDCMeta;
    HANDLE   hMeta;

    /* Create the metafile with output going to the disk. */

    hDCMeta = CreateMetaFile( (LPSTR) "sample.met");

    hMetaGreenPen = CreatePen(0, 0, (DWORD) 0x0000FF00);
    SelectObject(hDCMeta, hMetaGreenPen);

    hMetaVioletBrush = CreateSolidBrush((DWORD) 0x00FF00FF);
    SelectObject(hDCMeta, hMetaVioletBrush);

    Rectangle(hDCMeta, 0, 0, 150, 70);

    TextOut(hDCMeta, 10, 10, (LPSTR) "Hello People", 12);

    /* We are done with the metafile. */

    hMeta = CloseMetaFile(hDCMeta);

    /* Play the metafile that we just created. */

    PlayMetaFile(hDC, hMeta);
}
```

The resulting metafile, SAMPLE.MET, consists of a metafile header and six records. It has the following binary form:

```
0001         mtType... disk metafile
0009         mtSize...
0300         mtVersion
0000 0036    mtSize
0002         mtNoObjects
0000 000C    mtMaxRecord
0000         mtNoParameters

0000 0008    rdSize
```

```
02FA         rdFunction (CreatePenIndirect function)
0000 0000 0000 0000 FF00  rdParm (LOGPEN structure defining pen)

0000 0004    rdSize
012D         rdFunction (SelectObject)
0000         rdParm (index to object #0... the above pen)

0000 0007    rdSize
02FC         rdFunction (CreateBrushIndirect)
0000 00FF 00FF 0000 rdParm (LOGBRUSH structure defining the brush)

0000 0004    rdSize
012D         rdFunction (SelectObject)
0001         rdParm (index to object #1... the brush)

0000 0007    rdSize
041B         rdFunction (Rectangle)
0046 0096 0000 0000 rdParm (parameters sent to Rectangle...
                    in reverse order)

0000 000C    rdSize
0521         rdFunction (TextOut)
rdParm
000C         count
string
48 65 6C 6C 6F 20 50 65 6F 70 6C 65   "Hello People"
000A             y-value
000A             x-value
```

Metafile Records

Function-Specific Metafile Records

The graphics-device interface stores most of the GDI functions for creating metafiles in typical records. The remainder are stored in function-specific records that contain structures in the **rdParm** member. This section contains definitions for these records.

AnimatePalette
BitBlt
CreateBrushIndirect
CreateFontIndirect
CreatePalette
CreatePatternBrush
CreatePenIndirect
CreateRegion
DeleteObject
Escape
ExtTextOut
Polygon
PolyPolygon
Polyline
SelectClipRgn
SelectObject
SelectPalette
SetDIBitsToDevice
SetPaletteEntries
StretchBlt
StretchDIBits
TextOut

AnimatePalette Metafile Record

AnimatePalette Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0436.
rdParm	Contains the following elements:

Element	Description
start	First entry to be animated
numentries	Number of entries to be animated
entries	**PALETTEENTRY** blocks.

BitBlt Metafile Record

BitBlt Metafile Record (3.0)

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

The **BitBlt** record contains a device-independent bitmap suitable for playback on any device.

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0940.
rdParm	Contains the following elements:

Element	Description
raster op	High-order word of the raster operation
SY	Y-coordinate of the source origin
SX	X-coordinate of the source origin
DYE	Destination y-extent
DXE	Destination x-extent
DY	Y-coordinate of the destination origin
DX	X-coordinate of the destination origin
BitmapInfo	**BITMAPINFO** structure
bits	Actual device-independent bitmap bits

BitBlt Metafile Record (2.x)

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

The **BitBlt** record stored by Windows versions earlier than 3.0 contains a device-dependent bitmap that may not be suitable for playback on all devices.

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0922.
rdParm	Contains the following elements:

Element	Description
raster op	High-order word of the raster operation
SY	Y-coordinate of the source origin
SX	X-coordinate of the source origin
DYE	Destination y-extent
DXE	Destination x-extent
DY	Y-coordinate of the destination origin
DX	X-coordinate of the destination origin
bmWidth	Width of bitmap, in pixels

bmHeight	Height of bitmap, in raster lines
bmWidthBytes	Number of bytes in each raster line
bmPlanes	Number of color planes in the bitmap
bmBitsPixel	Number of adjacent color bits
bits	Actual device-dependent bitmap bits

CreateBrushIndirect Metafile Record

CreateBrushIndirect Metafile Record

```
struct {
    DWORD    rdSize;
    WORD     rdFunction;
    LOGBRUSH rdParm;
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x02FC.
rdParm	Specifies the logical brush.

CreateFontIndirect Metafile Record

CreateFontIndirect Metafile Record

```
struct {
    DWORD   rdSize;
    WORD    rdFunction;
    LOGFONT rdParm;
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x02FB.
rdParm	Specifies the logical font.

CreatePalette Metafile Record

CreatePalette Metafile Record

```
struct {
    DWORD       rdSize;
    WORD        rdFunction;
    LOGPALETTE rdParm;
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x00F7.
rdParm	Specifies the logical palette.

CreatePatternBrush Metafile Record

CreatePatternBrush Metafile Record (3.0)

```
struct {
 DWORD rdSize;
 WORD  rdFunction;
 WORD  rdParm[];
}
```

The **CreatePatternBrush** record contains a device-independent bitmap suitable for playback on all devices.

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0142.
rdParm	Contains the following elements:

Element	Description
type	Bitmap type. This element may be either of these two values: BS_PATTERN--Brush is defined by a device-dependent bitmap through a call to the **CreatePatternBrush** function. BS_DIBPATTERN--Brush is defined by a device-independent bitmap through a call to the **CreateDIBPatternBrush** function.
wUsage	Color-table type. This element specifies whether the **bmiColors** member of the **BITMAPINFO** structure contains explicit **RGB** values or indexes to the currently realized logical palette. This element must be one of the following values: DIB_RGB_COLORS--The color table contains literal **RGB** values. DIB_PAL_COLORS--The color table consists of an array of indexes to the currently realized logical palette.
bmi	**BITMAPINFO** structure
bits	Actual device-independent bitmap bits.

CreatePatternBrush Metafile Record (2.x)

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

The **CreatePatternBrush** record contains a device-dependent bitmap that may not be suitable for playback on all devices.

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x01F9.
rdParm	Contains the following elements:

Element	Description
bmWidth	Bitmap width
bmHeight	Bitmap height
bmWidthBytes	Bytes per raster line
bmPlanes	Number of color planes

bmBitsPixel	Number of adjacent color bits that define a pixel
bmBits	Pointer to bit values
bits	Actual bits of pattern

CreatePenIndirect Metafile Record

CreatePenIndirect Metafile Record

```
struct {
    DWORD  rdSize;
    WORD   rdFunction;
    LOGPEN rdParm;
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x02FA.
rdParm	Specifies the logical pen.

CreateRegion Metafile Record

CreateRegion Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x06FF.
rdParm	Specifies the region to be created.

DeleteObject Metafile Record

DeleteObject Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm;
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x01F0.
rdParm	Specifies the index to the handle table for the object to be deleted.

Escape Metafile Record

Escape Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0626.
rdParm	Contains the following elements:

Element	Description
escape number	Number identifying individual escape.
count	Number of bytes of information.
input data	Variable-length field. The member is ((count+1) >> 1) words long.

ExtTextOut Metafile Record

ExtTextOut Metafile Record

```
struct{
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0A32.
rdParm	Contains the following elements:

Element	Description
y	Logical y-value of the starting point for the string.
x	Logical x-value of the starting point for the string.
count	Length of the string.
options	Rectangle type. An application should use the AND (&) operator to determine if this element has either the **ETO_CLIPPED** or **ETO_OPAQUE** bits set. Using the equality operator (==) is discouraged in this case, because some applications set additional bits in the *wOptions* parameter of the rectangular region in which the **ExtTextOut** function writes text.
rectangle	**RECT** structure defining the rectangular region in which the **ExtTextOut** function writes text. This element does not exist if the options element is zero.
string	Byte array containing the string. The array is ((count + 1) >> 1) words long.
dxarray	Optional word array of intercharacter distances.

Polygon Metafile Record

Polygon Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0324.
rdParm	Contains the following elements:

Element	Description
count	Number of points
list of points	List of individual points

PolyPolygon Metafile Record

PolyPolygon Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0538.
rdParm	Contains the following elements:

Element	Description
count	Total number of polygons
list of polygon counts	List of number of points for each polygon
list of points	List of individual points

Polyline Metafile Record

Polyline Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0325.
rdParm	Contains the following elements:

Element	Description
count	Number of points
list of points	List of individual points

SelectClipRgn Metafile Record

SelectClipRgn Metafile Record

```
struct{
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm;
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x012C.
rdParm	Specifies the index to the handle table for the region being selected.

SelectObject Metafile Record

SelectObject Metafile Record

```
struct{
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm;
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x012D.
rdParm	Specifies the index to the handle table for the object being selected.

SelectPalette Metafile Record

SelectPalette Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm;
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0234.
rdParm	Specifies the index to the handle table for the logical palette being selected.

SetDIBitsToDevice Metafile Record

SetDIBitsToDevice Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0D33.
rdParm	Contains the following elements:

Element	Description
wUsage	Flag indicating whether the bitmap color table contains **RGB** values or indexes to the currently realized logical palette
numscans	Number of scan lines in the bitmap
startscan	First scan line in the bitmap
srcY	Y-coordinate for the origin of the source rectangle in the bitmap
srcX	X-coordinate for the origin of the source rectangle in the bitmap
extY	Height of the source rectangle in the bitmap
extX	Width of the source rectangle in the bitmap
destY	Y-coordinate of the origin of the destination rectangle
destX	X-coordinate of the origin of the destination rectangle
BitmapInfo	**BITMAPINFO** structure
bits	Actual device-independent bitmap bits

SetPaletteEntries Metafile Record

SetPaletteEntries Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0037.
rdParm	Contains the following elements:

Element	Description
start	First entry to be set in the palette
numentries	Number of entries to be set in the palette
entries	**PALETTEENTRY** blocks

StretchBlt Metafile Record

StretchBlt Metafile Record (3.0)

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

The **StretchBlt** record contains a device-independent bitmap suitable for playback on all devices.

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0B41.
rdParm	Contains the following elements:

Element	Description
raster op	Low-order word of the raster operation
raster op	High-order word of the raster operation
SYE	Source y-extent
SXE	Source x-extent
SY	Y-coordinate of the source origin
SX	X-coordinate of the source origin
DYE	Destination y-extent
DXE	Destination x-extent
DY	Y-coordinate of the destination origin
DX	X-coordinate of the destination origin
BitmapInfo	**BITMAPINFO** structure
bits	Actual device-independent bitmap bits

StretchBlt Metafile Record (2.x)

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

The **StretchBlt** record contains a device-dependent bitmap that may not be suitable for playback on all devices.

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0B23.
rdParm	Contains the following elements:

Element	Description
raster op	Low-order word of the raster operation
raster op	High-order word of the raster operation
SYE	Source y-extent
SXE	Source x-extent
SY	Y-coordinate of the source origin

SX	X-coordinate of the source origin
DYE	Destination y-extent
DXE	Destination x-extent
DY	Y-coordinate of the destination origin
DX	X-coordinate of the destination origin
bmWidth	Width of the bitmap, in pixels
bmHeight	Height of the bitmap, in raster lines
bmWidthBytes	Number of bytes in each raster line
bmPlanes	Number of color planes in the bitmap
bmBitsPixel	Number of adjacent color bits
bits	Actual bitmap bits

StretchDIBits Metafile Record

StretchDIBits Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0F43.
rdParm	Contains the following elements:

Element	Description
dwRop	Raster operation to be performed
Usag	Flag indicating whether the bitmap color table contains **RGB** values or indexes to the currently realized logical palette
srcYExt	Height of the source in the bitmap
srcXExt	Width of the source in the bitmap
srcY	Y-coordinate of the origin of the source in the bitmap
srcX	X-coordinate of the origin of the source in the bitmap
dstYExt	Height of the destination rectangle
dstXExt	Width of the destination rectangle
dstY	Y-coordinate of the origin of the destination rectangle
dstX	X-coordinate of the origin of the destination rectangle
BitmapInfo	**BITMAPINFO** structure
bits	Actual device-independent bitmap bits

TextOut Metafile Record

TextOut Metafile Record

```
struct {
    DWORD rdSize;
    WORD  rdFunction;
    WORD  rdParm[];
}
```

Member	Description
rdSize	Specifies the record size, in words.
rdFunction	Specifies the GDI function number 0x0521.
rdParm	Contains the following elements:

Element	Description
count	Length of the string
string	Actual string
y-value	Logical y-coordinate of the starting point for the string
x-value	Logical x-coordinate of the starting point for the string

Font-File Format

This topic describes the file formats for raster and vector fonts used by the Microsoft Windows operating system. These file formats may be used by smart text generators in some support modules for the graphics device interface (GDI). Vector formats, however, are more frequently used by GDI than by the support modules. TrueType font files are described in *TrueType Font Files,* available from Microsoft Corporation.

Organization of a Font File

Raster and vector font files begin with information that is common to both types of file and then continue with information that differs for each type. These font files are stored with an .FNT extension.

In Windows versions 3.0 and later, the font-file header for raster and vector fonts includes six new members: **dFlags**, **dfAspace**, **dfBspace**, **dfCspace**, **dfColorPointer**, and **dfReserved1**. All device drivers support the fonts in Windows 2.*x.* However, not all drivers support those in versions 3.0 and later.

In Windows, font files for raster and vector fonts include the glyph table in the **dfCharTable** member, which consists of structures describing the bits for characters in the font file.The use of 32-bit offsets to the character glyphs in the **dfCharTable** member enables fonts to exceed 64K, the size limit of Windows 2.*x* fonts.

Because of their 32-bit offsets and potentially large size, the newer fonts are designed for use on systems that are running Windows versions 3.0 and later in protected (standard or 386-enhanced) mode and are using an 80386 (or higher) processor whose 32-bit registers can access the character glyphs. Typically, newer drivers use the newer version of a font only when both of these conditions are true.

Font-File Structure

Font information is found at the beginning of both raster and vector font files.

Following are the members of the **FONTINFO** structure:

dfVersion Specifies the version (0x0200 or 0x0300) of the file.

dfSize Specifies the total size of the file, in bytes.

dfCopyright Specifies copyright information.

dfType Specifies the type of font file. This information is organized as follows:

Byte	Description
Low-order	Exclusively for GDI use. If the low-order bit of the word is zero, it is a bitmap (raster) font file. If the low-order bit is 1, it is a vector font file. The second bit is reserved and must be zero. If no bits follow in the file and the bits are located in memory at a fixed address specified by the **dfBitsOffset** member, the third bit is set to 1. Otherwise, the bit is set to zero. If the font is realized by a device, the high-order bit of the low-order byte is set. The remaining bits in the low-order byte are then reserved and set to zero.
High-order	Reserved for device use and is always set to zero for standard fonts realized by GDI. Physical fonts that set the high-order bit of the low-order byte may use this byte to describe themselves. GDI never inspects the high-order byte.

dfPoints Specifies the nominal point size (that is, the number identifying the point size) at which this character set looks best.

dfVertRes Specifies the nominal vertical resolution (that is, the number identifying the vertical resolution), in dots per inch, at which this character set was digitized.

dfHorizRes Specifies the nominal horizontal resolution (that is, the number identifying the

horizontal resolution), in dots per inch, at which this character set was digitized.

dfAscent Specifies the distance from the top of a character-definition cell to the base line of the typographical font. The **dfAscent** member is useful for aligning the base lines of fonts with different heights.

dfInternalLeading Specifies the amount of leading inside the bounds set by the **dfPixHeight** member. Accent marks can occur in this area. The designer can set the value to zero.

dfExternalLeading Specifies the amount of extra leading that the designer requests the application to add between rows. Since this area is outside the font proper, it contains no marks and is not altered by text-output calls in either opaque or transparent mode. The designer can set the value to zero.

dfItalic Specifies whether the character-definition data represents an italic font. If the flag is set, the low-order bit is 1. All other bits are zero.

dfUnderline Specifies whether the character-definition data represents an underlined font. If the flag is set, the low-order bit is 1. All other bits are zero.

dfStrikeOut Specifies whether the character-definition data represents a strikeout font. If the flag is set, the low-order bit is 1. All other bits are zero.

dfWeight Specifies the weight of the characters in the character-definition data, on a scale of 1 through 1000. A **dfWeight** value of 400 specifies a regular weight.

dfCharSet Specifies the character set defined by this font.

dfPixWidth Specifies the width of the grid on which a vector font was digitized. For raster fonts, if the **dfPixWidth** member is nonzero, it represents the width for all the characters in the bitmap. If the member is zero, the font has variable-width characters whose widths are specified in the array for the **dfCharTable** member.

dfPixHeight Specifies the height of the character bitmap for raster fonts or the height of the grid on which a vector font was digitized.

dfPitchAndFamily Specifies the pitch and font family. If the font is variable pitch, the low bit is set. The four high bits give the family name of the font. Font families describe the general look of a font. They identify fonts when the exact name is not available. The font families are described as follows:

Family	Description
FF_DONTCARE	Unknown.
FF_ROMAN	Proportionally spaced fonts with serifs.
FF_SWISS	Proportionally spaced fonts without serifs.
FF_MODERN	Fixed-pitch fonts.
FF_SCRIPT	Cursive or script fonts. (Both are designed to look similar to handwriting. Script fonts have joined letters; cursive fonts do not.)
FF_DECORATIVE	Novelty fonts.

dfAvgWidth Specifies the width of characters in the font. For fixed-pitch fonts, this value is the same as the value for the **dfPixWidth** member. For variable-pitch fonts, it is the width of the character "X".

dfMaxWidth Specifies the maximum pixel width of any character in the font. For fixed-pitch fonts, this value is the same as the value of the **dfPixWidth** member.

dfFirstChar Specifies the first character code defined by the font. Character definitions are stored only for the characters actually present in the font. Use this member, therefore, when calculating indexes for either the **dfBits** or **dfCharOffset** member.

dfLastChar Specifies the last character code defined by the font. All characters with codes

between the values for the **dfFirstChar** and **dfLastChar** members must be present in the character definitions for the font.

dfDefaultChar Specifies the character to substitute whenever a string contains a character that is out of range. The character is given relative to the **dfFirstChar** member so that the **dfDefaultChar** member is the actual value of the character less the value of the **dfFirstChar** member. The **dfDefaultChar** member indicates a special character that is not a space.

dfBreakChar Specifies the character that defines word breaks for word wrapping and word-spacing justification. The character is given relative to the **dfFirstChar** member so that the **dfBreakChar** member is the actual value of the character less that of the **dfFirstChar** member. The **dfBreakChar** member is normally 32 minus the value of the **dfFirstChar** member (the ASCII space character).

dfWidthBytes Specifies the number of bytes in each row of the bitmap. This value is always even so that the rows start on word boundaries. For vector fonts, this member has no meaning.

dfDevice Specifies the offset in the file to the string giving the device name. For a generic font, this value is zero.

dfFace Specifies the offset in the file to the null-terminated string that names the face.

dfBitsPointer Specifies the absolute machine address of the bitmap. This is set by GDI at load time. The value of the **dfBitsPointer** member is guaranteed to be even.

dfBitsOffset Specifies the offset in the file to the beginning of the bitmap information. If the third bit in the **dfType** member is set, the **dfBitsOffset** member is an absolute address of the bitmap (probably in read-only memory).

For raster fonts, the **dfBitsOffset** member points to a sequence of bytes that make up the bitmap of the font. The height of the bitmap is the height of the font, and its width is the sum of the widths of the characters in the font, rounded up to the next word boundary.

For vector fonts, the **dfBitsOffset** member points to a string of bytes or words (depending on the size of the grid on which the font was digitized) that specify the strokes for each character of the font. The value of the **dfBitsOffset** member must be even.

dfReserved Not used.

dfFlags Specifies the bit flags that define the format of the glyph bitmap, as follows:

Pitch value	Address
DFF_FIXED	0x0001
DFF_PROPORTIONAL	0x0002
DFF_ABCFIXED	0x0004
DFF_ABCPROPORTIONAL	0x0008
DFF_1COLOR	0x0010
DFF_16COLOR	0x0020
DFF_256COLOR	0x0040
DFF_RGBCOLOR	0x0080

dfAspace Specifies the global A space, if any. The value of the **dfAspace** member is the distance from the current position to the left edge of the bitmap.

dfBspace Specifies the global B space, if any. The value of the **dfBspace** member is the width of the character.

dfCspace Specifies the global C space, if any. The value of the **dfCspace** member is the distance from the right edge of the bitmap to the new current position. The increment of a character is the sum of the A, B, and C spaces. These spaces apply to all glyphs, including DFF_ABCFIXED.

dfColorPointer Specifies the offset to the color table for color fonts, if any. The format of the bits is like a device-independent bitmap (DIB), but without the header. (That is, the characters are not split into disjoint bytes; instead, they are left intact.) If no color table is needed, this entry is NULL.

dfReserved1 Not used.

dfCharTable Specifies an array of entries for raster, fixed-pitch vector, and proportionally spaced vector fonts, as follows:

Font type	Description
Raster	Each entry in the array consists of two 2-byte words for Windows 2.*x* and three 2-byte words for Windows 3.0 and later. The first word of each entry is the character width. The second word of each entry is the byte offset from the beginning of the **FONTINFO** structure to the character bitmap. For Windows 3.0 and later, the second and third words are used for the offset.
Fixed-pitch vector	Each 2-byte entry in the array specifies the offset from the start of the bitmap to the beginning of the string of stroke specification units for the character. The number of bytes or words to be used for a particular character is calculated by subtracting its entry from the next one, so that there is a sentinel at the end of the array of values.
Proportionally-spaced vector	Each 4-byte entry in the array is divided into two 2-byte fields. The first field gives the starting offset from the start of the bitmap of the character strokes. The second field gives the pixel width of the character.

One extra entry at the end of the character table describes an absolute-space character, which is guaranteed to be blank. This character is not part of the normal character set.

The number of entries in the table is calculated as follows: (**dfLastChar** - **dfFirstChar**) + 2. This number includes a "spare," the sentinel offset.

For more information on the **dfCharTable** member, see Section 4.3, "Version-Specific Glyph Tables."

facename Specifies an ASCII character string that constitutes the name of the font face. The size of this member is the length of the string plus a null terminating character.

devicename Specifies an ASCII character string that constitutes the name of the device if this font file is for a specific one. The size of this member is the length of the string plus a null terminating character.

bitmaps Specifies character bitmap definitions. Unlike the old font format, each character is stored as a contiguous set of bytes.

The first byte contains the first 8 bits of the first scan line (that is, the top line of the character). The second byte contains the first 8 bits of the second scan line. This continues until the first "column" is completely defined. The subsequent byte contains the next 8 bits of the first scan line, padded with zeros on the right if necessary (and so on, down through the second "column"). If the glyph is quite narrow, each scan line is covered by one byte, with bits set to zero as necessary for padding. If the glyph is very wide, a third or even fourth set of bytes can be present.

Character bitmaps must be stored contiguously and arranged in ascending order. The bytes for a 12-pixel by 14-pixel "A" character, for example, are given in two sets, because the character is less than 17 pixels wide:

```
00 06 09 10 20 20 20 3F 20 20 20 00 00 00
00 00 00 80 40 40 40 C0 40 40 40 00 00 00
```

Note that in the second set of bytes, the second digit of the byte is always zero. The zeros correspond to the thirteenth through sixteenth pixels on the right side of the character, which are not used by this character bitmap.

Version-Specific Glyph Tables

The **dfCharTable** member for Windows 2.*x* has a **GlyphEntry** structure with the following format:

```
GlyphEntry      struc
geWidth                 dw      ?  ; width of char bitmap, pixels
geOffset                dw      ?  ; pointer to the bits
GlyphEntry      ends
```

The **dfCharTable** member in Windows 3.0 and later is dependent on the format of the glyph bitmap. The only formats supported are DFF_FIXED and DFF_PROPORTIONAL.

```
DFF_FIXED
DFF_PROPORTIONAL

GlyphEntry      struc
geWidth                 dw      ?  ; width of char bitmap, pixels
geOffset                dd      ?  ; pointer to the bits
GlyphEntry      ends

DFF_ABCFIXED
DFF_ABCPROPORTIONAL

GlyphEntry      struc
geWidth                 dw      ?  ; width of char bitmap, pixels
geOffset                dd      ?  ; pointer to the bits
geAspace                dd      ?  ; A space, fract pixels (16.16)
geBspace                dd      ?  ; B space, fract pixels (16.16)
geCspace                dw      ?  ; C space, fract pixels (16.16)
GlyphEntry      ends
```

Fractional pixels are expressed as 32-bit signed numbers with an implicit binary point between bits 15 and 16. This is referred to as a 16.16 ("sixteen dot sixteen") fixed-point number.

The **ABC** spacing in the following example is the same as defined previously. However, specific sets are defined for each character:

```
DFF_1COLOR                      ; 8 pixels per byte
DFF_16COLOR                     ; 2 pixels per byte
DFF_256COLOR                    ; 1 pixel per byte
DFF_RGBCOLOR                    ; RGB quads

GlyphEntry      struc
geWidth                 dw      ?  ; width of char bitmap, pixels
geOffset                dd      ?  ; pointer to the bits
geHeight                dw      ?  ; height of char bitmap, pixels
geAspace                dd      ?  ; A space, fract pixels (16.16)
geBspace                dd      ?  ; B space, fract pixels (16.16)
```

```
geCspace                dd      ?  ; C space, fract pixels (16.16)
GlyphEntry      ends
```

Group File Format Overview (3.1)

This topic describes the format of group files used by the Microsoft Windows operating system. A group file contains data that Microsoft Windows Program Manager (PROGMAN.EXE) uses to display the icons of the applications in a group, start the applications in a group, and open related documents.

Organization of a Group File

The first element in a group file is the group-file header. The data in the group-file header includes an identifier, a count of bytes, a count of items in the file, and information that the system uses to display group icons.

The group-file header is followed by one or more entries that contain item data describing the icon of an application. These entries include the coordinates that the system uses to display the icon; the count of bytes in the header, AND mask, and XOR mask for the icon; and the offset to the header, AND mask, and XOR mask for the icon.

The item data entries are followed by entries that contain the color data for the application icons. For more information about these entries, see Graphics Device Interface Overview.

For Windows version 3.1, the icon data is followed by tag data. The tag data contains information that Program Manager uses when it displays the Program Item Properties dialog box. This data identifies the directory in which the application is stored and the shortcut key (if one exists). It also specifies the state of the Run Minimized box.

Group-File Structures

This topic uses C structures to depict the organization of data within a group file. These structures were created solely to show the organization of data in a resource; they do not appear in any of the include files shipped with the Microsoft Windows 3.1 Software Development Kit (SDK).

Group-File Header

The group-file header contains general information about the group file. The **GROUPHEADER** structure has the following form:

```
struct tagGROUPHEADER {
    char  cIdentifier[4];
    WORD  wCheckSum;
    WORD  cbGroup;
    WORD  nCmdShow;
    RECT  rcNormal;
    POINT ptMin;
    WORD  pName;
    WORD  wLogPixelsX;
    WORD  wLogPixelsY;
    WORD  wBitsPerPixel;
    WORD  wPlanes;
    WORD  cItems;
    WORD  rgiItems[cItems];
};
```

Following are the members in the **GROUPHEADER** structure:

cIdentifier	Identifies an array of 4 characters. If the file is a valid group file, this array must contain the string "PMCC".
wCheckSum	Specifies the negative sum of all words in the file (including the value specified by the **wCheckSum** member).
cbGroup	Specifies the size of the group file, in bytes.
nCmdShow	Specifies whether Program Manager should display the group in minimized,

normal, or maximized form. This member can be one of the following values:

Value	Flag
0x00	SW_HIDE
0x01	SW_SHOWNORMAL
0x02	SW_SHOWMINIMIZED
0x03	SW_SHOWMAXIMIZED
0x04	SW_SHOWNOACTIVATE
0x05	SW_SHOW
0x06	SW_MINIMIZE
0x07	SW_SHOWMINNOACTIVATE
0x08	SW_SHOWNA
0x09	SW_RESTORE

rcNormal Specifies the coordinates of the group window (the window in which the group icons appear). It is a rectangular structure.

ptMin Specifies the coordinate of the lower-left corner of the group window with respect to the parent window. It is a point structure.

pName Specifies an offset from the beginning of the file to a null-terminated string that specifies the group name.

wLogPixelsX Specifies the horizontal resolution of the display for which the group icons were created.

wLogPixelsY Specifies the vertical resolution of the display for which the group icons were created.

wBitsPerPixel Specifies the format of the icon bitmaps, in bits per pixel.

wPlanes Specifies the count of planes in the icon bitmaps.

cItems Specifies the number of **ITEMDATA** structures in the **rgiItems** array. This is not necessarily the number of items in the group, because there may be NULL entries in the **rgiItems** array.

rgiItems[cItems] Specifies an array of **ITEMDATA** structures.

Item Data

The item data contains information about a particular application and its icon. The **ITEMDATA** structure has the following form:

```
struct tagITEMDATA {
    POINT pt;
    WORD  iIcon;
    WORD  cbResource;
    WORD  cbANDPlane;
    WORD  cbXORPlane;
    WORD  pHeader;
    WORD  pANDPlane;
    WORD  pXORPlane;
    WORD  pName;
    WORD  pCommand;
    WORD  pIconPath;
};
```

Following are the members in the **ITEMDATA** structure:

pt Specifies the coordinates for the lower-left corner of an icon in the group window. It is a point structure.

iIcon Specifies the index value for an icon. This value indicates the position of the icon in

an executable file.

cbResource Specifies the count of bytes in the icon resource, which appears in the executable file for the application.

cbANDPlane Specifies the count of bytes in the AND mask for the icon.

cbXORPlane Specifies the count of bytes in the XOR mask for the icon.

pHeader Specifies an offset from the beginning of the group file to the resource header for the icon.

pANDPlane Specifies an offset from the beginning of the group file to the AND mask for the icon.

pXORPlane Specifies an offset from the beginning of the group file to the XOR mask for the icon.

pName Specifies an offset from the beginning of the group file to a string that specifies the item name.

pCommand Specifies an offset from the beginning of the group file to a string that specifies the name of the executable file containing the application and the icon resource(s).

pIconPath Specifies an offset from the beginning of the group file to a string that specifies the path where the executable file is located. This path can be used to extract icon data from an executable file.

Tag Data

The tag data contains general information used to display the Program Item Properties dialog box. The **TAGDATA** structure has the following form:

```
struct tagTAGDATA{
    WORD wID;
    WORD wItem;
    WORD cb;
    BYTE rgb[1];
};
```

Following are the members in the **TAGDATA** structure:

wID Specifies the type of tag data. This member can have one of the following values:

Value	Meaning
0x8101	Array at which the **rgb** member points is a null-terminated string that identifies the path for the application.
0x8102	Array at which the **rgb** member points is a 16-bit word value that identifies the shortcut key specified by the user.
0x8103	Minimized version of the item is displayed. If this value is specified, the array to which the **rgb** member points is not present in the structure and the value of the **cb** member is 0x06.

wItem Specifies the index to the item the tag data refers to. If the data is not specific to a particular item, this value is 0xFFFF.

cb Specifies the size of the **TAGDATA** structure, in bytes.

rgb Specifies an array of byte values. The length of this array can be found by subtracting 6 from the value of the **cb** member.

Executable-File Header Format (3.1)

An executable (.EXE) file for the Microsoft Windows operating system contains a combination of code and data or a combination of code, data, and resources. The executable file also contains two headers: an MS-DOS header and a Windows header. The next two sections describe these headers; the third section describes the code and data contained in a Windows executable file.

MS-DOS Header

The MS-DOS (old-style) executable-file header contains four distinct parts: a collection of header information (such as the signature word, the file size, and so on), a reserved section, a pointer to a Windows header (if one exists), and a stub program. The following illustration shows the MS-DOS executable-file header:

If the word value at offset 18h is 40h or greater, the word value at 3Ch is typically an offset to a Windows header. Applications must verify this for each executable-file header being tested, because a few applications have a different header style.

MS-DOS uses the stub program to display a message if Windows has not been loaded when the user attempts to run a program.

For more information about the MS-DOS executable-file header, see the *Microsoft MS-DOS Programmer's Reference* (Redmond, Washington: Microsoft Press, 1991).

Windows Header

The Windows (new-style) executable-file header contains information that the loader requires for segmented executable files. This information includes the linker version number, data specified by the linker, data specified by the resource compiler, tables of segment data, tables of resource data, and so on. The following illustration shows the Windows executable-file header:

The following sections describe the entries in the Windows executable-file header.

Information Block

The information block in the Windows header contains the linker version number, the lengths of various tables that further describe the executable file, the offsets from the beginning of the header to the beginning of these tables, the heap and stack sizes, and so on. The following list summarizes the contents of the header information block (the locations are relative to the beginning of the block):

Location	Description
00h	Specifies the signature word. The low byte contains "N" (4Eh) and the high byte contains "E" (45h).
02h	Specifies the linker version number.
03h	Specifies the linker revision number.
04h	Specifies the offset to the entry table (relative to the beginning of the header).
06h	Specifies the length of the entry table, in bytes.
08h	Reserved.
0Ch	Specifies flags that describe the contents of the executable file. This value can be one or more of the following bits:

Bit	Meaning
0	The linker sets this bit if the executable-file format is **SINGLEDATA**. An executable file with this format contains one data segment. This bit is set if the file is a dynamic-link library (DLL).
1	The linker sets this bit if the executable-file format is **MULTIPLEDATA**. An executable file with this format contains multiple data segments. This bit is set if the file is a Windows application.
	If neither bit 0 nor bit 1 is set, the executable-file format is **NOAUTODATA**. An

executable file with this format does not contain an automatic data segment.

2 Reserved.

3 Reserved.

8 Reserved.

9 Reserved.

11 If this bit is set, the first segment in the executable file contains code that loads the application.

13 If this bit is set, the linker detects errors at link time but still creates an executable file.

14 Reserved.

15 If this bit is set, the executable file is a library module.

If bit 15 is set, the CS:IP registers point to an initialization procedure called with the value in the AX register equal to the module handle. The initialization procedure must execute a far return to the caller. If the procedure is successful, the value in AX is nonzero. Otherwise, the value in AX is zero.

The value in the DS register is set to the library's data segment if **SINGLEDATA** is set. Otherwise, DS is set to the data segment of the application that loads the library.

0Eh Specifies the automatic data segment number. (0Eh is zero if the **SINGLEDATA** and **MULTIPLEDATA** bits are cleared.)

10h Specifies the initial size, in bytes, of the local heap. This value is zero if there is no local allocation.

12h Specifies the initial size, in bytes, of the stack. This value is zero if the SS register value does not equal the DS register value.

14h Specifies the segment:offset value of CS:IP.

18h Specifies the segment:offset value of SS:SP.

The value specified in SS is an index to the module's segment table. The first entry in the segment table corresponds to segment number 1.

If SS addresses the automatic data segment and SP is zero, SP is set to the address obtained by adding the size of the automatic data segment to the size of the stack.

1Ch Specifies the number of entries in the segment table.

1Eh Specifies the number of entries in the module-reference table.

20h Specifies the number of bytes in the nonresident-name table.

22h Specifies a relative offset from the beginning of the Windows header to the beginning of the segment table.

24h Specifies a relative offset from the beginning of the Windows header to the beginning of the resource table.

26h Specifies a relative offset from the beginning of the Windows header to the beginning of the resident-name table.

28h Specifies a relative offset from the beginning of the Windows header to the beginning of the module-reference table.

2Ah Specifies a relative offset from the beginning of the Windows header to the beginning of the imported-name table.

2Ch Specifies a relative offset from the beginning of the file to the beginning of the nonresident-name table.

30h Specifies the number of movable entry points.

32h Specifies a shift count that is used to align the logical sector. This count is log2 of the segment sector size. It is typically 4, although the default count is 9. (This value corresponds to the **/alignment** [**/a**] linker switch. When the linker command line contains

/a:16, the shift count is 4. When the linker command line contains **/a:512**, the shift count is 9.)

34h — Specifies the number of resource segments.

36h — Specifies the target operating system, depending on which bits are set:

Bit	Meaning
0	Operating system format is unknown.
1	Reserved.
2	Operating system is Microsoft Windows.
3	Reserved.
4	Reserved.

37h — Specifies additional information about the executable file. It can be one or more of the following values:

Bit	Meaning
1	If this bit is set, the executable file contains a Windows 2.*x* application that runs in version 3.*x* protected mode.
2	If this bit is set, the executable file contains a Windows 2.*x* application that supports proportional fonts.
3	If this bit is set, the executable file contains a fast-load area.

38h — Specifies the offset, in sectors, to the beginning of the fast-load area. (Only Windows uses this value.)

3Ah — Specifies the length, in sectors, of the fast-load area. (Only Windows uses this value.)

3Ch — Reserved.

3Eh — Specifies the expected version number for Windows. (Only Windows uses this value.)

Segment Table

The segment table contains information that describes each segment in an executable file. This information includes the segment length, segment type, and segment-relocation data. The following list summarizes the values found in the segment table (the locations are relative to the beginning of each entry):

Location	Description
00h	Specifies the offset, in sectors, to the segment data (relative to the beginning of the file). A value of zero means no data exists.
02h	Specifies the length, in bytes, of the segment, in the file. A value of zero indicates that the segment length is 64K, unless the selector offset is also zero.
04h	Specifies flags that describe the contents of the executable file. This value can be one or more of the following:

Bit	Meaning
0	If this bit is set, the segment is a data segment. Otherwise, the segment is a code segment.
1	If this bit is set, the loader has allocated memory for the segment.
2	If this bit is set, the segment is loaded.
3	Reserved.
4	If this bit is set, the segment type is **MOVABLE**. Otherwise, the segment type is **FIXED**.
5	If this bit is set, the segment type is **PURE** or **SHAREABLE**. Otherwise, the segment type is **IMPURE** or **NONSHAREABLE**.
6	If this bit is set, the segment type is **PRELOAD**. Otherwise, the segment type is **LOADONCALL**.
7	If this bit is set and the segment is a code segment, the segment type is

EXECUTEONLY. If this bit is set and the segment is a data segment, the segment type is **READONLY**.

8	If this bit is set, the segment contains relocation data.
9	Reserved.
10	Reserved.
11	Reserved.
12	If this bit is set, the segment is discardable.
13	Reserved.
14	Reserved.
15	Reserved.

06h Specifies the minimum allocation size of the segment, in bytes. A value of zero indicates that the minimum allocation size is 64K.

Resource Table

The resource table describes and identifies the location of each resource in the executable file. The table has the following form:

```
WORD     rscAlignShift;
TYPEINFO rscTypes[];
WORD     rscEndTypes;
BYTE     rscResourceNames[];
BYTE     rscEndNames;
```

Following are the members in the resource table:

rscAlignShift Specifies the alignment shift count for resource data. When the shift count is used as an exponent of 2, the resulting value specifies the factor, in bytes, for computing the location of a resource in the executable file.

rscTypes Specifies an array of **TYPEINFO** structures containing information about resource types. There must be one **TYPEINFO** structure for each type of resource in the executable file.

rscEndTypes Specifies the end of the resource type definitions. This member must be zero.

rscResourceNames Specifies the names (if any) associated with the resources in this table. Each name is stored as consecutive bytes; the first byte specifies the number of characters in the name.

rscEndNames Specifies the end of the resource names and the end of the resource table. This member must be zero.

Type Information

The **TYPEINFO** structure has the following form:

```
typedef struct _TYPEINFO {
    WORD        rtTypeID;
    WORD        rtResourceCount;
    DWORD       rtReserved;
    NAMEINFO    rtNameInfo[];
} TYPEINFO;
```

Following are the members in the **TYPEINFO** structure:

rtTypeID Specifies the type identifier of the resource. This integer value is either a resource-type value or an offset to a resource-type name. If the high bit in this member is set (0x8000), the value is one of the following resource-type values:

Value	Resource type

RT_ACCELERATOR	Accelerator table
RT_BITMAP	Bitmap
RT_CURSOR	Cursor
RT_DIALOG	Dialog box
RT_FONT	Font component
RT_FONTDIR	Font directory
RT_GROUP_CURSOR	Cursor directory
RT_GROUP_ICON	Icon directory
RT_ICON	Icon
RT_MENU	Menu
RT_RCDATA	Resource data
RT_STRING	String table

If the high bit of the value in this member is not set, the value represents an offset, in bytes relative to the beginning of the resource table, to a name in the **rscResourceNames** member.

rtResourceCount Specifies the number of resources of this type in the executable file.

rtReserved Reserved.

rtNameInfo Specifies an array of **NAMEINFO** structures containing information about individual resources. The **rtResourceCount** member specifies the number of structures in the array.

Name Information

The **NAMEINFO** structure has the following form:

```
typedef struct _NAMEINFO {
    WORD rnOffset;
    WORD rnLength;
    WORD rnFlags;
    WORD rnID;
    WORD rnHandle;
    WORD rnUsage;
} NAMEINFO;
```

Following are the members in the **NAMEINFO** structure:

rnOffset Specifies an offset to the contents of the resource data (relative to the beginning of the file). The offset is in terms of alignment units specified by the **rscAlignShift** member at the beginning of the resource table.

rnLength Specifies the resource length, in bytes.

rnFlags Specifies whether the resource is fixed, preloaded, or shareable. This member can be one or more of the following values:

Value	Meaning
0x0010	Resource is movable (**MOVEABLE**). Otherwise, it is fixed.
0x0020	Resource can be shared (**PURE**).
0x0040	Resource is preloaded (**PRELOAD**). Otherwise, it is loaded on demand.

rnID Specifies or points to the resource identifier. If the identifier is an integer, the high bit is set (8000h). Otherwise, it is an offset to a resource string, relative to the beginning of the resource table.

rnHandle Reserved.

rnUsage Reserved.

Resident-Name Table

The resident-name table contains strings that identify exported functions in the executable file. As the name implies, these strings are resident in system memory and are never discarded. The resident-name strings are case-sensitive and are not null-terminated. The following list summarizes the values found in the resident-name table (the locations are relative to the beginning of each entry):

Location	Description
00h	Specifies the length of a string. If there are no more strings in the table, this value is zero.
01h - *xx*h	Specifies the resident-name text. This string is case-sensitive and is not null-terminated.
*xx*h + 01h	Specifies an ordinal number that identifies the string. This number is an index into the entry table.

The first string in the resident-name table is the module name.

Module-Reference Table

The module-reference table contains offsets for module names stored in the imported-name table. Each entry in this table is 2 bytes long.

Imported-Name Table

The imported-name table contains the names of modules that the executable file imports. Each entry contains two parts: a single byte that specifies the length of the string and the string itself. The strings in this table are not null-terminated.

Entry Table

The entry table contains bundles of entry points from the executable file (the linker generates each bundle). The numbering system for these ordinal values is 1-based--that is, the ordinal value corresponding to the first entry point is 1.

The linker generates the densest possible bundles under the restriction that it cannot reorder the entry points. This restriction is necessary because other executable files may refer to entry points within a given bundle by their ordinal values.

The entry-table data is organized by bundle, each of which begins with a 2-byte header. The first byte of the header specifies the number of entries in the bundle (a value of 00h designates the end of the table). The second byte specifies whether the corresponding segment is movable or fixed. If the value in this byte is 0FFh, the segment is movable. If the value in this byte is 0FEh, the entry does not refer to a segment but refers, instead, to a constant defined within the module. If the value in this byte is neither 0FFh nor 0FEh, it is a segment index.

For movable segments, each entry consists of 6 bytes and has the following form:

Location	Description
00h	Specifies a byte value. This value can be a combination of the following bits: **Bit(s)** **Meaning** 0 If this bit is set, the entry is exported. 1 If this bit is set, the segment uses a global (shared) data segment. 3-7 If the executable file contains code that performs ring transitions, these bits specify the number of words that compose the stack. At the time of the ring transition, these words must be copied from one ring to the other.
01h	Specifies an **int 3fh** instruction.
03h	Specifies the segment number.
04h	Specifies the segment offset.

For fixed segments, each entry consists of 3 bytes and has the following form:

Location	Description
00h	Specifies a byte value. This value can be a combination of the following bits:

Bit(s)	Meaning
0	If this bit is set, the entry is exported.
1	If this bit is set, the entry uses a global (shared) data segment. (This may be set only for **SINGLEDATA** library modules.)
3-7	If the executable file contains code that performs ring transitions, these bits specify the number of words that compose the stack. At the time of the ring transition, these words must be copied from one ring to the other.

01h Specifies an offset.

Nonresident-Name Table

The nonresident-name table contains strings that identify exported functions in the executable file. As the name implies, these strings are not always resident in system memory and are discardable. The nonresident-name strings are case-sensitive; they are not null-terminated. The following list summarizes the values found in the nonresident-name table (the specified locations are relative to the beginning of each entry):

Location	Description
00h	Specifies the length, in bytes, of a string. If this byte is 00h, there are no more strings in the table.
01h - *xx*h	Specifies the nonresident-name text. This string is case-sensitive and is not null-terminated.
xx + 01h	Specifies an ordinal number that is an index to the entry table.

The first name that appears in the nonresident-name table is the module description string (which was specified in the module-definition file).

Code Segments and Relocation Data

Code and data segments follow the Windows header. Some of the code segments may contain calls to functions in other segments and may, therefore, require relocation data to resolve those references. This relocation data is stored in a relocation table that appears immediately after the code or data in the segment. The first 2 bytes in this table specify the number of relocation items the table contains. A relocation item is a collection of bytes specifying the following information:

- Address type (segment only, offset only, segment and offset)
- Relocation type (internal reference, imported ordinal, imported name)
- Segment number or ordinal identifier (for internal references)
- Reference-table index or function ordinal number (for imported ordinals)
- Reference-table index or name-table offset (for imported names)

Each relocation item contains 8 bytes of data, the first byte of which specifies one of the following relocation-address types:

Value	Meaning
0	Low byte at the specified offset
2	16-bit selector
3	32-bit pointer
5	16-bit offset
11	48-bit pointer
13	32-bit offset

The second byte specifies one of the following relocation types:

Value	Meaning
0	Internal reference
1	Imported ordinal

2 Imported name

3 **OSFIXUP**

The third and fourth bytes specify the offset of the relocation item within the segment.

If the relocation type is imported ordinal, the fifth and sixth bytes specify an index to a module's reference table and the seventh and eighth bytes specify a function ordinal value.

If the relocation type is imported name, the fifth and sixth bytes specify an index to a module's reference table and the seventh and eighth bytes specify an offset to an imported-name table.

If the relocation type is internal reference and the segment is fixed, the fifth byte specifies the segment number, the sixth byte is zero, and the seventh and eighth bytes specify an offset to the segment. If the relocation type is internal reference and the segment is movable, the fifth byte specifies 0FFh, the sixth byte is zero; and the seventh and eighth bytes specify an ordinal value found in the segment's entry table.

Resource Format Overview (3.1)

This topic describes the format of executable-file resources used by the Microsoft Windows operating system. A resource, or collection of binary data, can be one of two types: standard or user-defined. The data in a standard resource describes an icon, cursor, menu, dialog box, bitmap, font, string table, or accelerator. The data in a user-defined resource describes an application-specific object. This topic describes standard resources.

A Windows executable file contains a resource table that describes each of the resources in the file. The data in this table includes an offset from the beginning of the file to each resource. It also includes values that specify the resource type, the resource length, and so on. For more information about the organization of the resource table, see Executable-File Header Format.

This topic uses C structures to depict the organization of data in resources. In some cases, these structures are not true C structures, because they contain members that can be variable-length strings. These structures were created only to depict the organization of data within a resource; they do not appear in any of the include files shipped with the Microsoft Windows 3.1 Software Development Kit (SDK).

Icon Resource (3.1)

An icon resource is identical in format to an icon image in an icon-resource file. The resource contains the icon-image header, color table, and XOR and AND masks. For more information about the icon-image format, see Graphics Device Interface Overview.

Each icon resource must have a corresponding entry in the resource table of the executable file. This means the resource table must contain a **TYPEINFO** structure in which the **rscTypeID** member is set to the **RT_ICON** value.

Icon-Directory Resource

An icon-directory resource is nearly identical in format to an icon directory in an icon-resource file. The resource specifies the number of icon images associated with this resource, as well as the dimensions and color formats for each icon. However, the last member of the **ICONDIRENTRY** structure (**dwImageOffset**) is replaced with a 16-bit value that specifies the resource-table index of the corresponding icon-image resource. The index is 1-based. If an executable file contains multiple icon resources, the index must be unique across all directories. For more information about the icon-directory format, see Graphics Device Interface Overview.

Each icon-directory resource must have a corresponding entry in the resource table of the executable file. This means the resource table must contain a **TYPEINFO** structure in which the **rscTypeID** member is set to the RT_GROUP_ICON value.

Cursor Resource (3.1)

A cursor resource is nearly identical in format to a cursor image in a cursor-resource file. The resource contains the cursor hot spot as well as the cursor-image header, color table, and XOR and AND masks. The x- and y-coordinates for the cursor hot spot (both 16-bit values) appear first in the resource, immediately followed by the cursor-image header. For more information about the cursor-image format, see Graphics Device Interface Overview.

Each cursor resource must have a corresponding entry in the resource table of the executable file. This means the resource table must contain a **TYPEINFO** structure in which the **rscTypeID** member is set to the **RT_CURSOR** value.

Cursor-Directory Resource

A cursor-directory resource is nearly identical in format to a cursor directory in a cursor-resource file. The resource specifies the number of cursor images associated with this resource, as well as the dimensions of the images, but it does not include the hot-spot data. Furthermore, the last member of the **ICONDIRENTRY** structure (**dwImageOffset**) is replaced with a 16-bit value that specifies the resource-table index of the corresponding cursor-image resource.

In an executable file, the **CURSORDIRENTRY** structure has the following form:

```
typedef struct _CURSORDIRENTRY {
    WORD  wWidth;
    WORD  wHeight;
    WORD  wPlanes;
    WORD  wBitCount;
    DWORD lBytesInRes;
    WORD  wImageIndex;
} CURSORDIRENTRY;
```

Following are the members in the **CURSORDIRENTRY** structure:

wWidth	Specifies the width of the cursor, in pixels.
wHeight	Specifies the height of the cursor, in pixels.
wPlanes	Specifies the number of color planes in the bitmap. This member must be set to 1.
wBitCount	Specifies the number of color bits per pixel in the bitmap. This member must be set to 1.
lBytesInRes	Specifies the size of the resource, in bytes.
wImageIndex	Specifies the 1-based index identifying the cursor image associated with this cursor-directory resource. If an executable file contains multiple icon resources, the index must be unique across all directories.

Each cursor-directory resource must have a corresponding entry in the resource table of the executable file. This means the resource table must contain a **TYPEINFO** structure in which the **rscTypeID** member is set to the RT_GROUP_CURSOR value.

Menu Resource (3.1)

A menu resource contains a header followed by a list of normal and pop-up menu items.

Each entry in the executable file's resource table contains a member that identifies the resource type. The **RT_MENU** constant identifies a menu resource.

Menu Header

The menu header contains version information for the menu resource. The header consists of two 16-bit values (which must be zero for Windows version 3.0 and later). A **MenuHeader** structure has the following form:

```
struct MenuHeader {
    WORD wVersion;
    WORD wReserved;
};
```

Following are the members in the **MenuHeader** structure:

wVersion Specifies the version number. (For Windows 3.0 and later, this value is zero.)

wReserved Reserved; must be zero.

Pop-up Menu Item

A menu resource contains data for each pop-up item in a menu. The first 16 bits indicate whether the item is grayed, inactive, checked, and so on. This data also includes a string that appears in the rectangle corresponding to that item. A **PopupMenuItem** structure has the following form:

```
struct PopupMenuItem {
    WORD fItemFlags;
    char szItemText[];
};
```

Following are the members in the **PopupMenuItem** structure:

fItemFlags Specifies menu-item information. This member can have one or more of the following values:

Value	Meaning
MF_GRAYED	Item is grayed.
MF_DISABLED	Item is inactive.
MF_CHECKED	Item can be checked.
MF_POPUP	Item is a popup (must be specified for pop-up items).
MF_MENUBARBREAK	Item is a menu-bar break.
MF_MENUBREAK	Item is a menu break.
MF_END	Item ends the menu.

szItemText Specifies a null-terminated string that appears in the menu and identifies the menu item. There is no fixed limit on the size of this string.

Normal Menu Item

A normal menu item is very similar to a pop-up menu item, except that it has an additional menu identifier. A **NormalMenuItem** structure has the following form:

```
struct NormalMenuItem {
    WORD fItemFlags;
    WORD wMenuID;
    char szItemText[];
};
```

Following are the members in the **NormalMenuItem** structure:

fItemFlags Specifies menu-item information. This member can have one or more of the following values:

Value	Meaning
MF_GRAYED	Item is grayed.
MF_DISABLED	Item is inactive.
MF_CHECKED	Item can be checked.
MF_MENUBARBREAK	Item is a menu-bar break.
MF_MENUBREAK	Item is a menu break.
MF_END	Item ends the menu.

wMenuID Identifies the menu item.

szItemText Specifies a null-terminated string that appears in the menu and identifies the menu item. There is no fixed limit on the size of this string.

A menu separator is a normal menu item for which **fItemFlags** is zero, **wMenuID** is zero, and the **szItemText** array is empty.

Combined Menu Items

Pop-up and normal menu items are often combined in menus. A mixture of the two is shown in the following example:

```
POPUP ITEM
    NORMAL ITEM
    NORMAL ITEM
    .
    .
    .
    NORMAL ITEM
    NORMAL ITEM (fItemFlags contains the MF_END constant)
```

Note that the terminating item is a normal menu item, not a pop-up item, and that the **fItemFlags** member in the last item contains the MF_END constant.

Pop-up and normal menu items can also be nested to create hierarchical blocks, as shown in the following example:

```
POPUP ITEM
    NORMAL ITEM
    NORMAL ITEM
    .
    .
    .
    NORMAL ITEM
    POPUP ITEM
        NORMAL ITEM
        NORMAL ITEM
        NORMAL ITEM
        POPUP ITEM (fItemFlags contains the MF_END constant)
            NORMAL ITEM
            NORMAL ITEM (fItemFlags contains the MF_END constant)
    NORMAL ITEM (fItemFlags contains the MF_END constant)
```

Note that, although the pop-up menu item has its own terminating item, the terminating item for the entire menu is again a normal menu item.

Dialog Box Resource (3.1)

A dialog box resource contains a dialog box header and data for each control within the dialog box.

Each entry in the executable file's resource table contains a member that identifies the resource type. The **RT_DIALOG** constant identifies a dialog box resource.

Dialog Box Header

The dialog box header contains general dialog box data, such as the dialog box window style, the number of controls in the dialog box, the coordinates of the upper-left corner of the box, the width and height of the box, the name of the menu to be displayed, and so on. The **DialogBoxHeader** structure has the following form:

```
struct DialogBoxHeader {
    DWORD lStyle;
    BYTE  bNumberOfItems;
    WORD  x;
    WORD  y;
    WORD  cx;
    WORD  cy;
    char  szMenuName[];
    char  szClassName[];
    char  szCaption[];
    WORD  wPointSize;    /* only if DS_SETFONT */
    char  szFaceName[];  /* only if DS_SETFONT */
};
```

Following are the members in the **DialogBoxHeader** structure:

lStyle	Specifies the dialog-window style. This member is a combination of the window-style and dialog-style flags that are found in the WINDOWS.H include file.
bNumberOfItems	Specifies the number of controls in the dialog box.
x	Specifies the x-coordinate of the upper-left corner of the dialog box. This coordinate is a horizontal distance from the left edge of the parent window. This distance is specified by using a special horizontal dialog box unit equivalent to the average character width of the font divided by 4. If the DS_SETFONT flag is set, the average character width of the font specified in the dialog box header is used. Otherwise, the average character width of the system font is used.
y	Specifies the y-coordinate of the lower-left corner of the dialog box. This coordinate is a vertical distance from the top of the parent window. This distance is specified by using a special vertical dialog box unit equivalent to the character height of the current font divided by 8. If the DS_SETFONT flag is set, the height of the font specified in the dialog box header is used. Otherwise, the height of the system font is used.
cx	Specifies the width of the dialog box, in horizontal dialog units. (See the description of the **x** member for a definition of horizontal dialog units.)
cy	Specifies the height of the dialog box, in vertical dialog units. (See the description of the **y** member for a definition of vertical dialog units.)
szMenuName	Identifies a menu resource associated with the dialog box. If no menu is associated with the dialog box, this array contains a single-byte value of zero. If the menu has an ordinal identifier, the first byte of this member contains 0xFF and the subsequent two bytes contain the ordinal value. If the menu has a name identifier, the member contains a null-terminated string that specifies the menu name.

szClassName Specifies the class name for the dialog box. If the dialog box uses the default class, this member contains a single-byte value of zero. Otherwise, this member contains a null-terminated string that specifies the name of the dialog class.

szCaption Specifies a dialog box caption. This array must contain a null-terminated string.

wPointSize Specifies the point size of a font that is unique to the dialog box. (This member is present only if the DS_SETFONT flag is set by the **lStyle** member.)

szFaceName Specifies the typeface name of a dialog box font. This array must contain a null-terminated string. (This member is present only if the DS_SETFONT flag is set by the **lStyle** member.)

Control Data

A dialog box resource contains data for each control in a given dialog box. This data contains the coordinates of the upper-left corner of the control, the dimensions of the control, a control identifier, and so on. A **ControlData** structure has the following form:

```
struct ControlData {
    WORD  x;
    WORD  y;
    WORD  cx;
    WORD  cy;
    WORD  wID;
    DWORD lStyle;
    union
    {
        BYTE class;     /* if (class & 0x80) */
        char szClass[]; /* otherwise         */
    } ClassID;
    szText;
};
```

Following are the members in the **ControlData** structure:

x Specifies the x-coordinate of the upper-left corner of the control.

y Specifies the y-coordinate of the upper-left corner of the control.

cx Specifies the width of the control, in horizontal dialog box units. For a definition of these units, see the **DialogBoxHeader** structure in the preceding section.

cy Specifies the height of the control, in vertical dialog box units. For a definition of these units, see the **DialogBoxHeader** structure in the preceding section.

wID Identifies the control.

lStyle Specifies the control style. This member is a combination of the window-style flags that appear in the WINDOWS.H file.

ClassID Specifies the class type. This member is either a single-byte value or a null-terminated string.

If this member is a byte value, it can be one of the following:

Value	Class type
0x80	Button
0x81	Edit
0x82	Static
0x83	List box
0x84	Scroll bar
0x85	Combo box

If this number is not a byte value, it takes the form described in the **szClass** member.

szClass Identifies the class type. This member is a null-terminated string.
szText Specifies the control text. This member is a null-terminated string.

Bitmap Resource (3.1)

A bitmap resource is identical in format to a Windows bitmap file with its **BITMAPFILEHEADER** structure removed. In other words, the bitmap resource contains only the bitmap header, color table, and bitmap bits. For more information about the bitmap format, see Graphics Device Interface Overview.

Each bitmap resource must have a corresponding entry in the resource table of the executable file. This means the resource table must contain a **TYPEINFO** structure in which the **rscTypeID** member is set to the **RT_BITMAP** value.

Font Resource (3.1)

A font resource consists of two parts: a directory and its components. The font-directory data describes all the fonts in a resource. This data includes a value specifying the number of fonts in the resource and a table of metrics for each of these fonts. The font-component data describes a single font in the resource. There is one component for each of the fonts in the resource. The component data is identical to the data found in a Windows font file (.FNT).

Each entry in the executable file's resource table contains a member that identifies the resource type. The **RT_FONTDIR** and **RT_FONT** constants identify a font directory and a font component, respectively.

Font-Directory Data

Font-directory data consists of a font count and one or more font directory entries.

Font Count

The font count is an integer that specifies the number of fonts in the resource. This value also corresponds to the number of font directories and font components.

Font Directory

The font directory is a collection of font metrics for a particular font. These metrics specify the point size for the font, aspect ratio, stroke width, and so on. The **FontDirEntry** structure has the following form:

```
struct FontDirEntry {
        WORD  fontOrdinal;
        WORD  dfVersion;
        DWORD dfSize;
        char  dfCopyright[60];
        WORD  dfType;
        WORD  dfPoints;
        WORD  dfVertRes;
        WORD  dfHorizRes;
        WORD  dfAscent;
        WORD  dfInternalLeading;
        WORD  dfExternalLeading;
        BYTE  dfItalic;
        BYTE  dfUnderline;
        BYTE  dfStrikeOut;
        WORD  dfWeight;
        BYTE  dfCharSet;
        WORD  dfPixWidth;
        WORD  dfPixHeight;
        BYTE  dfPitchAndFamily;
        WORD  dfAvgWidth;
        WORD  dfMaxWidth;
        BYTE  dfFirstChar;
        BYTE  dfLastChar;
        BYTE  dfDefaultChar;
        BYTE  dfBreakChar;
        WORD  dfWidthBytes;
        DWORD dfDevice;
        DWORD dfFace;
        DWORD dfReserved;
        char  szDeviceName[];
        char  szFaceName[];
};
```

Font-Component Data

Font-component data consists of one or more font-component entries.

Font Component

Each font-component entry consists of a header, extension data, extended text metrics, kerning-pair data, and track-kerning data.

Following are the five parts of the font component entries:

Data structure	Contents
Header	Font metrics, such as the aspect ratio for which the font was created; leading values; italic, underline, strikeout, and bold descriptions; width information; first and last character identifiers; default and break character identifiers; and a pointer to the actual character data
Extension data	Offset to the extended font metrics, offset to the extent table, offset to the origin table, and offset to the table of kerning data
Extended text metrics	Additional font metrics, such as the point size of the font, the minimum point size to which it can be scaled, the maximum point size to which it can be scaled, the "X" height, the lowercase ascent and descent values, superscript metrics and offsets, subscript metrics and offsets, underline offset and width, strikeout offset and width, and the number of kerning pairs associated with the font
Kerning-pair data	An identifier for each character in the pair of kerned characters, and a kerning value
Track-kerning data	Additional kerning data

For a complete description of Windows font files, see the Microsoft Windows Device Development Kit documentation.

String-Table Resources (3.1)

A string table consists of one or more separate resources, each containing exactly 16 strings. The maximum length of each string is 255 bytes. One or more strings in a block can be null or empty. The first byte in the string specifies the number of characters in the string. (For null or empty strings, the first byte contains the value zero.)

Windows uses a 16-bit identifier to locate a string in a string-table resource. Bits 4 through 15 specify the block in which the string appears; bits 0 through 3 specify the location of that string relative to the beginning of the block.

Each entry in an executable file's resource table contains a member that identifies the resource type. The **RT_STRING** constant identifies a string table.

Accelerator Resource (3.1)

An accelerator resource contains one or more accelerator entries.

Each entry in an executable file's resource table contains a member that identifies the resource type. The **RT_ACCELERATOR** constant identifies an accelerator resource.

The accelerator entry is a 5-byte entry with the following form:

```
struct AccelTableEntry {
        BYTE fFlags;
        WORD wEvent;
        WORD wId;
};
```

Following are the members in the **AccelTableEntry** structure:

fFlags Specifies accelerator characteristics. It can be one or more of the following values:

Value	Meaning
0x02	Top-level menu item is not highlighted when accelerator is used.
0x04	Accelerator is activated only if user presses the SHIFT key. This flag applies only to virtual keys.
0x08	Accelerator is activated only if user presses the **CONTROL** key. This flag applies only to virtual keys.
0x10	Accelerator is activated only if user presses the ALT key. This flag applies only to virtual keys.
0x80	Entry is last entry in accelerator table.

wEvent Specifies an ASCII character value or a virtual-key code that identifies the accelerator key.

wID Identifies the accelerator. This is the value passed to the window procedure when the user presses the key.

Name-Table Resource (3.1)

Name-table entries are not used in Windows 3.1. They are supported in Windows 3.0, but they can adversely affect system performance.

The header in a Windows executable file contains a resource table. This table contains data that describes many of the resources in the file. In Windows 3.0, the resource table does not describe named resources or resources that use a type name as a unique identifier. Instead, a name-table structure in the resource table maps a unique integer value to each resource name or type.

Each entry in an executable file's resource table contains a member that identifies the resource type. The decimal value 15 identifies a name-table resource.

Version-Information Resource (3.1)

A version-information resource contains data that identifies the version, language, and distribution of the application, dynamic-link library, driver, or device containing the resource. Installation programs use the functions in the File Installation library (VER.DLL) to retrieve the version-information resource from a file and to extract the version-information blocks from the resource. (For more information about the File Installation library, see the *Microsoft Windows Programmer's Reference, Volume 1*.)

A version-information resource consists of one or more information blocks, each with the following form:

```
WORD    cbBlock;
WORD    cbValue;
char    szKey[];
BYTE    abValue[];
```

Following are the members in a version-information block:

cbBlock Specifies the size, in bytes, of the complete block. This value includes the size of nested blocks, if any.

cbValue Specifies the size, in bytes, of the **abValue** member.

szKey Specifies the name of the block. This value is a null-terminated string. Additional zero bytes are appended to the string to align the last byte on a 32-bit boundary.

abValue Specifies either an array of word values or a null-terminated string. The format of this member depends on the **szKey** value. Additional zero bytes are appended to align the last byte on a 32-bit boundary.

A block can contain nested blocks. In such cases, the nested block immediately follows the **abValue** member and the size specified by the **cbBlock** member in the first block is the sum of the two sizes. If a block contains more than one nested block, the nested blocks are stored sequentially and the **cbBlock** member in the first block specifies the total size of all blocks.

A version-information resource usually contains the following predefined blocks:

- Root
- Variable information
- String information
- Language-specific

In addition, the string and variable information blocks usually contain nested blocks that define the details about the file. This section describes the predefined information blocks.

Root Block

A root block is always the first block in the version resource. It contains such information as the file version, product version, release status, operating system, file type, and date the file was created.

The name of the root block, as specified by the **szKey** member, is VS_VERSION_INFO. The value (in **abValue**) is a **VS_FIXEDFILEINFO** structure. For a description of the **VS_FIXEDFILEINFO** structure, see the *Microsoft Windows Programmer's Reference, Volume 3.*

The variable and string information blocks in the resource are nested within the root block.

Variable Information Block

A variable information block typically contains a single nested block that defines the languages and character sets supported by the file.

The variable information block has the name **VarFileInfo** but has no corresponding value. Instead, the block is immediately followed by a nested block that has the name **Translation** and has a value consisting of an array of language and character-set identifiers. Each element in the array consists of two 16-bit values. The first value is a language identifier, the second a character-set identifier.

The language identifier can be one of the following values:

Value	Language
0x0401	Arabic
0x0402	Bulgarian
0x0403	Catalan
0x0404	Traditional Chinese
0x0405	Czech
0x0406	Danish
0x0407	German
0x0408	Greek
0x0409	U.S. English
0x040A	Castilian Spanish
0x040B	Finnish
0x040C	French
0x040D	Hebrew
0x040E	Hungarian
0x040F	Icelandic
0x0410	Italian
0x0411	Japanese
0x0412	Korean
0x0413	Dutch
0x0414	Norwegian - Bokmål
0x0415	Polish
0x0416	Brazilian Portuguese
0x0417	Rhaeto-Romanic
0x0418	Romanian
0x0419	Russian
0x041A	Croato-Serbian (Latin)
0x041B	Slovak
0x041C	Albanian
0x041D	Swedish
0x041E	Thai
0x041F	Turkish
0x0420	Urdu
0x0421	Bahasa
0x0804	Simplified Chinese
0x0807	Swiss German
0x0809	U.K. English
0x080A	Mexican Spanish
0x080C	Belgian French
0x0810	Swiss Italian
0x0813	Belgian Dutch
0x0814	Norwegian - Nynorsk
0x0816	Portuguese
0x081A	Serbo-Croatian (Cyrillic)
0x0C0C	Canadian French

0x100C Swiss French

The character-set identifier can be one of the following values:

Value	Character set
0	7-bit ASCII
932	Windows, Japan (Shift - JIS X-0208)
949	Windows, Korea (Shift - KSC 5601)
950	Windows, Taiwan (GB5)
1200	Unicode
1250	Windows, Latin-2 (Eastern European)
1251	Windows, Cyrillic
1252	Windows, Multilingual
1253	Windows, Greek
1254	Windows, Turkish
1255	Windows, Hebrew
1256	Windows, Arabic

Character set 1252 is typically given for files designed for the U.S. English version of Windows.

String Information Block

A string information block contains version information in the form of null-terminated strings.

The string information block has the name **StringFileInfo** but has no corresponding value. Instead, the block contains one or more nested blocks. Each nested block corresponds to one pair of language and character-set identifiers given in the variable information block.

Language-Specific Blocks

A language-specific block contains nested blocks that specify such information as the product name, company name, copyrights, trademarks, operating system, and so on.

A language-specific block can contain any number of nested blocks. Each block corresponds to one of the language and character-set identifier pairs given in the resource's variable information block. The name of the language-specific block is a null-terminated string consisting of a concatenation of the language and character-set identifiers. The block has no corresponding value.

Each nested block contains a name that identifies version-specific information and a string that represents the value associated with the name. A nested block can have one of the following predefined names and associated values:

Name	Value
Comments	Specifies additional information that should be displayed for diagnostic purposes.
CompanyName	Specifies the company that produced the file--for example, "Microsoft Corporation" or "Standard Microsystems Corporation, Inc.". This string is required.
FileDescription	Specifies a file description to be presented to users. This string may be displayed in a list box when the user is choosing files to install--for example, "Keyboard Driver for AT-Style Keyboards" or "Microsoft Word for Windows". This string is required.
FileVersion	Specifies the version number of the file--for example, "3.10" or "5.00.RC2". This string is required.
InternalName	Specifies the internal name of the file, if one exists--for example, a module name if the file is a dynamic-link library. If the file has no internal name, this string should be the original filename, without extension. This string is required.

LegalCopyright	Specifies all copyright notices that apply to the file. This should include the full text of all notices, legal symbols, copyright dates, and so on--for example, "Copyright Microsoft Corporation 1990-1991". This string is optional.
LegalTrademarks	Specifies all trademarks and registered trademarks that apply to the file. This should include the full text of all notices, legal symbols, trademark numbers, and so on--for example, "Windows(TM) is a trademark of Microsoft Corporation". This string is optional.
OriginalFilename	Specifies the original name of the file, not including a path. This information enables an application to determine whether a file has been renamed by a user. The format of the name depends on the file system for which the file was created. This string is required.
PrivateBuild	Specifies information about a private version of the file--for example, "Built by TESTER1 on \TESTBED". This string should be present only if the VS_FF_PRIVATEBUILD flag is set in the **dwFileFlags** member of the **VS_FIXEDFILEINFO** structure of the root block.
ProductName	Specifies the name of the product with which the file is distributed--for example, "Microsoft Windows". This string is required.
ProductVersion	Specifies the version of the product with which the file is distributed--for example, "3.10" or "5.00.RC2". This string is required.
SpecialBuild	Specifies how this version of the file differs from the standard version--for example, "Private build for TESTER1 solving mouse problems on M250 and M250E computers". This string should be present only if the VS_FF_SPECIALBUILD flag is set in the **dwFileFlags** member of the **VS_FIXEDFILEINFO** structure in the root block.

Symbol-File Format Overview (3.1)

This topic describes the format of symbol files created by Microsoft Symbol File Generator (**MAPSYM**). Symbol files contain information that the Microsoft Windows 80386 Debugger (WDEB386.EXE) can use to locate program modules and global data in an executable module.

The following topics describe the information in a symbol file:

Map Definitions
Segment Definitions
Symbol Definitions
Constant Definitions
Line Definitions

Map Definitions

Every symbol file contains a list that links two or more map definitions. Each map definition describes a module in the executable file.

The first map definition in the chain starts at the beginning of the file, as follows:

```
/* File is loaded at pFileBuffer. */

pMapDef = (MAPDEF *)pFileBuffer;
```

Each map definition (except the last) contains a pointer to the next map definition in the chain. This pointer is a 16-bit number that, when multiplied by 16, gives the byte offset of the next map definition in the file, as follows:

```
pNextMapDef = (MAPDEF *)(pFileBuffer + (pMapDef->ppNextMap * 16));
```

The pointer in the last map definition is zero.

The **MAPDEF** structure for each map definition (except the last) has the following form:

```
typedef struct {
    WORD ppNextMap;     /* paragraph pointer to next map        */
    BYTE bFlags;        /* symbol types                         */
    BYTE bReserved1;    /* reserved                             */
    WORD pSegEntry;     /* segment entry-point value            */
    WORD cConsts;       /* count of constants in map            */
    WORD pConstDef;     /* pointer to constant chain            */
    WORD cSegs;         /* count of segments in map             */
    WORD ppSegDef;      /* paragraph pointer to first segment   */
    BYTE cbMaxSym;      /* maximum symbol-name length           */
    BYTE cbModName;     /* length of module name                */
    char achModName[1]; /* n bytes of module-name member        */
} MAPDEF;
```

The last **MAPDEF** structure contains the version and release number for the version of Symbol File Generator used to create the symbol file. It has the following form:

```
typedef struct {
    WORD ppNextMap; /* always zero                            */
    BYTE release;   /* release number (minor version number) */
    BYTE version;   /* major version number                   */
} LAST_MAPDEF;
```

Following are the members of the **MAPDEF** structure:

ppNextMap Specifies the offset from the beginning of the file to the next **MAPDEF** structure in the chain. Multiply the value of the **ppNextMap** member by 16 to obtain the offset.

bFlags Specifies the type of symbols in the file. The **bFlags** member can be one or more of the following values:

Value	Meaning
0	Contains 16-bit symbols.
1	Contains 32-bit symbols.
2	Includes alphabetic symbol table.

bReserved1 Reserved.

pSegEntry Specifies the segment of the entry point for the application.

cConsts Specifies the number of constants in this module.

pConstDef Specifies a 16-bit offset from the beginning of the file to an array of pointers to

	constant definitions. This value is not multiplied by 16 to obtain the offset.
cSegs	Specifies the number of segments in this module.
ppSegDef	Specifies the offset from the beginning of the file to the first segment definition in this module. Multiply the value of the **ppSegDef** member by 16 to obtain the offset.
cbMaxSym	Specifies the length of the longest symbol name in this module.
cbModName	Specifies the length of the module name.
achModName	Specifies a variable-length array of characters containing the module name. The name is not null-terminated.

Segment Definitions

Each module in the symbol file contains a linked list of segment definitions. To obtain a pointer to the first segment definition, multiply the value of the **ppSegDef** member in the current **MAPDEF** structure by 16, as follows:

```
/* File is loaded at pFileBuffer. */

pSegDef = (SEGDEF *)(pFileBuffer + (md.ppSegDef * 16));
```

Each segment definition contains a pointer to the next segment definition in the chain. This pointer is a 16-bit number that, when multiplied by 16, gives the byte offset of the next segment definition in the file, as follows:

```
pNextSegDef = (SEGDEF *)(pFileBuffer + (pSegDef->ppNextSeg * 16));
```

The pointer in the last segment definition is not zero. The linked list of segment definitions is circular--the pointer in the last segment definition gives the offset of the first segment definition. You can use the **cSegs** member in the **MAPDEF** structure to determine the number of segments in the module.

The **SEGDEF** structure for these lists has the following form:

```
typedef struct {
    WORD ppNextSeg;     /* paragraph pointer to next segment    */
    WORD cSymbols;      /* count of symbols in list             */
    WORD pSymDef;       /* offset of symbol chain               */
    WORD wReserved1;    /* reserved                             */
    WORD wReserved2;    /* reserved                             */
    WORD wReserved3;    /* reserved                             */
    WORD wReserved4;    /* reserved                             */
    BYTE bFlags;        /* symbol types                         */
    BYTE bReserved1;    /* reserved                             */
    WORD ppLineDef;     /* offset of line-number record         */
    BYTE bReserved2;    /* reserved                             */
    BYTE bReserved3;    /* reserved                             */
    BYTE cbSegName;     /* length of segment name               */
    char achSegName[1]; /* n bytes of segment-name member       */
} SEGDEF;
```

Following are the members of the **SEGDEF** structure:

ppNextSeg Specifies the offset from the beginning of the file to the next **SEGDEF** structure in the chain. Multiply the value of the **ppNextSeg** member by 16 to obtain the offset.

cSymbols Specifies the number of symbols in this segment.

pSymDef Specifies the offset from the beginning of the segment definition to an array of pointers to symbol definitions. This value is not multiplied by 16 to obtain the offset. For more details, see Section 12.3, **"Symbol Definitions."**

wReserved1 Reserved.

wReserved2 Reserved.

wReserved3 Reserved.

wReserved4 Reserved.

bFlags Specifies the type of symbols in this segment. The **bFlags** member can be one or more of the following values:

Value	Meaning
0	Contains 16-bit symbols.
1	Contains 32-bit symbols.

	2 Includes alphabetic symbol table.
bReserved1	Reserved.
ppLineDef	Specifies the offset from the beginning of the file to the first line-number definition. Multiply the value of the **ppLineDef** member by 16 to obtain the offset.
bReserved2	Reserved.
bReserved3	Reserved.
cbSegName	Specifies the length of the segment name.
achSegName	Specifies a variable-length array of characters containing the segment name. The name is not null-terminated.

Symbol Definitions

Each segment definition contains a pointer to an array of pointers to symbol definitions.

All symbol files contain an array of pointers to symbols, sorted by symbol value. The **bFlags** member in the **SEGDEF** structure indicates whether the segment has an alphabetic symbol table. To obtain a pointer to the numerically ordered array of symbol-definition pointers, add the **pSymDef** pointer in the current segment definition to the pointer to the current segment definition, as follows:

```
aSymPtr = (WORD *)((BYTE *)pSegDef + pSegDef->pSymDef);
```

In addition, symbol files created by **MAPSYM** versions 5.0 and later may contain an array of pointers sorted alphabetically by symbol name. This array begins immediately after the numeric array:

```
aSymPtrAlpha = (WORD *)((BYTE *)pSegDef +
        pSegDef->pSymDef + pSegDef->cSymbols * sizeof(WORD));
```

To obtain a pointer to each symbol definition, add the offset specified by each element in the array of symbol-definition pointers to the pointer to the current segment definition, as follows:

```
for (n = 0; n < pSegDef->cSymbols; n++) {
    pSymDef = (SYMDEF *)((BYTE *)pSegDef + aSymPtr[n]);
    .
    .
    /* Use the symbol information here. */
    .
    .
}
```

The **SYMDEF** structure for these symbol definitions has the following form:

```
typedef struct {
    WORD wSymVal;       /* symbol address or constant    */
    BYTE cbSymName;     /* length of symbol name         */
    char achSymName[1]; /* n bytes of symbol-name member */
} SYMDEF;
```

Following are the members of the **SYMDEF** structure:

wSymVal Specifies the address of the symbol or the value of a constant.

cbSymName Specifies the length of the symbol name.

achSymName Specifies a variable-length array of characters containing the segment name. The name is not null-terminated.

The **wSymVal** member in the **SYMDEF** structure is a doubleword value for 32-bit symbols.

Constant Definitions

Each **MAPDEF** structure contains a pointer to an array of pointers to constant definitions. The format of a constant definition is the same as that of a symbol definition (you can use the **SYMDEF** structure described in Section 12.3, "Symbol Definitions").

The **ppConstDef** member in the current **MAPDEF** structure specifies the file offset of the array of constant-definition pointers, and the offset to each constant definition can be calculated from each element in the array, as follows:

```
aConstPtr = (WORD *)(pFileBuffer + md.ppConstDef);

for (n = 0; n < md.cConsts; n++) {
    pConstDef = (SYMDEF *)(pFileBuffer + aConstPtr[n]);
    .
    .
    /* Use the symbol information here. */
    .
    .
}
```

Line Definitions

Symbol files created by linking with the **/LI** option also contain line-number information. Each segment definition contains a pointer to the first line definition in a circularly linked list. If the pointer in the **SEGDEF** structure is zero, the segment has no line-number information.

LINEDEF Structure

To obtain a pointer to the first **LINEDEF** structure in the linked list, multiply the value of the **ppLineDef** member in the current **SEGDEF** structure by 16, as follows:

```
pLineDef = (LINEDEF *)(pBuf + (pSegDef->ppLineDef * 16));
```

Each **LINEDEF** structure (except the last) contains a pointer to the next **LINEDEF** structure in the linked list. The pointer in the last **LINEDEF** structure is zero.

The **LINEDEF** structure for each line definition has the following form:

```
typedef struct {
    WORD ppNextLine;      /* ptr to next linedef (0 if last) */
    WORD wReserved1;      /* reserved                        */
    WORD pLines;          /* pointer to line numbers         */
    WORD wReserved2;      /* reserved                        */
    int  cLines;          /* count of line numbers           */
    BYTE cbFileName;      /* filename length                 */
    char achFileName[1];  /* filename (contains lines)       */
} LINEDEF;
```

Following are the members of the **LINEDEF** structure:

ppNextLine Specifies the offset from the beginning of the file to the next **LINEDEF** structure in the chain. Multiply the value of the **ppNextLine** member by 16 to obtain the offset. If this member is zero, there is no line-number information for this segment.

wReserved1 Reserved.

pLines Specifies the offset from the beginning of the current **LINEDEF** structure to the array of line-information structures.

wReserved2 Reserved.

cLines Specifies the number of lines in the line-information array.

cbFileName Specifies the number of characters in the name of the source file. This file was compiled and linked to produce the map file.

achFileName Specifies a variable-length array of characters containing the name of the source file. The name is not null-terminated.

LINEINF Structure

To obtain a pointer to the first **LINEINF** structure in the array for the line-definition structure, add the **pLines** pointer in the current **LINEDEF** structure to the current **LINEDEF** pointer, as follows:

```
pLines = (LINEINF *)((BYTE *)pLineDef + pLineDef->pLines);
```

Each element in the line-information array contains the offset into the source file for a line and the offset into the executable file for the code resulting from the source line.

The **LINEINF** structure has the following form:

```
typedef struct {
    WORD wCodeOffset;   /* executable offset */
    WORD dwFileOffset;  /* source offset     */
} LINEINF;
```

Following are the members of the **LINEINF** structure:

wCodeOffset Specifies the offset in this segment to the code resulting from compiling this line in the source file.

dwFileOffset Specifies the offset to this line in the source file.

Write File Format

This topic describes the binary file format used by Microsoft Write. A Write binary file contains information about file content, text and pictures (including object-linking-and-embedding, or OLE, objects), and formatting.

Write-File Header

The Write-file header describes the content of the file. It contains data, pointers to subdivisions of the formatting section, and information about the length of the file. The file header has the following form:

Word	Name	Description
0	**wIdent**	Must be 0137061 octal (or 0137062 octal if the file contains OLE objects)
1	**dty**	Must be zero
2	**wTool**	Must be 0125400 octal
3		Reserved; must be zero
4		Reserved; must be zero
5		Reserved; must be zero
6		Reserved; must be zero
7-8	**fcMac**	Number of bytes of actual text plus 128, the bytes in one sector (low-order word first)
9	**pnPara**	Page number for start of paragraph information
10	**pnFntb**	Page number of footnote table (FNTB) or **pnSep**, if none
11	**pnSep**	Page number of section property (SEP) or **pnSetb**, if none
12	**pnSetb**	Page number of section table (SETB) or **pnPgtb**, if none
13	**pnPgtb**	Page number of page table (PGTB) or **pnFfntb**, if none
14	**pnFfntb**	Page number of font face-name table (FFNTB) or **pnMac**, if none
15-47	**szSsht**	Reserved for Microsoft Word compatibility
48	**pnMac**	Count of pages in whole file (last page number plus 1)

In the preceding list, a "page number" means an offset in 128-byte blocks from the start of the file. For example, if **pnPara** equals 10, the paragraph information is at offset 10*128 = 1280 in the file.

The starting page number of character information (**pnChar**) is not stored but is computable, as follows:

pnChar = (*fcMac* + 127) / 128

Examining the value of word 48 of the header is a good way to distinguish Write files from Microsoft Word files. If **pnMac** equals zero, the file originated in Word. Any other value identifies a Write file.

Text and Pictures

After the header comes information about text and pictures. This information constitutes a separate section of the file.

Text

The text of the Write file starts at word 64 (page 1). Write uses the Windows character set (except for the pictures in the file) as well as the following special characters:

- ASCII character codes 13, 10 (carriage return, linefeed) for paragraph ends. No other occurrences of these two characters are allowed.
- ASCII character code 12 for explicit page breaks.
- ASCII character code 9 (normal) for tab characters.

Other line-break or wordwrap information is not stored.

Pictures

Pictures (including OLE objects) are stored as a sequence of bytes in the text stream. These bytes can be identified as picture information by examining their paragraph formatting. One picture is exactly one paragraph. Paragraphs that are pictures have a special bit set in their paragraph property (PAP) structure. For more information on the PAP structure, see Section 8.3, "Formatting."

Each picture consists of a descriptive header followed by the data that makes up the picture. The header for OLE objects is different from the one used for pictures. The picture header has the following form:

Byte	Name	Description
0-7	**mfp**	Windows **METAFILEPICT** structure (**hMF** member undefined)
8-9	**dxaOffset**	Offset of picture from left margin, in twips (1/1440 inch)
10-11	**dxaSize**	Horizontal size, in twips
12-13	**dyaSize**	Vertical size, in twips
14-15	**cbOldSize**	Number of following bytes (actual metafile or bitmap bits); set to zero
16-29	**bm**	Additional information for bitmaps only
30-31	**cbHeader**	Number of bytes in this header
32-35	**cbSize**	Number of following bytes (actual metafile or bitmap bits), replacing **cbOldSize** for new files
36-37	**mx**	Scaling factor (*x*)
38-39	**my**	Scaling factor (*y*)
40–?	**cbHeader**	Picture contents, through **cbHeader+cbSize–1**

The **mm** member (bytes 0-1) of the **METAFILEPICT** structure specifies the mapping mode used to draw the picture. The last set of bytes will be bitmap bits if the value of the **mm** member is 0xE3. This is a special value used only in Write. Otherwise, the bytes will be metafile contents.

If the picture has never been rescaled with the Size Picture command in Write, the scaling factors in each direction will be 1000 (decimal). If the picture has been resized, the scaling factor will be the percentage of the original size that the picture is now, relative to 1000 (100 per cent).

For information about the **METAFILEPICT** structure and bitmaps, see the *Microsoft Windows Guide to Programming* and the *Microsoft Windows Programmer's Reference, Volumes 1* and *3.*

The descriptive header for OLE objects is similar to the one used for pictures. The OLE object header has the following form:

Byte	Name	Description
0-1	**mm**	Must be 0xE4
2-5		Not used
6-7	**objectType**	Type: 1=static, 2=embedded, 3=link
8-9	**dxaOffset**	Offset of picture from left margin, in twips (1/1440 inch)
10-11	**dxaSize**	Horizontal size, in twips
12-13	**dyaSize**	Vertical size, in twips
14-15		Not used
16-19	**dwDataSize**	Number of bytes in the object data that follows the header
20-23		Not used
24-27	**dwObjNum**	Hexadecimal number that, when converted to an 8-digit string, represents the object's unique name
28-29		Not used
30-31	**cbHeader**	Number of bytes in this header
32-35		Not used
36-37	**mx**	Scaling factor (*x*)

38-39	**my**	Scaling factor (*y*)
40–?	**cbHeader**	Object contents, through **cbHeader+dwDataSize–1**

The scaling factors for OLE objects work the same way as they do with pictures.

Formatting

Write files contain both character and paragraph formatting information. There can be no gaps in either; each must begin with the first text character (byte 128) and continue through the last. The format descriptors (FODs) for the first and last paragraph must, therefore, have the value of **fcLim** equal to the value of **fcMac**, as defined in the header section.

There is a difference between paragraph and character FODs. A character FOD may describe any number of consecutive characters with the same formatting. However, there must be exactly one paragraph FOD for each text paragraph. In either case, it is advisable to have multiple FODs point to the same formatting properties (FPROPs) on a given page because it saves space in the file. No FOD may point off its page.

Characters and Paragraphs

Both the character and paragraph sections are structured as a set of pages. Each page contains an array of FODs and a group of FPROPs, both of which are described later in this section. Following is the format of a page:

Byte	Name	Description
0-3	**fcFirst**	Byte number of first character covered by this page of formatting information; equals 128 for first character in the text (low-order byte first)
4–**n**	**rgfod**	Array of FODs
n+1-126	**grpfprop**	Group of FPROPs
127	**cfod**	Number of FODs on this page

An FOD is fixed in size. It contains the byte offset to the corresponding FPROP. Following is the structure of an FOD:

Word	Name	Description
0-1	**fcLim**	Byte number after last character covered by this FOD
2	**bfprop**	Byte offset from beginning of FOD array to corresponding FPROP for these characters or this paragraph

An FPROP is variable in size. It contains the prefix for a character property (CHP) or paragraph property (PAP), both of which are described later in this section. Following is the structure of an FPROP:

Byte	Name	Description
0	**cch**	Number of bytes in this FPROP
1–**n**	**rgchProp**	Prefix for a CHP (for characters) or a PAP (for paragraphs) sufficient to include all bits that differ from the default CHP or PAP

Following is the format of a CHP:

Byte	Bit	Name	Description
0			Reserved; ignored by Write
1	0	**fBold**	Bold characters
	1	**fItalic**	Italic characters
	2-7	**ftc**	Font code (low bits); index into the FFNTB
2		**hps**	Size of font, in half points (standard is 24)
3	0	**fUline**	Underlined characters
	1	**fStrike**	Reserved; ignored by Write

	2	**fDline**	Reserved; ignored by Write
	3	**fOverset**	Reserved; ignored by Write
	4-5	**csm**	Reserved; ignored by Write
	6	**fSpecial**	Set for "(page)" only
	7		Reserved; ignored by Write
4	0-2	**ftcXtra**	Font code (high-order bits, concatenated with **ftc**)
	3	**fOutline**	Reserved; ignored by Write
	4	**fShadow**	Reserved; ignored by Write
	5-7		Reserved; ignored by Write
5		**hpsPos**	Position: 0=normal, 1-127=superscript, 128-255=subscript

If the user doesn't select any special character properties, the CHP is filled with the following default values:

Byte	Value
0	1
2	24
3-5	0

Each character FPROP must, therefore, have a count of characters (**cch**) greater than or equal to 1.

Each PAP can contain up to 14 tab descriptors (TBDs), which are described later in this section. Following is the structure of a PAP:

Byte	Bit	Name	Description
0			Reserved; must be zero
1	0-1	**jc**	Justification: 0=left, 1=center, 2=right, 3=both
	2-7		Reserved; must be zero
2			Reserved; must be zero
3			Reserved; must be zero
4-5		**dxaRight**	Right indent, in 20ths of a point
6-7		**dxaLeft**	Left indent, in 20ths of a point
8-9		**dxaLeft1**	First-line left indent (relative to **dxaLeft**)
10-11		**dyaLine**	Interline spacing (standard is 240)
12-13		**dyaBefore**	Reserved; ignored by Write (standard is zero)
14-15		**dyaAfter**	Reserved; ignored by Write (standard is zero)
16	0	**rhcPage**	0=header, 1=footer
	1-2		Reserved; 0=normal paragraph, nonzero=header or footer paragraph
	3	**rhcFirst**	Start of printing: 1=print on first page, 0=do not print on first page
	4	**fGraphics**	Paragraph type: 1=picture, 0=text
	5-7		Reserved; must be zero
17-21			Reserved; must be zero
22-78			Tab descriptors (up to 14)

Following is the format of a TBD:

Byte	Bit	Name	Description
0-1		**dxa**	Indent from left margin of tab stop, in 20ths of a point
2	0-2	**jcTab**	Tab type: 0=normal tabs, 3=decimal tabs
	3-5	**tlc**	Reserved; ignored by Write
	6-7		Reserved; must be zero

3	**chAlign**	Reserved; ignored by Write

If the user doesn't select any special paragraph properties, the PAP is filled with the following default values:

Byte	Value
0	61
2	30
10-11	240 (word)
12-78	0

Each paragraph FPROP must have a count of characters (**cch**) greater than or equal to 1.

Footnotes

Write documents do not have footnote tables (FNTBs), so **pnFntb** is always equal to **pnSep**. In fact, all their header and footer paragraphs appear at the beginning of the document before any normal paragraphs. When reading files created by Word, Write recognizes only those headers and footers that appear at the beginning of the document; it treats all others as normal text.

Sections

A Write document has only one section. If the section properties of a Write document differ from the defaults, the document contains a section property (SEP) section and a section table (SETB) section. If not, then neither section is present and **pnSep** and **pnSetb** are both equal to **pnPgtb**.

Following is the format of an SEP:

Byte	Name	Description
0	**cch**	Count of bytes used, excluding this byte (all properties at byte positions greater than **cch** are set to their default values)
1-2		Reserved; must be zero
3-4	**yaMac**	Page length, in 20ths of a point (default is 11*1440=15840)
5-6	**xaMac**	Page width, in 20ths of a point (default is 8.5*1440=12240)
7-8		Reserved; must be 0xFFFF
9-10	**yaTop**	Top margin, in 20ths of a point (default is 1440)
11-12	**dyaText**	Height of text, in 20ths of a point (default is 9*1440=12960)
13-14	**xaLeft**	Left margin, in 20ths of a point (default is 1.25*1440=1800)
15-16	**dxaText**	Width of text area, in 20ths of a point (default is 6*1440=8640)

The page length (**yaMac**) is equal to **yaTop**+**dyaText**. The page width (**xaMac**) is equal to **xaLeft**+**dxaText**+(right margin, not stored).

If all the above properties are set to their defaults, no SEP or SETB is needed. Otherwise, the count of characters (**cch**) is greater than or equal to 1 and less than or equal to 16.

The SETB section contains an array of section descriptors (SEDs), described later in this section. Following is the structure of an SETB:

Word	Name	Description
0	**csed**	Number of sections (always 2 for Write documents)
1	**csedMax**	Undefined
2–**n**	**rgsed**	Array of SEDs plus zero-padding to fill the sector

Following is the structure of an SED:

Word	Name	Description
0-1	**cp**	Byte address of first character following section

2	**fn**	Undefined
3-4	**fcSep**	Byte address of associated SEP

A Write document always has exactly two SED entries. The **cp** value of the first entry indicates that it affects all the characters in the document. The **fcSep** value of the first entry points to the one SEP in the file. The second SED entry is a dummy with **fcSep** set to 0xFFFFFFFF.

The PGTB section (optional) is on the page immediately after the SEP section.

Note: The term "page" used in the rest of this section refers to printed pages of a Write document, not 128-byte "pages" of a disk file.

The page table (PGTB) contains an array of page descriptors (PGDs), which are described later in this section. Following is the structure of a PGTB:

Word	Name	Description
0	**cpgd**	Number of PGDs (1 or more)
1	**cpgdMac**	Undefined
2–**n**	**rgpgd**	Array of PGDs plus zero padding to fill the sector

Following is the structure of a PGD:

Word	Name	Description
0	**pgn**	Page number in printed Word documents
1-2	**cpMin**	Byte address of first character on printed page

Font Table

The font face-name table (FFNTB) contains the number of font face names (FFNs) and a list of FFNs. Following is the structure of an FFNTB:

Byte	Name	Description
0-1	**cffn**	Number of FFNs
2–**n**	**grpffn**	List of FFNs

Following is the structure of an FFN:

Byte	Name	Description
0-1	**cbFfn**	Number of bytes following in this FFN (not including these 2 bytes)
2	**ffid**	Font family identifier (see below)
3–(**cbffn**+2)	**szFfn**	Font name (variable length; null-terminated)

A **cbFfn** value of 0xFFFF means that the next FFN entry will be found at the start of the next 128-byte page. A **cbFfn** value of zero means that there are no more FFN entries in the table.

Possible values for **ffid** are FF_DONTCARE, FF_ROMAN, FF_SWISS, FF_MODERN, FF_SCRIPT, and FF_DECORATIVE. These constants are defined in WINDOWS.H. Additional values may be added to the list in future versions of Windows.

Calendar File Format

This topic describes the binary file format used by Microsoft Windows Calendar (CALENDAR.EXE). A Calendar binary file contains information about file content, dates, days, and appointments.

Calendar-File Header

The first 8 bytes of a Calendar file are a character array identifying the file as a Calendar file. Following are the contents of the array:

```
'C' + 'r' = b5
'A' + 'a' = a2
'L' + 'd' = b0
'E' + 'n' = b3
'N' + 'e' = b3
'D' + 'l' = b0
'A' + 'a' = a2
'R' + 'c' = b5
```

The next 2 bytes (**cDateDescriptors**) contain the integer count of dates described in the file.

The next 12 bytes contain six 2-byte fields of information that is global to the entire file. These variables are normally set by the user through the Alarm Controls and Options Day dialog boxes. The header information has the following form:

```
WORD    MinEarlyRing
BOOL    fSound
int     interval
int     mininterval
BOOL    f24HourFormat
int     StartTime
```

Following are the members in the header structure:

MinEarlyRing	Specifies an early ring, in minutes.
fSound	Specifies whether alarms should be audible.
interval	Specifies the interval between appointments: 0 = 15 minutes, 1 = 30 minutes, 2 = 60 minutes.
mininterval	Specifies the interval, in minutes.
f24HourFormat	Specifies the time format: nonzero=24-hour format.
StartTime	Specifies the starting time in day mode--that is, the time that normally appears first in the display, in minutes past midnight.

The rest of the first 64 bytes are reserved.

Date Descriptors

A date-descriptor array appears next. Each entry in the array describes one day. The number of entries in the array is **cDateDescriptors** (described in the preceding section). Each element in the array consists of 12 bytes, in six 2-byte fields. The date-descriptor array has the following form:

```
unsigned    Date
int         fMarked
int         cAlarms
unsigned    FileBlockOffset
int         reserved
unsigned    reserved
```

Following are the members in the date-descriptor array:

Date	Specifies the date, in days past 1/1/1980.
fMarked	Specifies which mark(s) are set for the date: box = 128, parentheses = 256, circle = 512, cross = 1024, underscore = 2048.
cAlarms	Specifies the number of alarms set for the day.
FileBlockOffset	Specifies the file offset, in 64-byte blocks, to the day's information. Only the low 15 bits are used (the high bit will be zero). Thus, if this offset is 6, the day's information is stored at byte 6*64 in the file.
reserved	Reserved; must be 0xFFF.
reserved	Reserved; must be 0xFFF.

Day-Specific Information

All day information is stored after the date-descriptor array, on even 64-byte boundaries. The day-information structure has the following form:

```
unsigned    reserved
unsigned    Date
unsigned    reserved
unsigned    cbNotes
unsigned    cbAppointment
char        Notes[cbNotes]
BYTE        ApptInfo[]
```

Following are the members in the day-information structure:

reserved	Reserved; must be zero.
Date	Specifies the date, in days past 1/1/1980.
reserved	Reserved; must be 1.
cbNotes	Specifies the number of bytes of note information, including null bytes. This information appears in the note array below the appointment list.
cbAppointment	Specifies the count of bytes of appointment information.
Notes	Contains the text of the note.
ApptInfo	Contains the block of appointments.

Appointment-Specific Information

The information in the appointment block is stored as a list of single appointments. Each appointment consists of a structure similar to the following:

```
struct {
    char cb;
    char flags;
    int  time;
    char szApptDesc[];
};
```

Following are the members in each appointment structure:

cb Specifies the size, in bytes, of the structure containing the appointment. The structure address of the next appointment is the current appointment plus the value of the **cb** member.

flags Contains various flags. This member can have one or more of the following values:

Value	Meaning
1	Alarm will go off at the specified time of the appointment.
2	Appointment is a special time.

time Specifies the number of minutes past midnight.

szApptDesc Contains a null-terminated string consisting of text associated with an appointment.

Installable Drivers

This topic describes installable drivers and the installable-driver interface for the Microsoft Windows operating system. Topics discussed in this topic include: the common entry point for installable drivers, messages used by the common entry point, actions that an installable driver should take in response to these messages, and functions available for the installable driver interface.

About Installable Drivers

An installable driver is a Windows dynamic-link library (DLL) that a Windows application (or another Windows DLL) can open, enable, query, disable, and close. An application can perform these operations by calling the following functions:

Function	Description
CloseDriver	Closes an installable driver.
GetDriverInfo	Retrieves installable-driver data.
GetDriverModuleHandle	Retrieves an installable driver's module handle.
GetNextDriver	Enumerates installed drivers.
OpenDriver	Opens an installable driver.
SendDriverMessage	Sends a message to an installable driver.

When an application calls the **OpenDriver**, **SendDriverMessage**, or **CloseDriver** function, Windows processes the call and issues one or more of the following driver messages:

Message	Description
DRV_CLOSE	Notifies an installable driver that Windows will decrement the use count for the driver and send a **DRV_FREE** message if the use count reaches zero.
DRV_CONFIGURE	Notifies an installable driver that it should display a custom-configuration dialog box. (This message should only be sent if the driver returns a nonzero value when the **DRV_QUERYCONFIGURE** message is processed.)
DRV_DISABLE	Notifies an installable driver that the memory that it has allocated is about to be freed.
DRV_ENABLE	Notifies an installable driver that it has been loaded or reloaded or that Windows has been enabled.
DRV_FREE	Notifies an installable driver that it will be discarded.
DRV_INSTALL	Notifies an installable driver that it has been successfully installed.
DRV_LOAD	Notifies an installable driver that it has been successfully loaded.
DRV_OPEN	Notifies an installable driver that it is about to be opened.
DRV_POWER	Notifies an installable driver that the power source for the device is about to be turned off or on.
DRV_QUERYCONFIGURE	Queries an installable driver about whether it supports the **DRV_CONFIGURE** message and can display a private configuration dialog box.
DRV_REMOVE	Notifies an installable driver that it is about to be removed from the system.

These messages, which are defined in the Windows header file (WINDOWS.H), are processed by the main routine in an installable driver. This routine is called the **DriverProc** function.

Some of the preceding messages should be sent by Windows only when one of the installable driver functions is called by an application. The circumstances under which these messages are sent are described in the following list:

Message	Description
DRV_CLOSE	Issued by Windows when an application calls the **CloseDriver** function.
DRV_DISABLE	Issued prior to exiting Windows and returning to MS-DOS or when the driver is freed.
DRV_ENABLE	Issued when returning to Windows from MS-DOS or the first time the installable driver is loaded.
DRV_FREE	Issued by Windows after an application calls the **CloseDriver** function and the use count is decremented to zero.
DRV_LOAD	Issued by Windows after the first **OpenDriver** call is made for a particular installable driver.

The remaining messages can be sent by an application to an installable driver by calling the **SendDriverMessage** function.

Creating an Installable Driver

An installable driver is a Windows dynamic-link library (DLL) that supports a special entry point, the **DriverProc** function. This function processes the driver messages described in the previous section. This function may also process private driver messages. These messages can be assigned values ranging from DRV_RESERVED to **DRV_USER** (two constants that appear in WINDOWS.H).

The following example shows the basic structure of the **DriverProc** function:

```
LRESULT CALLBACK* DriverProc (DWORD   dwDriverIdentifier,
                              HDRVR   hDriver,
                              UINT    wMessage,
                              LPARAM  lParam1,
                              LPARAM  lParam2)
{
DWORD dwRes = 0L;

switch (wMessage)
    {

    case DRV_LOAD:

        /* Sent when the driver is loaded. This is always   */
        /* the first message received by a driver.          */

        dwRes = 1L;     /* Return 0L to fail.               */
        break;

    case DRV_FREE:

        /* Sent when the driver is about to be discarded.   */
        /* This is the last message a driver receives       */
        /* before it is freed.                              */

        dwRes = 1L;     /* Return value is ignored.         */
        break;

    case DRV_OPEN:

        /* Sent when the driver is opened.                  */

        dwRes = 1L;     /* Return 0L to fail.               */
                        /* This value is subsequently used  */
```

```
                    /* for dwDriverIdentifier.          */

    break;

case DRV_CLOSE:

    /* Sent when the driver is closed. Drivers are      */
    /* unloaded when the open count reaches zero.       */

    dwRes = 1L;     /* Return 0L to fail.               */
    break;

case DRV_ENABLE:

    /* Sent when the driver is loaded or reloaded and   */
    /* when Windows is enabled. Hook or rehook          */
    /* interrupts and initialize hardware. Expect the   */
    /* driver to be in memory only between the enable   */
    /* and disable messages.                            */

    dwRes = 1L;     /* Return value is ignored.         */
    break;

case DRV_DISABLE:

    /* Sent before the driver is freed or when Windows  */
    /* is disabled. Unhook interrupts and place         */
    /* peripherals in an inactive state.                */

    dwRes = 1L;     /* Return value is ignored.         */
    break;

case DRV_INSTALL:

    /* Sent when the driver is installed.               */

    dwRes = DRV_OK; /* Can also return DRV_CANCEL       */
                    /* and DRV_RESTART.                 */
    break;

case DRV_REMOVE:

    /* Sent when the driver is removed.                 */

    dwRes = 1L;     /* Return value is ignored.         */
    break;

case DRV_QUERYCONFIGURE:

    /* Sent to determine if the driver can be           */
    /* configured.                                      */

    dwRes = 0L;     /* Zero indicates configuration     */
                    /* NOT supported.                   */
    break;

case DRV_CONFIGURE:
```

```
        /* Sent to display the custom-configuration         */
        /* dialog box for the driver.                       */

        dwRes = DRV_OK; /* Can also return DRV_CANCEL       */
                        /* and DRV_RESTART.                 */
        break;

    default:

        /* Process any messages not explicitly trapped.     */

        return DefDriverProc (dwDriverIdentifier, hDriver,
                              wMessage, lParam1, lParam2);

    }
return dwRes;
}
```

Opening an Installable Driver

An application opens an installable driver by calling the **OpenDriver** function. When an application calls this function, Windows adds the driver name to an internal list of installed drivers. (When the application calls the **CloseDriver** function, Windows deletes the corresponding driver name from this list.)

When an application calls the **OpenDriver** function to open the first instance of a driver, Windows issues the **DRV_LOAD**, **DRV_ENABLE**, and **DRV_OPEN** messages, in that order. (Subsequent calls to **OpenDriver** cause only DRV_OPEN to be sent.) When the driver processes the DRV_LOAD message, it reads the configuration settings (if any exist) from the corresponding entry in the SYSTEM.INI file and configures the driver and any associated hardware. In addition to configuring the driver and associated hardware, the driver also allocates required memory.

After processing the **DRV_LOAD** message, the driver returns a nonzero value if it loads successfully. If it returns zero, Windows immediately unloads the driver (without issuing a **DRV_FREE** message).

When the driver processes the **DRV_ENABLE** message, it hooks or chains required interrupts and prepares associated peripherals.

When the driver processes the **DRV_OPEN** message, it allocates memory required by a single instance of the driver.

Closing an Installable Driver

An application closes an installable driver by calling the **CloseDriver** function. When the application calls this function, Windows deletes the corresponding driver name from an internal list.

When an application calls the **CloseDriver** function to close the last instance of a driver, Windows issues the **DRV_CLOSE**, **DRV_DISABLE**, and **DRV_FREE** messages, in that order. (When the application is not closing the last instance of the driver, only DRV_CLOSE is sent.) When the driver processes the DRV_CLOSE message, it frees any resources that were allocated when the driver was opened and returns a nonzero value. If the driver returns a value of zero, closing fails.

When the driver processes the **DRV_DISABLE** message, it places any associated peripherals in an inactive state and unhooks all interrupts.

When the driver processes the **DRV_FREE** message, it frees any resources that are still allocated.

Configuring an Installable Driver

Many installable drivers support a private configuration dialog box that lets the user configure the driver and associated hardware. To determine whether a driver supports such a dialog box, an

application calls the **SendDriverMessage** function and issues the **DRV_QUERYCONFIGURE** message. If the driver is configurable, this function returns a nonzero value. If it is not configurable, this function returns zero. If the **SendDriverMessage** function returns a nonzero value, the application displays the configuration dialog box by calling the **SendDriverMessage** function a second time and sending the **DRV_CONFIGURE** message.

If the driver supports a private configuration dialog box, it should display the dialog box and process user input when it receives the **DRV_CONFIGURE** message. Typically, any configuration data specified by the user is maintained in the [drivers] section of the Windows SYSTEM.INI file.

Enumerating Instances of an Installable Driver

An application can retrieve a handle identifying either the first instance of an installable driver or each instance of the driver by calling the **GetNextDriver** function.

Updating the SYSTEM.INI File

Upon installation, the [drivers] section of the SYSTEM.INI file contains an entry for each installable driver. This entry has the following form:

entry=driver_filename optional_information

An application can open a driver by using its filename or its entry. If a fully qualified path is not specified with the filename, the driver file must exist on the standard Windows search path. The driver interface searches for the driver as follows:

- If an application specifies a section name, that section of SYSTEM.INI is searched instead of the [drivers] section.
- If an application specifies an entry in the search section, the driver with a filename corresponding to the entry is opened.
- If the string specified by the application does not match an entry in the search section, the system assumes the string is a driver filename.

The optional information (*optional_information*) following the driver name (*driver_filename*) lists information a driver needs after installation. A driver maintains configuration information here if the information is limited or if it needs to be associated with the entry. For example, two prototype drivers could be installed in the system. The first driver could be associated with serial port one, and the second driver could be associated with serial port two. The [drivers] section of the SYSTEM.INI might show this association in the following way:

```
[drivers]
prototype1=proto.drv com1
prototype2=proto.drv com2
```

If your driver uses more extensive configuration information, it can create a section in the SYSTEM.INI file reserved for its parameters. For example, the installable driver PROTO.DRV might create the following [proto.drv] section:

```
[proto.drv]
port=230
int=3
```

When reserving a section for your driver, use the filename of your driver to identify the section. A driver usually configures and maintains this section of information when it displays the configuration dialog box used for the **DRV_CONFIGURE** message.

If you want your installable driver loaded when Windows starts, place its filename or an alias from the [drivers] section of the SYSTEM.INI file on the drivers= line of the [boot] section found in the SYSTEM.INI file. Windows loads these drivers at startup and sends **DRV_LOAD** and **DRV_ENABLE** messages to them but does not open them. This makes it possible for you to install drivers that remain resident while Windows is enabled.

Contents of the OEMSETUP.INF Files

The OEMSETUP.INF file uses the same format as the Windows 3.0 SETUP.INF file with the exception of a new [Installable.Drivers] section. This section identifies the names and characteristics of each driver on the disk. Each driver entry has the following form:

entry=disk:filename, type(s), description, VxD(s), default_params

Note that the elements that compose a driver entry are separated by commas. Comments are delimited by semicolons; all characters following a semicolon are considered part of the comment string.

Following are the elements that compose a driver entry:

Element	Description
entry	Identifies the driver. This string must be unique.
disk	Specifies the disk number for the disk that contains the driver. This entry corresponds to an entry in the [disks] section of SETUP.INF.
filename	Specifies the name of the file that contains the driver.
type(s)	Specifies the driver type.
description	Describes the driver. This string appears in the dialog box displayed by the Drivers Control Panel application.
VxDs	Identifies any VxDs required by the driver. (For a description of the manner in which multiple VxD names are parsed, see the *Microsoft Windows Virtual Device Adaptation Guide.*)
default_params	Specifies default parameters for the driver. Additional options are appended to the driver entry in the [drivers] section of SYSTEM.INI.

If you create an OEMSETUP.INF file to distribute with your driver, it must include the [disks] and [Installable.Drivers] sections. For example, the following entries could be used in an OEMSETUP.INF file for a prototype installable driver:

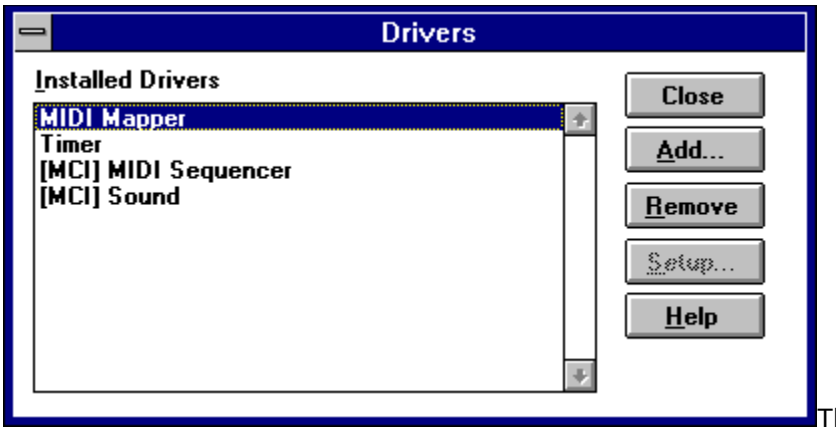
```
[disks]
; Numeric mappings for disk titles

1 = ., "Sample Distribution Disk 1"

[Installable.Drivers]
; The installable drivers section is unique to the drivers application.
; It is parsed with comma-separated fields.

prototype=1:proto.drv,"ampl,freq","Sample scope driver","1:VXDA.386"
```

The Drivers Control Panel application may need to copy files that support your driver. If any of these files are not VxDs, include a section in the SYSTEM.INI file listing them. Use the entry (that is, prototype) as the name of this new section. For example, if the prototype driver has an additional file called POWERSRC.DLL, include the following section:

```
[prototype]
; Keyname sections can be created for dependent files.  All
; dependent files will be copied directly to the system directory.

1:POWERSRC.DLL
```

Drivers Control Panel Application

The Drivers Control Panel application installs, configures, and removes drivers. When started, the Drivers Control Panel application displays the following dialog box.



The Installed Drivers list box displays the description strings of the installed drivers. The installed drivers are determined by examining the [drivers] and [mci] sections of the SYSTEM.INI file. The description strings are cached in the [drivers.description] section of the CONTROL.INI file to reduce delays in finding and loading them. If a description string does not match an installed driver, the application searches the MMSETUP.INF file and then the header of the driver file to obtain the description string. A scroll bar appears in the list box if there are more drivers than can be displayed.
The following buttons are found in the Control Panel dialog box:

Button	Result when chosen
OK	Exits the dialog box and makes any changes permanent.
Cancel	Exits the dialog box. The application ignores any requests to install or remove drivers made during the session. Any configuration changes made during the session are retained because they are done by the driver.
Remove	Removes the information about the selected driver from the SYSTEM.INI file. When removing drivers, the Control Panel application sends the **DRV_REMOVE** message to the driver if there is only one entry in the SYSTEM.INI file for it.
Setup	Applies only to configurable drivers. When the user selects a driver in the list box, the application opens the driver and sends it the **DRV_QUERYCONFIGURE** message. If a driver responds that it can be configured--that is, it supports a configuration dialog box to set such parameters as the COM port, the interrupt number, or input and output (I/O) port address--then the application enables the Setup button. If the user chooses the Setup button, the application sends a **DRV_CONFIGURE** message to the driver.
Add Drivers	Installs a new driver.
Default	Redisplays the list of files from the MMSETUP.INF file. Note that the Default button is active when the OEM drivers are displayed.

Installing a Driver

When the user selects a driver from the Installed Drivers list box, the Add Driver dialog box closes. The new driver becomes selected in the list box when the user chooses the OK button. The Drivers Control Panel application sends the **DRV_INSTALL** message to the driver if there is only one entry in the SYSTEM.INI file for it. (A driver receives the DRV_INSTALL message for its initial installation.) The Drivers Control Panel application can install up to four wave devices, four musical instrument digital interface (MIDI) devices, and ten media control interface (MCI) devices of the same type.

If the selected driver is not an installable driver, the Driver Control Panel applications displays a "Cannot Install" message. If the user chooses the Cancel button, the dialog box closes with no changes made.

Using Drivers with the Drivers Control Panel Application

During installation, the Drivers Control Panel application opens the driver and obtains the description line, originally defined in the module-definition (.DEF) file, from the driver header. The application uses

the description line to construct the settings for the [drivers] section. The description line in the .DEF file should have the following form:

DESCRIPTION *type(s)***:***text*

Following are the parameters in the description line:

Parameter	Meaning
type(s)	Type of driver used for the entry in the SYSTEM.INI file. Multiple entries are separated by commas.
text	Text that describes the driver. This will be displayed in the Drivers Control Panel application.

For example, the header file for an oscilloscope driver (OSCI.DRV) can use the following description line:

```
DESCRIPTION 'FREQ,AMPL:Oscilloscope frequency and amplitude drivers.'
```

Based on this definition, if both drivers are installed (that is, if the Drivers Control Panel application displays a selection for both FREQ and AMPL), the Drivers Control Panel application creates the following settings in the SYSTEM.INI file:

```
[drivers]
FREQ = osci.drv
AMPL = osci.drv
```

If you want your driver added to a named section of the SYSTEM.INI file, you can add the section name to the type of driver. For example, the following description line specifies that a voltmeter driver be added to the [RCC] section:

```
DESCRIPTION 'VOLTMETER[RCC]:RCC voltmeter driver.'
```

Creating a Custom Configuration Application

The Drivers Control Panel application provides a convenient interface for installing drivers. You should use this interface for configuring features that are hardware- or driver-dependent.

If your driver configures system features--those features that are hardware- and device-independent--you should create a custom Control Panel application.

BootApp (3.1)

void BootApp(*hBlock, hFile***)**

HANDLE *hBlock;* /* handle of information block */
HANDLE *hFile;* /* handle of executable file */

The **BootApp** function loads the given application.

Parameter	Description
hBlock	Identifies the selector for the segment that contains the information block in the Windows (new-style) header.
hFile	Identifies the executable file that contains the application. The *hFile* parameter must be a valid MS-DOS file handle.

Returns

This function does not return a value.

Comments

The information block in the Windows header that is identified by the *hBlock* parameter specifies the linker version number, the length of various tables of data, offsets to those tables, heap and stack sizes, and so on.

The **BootApp** function is one of three functions required for self-loading Windows applications. The application developer must provide the code for this function and store a pointer to the function at offset 0x0004 in the application's loader code and data table.

The Windows kernel calls this function after loading the application's executable header and data tables.

EntryAddrProc (3.1)

DWORD EntryAddrProc(*hBlock, wEntryNo***)**

HANDLE *hBlock;* /* selector for information block */
WORD *wEntryNo;* /* entry-table procedure index */

The **EntryAddrProc** function retrieves an address for the specified procedure.

Parameter	Description
hBlock	Specifies the selector for the segment that contains the information block in the Windows (new-style) header.
wEntryNo	Specifies the index to the entry in an entry table that identifies the procedure for which the function should return an address.

Returns

The return value is the address of the specified procedure if the function is successful. Otherwise, the return value is zero.

Comments

The *wEntryNo* parameter is also known as the procedure's ordinal number.

The **EntryAddrProc** function is one of three functions supplied by the Windows kernel. The kernel loads a pointer to this function at offset 0x0014 in the loader's code and data table. The kernel loads the pointer before calling the private startup procedure (the **BootApp** function).

EntryAddrProc is called from the **LoadAppSeg** function, which the application developer must supply.

ExitProc (3.1)

void ExitProc(*hBlock***)**

HANDLE *hBlock;* /* selector of information block */

The **ExitProc** function closes a self-loading application.

Parameter	Description
hBlock	Specifies the selector for the segment that contains the information block in the Windows (new-style) header.

Returns

This function does not return a value.

Comments

The Windows header information block identified by the *hBlock* parameter specifies the linker version number, the length of various tables of data, offsets to those tables, heap and stack sizes, and so on.

The **ExitProc** function is one of three functions required for self-loading Windows applications. The application developer must provide the code for this function and store a pointer to it at offset 0x0018 in the application's loader code and data table.

ExitProc does not need to free memory owned by the application, nor is it necessary for the function to close any open files.

MyAlloc (3.1)

DWORD MyAlloc(*wFlags, wSize, wElem***)**

```
WORD wFlags;     /* segment flags                */
WORD wSize;      /* size of element              */
WORD wElem;      /* number of elements in segment */
```

The **MyAlloc** function allocates memory for a segment in a self-loading application.

Parameter	Description
wFlags	Specifies the segment flags.
wSize	Specifies the element size, in bytes.
wElem	Specifies the number of elements in the segment.

Returns

The low-order word of the return value contains a segment handle if the function is successful; the high-order word contains a selector if the function is successful. (However, if the function allocates only a handle for the segment, the low-order word contains zero and the high-order word contains the handle.) Otherwise, the return value is zero for both high-order and low-order words.

Comments

The flags specified by the *wFlags* parameter are the values that precede the segment table appearing immediately after the information block in the Windows (new-style) header. The kernel translates *wFlags* into the proper values before calling the **GlobalAlloc** function.

The segment size, in bytes, is obtained by shifting the value specified in the *wSize* parameter left by the number of bits specified by the *wElem* parameter.

The **MyAlloc** function is one of three functions supplied by the Windows kernel. The kernel loads a pointer to this function at offset 0x0014 in the loader's code and data table. The kernel loads the pointer before calling the private startup procedure (the **BootApp** function).

See Also

BootApp

PatchCodeHandle (3.1)

void PatchCodeHandle(*hSeg***)**

WORD *hSeg;* /* segment with entry points */

The **PatchCodeHandle** function modifies prolog code for self-loading applications.

Parameter	Description
hSeg	Identifies the segment containing the entry points to be modified.

Returns
This function does not return a value.

Comments
This function is one of four supplied by the Windows kernel. An application can reference this function by including the following statement in the **IMPORTS** section of its module-definition file:

```
PatchCodeHandle = KERNEL.110
```

If the entry points in a segment use the DS register, the prolog is modified as follows:

Original prolog	Modified prolog
push ds	**mov ax, dgroup**
pop ax	
nop	

If the entry points do not use the DS register, the prolog is modified as follows:

Original prolog	Modified prolog
push ds	**mov ax, ds**
pop ax	**nop**
nop	

The loader calls the **PatchCodeHandle** function from the **LoadAppSeg** function, which reloads a segment that has been discarded. The loader must call the **SetOwner** function and identify the segment's owner before it calls the **PatchCodeHandle** function. In addition, the loader must set the **SINGLEDATA** bit in the Windows (new-style) header's information block.

See Also
LoadAppSeg, **SetOwner**

LoadAppSeg (3.1)

WORD LoadAppSeg(*hBlock, hFile, wSegID***)**

```
HANDLE hBlock;      /* handle of module information block */
HANDLE hFile;       /* handle of executable file          */
WORD wSegID;        /* segment identifier                 */
```

The **LoadAppSeg** function loads a segment for the first time or reloads a discarded segment. The segment is identified by the *wSegID* parameter and belongs to the given application.

Parameter	Description
hBlock	Specifies the segment selector for the segment containing the module information block.
hFile	Identifies the executable file that contains the application. This parameter is an MS-DOS file handle. (This handle is -1 if the file is not open.)
wSegID	Identifies the segment that the function should reload.

Returns

The return value is a selector for the segment if the function is successful. Otherwise, it is zero.

Comments

The information block in the Windows (new-style) header identified by the *hBlock* parameter specifies the linker version number, the length of various tables of data, offsets to those tables, heap and stack sizes, and so on.

The third parameter, *wSegID,* is determined by the linker at link time.

The **LoadAppSeg** function is one of three functions required for self-loading Windows applications. The application developer must provide the code for this function and store a pointer to it at offset 0x0008 in the application's loader code and data table.

SetOwner (3.1)

void SetOwner(*hSel, hOwner***)**

WORD *hSel;* /* selector of segment */
HANDLE *hOwner;* /* handle of information block */

The **SetOwner** function associates the given segment with an executable file or application.

Parameter	Description
hSel	Specifies a selector or handle identifying the segment to be associated with the executable file or application.
hOwner	Identifies the information bock in the Windows (new-style) executable-file header for the application that contains the segment.

Returns

This function does not return a value.

Comments

The Windows header information block identified by the *hOwner* parameter specifies the linker version number, the length of various tables of data, offsets to these tables, heap and stack sizes, and so on.

The **SetOwner** function is one of three functions required for self-loading Windows applications. The application developer must provide the code for this function and store a pointer to it at offset 0x0004 in the application's loader code and data table.

After the kernel allocates memory for a segment by using the **MyAlloc** function, it calls **SetOwner**.

Floating Point Emulation Library

This topic describes two methods that can be used to support floating-point emulation in Windows applications. In particular, the topic describes in detail the Windows 80x87 floating-point emulator in the dynamic-link library WIN87EM.DLL. This information is intended to be used by compiler vendors who want to develop floating-point emulators that are compatible with WIN87EM.DLL.

Emulation Methods

With floating-point emulation, Windows applications that contain floating-point instructions can run on any computer, regardless of whether the computer has floating-point hardware.

To support floating-point emulation for Windows applications, compiler vendors can use one of the following methods:

- Emulation by exception handler
- Windows 80x87 floating-point emulation

Emulation by Exception Handler

With emulation by exception handler, a Windows application contains floating-point instructions for all floating-point operations and an exception handler for occurrences of Interrupt 07h (coprocessor not available). When the application starts, it installs the exception handler and the exception handler processes any floating-point exceptions that occur thereafter.

When the application runs on a computer with no floating-point hardware, a floating-point exception occurs the first time a floating-point instruction is executed. The exception handler is responsible for patching and then restarting the instruction. To patch the floating-point instruction, the exception handler actually replaces it with a call to emulation code. The new instruction calls the emulation code directly (rather than generating an exception) for as long as the patched instruction remains in memory.

This method can be used only with the Microsoft Windows operating system, version 3.1, because Windows version 3.0 standard mode does not save and restore the state of the exception handler across task switches.

This method may be less efficient than other methods because it requires that floating-point instructions be patched while the application is running rather than while it is loading. As long as the patched instructions remain in memory, however, this method is as efficient as other methods. If Windows discards the code segments that contain the patched instructions, the floating-point instructions must be patched again because Windows always loads a fresh copy of the code when it restores the discarded segments.

Windows 80x87 Floating-Point Emulation

With Windows 80x87 floating-point emulation, the Windows application contains calls to floating-point instructions for all floating-point operations, but the application also includes fixup records for each instruction. When Windows loads the application, Windows determines whether floating-point hardware is present. If the hardware it is not present, Windows uses the fixup records to replace the actual instructions with calls to emulation code.

To support this method, the application's startup routine must check whether WIN87EM.DLL is present. Then the routine must initialize WIN87EM.DLL by calling the **__fpmath** function with the BX register set to 0 and must set the floating-point exception handler by calling the **__fpmath** function with the BX register set to 3 and the DS:AX registers pointing to the exception handler. When the application's **WinMain** function returns to the startup routine, the routine must release WIN87EM.DLL by calling the **__fpmath** function with the BX register set to 2. After WIN87EM.DLL has been released, the startup routine can end the application.

For this method to work correctly, the Windows application must contain the proper fixup records--sometimes called operating system (OS) fixups--to convert instructions to emulation calls. For WIN87EM.DLL, each call consists of an interrupt (**int**) instruction followed by one or more words

defining the floating-point operation and operands. The call is actually generated by the addition of fixup values to the first two words of the corresponding floating-point instruction. The fixup values to use depend on the instruction--the values are defined as follows:

```
fINT    equ     0CDh
fFWAIT  equ     09Bh
fESCAPE equ     0D8h
fFNOP   equ     090h
fES     equ     026h
fCS     equ     02Eh
fSS     equ     036h
fDS     equ     03Eh
BEGINT  equ     034h

FIARQQ  equ     (fINT + 256*(BEGINT + 8)) - (fFWAIT + 256*fDS)
FISRQQ  equ     (fINT + 256*(BEGINT + 8)) - (fFWAIT + 256*fSS)
FICRQQ  equ     (fINT + 256*(BEGINT + 8)) - (fFWAIT + 256*fCS)
FIERQQ  equ     (fINT + 256*(BEGINT + 8)) - (fFWAIT + 256*fES)
FIDRQQ  equ     (fINT + 256*(BEGINT + 0)) - (fFWAIT + 256*fESCAPE)
FIWRQQ  equ     (fINT + 256*(BEGINT + 9)) - (fFNOP  + 256*fFWAIT)
FJARQQ  equ     256*(((0 shl 6) or (fESCAPE and 03Fh)) - fESCAPE)
FJSRQQ  equ     256*(((1 shl 6) or (fESCAPE and 03Fh)) - fESCAPE)
FJCRQQ  equ     256*(((2 shl 6) or (fESCAPE and 03Fh)) - fESCAPE)
```

Each of the six fixup record types consists of two one-word values, as shown in the following example:

```
osfixuptbl  label word
    DW  FIARQQ, FJARQQ
    DW  FISRQQ, FJSRQQ
    DW  FICRQQ, FJCRQQ
    DW  FIERQQ, 0h
    DW  FIDRQQ, 0h
    DW  FIWRQQ, 0h
osfixuptbllen = $-osfixuptbl
```

The loader assumes that each floating-point instruction is preceded by a **wait** instruction. The loader adds the first word to the combination of the **wait** instruction byte and the first byte in the floating-point instruction. For fixup types 1 through 3, the loader adds the second word to the second and third bytes of the floating-point instruction. For types 4 through 6, the loader makes no changes to these bytes (it adds zero).

Because WIN87EM.DLL polls for exceptions by using the **fwait** instruction, the loader must replace each **nop** and **fwait** instruction pair with a call to emulation code, even if a floating-point coprocessor is available. These instructions must have a corresponding fixup record of type 6.

WIN87EM.DLL does not emulate the following floating-point instructions:

fbld **fsave**
fbstp **fsetpm**
fcos **fsin**
fdecstp **fsincos**
fincstp **fstenv**
finit **fucom**
fldenv **fucomp**
fnop **fucompp**
fprem1 **fxtract**

frstor

Windows 3.0 Limitations

Windows 3.0 does not correctly save and restore the emulator state for emulator functions 0x38 through 0x3E. This means that Windows applications that use a floating-point emulator other than WIN87EM.DLL may not run successfully if another application that is using WIN87EM.DLL is also running.

Windows 3.1 does correctly save and restore the emulator state. Therefore, applications that use other floating-point emulators should be run only under Windows 3.1.

_fpmath (2.x)

```
extern     __fpmath:far

mov        bx, Function        ; floating-point function
call       __fpmath            ; floating-point math
```

The **__fpmath** function is the control function for Windows 80x87 floating-point emulation.

Parameter	Description
Function	Specifies the floating-point function to execute. The *Function* parameter can be one of the following values:

Value	Meaning
0	Initializes the floating-point emulator. An application calls this function when it starts. If an error occurs, the function sets the carry flag. Otherwise, it clears the flag.
1	Resets the floating-point emulator. The action carried out by this function is similar to the action carried out by the **finit** instruction.
2	Stops the floating-point emulator. An application called this function just before it ended.
3	Sets the handler for the coprocessor error exception (Interrupt 16). The DS:AX registers must contain the 32-bit address of the exception handler. The emulator calls the handler whenever an unmasked floating-point exception occurs. The exception handler can carry out any action--it does not have to return.
10	Retrieves a count of the elements on the floating-point stack, copying the count to the AX register. The number of elements is equal to the number of floating-point values on the floating-point coprocessor (if one is present) plus any additional values stored by the emulator.
11	Indicates whether a floating-point coprocessor is present. This function returns 1 in the AX register if a coprocessor is present. Otherwise, it returns 0.

Comments

Function values 4 through 9 are not used.

Example

The following example initializes the floating-point emulator:

```
xor      bx, bx          ; bx = 0 to initialize floating point
call     __fpmath
```

__Win87EmInfo (3.1)

int __Win87EmInfo(*pWIS, cbWin87EmInfoStruct***)**

```
Win87EmInfoStruct far *pWIS;        /* buffer to receive information */
int cbWin87EmInfoStruct;            /* size of buffer, in bytes      */
```

The **__Win87EmInfo** function retrieves information about the floating-point emulator, such as whether a floating-point coprocessor is present and the code and data segment addresses of the emulator.

Parameter	Description
pWIS	Points to the **Win87EmInfoStruct** structure that is to receive the floating-point emulator information.
cbWin87EmInfoStruct	Specifies the size, in bytes, of the structure that is to receive the information.

Returns

This function returns zero if no errors occur. Otherwise, it returns a nonzero value.

See Also

Win87EmInfoStruct

__Win87EmRestore (3.1)

int __Win87EmRestore(void far * *pWin87EmSaveArea,* **int** *cbWin87EmSaveArea***)**

```
void far *pWin87EmSaveArea;     /* buffer containing state   */
int cbWin87EmSaveArea;          /* size, in bytes, of buffer  */
```

The **__Win87EmRestore** function restores the states of the floating-point coprocessor (if one is present) and the floating-point emulator to the states previously saved by the **__Win87EmSave** function.

Parameter	Description
pWin87EmSaveArea	Points to the **Win87EmSaveArea** structure containing the state of the floating-point coprocessor and emulator. The **__Win87EmSave** function must have been used previously to fill the structure.
cbWin87EmSaveArea	Specifies the size, in bytes, of the structure containing the emulator state.

Returns

This function returns zero if the function is successful. Otherwise, it returns a nonzero value.

See Also

__Win87EmSave, **Win87EmSaveArea**

__Win87EmSave (3.1)

int __Win87EmSave(*pWin87EmSaveArea, cbWin87EmSaveArea***)**

void far **pWin87EmSaveArea;* /* buffer to receive state */
int *cbWin87EmSaveArea;* /* size, in bytes, of buffer */

The **__Win87EmSave** function saves the current states of the floating-point coprocessor (if one is present) and the floating-point emulator, copying the states to the buffer pointed to by *pWin87EmSaveArea.*

An application that calls **__Win87EmSave** should call the **__Win87EmRestore** function before carrying out any floating-point operations.

Parameter	Description
pWin87EmSaveArea	Points to the **Win87EmSaveArea** structure that is to receive the state of the floating-point emulator.
cbWin87EmSaveArea	Specifies the size, in bytes, of the structure to receive the emulator state.

Returns

This function returns zero if the function is successful. Otherwise, it returns a nonzero value.

Comments

An application can find out the size, in bytes, of the buffer needed to save the floating-point states by using the **__Win87EmInfo** function to retrieve the **Win87EmInfoStruct** structure. The **SizeSaveArea** member of this structure specifies the size of the buffer.

See Also

__Win87EmInfo, **__Win87EmRestore**, **Win87EmInfoStruct**, **Win87EmSaveArea**

Win87EmStruct (3.1)

```
typedef  struct _Win87EmInfoStruct {
    unsigned Version;
    unsigned SizeSaveArea;
    unsigned WinDataSeg;
    unsigned WinCodeSeg;
    unsigned Have80x87;
    unsigned Unused;
} Win87EmInfoStruct;
```

The **Win87EmInfoStruct** structure contains information about the floating-point emulator.

Member	Description
Version	Specifies the major and minor version numbers. The high-order byte specifies the major version number, the low-order byte the minor version number.
SizeSaveArea	Specifies the size, in bytes, of the buffer needed to save the floating-point emulator state. An application uses the specified size to allocate sufficient space to save the state before calling the __**Win87EmSave** function.
WinDataSeg	Specifies the emulator's data segment address or selector.
WinCodeSeg	Specifies the emulator's code segment address or selector.
Have80x87	Specifies the floating-point emulator flag. If an 80287 or 80387 floating-point coprocessor is present, this member is 1. Otherwise, it is 0.
Unused	Not used.

See Also
__**Win87EmInfo**, __**Win87EmSave**

Win87EmSaveArea (3.1)

```
typedef  struct _Win87EmSaveArea {
    unsigned char  Save80x87Area[SIZE_80X87_AREA];
    unsigned char  SaveEmArea[];
} Win87EmSaveArea;
```

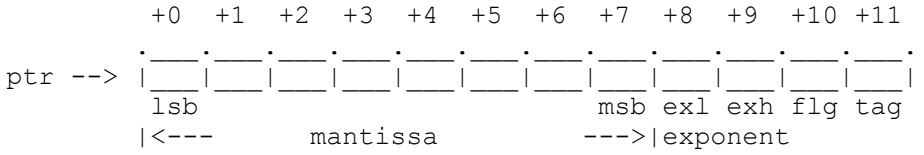
The **Win87EmSaveArea** structure contains the states of the floating-point coprocessor and floating-point emulator.

Member	Description
Save80x87Area	Specifies an array of values defining the state of the floating-point coprocessor if one is present. The array has the same format as data saved by an **fsave** instruction and consists of SIZE_80X87_AREA (94) array elements.
SaveEmArea	Specifies an array of values defining the state of the floating-point emulator. The array has the following form:

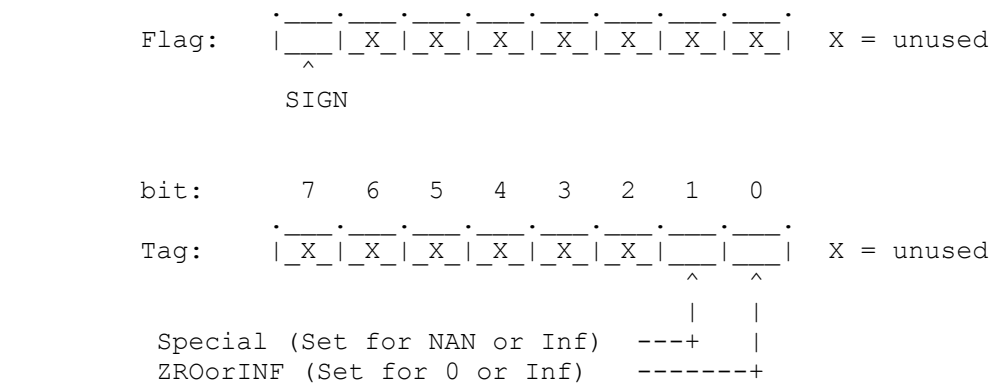
```
Have8087    db  0        ; 1 if coprocessor is present;
                         ;     otherwise, 0
            db  ?        ; reserved
            dw  ?        ; reserved
            dw  ?        ; reserved

ControlWord label   word ; emulator control word
CWmask      db      ?    ; exception masks
CWcntl      db      ?    ; arithmetic control flags

StatusWord  label   word ; emulator status word
SWerr       db      ?    ; exception flags
SWcc        db      ?    ; condition codes

BASstk      dw      ?    ; offset of start of emulator
                         ;     register area
CURstk      dw      ?    ; offset of current top-of-stack
                         ;     register
LIMstk      dw      ?    ; offset of end of emulator
register
                         ;     area

            dw      ? dup(?)    ; reserved
```

Comments

The **BASstk**, **CURstk**, and **LIMstk** fields specify the offsets from the start of the **SaveEmArea** member into the emulator's register area. If **BASstk** and **CURstk** have the same value, the stack is empty. Each of the emulator's registers is 12 bytes long and has the form shown in the following illustration.



The mantissa contains the leading 1 before the decimal point in the high-order bit of the most significant byte (msb). The exponent is not biased, that is, it is a signed integer. The following illustration shows the flag and tag bytes.




```
Special         equ     2
ZROorINF        equ     1
Reg87Len        equ     12
```

See Also

__Win87EmRestore, **__Win87EmSave**

Floating Point Functions (3.1)

__fpmath	Floating Point Math
__Win87EmInfo	Get Floating Point Emulator Information
__Win87EmRestore	Restore Floating Point Emulator State
__Win87EmSave	Save Floating Point Emulator State

Floating Point Structures (3.1)

Win87EmInfoStruct	Floating Point Emulator Information
Win87EmSaveArea	Floating Point Emulator Save Area

```
externFP InitApp

push    hInstance       ; instance handle
call    InitApp

or      ax,ax           ; zero if error
jz      error_handler
```

The **InitApp** function creates the application queue and installs application-support routines, such as the signal procedure, version-specific resource loaders, and the divide-by-zero interrupt routine.

Parameter	Description
hInstance	Identifies the task to be initialized. This parameter must have been previously supplied by Windows.

Returns

This function returns a nonzero value in the AX register if successful. Otherwise, it returns zero in the AX register to indicate an error.

See Also

InitTask

```
externFP InitTask

call    InitTask    ; Initialize a task.
```

The **InitTask** function initializes the task by setting registers, setting up the command line, and initializing the heap. This must be the first function called by the startup routine for the application.

Returns

This function returns 1 in the AX register and fills the CX, DX, ES:BX, SI, and DI registers with information about the new task, if the function is successful. Otherwise, it returns zero in the AX register to indicate an error.

Comments

When the function is successful, other registers contain the following values:

Register	Value
CX	Contains the stack limit, in bytes. The startup routines should check the limit to ensure there is a minimum of 100 bytes in the stack.
DI	Contains the instance handle for the new task. The startup routine passes this address to the **WinMain** function.
DX	Contains an *nCmdShow* parameter. The startup routine passes this parameter to the **WinMain** function for use with the **CreateWindow** function.
ES	Contains the segment address of the program segment prefix (PSP) for the new task.
ES:BX	Contains the 32-bit address of the command line (MS-DOS format). The startup routine passes this address to the **WinMain** function.
SI	Contains the instance handle for the previous instance of the application, if any. The startup routine passes this address to the **WinMain** function.

The **InitTask** function also copies the top, minimum, and bottom address offsets of the stack to the 16 bytes of reserved memory at the beginning of the automatic data segment for the application. The reserved memory has the following format:

```
        DW  0
globalW oOldSP,0
globalW hOldSS,5
globalW pLocalHeap,0
globalW pAtomTable,0
globalW pStackTop,0
globalW pStackMin,0
globalW pStackBot,0
```

See Also

InitApp

```
externFP WaitEvent

push    taskID      ; task identifier
call    WaitEvent

or      ax,ax
jnz     resched     ; nonzero if rescheduled
```

The **WaitEvent** function checks for a posted event and, if one is found, clears the event and returns control to the application. If no event is found, the function suspends execution of the application by calling the Windows scheduler.

Parameter	Description
taskID	Identifies the task to check events for. If this parameter is zero, the function checks events for the current task.

Returns

This function returns a nonzero value if the Windows scheduler has scheduled another application. Otherwise, it returns zero.

Application Startup Functions

InitApp	Initializes a Windows application
InitTask	Initializes a Task
WaitEvent	Suspends Execution Until an Event

GetWinMem32Version (3.0)

#include <winmem32.h>

WORD GetWinMem32Version(void)

The **GetWinMem32Version** function retrieves the application programming interface (API) version implemented by the WINMEM32.DLL dynamic-link library. This is not the version number of the library itself.

Returns

The return value specifies the version of the 32-bit memory API implemented by WINMEM32.DLL. The high-order 8 bits contain the major version number, and the low-order 8 bits contain the minor version number.

Global16PointerAlloc (3.0)

#include <winmem32.h>

WORD Global16PointerAlloc(*wSelector, dwOffset, lpBuffer, dwSize, wFlags***)**

```
WORD wSelector;     /* selector of object              */
DWORD dwOffset;     /* offset of first byte for alias  */
LPDWORD lpBuffer;   /* address of location for alias   */
DWORD dwSize;       /* size of region                  */
WORD wFlags;        /* reserved, must be zero          */
```

The **Global16PointerAlloc** function converts a 16:32 pointer into a 16:16 pointer alias that the application can pass to a Windows function or to other 16:16 functions.

Parameter	Description
wSelector	Specifies the selector of the object for which an alias is to be created. This must be the selector returned by a previous call to the **Global32Alloc** function.
dwOffset	Specifies the offset of the first byte for which an alias is to be created. The offset is from the first byte of the object specified by the *wSelector* parameter. Note that *wSelector:dwOffset* forms a 16:32 address of the first byte of the region for which an alias is to be created.
lpBuffer	Points to a four-byte location in memory that receives the 16:16 pointer alias for the specified region.
dwSize	Specifies the addressable size, in bytes, of the region for which an alias is to be created. This value must be no larger than 64K.
wFlags	Reserved; must be zero.

Returns

The return value is zero if the function is successful. Otherwise, it is an error value, which can be one of the following:

WM32_Insufficient_Mem
WM32_Insufficient_Sels
WM32_Invalid_Arg
WM32_Invalid_Flags
WM32_Invalid_Func

Comments

When this function returns successfully, the location pointed to by the *lpBuffer* parameter contains a 16:16 pointer to the first byte of the region. This is the same byte to which *wSelector:dwOffset* points.

The returned selector identifies a descriptor for a data segment that has the following attributes: read-write, expand up, and small (B bit clear). The descriptor privilege level (DPL) and the granularity (the G bit) are set at the system's discretion, so you should make no assumptions regarding their settings. The DPL and requestor privilege level (RPL) are appropriate for a Windows application.

Note: An application must not change the setting of any bits in the DPL or the RPL selector. Doing so can result in a system crash and will prevent the application from running on compatible platforms.

Because of tiling schemes implemented by some systems, the offset portion of the returned 16:16 pointer is not necessarily zero.

When writing your application, you should not assume the size limit of the returned selector. Instead, assume that at least *dwSize* bytes can be addressed starting at the 16:16 pointer created by this function.

See Also

Global16PointerFree

Global16PointerFree (3.0)

#include <winmem32.h>

WORD Global16PointerFree(*wSelector, dwAlias, wFlags***)**

WORD *wSelector;* /* selector of object */
DWORD *dwAlias;* /* pointer alias to free */
WORD *wFlags;* /* reserved, must be zero */

The **Global16PointerFree** function frees the 16:16 pointer alias previously created by a call to the **Global16PointerAlloc** function.

Parameter	Description
wSelector	Specifies the selector of the object for which the alias is to be freed. This must be the selector returned by a previous call to the **Global32Alloc** function.
dwAlias	Specifies the 16:16 pointer alias to be freed. This must be the alias (including the original offset) returned by a previous call to the **Global16PointerAlloc** function.
wFlags	Reserved; must be zero.

Returns

The return value is zero if the function is successful. Otherwise, it is an error value, which can be one of the following:

WM32_Insufficient_Mem
WM32_Insufficient_Sels
WM32_Invalid_Arg
WM32_Invalid_Flags
WM32_Invalid_Func

Comments

An application should free a 16:16 pointer alias as soon as it is no longer needed. Freeing the alias releases space in the descriptor table, a limited system resource.

See Also

Global16PointerAlloc

Global32Alloc (3.0)

#include <winmem32.h>

WORD Global32Alloc(*dwSize, lpSelector, dwMaxSize, wFlags***)**

```
DWORD dwSize;       /* size of block to allocate          */
LPWORD lpSelector;  /* address of location for selector   */
DWORD dwMaxSize;    /* maximum size of object             */
WORD wFlags;        /* sharing flag                       */
```

The **Global32Alloc** function allocates a memory object to be used as a 16:32 (USE32) code or data segment and retrieves the selector portion of the 16:32 address of the memory object. The first byte of the object is at offset 0 from this selector.

Parameter	Description
dwSize	Specifies the initial size, in bytes, of the object to be allocated. This value must be in the range 1 through (16 megabytes - 64K).
lpSelector	Points to a 2-byte location in memory that receives the selector portion of the 16:32 address of the allocated object.
dwMaxSize	Specifies the maximum size, in bytes, that the object will reach when it is reallocated by the **Global32Realloc** function. This value must be in the range 1 through (16 megabytes - 64 K). If the application will never reallocate this memory object, the *dwMaxSize* parameter should be set to the same value as the *dwSize* parameter.
wFlags	Depends on the return value of the **GetWinMem32Version** function. If the return value is less than 0x0101, this parameter must be zero. If the return value is greater than or equal to 0x0101, this parameter can be set to **GMEM_DDESHARE** (to make the object sharable). Otherwise, this parameter should be zero. For more information about GMEM_DDESHARE, see the description of the **GlobalAlloc** function.

Returns

The return value is zero if the function is successful. Otherwise, it is an error value, which can be one of the following:

WM32_Insufficient_Mem
WM32_Insufficient_Sels
WM32_Invalid_Arg
WM32_Invalid_Flags
WM32_Invalid_Func

Comments

If the **Global32Alloc** function fails, the value to which the *lpSelector* parameter points is zero. If the function succeeds, *lpSelector* points to the selector of the object. The valid range of offsets for the object referenced by this selector is 0 through (but not including) *dwSize.*

In Windows 3.0 and later, the largest object that can be allocated is 0x00FF0000 (16 megabytes - 64K). This is the limitation placed on WINMEM32.DLL by the current Windows kernel.

The returned selector identifies a descriptor for a data segment that has the following attributes: read-write, expand-up, and big (B bit set). The descriptor privilege level (DPL) and the granularity (the G bit) are set at the system's discretion, so you should make no assumptions regarding these settings. Because the system sets the granularity, the size of the object (and the selector size limit) may be greater than the requested size by up to 4095 bytes (4K minus 1). The DPL and requestor privilege level (RPL) will be appropriate for a Windows application.

Note: An application must not change the setting of any bits in the DPL or the RPL selector. Doing so can result in a system crash and will prevent the application from running on compatible platforms.

The allocated object is neither movable nor discardable but can be paged. An application should not page-lock a 32-bit memory object. Page-locking an object is useful only if the object contains code or data that is used at interrupt time, and 32-bit memory cannot be used at interrupt time.

See Also
Global32Free, **Global32Realloc**

Global32CodeAlias (3.0)

#include <winmem32.h>

WORD Global32CodeAlias(*wSelector, lpAlias, wFlags***)**

```
WORD wSelector;     /* selector of object for alias              */
LPWORD lpAlias;     /* address of location for alias selector    */
WORD wFlags;        /* reserved, must be zero                    */
```

The **Global32CodeAlias** function creates a 16:32 (USE32) code-segment alias selector for a 32-bit memory object previously created by the **Global32Alloc** function. This allows the application to execute code contained in the memory object.

Parameter	Description
wSelector	Specifies the selector of the object for which an alias is to be created. This must be the selector returned by a previous call to the **Global32Alloc** function.
lpAlias	Points to a 2-byte location in memory that receives the selector portion of the 16:32 code-segment alias for the specified object.
wFlags	Reserved; must be zero.

Returns

The return value is zero if the function is successful. Otherwise, it is an error value, which can be one of the following:

WM32_Insufficient_Mem
WM32_Insufficient_Sels
WM32_Invalid_Arg
WM32_Invalid_Flags
WM32_Invalid_Func

Comments

If the function fails, the value pointed to by the *lpAlias* parameter is zero. If the function is successful, *lpAlias* points to a USE32 code-segment alias for the object specified by the *wSelector* parameter. The first byte of the object is at offset 0 from the selector returned in *lpAlias.* Valid offsets are determined by the size of the object as set by the most recent call to the **Global32Alloc** or **Global32Realloc** function.

The returned selector identifies a descriptor for a code segment that has the following attributes: read-execute, nonconforming, and USE32 (D bit set). The descriptor privilege level (DPL) and the granularity (the G bit) are set at the system's discretion, so you should make no assumptions regarding their settings. The granularity will be consistent with the current data selector for the object. The DPL and requestor privilege level (RPL) are appropriate for a Windows application.

Note: An application must not change the setting of any bits in the DPL or the RPL selector. Doing so can result in a system crash and will prevent the application from running on compatible platforms.

An application should not call this function more than once for an object. Depending on the system, the function might fail if an application calls it a second time for a given object without first calling the **Global32CodeAliasFree** function for the object.

See Also

Global32Alloc, **Global32CodeAliasFree**

Global32CodeAliasFree (3.0)

#include <winmem32.h>

WORD Global32CodeAliasFree(*wSelector, wAlias, wFlags***)**

```
WORD wSelector;     /* selector of object                  */
WORD wAlias;        /* code-segment alias selector to free */
WORD wFlags;        /* reserved, must be zero              */
```

The **Global32CodeAliasFree** function frees the 16:32 (USE32) code-segment alias selector previously created by a call to the **Global32CodeAlias** function.

Parameter	Description
wSelector	Specifies the selector of the object for which the alias is to be freed. This must be the selector returned by a previous call to the **Global32Alloc** function.
wAlias	Specifies the USE32 code-segment alias selector to be freed. This must be the alias returned by a previous call to the **Global32CodeAlias** function.
wFlags	Reserved; must be zero.

Returns

The return value is zero if the function is successful. Otherwise, it is an error value, which can be one of the following:

WM32_Insufficient_Mem
WM32_Insufficient_Sels
WM32_Invalid_Arg
WM32_Invalid_Flags
WM32_Invalid_Func

See Also

Global32CodeAlias

Global32Free (3.0)

#include <winmem32.h>

WORD Global32Free(*wSelector, wFlags***)**

WORD *wSelector;* /* selector of object to free */
WORD *wFlags;* /* reserved, must be zero */

The **Global32Free** function frees an object previously allocated by the **Global32Alloc** function.

Parameter	Description
wSelector	Specifies the selector of the object to be freed. This must be the selector returned by a previous call to the **Global32Alloc** function.
wFlags	Reserved; must be zero.

Returns

The return value is zero if the function is successful. Otherwise, it is an error value, which can be one of the following:

WM32_Insufficient_Mem
WM32_Insufficient_Sels
WM32_Invalid_Arg
WM32_Invalid_Flags
WM32_Invalid_Func

Comments

The **Global32Alloc** function frees the object itself; it also frees all aliases created for the object by the 32-bit memory application programming interface (API).

Note: Before terminating, an application must call this function to free each object allocated by the **Global32Alloc** function to ensure that all aliases created for the object are freed.

See Also

Global32Alloc, **Global32Realloc**

Global32Realloc (3.0)

#include <winmem32.h>

WORD Global32Realloc(*wSelector, cNew, flags***)**

WORD *wSelector;* /* selector of object to reallocate */
DWORD *cNew;* /* new size of object */
WORD *flags;* /* reserved, must be zero */

The **Global32Realloc** function changes the size of a 32-bit memory object previously allocated by the **Global32Alloc** function.

Parameter	Description
wSelector	Specifies the selector of the object to be changed. This must be the selector returned by a previous call to the **Global32Alloc** function.
cNew	Specifies the new size, in bytes, of the object. This value must be greater than zero and less than or equal to the size specified by the *dwMaxSize* parameter of the **Global32Alloc** function call that created the object.
flags	Reserved; must be zero.

Returns

The return value is zero if the function is successful. Otherwise, it is an error value, which can be one of the following:

WM32_Insufficient_Mem
WM32_Insufficient_Sels
WM32_Invalid_Arg
WM32_Invalid_Flags
WM32_Invalid_Func

Comments

If this function fails, the previous state of the object is unchanged. If the function succeeds, it updates the state of the object and the state of all aliases to the object created by the 32-bit memory application programming interface (API) functions. For this reason, an application must call the **Global32Realloc** function to change the size of the object. Using other Windows functions to manipulate the object results in corrupted aliases.

This function does not change the selector specified by the *wSelector* parameter. If this function succeeds, the new valid range of offsets for the selector is zero through (but not including) *cNew.*

The system determines the appropriate granularity of the object. As a result, the size of the object (and the selector size limit) may be greater than the requested size by up to 4095 bytes (4K minus 1).

See Also

Global32Alloc, **Global32Free**

ABORTDOC

short Escape(*hdc,* **ABORTDOC, NULL, NULL, NULL)**

The **ABORTDOC** printer escape is maintained for backwards compatibility. Applications written for Windows 3.1 should use the **AbortDoc** function.

This escape stops the current job and erases everything the application has written to the device since the last **ENDDOC** escape.

The **ABORTDOC** escape should be used to stop:

- Printing operations that do not specify an Abort function by using the **SETABORTPROC** escape.
- Printing operations that have not yet reached their first call to the **NEWFRAME** or **NEXTBAND** escape.

Parameter	Description
hdc	**HDC** Identifies the device context.

Returns

This escape does not return a value.

Comments

If an application encounters a printing error, it should not try to stop the operation by using the **Escape** function with either the **ENDDOC** or **ABORTDOC** escape. Graphics device interface (GDI) automatically terminates the operation before returning the error value.

If the application displays a dialog box to allow the user to cancel the print operation, it must send the **ABORTDOC** escape before destroying the dialog box.

The application must send the **ABORTDOC** escape before freeing the procedure-instance address of the Abort function, if any.

See Also

Escape, **AbortDoc**

BANDINFO

short Escape(*hdc,* **BANDINFO, sizeof(BANDINFOSTRUCT),** *lpInData, lpOutData***)**

The **BANDINFO** printer escape is maintained for backwards compatibility. Applications written for Windows 3.1 should send both text and graphics in every band.

This escape copies information about a device with banding capabilities to a structure pointed to by the *lpOutData* parameter. It is implemented only for devices that use banding to send output to the printer.

Banding is the property of an output device that allows a page of output to be stored in a metafile and divided into bands, each of which is sent to the device to create a complete page.

The information copied to the structure pointed to by the *lpOutData* parameter includes:

- A value that indicates whether there are graphics in the next band.
- A value that indicates whether there is text on the page.
- A **RECT** structure that contains a bounding rectangle for all graphics on the page.

If no data is returned, the *lpOutData* parameter is NULL.

The *lpInData* parameter specifies information sent by the application to the printer driver. This information is read by the driver only on the first call to the **BANDINFO** escape on a page.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**BANDINFOSTRUCT FAR *** Points to a **BANDINFOSTRUCT** structure that contains information to be passed to the driver. For more information about this structure, see the following Comments section.
lpOutData	**BANDINFOSTRUCT FAR *** Points to a **BANDINFOSTRUCT** structure that contains information returned by the driver. For more information about this structure, see the following Comments section.

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful. It is zero if the function fails or is not implemented by the driver.

Comments

The **BANDINFOSTRUCT** structure contains information about the contents of a page and supplies a bounding rectangle for graphics on the page. This structure has the following form:

```
typedef struct tagBANDINFOSTRUCT {
    BOOL    fGraphics;
    BOOL    fText;
    RECT    rcGraphics;
} BANDINFOSTRUCT;
```

Following are the members in the **BANDINFOSTRUCT** structure:

fGraphics	Specifies nonzero if graphics are or are expected to be on the page or in the band. Otherwise, it is zero.
fText	Specifies nonzero if text is or is expected to be on the page or in the band. Otherwise, it is zero.
rcGraphics	Contains a **RECT** structure that supplies a bounding region for all graphics on the page.

The meaning of these members depends on which parameter contains the structure, as follows.

Member	When Used in lpInData	When used in lpOutData
fGraphics	Nonzero if the application informs the driver that graphics are on thepage	Nonzero if the driver informs the application that it expects graphics in this band

fText	Nonzero if the application informs the driver that text is on the page	Nonzero if the driver informs the application that it expects text in this band
rcGraphics	Bounding rectangle supplied for all graphics on the page	No valid return data

An application should call this escape immediately after each call to the **NEXTBAND** escape. The **BANDINFO** escape is in reference to the band that the driver returned to the **NEXTBAND** escape.

An application should use this escape in the following manner:

- On the first band, the driver may give the application a full-page band and ask for text only (the **fGraphics** member is set to zero and the **fText** member is set to nonzero). Then the application sends only text to the driver.
- If in the first band the application indicates that it has graphics (the **fGraphics** member is set to nonzero) or the driver encounters vector fonts, the driver bands the rest of the page.
- If there are no graphics or vector fonts, the next **NEXTBAND** escape returns an empty rectangle to indicate that the application should move on to the next page.
- If there are graphics but no vector fonts (the application sets the **fGraphics** member to nonzero, but there are no graphics in the first full-page text band), the driver may optionally band only into the rectangle the application passes for subsequent bands. This rectangle bounds all graphics on the page.
- If there are vector fonts, the driver bands the entire width and depth of the page with the **fText** member set to nonzero. It also sets the **fGraphics** flag to nonzero if the application has set it.

The driver assumes that an application using the **BANDINFO** escape only sends text in the first full-page text band because that is all the driver has requested. Therefore, if the driver encounters a vector font or graphics in the band, it assumes they were generated by a text primitive and sets the **fText** member to nonzero for all subsequent graphics bands, so they can be output as graphics. If the application does not meet this expectation, the image still generates properly, but the driver spends time sending spurious text primitives to graphics bands.

Older drivers written before the **BANDINFO** escape was designed use full-page banding for text. If a particular driver does not support the **BANDINFO** escape but sets the RC_BANDING raster capability, the application can detect full-page banding for text by determining if the first band on the page covers the entire page.

BEGIN_PATH

short Escape(*hdc,* **BEGIN_PATH, NULL, NULL, NULL)**

The **BEGIN_PATH** printer escape opens a path. A path is a connected sequence of primitives drawn in succession to form a single polyline or polygon. Paths enable applications to draw complex borders, filled shapes, and clipping regions by supplying a collection of other primitives to define the desired shape.

Printer escapes supporting paths enable applications to render images on sophisticated devices, such as PostScript printers, without generating huge polygons to simulate the images.

To draw a path, an application first issues the **BEGIN_PATH** escape. Then it draws the primitives defining the border of the desired shape and issues an **END_PATH** escape, which includes a parameter specifying how the path is to be rendered.

Parameter	Description
hdc	**HDC** Identifies the device context.

Returns

The return value specifies the current path nesting level. This value is the number of calls to the **BEGIN_PATH** escape without a corresponding call to the **END_PATH** escape if the escape is successful. Otherwise, the return value is zero.

Comments

This escape is used only by PostScript printer drivers.

An application may begin a subpath within another path. If the subpath is closed, it is treated just like a polygon. If it is open, it is treated just like a polyline.

An application may use the **CLIP_TO_PATH** escape to define a clipping region corresponding to the interior or exterior of the currently open path.

CLIP_TO_PATH

short Escape(*hdc,* **CLIP_TO_PATH, sizeof(int),** *lpClipMode,* **NULL)**

The **CLIP_TO_PATH** printer escape defines a clipping region bounded by the currently open path. It enables the application to save and restore the current clipping region and to set up an inclusive or exclusive clipping region bounded by the currently open path. If the path defines an inclusive clipping region, portions of primitives falling outside the interior bounded by the path are clipped. If the path defines an exclusive clipping region, portions of primitives falling inside the interior are clipped.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpClipMode	**LPINT** Points to a short integer that specifies the clipping mode. It can be one of the following values:

Value	Meaning
CLIP_SAVE (0)	Saves the current clipping region.
CLIP_RESTORE (1)	Restores the previous clipping region.
CLIP_INCLUSIVE (2)	Sets an inclusive clipping region.
CLIP_EXCLUSIVE (3)	Sets an exclusive clipping region.

Returns

The return value specifies the outcome of the escape. This value is nonzero if the escape is successful. Otherwise, it is zero.

Comments

This escape is used only by PostScript printer drivers.

To clip a set of primitives against a path, an application should follow these steps:

1 Save the current clipping region by using the **CLIP_TO_PATH** escape.

2 Begin a path with the **BEGIN_PATH** escape.

3 Draw the primitives bounding the clipping region.

4 Close the path with the **END_PATH** escape.

5 Set the clipping region by using the **CLIP_TO_PATH** escape.

6 Draw the primitives to be clipped.

7 Restore the original clipping region by using the **CLIP_TO_PATH** escape.

DEVICEDATA

short Escape(*hdc,* **DEVICEDATA,** *nCount, lpInData, lpOutData***)**

The **DEVICEDATA** printer escape is identical to the **PASSTHROUGH** escape. For further information, see the description of **PASSTHROUGH**.

DRAFTMODE

short Escape(*hdc,* **DRAFTMODE, sizeof(int),** *lpDraftMode,* **NULL)**

The **DRAFTMODE** printer escape turns draft mode off or on. Turning draft mode on instructs the driver to print faster and with lower quality, if necessary. The draft mode can be changed only at page boundaries (for example, after a **NEWFRAME** escape directing the driver to advance to a new page).

Parameter	Description
hdc	**HDC** Identifies the device context.
lpDraftMode	**LPINT** Points to a short integer that specifies the draft mode. It can be one of the following values:

Value	Meaning
0	Specifies draft mode off.
1	Specifies draft mode on.

Returns

The return value specifies the outcome of the escape. This value is positive if the escape is successful. Otherwise, it is zero or negative.

Comments

The default draft mode is off.

DRAWPATTERNRECT

short Escape(*hdc,* **DRAWPATTERNRECT, sizeof(PRECTSTRUCT),** *lpInData,* **NULL)**

The **DRAWPATTERNRECT** printer escape creates a pattern, gray scale, or solid black rectangle by using the pattern and rule capabilities of Page Control Language (PCL) on Hewlett-Packard LaserJet or LaserJet-compatible printers. A gray scale is a gray pattern that contains a specific mixture of black and white pixels.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**PRECT_STRUCT FAR *** Points to a **PRECT_STRUCT** structure that describes the rectangle. For more information on this structure, see the following Comments section.

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful. Otherwise, it is zero.

Comments

The *lpInData* parameter points to a **PRECT_STRUCT** structure that defines the rectangle to be created. This structure has the following form:

```
struct PRECT_STRUCT {
    POINT ptPosition;
    POINT ptSize;
    WORD  wStyle;
    WORD  wPattern;
};
```

Following are the members in the **PRECT_STRUCT** structure:

ptPosition Specifies the upper-left corner of the rectangle.

ptSize Specifies the lower-right corner of the rectangle.

wStyle Specifies the type of pattern. It can be one of the following values:

Value	Meaning
0	Black rule
1	White rule that erases bitmap data previously written to same area (available on the HP LaserJet IIP only)
2	Gray scale
3	HP-defined

wPattern Specifies the pattern. It is ignored for a black rule. It specifies the percentage of gray for a gray-scale pattern. It represents one of six patterns defined by Hewlett-Packard.

Comments

The output of the **DRAWPATTERNRECT** escape does not go through the graphics banding bitmap; it is sent to the printer in the text band. An application can use this escape to print line and block graphics without using graphics banding at all. Because many applications use only horizontal and vertical lines or blocks in graphic output, this is a significant optimization.

An application should use the **QUERYESCSUPPORT** escape to determine whether a device is capable of drawing patterns and rules before using the **DRAWPATTERNRECT** escape. If an application uses the **BANDINFO** escape, all patterns and rectangles sent by using **DRAWPATTERNRECT** should be treated as text and sent on a text band.

Applications that use the **DRAWPATTERNRECT** escape must observe two limitations. First, rules drawn with **DRAWPATTERNRECT** are not subject to clipping regions in the device context. Second,

applications should not try to erase patterns and rules created with **DRAWPATTERNRECT** by placing opaque objects over them. If the printer supports white rules, these can be used to erase patterns created by **DRAWPATTERNRECT**. If the printer does not support white rules, there is no method for erasing these patterns.

If an application cannot use the **DRAWPATTERNRECT** escape, it should generally use the **PatBlt** function instead. (If **PatBlt** is used to print a black rectangle, the application should use the **BLACKNESS** raster operator.) If the device is a plotter, the application should use the **Rectangle** function.

ENABLEDUPLEX

short Escape(*hdc,* **ENABLEDUPLEX, sizeof(WORD),** *lpInData,* **NULL)**

The **ENABLEDUPLEX** printer escape is maintained for backwards compatibility. Applications written for Windows 3.1 should use the **ExtDeviceMode** function. An application can determine whether an output device is capable of creating duplex output by checking the DM_DUPLEX bit of the **dmFields** member in the **DEVMODE** structure.

This escape enables the duplex printing capabilities of a printer. A device that possesses duplex printing capabilities is able to print on both sides of the output medium.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**LPWORD** Points to an unsigned 16-bit integer that specifies whether duplex or simplex printing is used. It can be one of the following values:

Value	Meaning
0	Simplex
1	Duplex with vertical binding
2	Duplex with horizontal binding

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful. Otherwise, it is zero.

Comments

An application should use the **QUERYESCSUPPORT** escape to determine whether an output device is capable of creating duplex output. If **QUERYESCSUPPORT** returns a nonzero value, the application should send the **ENABLEDUPLEX** escape even if simplex printing is desired. This procedure guarantees replacement of any values set in the driver-specific dialog box. If duplex printing is enabled and an uneven number of **NEXTFRAME** escapes are sent to the driver prior to the **ENDDOC** escape, the driver ejects an additional page before ending the print job.

ENABLEPAIRKERNING

short Escape(*hdc,* **ENABLEPAIRKERNING, sizeof(int),** *lpNewKernFlag, lpOldKernFlag***)**

The **ENABLEPAIRKERNING** printer escape enables or disables the ability of the driver to kern character pairs automatically. Kerning is the process of adding or subtracting space between characters in a string of text.

When pair kerning is enabled, the driver automatically kerns those pairs of characters that are listed in the character-pair kerning table for the font. The driver reflects this kerning both on the printer and in the **GetTextExtent** function calls.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpNewKernFlag	**LPINT** Points to a short-integer value that specifies whether automatic pair kerning is to be enabled (1) or disabled (zero).
lpOldKernFlag	**LPINT** Points to a short-integer value that receives the previous automatic pair-kerning value.

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful. It is zero if the escape is not successful or not implemented.

Comments

The default state of this escape is zero; automatic character-pair kerning is disabled.

A driver does not have to support the **ENABLEPAIRKERNING** escape just because it supplies the character-pair kerning table to the application by using the **GETPAIRKERNTABLE** escape. When the **GETPAIRKERNTABLE** escape is supported but the **ENABLEPAIRKERNING** escape is not, the application must properly space the kerned characters on the output device by using the **ExtTextOut** function.

ENABLERELATIVEWIDTHS

short Escape(*hdc,* **ENABLERELATIVEWIDTHS, sizeof(int),** *lpNewWidthFlag, lpOldWidthFlag***)**

The **ENABLERELATIVEWIDTHS** printer escape enables or disables relative character widths. When relative widths are disabled (the default), the width of each character can be expressed as a number of device units. This method guarantees that the extent of a string will equal the sum of the extents of the characters in the string. This allows applications to build an extent table by using one-character **GetTextExtent** function calls.

When relative widths are enabled, the sum of a string may not equal the sum of the widths of the characters. Applications that enable this feature are expected to retrieve the extent table for the font and compute relatively scaled string widths.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpNewWidthFlag	**LPINT** Points to a short integer that specifies whether relative widths are to be enabled (1) or disabled (zero).
lpOldWidthFlag	**LPINT** Points to a short integer that receives the previous relative character width value.

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful. It is zero if the escape is not successful or not implemented.

Comments

The default state of this escape is zero; relative character widths are disabled.

When the **ENABLERELATIVEWIDTHS** escape is enabled, the values specified as font units and accepted and returned by the escapes described in this topic are returned in the relative units of the font.

It is assumed that only linear-scaling devices are dealt with in a relative mode. Nonlinear-scaling devices do not implement this escape.

ENDDOC

short Escape(*hdc,* **ENDDOC, NULL, NULL, NULL)**

The **ENDDOC** printer escape is maintained for backwards compatibility. Applications written for Windows 3.1 should use the **EndDoc** function.

This escape ends a print job started by a **STARTDOC** escape.

Parameter	Description
hdc	**HDC** Identifies the device context.

Returns

The return value specifies the outcome of the escape. This value is positive if the escape is successful. Otherwise, it is zero or negative.

Comments

The **ENDDOC** escape should not be used inside metafiles.

END_PATH

short Escape(*hdc,* **END_PATH, sizeof(PATH_INFO),** *lpInData,* **NULL)**

The **END_PATH** printer escape ends a path. A path is a connected sequence of primitives drawn in succession to form a single polyline or polygon. Paths enable applications to draw complex borders, filled shapes, and clipping regions by supplying a collection of other primitives to define the desired shape.

Printer escapes that support paths enable applications to render images on sophisticated devices, such as PostScript printers, without generating huge polygons to simulate them.

To draw a path, an application first issues the **BEGIN_PATH** escape. Then it draws the primitives defining the border of the desired shape and issues an **END_PATH** escape.

The **END_PATH** escape takes, as a parameter, a pointer to a structure specifying the manner in which the path is to be rendered. The structure specifies whether or not the path is to be drawn and whether it is open or closed. Open paths define polylines, and closed paths define fillable polygons.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**PATH_INFO FAR *** Points to a **PATH_INFO** structure that defines how the path is to be rendered. For more information about this structure, see the following Comments section.

Returns

The return value specifies the current path nesting level. This value is the number of **BEGIN_PATH** escape calls without a corresponding **END_PATH** call if the escape is successful. Otherwise, it is -1.

Comments

This escape is used only by PostScript printer drivers.

An application may begin a subpath within another path. If the subpath is closed, it is treated just like a polygon. If it is open, it is treated just like a polyline.

An application may use the **CLIP_TO_PATH** escape to define a clipping region corresponding to the interior or exterior of the currently open path.

The *lpInData* parameter points to a **PATH_INFO** structure that specifies how to render the path. This structure has the following form:

```
struct PATH_INFO {
    short    RenderMode;
    BYTE     FillMode;
    BYTE     BkMode;
    LOGPEN   Pen;
    LOGBRUSH Brush;
    DWORD    BkColor;
};
```

Following are the members in the **PATH_INFO** structure:

RenderMode Specifies how the path is to be rendered. It can be one of the following values:

Value	Meaning
NO_DISPLAY (0)	Path is not drawn.
OPEN (1)	Path is drawn as an open polygon.
CLOSED (2)	Path is drawn as a closed polygon.

FillMode Specifies how the path is to be filled. It can be one of the following values:

Value	Meaning

	ALTERNATE (1)	Fill is done using the alternate fill algorithm.
	WINDING (2)	Fill is done using the winding fill algorithm.

BkMode Specifies the background mode for filling the path. It can be one of the following values:

Value	Meaning
OPAQUE	Background is filled with the background color before the brush is drawn.
TRANSPARENT	Background is not changed.

Pen Specifies the pen with which the path is to be drawn. If the **RenderMode** function is set to the NO_DISPLAY value, the pen is ignored.

Brush Specifies the brush with which the path is to be filled. If the **RenderMode** function is set to the NO_DISPLAY or OPEN value, the brush is ignored.

BkColor Specifies the color with which the path is filled if the **BkMode** function is set to the **OPAQUE** value.

ENUMPAPERBINS

short Escape(*hdc,* **ENUMPAPERBINS, sizeof(int),** *lpNumBins, lpOutData***)**

The **ENUMPAPERBINS** printer escape is maintained for backwards compatibility. Applications written for Windows 3.1 should call the **DeviceCapabilities** function with the **DC_BINNAMES** index to retrieve the number of available paper bins and the name of each bin.

This escape retrieves attribute information about a specified number of paper bins. The **GETSETPAPERBINS** escape retrieves the number of bins available on a printer.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpNumBins	**LPINT** Points to an integer that specifies the number of bins for which information is to be retrieved.
lpOutData	**LPSTR** Points to a structure to which information about the paper bins is copied. The size of the structure depends on the number of bins for which information was requested. For a description of this structure, see the following Comments section.

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful. It is zero if the escape is not successful or not implemented.

Comments

The structure to which the *lpOutData* parameter points consists of two arrays. The first is an array of short integers containing the paper-bin identifier numbers in the following form:

```
short BinList[cBinMax]
```

The number of integers in the array (the *cBinMax* value) is equal to the value pointed to by the *lpNumBins* parameter.

The second array in the structure to which *lpOutData* points is an array of characters in the following form:

```
char PaperNames[cBinMax][cchBinName]
```

The *cBinMax* value is equal to the value pointed to by the *lpNumBins* parameter. The *cchBinName* value is the length of each string (currently 24).

ENUMPAPERMETRICS

short Escape(*hdc,* **ENUMPAPERMETRICS, sizeof(int),** *lpMode, lpOutData***)**

The **ENUMPAPERMETRICS** printer escape performs one of two functions according to the mode:

- It determines the number of paper types supported and returns this value, which can then be used to allocate an array of **RECT** structures.
- It returns one or more **RECT** structures that define the areas on the page that can receive an image.

This escape is provided only for backward compatibility. An application should call the **DeviceCapabilities** function with the **DC_PAPERSIZE** index to discover the number of available paper sizes and the dimensions of each size.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpMode	**LPINT** Points to an integer that specifies the mode for the escape. It can be one of the following values:

Value	Meaning
0	Return value indicates how many **RECT** structures are required to contain the information about the available paper types.
1	Array of **RECT** structures to which the *lpOutData* parameter points is filled with the information.

lpOutData	**LPRECT** Points to an array of **RECT** structures that return all the areas capable of receiving an image.

Returns

The return value is positive if the escape is successful. The value is zero if the escape is not implemented and negative if an error occurred.

EPSPRINTING

short Escape(*hdc,* **EPSPRINTING, sizeof(BOOL),** *lpBool,* **NULL)**

The **EPSPRINTING** printer escape suppresses the output of the Windows PostScript header control section, which is about 7K. If an application uses this escape, no graphics device interface (GDI) calls are allowed.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpBool	**BOOL FAR *** Points to a Boolean value that indicates whether downloading should be enabled (nonzero) or disabled (zero).

Returns

The return value is positive if the escape is successful. This value is zero if the escape is not implemented and negative if an error occurred.

Comments

This escape is used only by PostScript printer drivers.

EXT_DEVICE_CAPS

short Escape(*hdc,* **EXT_DEVICE_CAPS, sizeof(int),** *lpIndex, lpCaps***)**

The **EXT_DEVICE_CAPS** printer escape retrieves information about device-specific capabilities. It supplements the **GetDeviceCaps** function.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpIndex	**LPINT** Points to a short integer that specifies the index of the capability to be retrieved. It can be any one of the following values:

Value	Meaning
R2_CAPS (1)	The *lpCaps* parameter indicates which of the 16 binary raster operations the device driver supports. A bit will be set for each supported raster operation. For further information, see the description of the **SetROP2** function.
PATTERN_CAPS (2)	The *lpCaps* parameter returns the maximum dimensions of a pattern brush bitmap. The low-order word of the capability value contains the maximum width of a pattern brush bitmap, and the high-order word contains the maximum height.
PATH_CAPS (3)	The *lpCaps* parameter indicates whether the device is capable of creating paths by using alternate and winding interiors, and whether the device can do exclusive or inclusive clipping to path interiors. The path capabilities are obtained by using the logical OR operation on the following values: PATH_ALTERNATE (1) PATH_WINDING (2) PATH_INCLUSIVE (4) PATH_EXCLUSIVE (8)
POLYGON_CAPS (4)	The *lpCaps* parameter returns the maximum number of polygon points supported by the device. The capability value is an unsigned value specifying the maximum number of points.
PATTERN_COLOR_CAPS (5)	The *lpCaps* parameter indicates whether the device can convert monochrome pattern bitmaps to color. The capability value is 1 if the device can do pattern bitmap color conversions and zero if it cannot.
R2_TEXT_CAPS (6)	The *lpCaps* parameter indicates whether the device is capable of performing binary raster operations on text. The low-order word of the capability value specifies which raster operations are supported for text. A bit is set for each supported raster operation, as in the R2_CAPS escape. The high-order word specifies the type of text to which the raster capabilities apply. It is obtained by applying the logical OR operation to the following values together:

		RASTER_TEXT (1) DEVICE_TEXT (2) VECTOR_TEXT (4)
	POLYMODE_CAPS (7)	The *lpcaps* parameter indicates which poly modes are supported by the printer driver. The capability value is obtained by using the bitwise OR operator to combine a bit in the corresponding position for each supported poly mode. For example, if the printer supports the PM_POLYSCANLINE and PM_BEZIER poly modes, the capability value would be: (1 << PM_POLYSCANLINE) | (PM_BEZIER)
lpCaps	**LPDWORD** Points to a 32-bit integer to which the capabilities will be copied.	

Returns

The return value is nonzero if the specified extended capability is supported. This value is zero if the capability is not supported.

Comments

This escape is used only by PostScript printer drivers.

EXTTEXTOUT

short Escape(*hdc,* **EXTTEXTOUT, sizeof(EXTTEXT_STRUCT),** *lpInData,* **NULL)**

The **EXTTEXTOUT** printer escape provides an efficient way for an application to call the graphics device interface (GDI) **TextOut** function when justification, letter spacing, or kerning is involved.

This function is provided only for backward compatibility. New applications should use the GDI **ExtTextOut** function instead.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**EXTTEXT_STRUCT FAR *** Points to an **EXTTEXT_STRUCT** structure that specifies the initial position, characters, and character widths of the string. For more information about this structure, see the following Comments section.

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful. It is zero if the escape is not successful or not implemented.

Comments

The **EXTTEXT_STRUCT** structure has the following form:

```
struct EXTTEXT_STRUCT {
    WORD   x;
    WORD   y;
    LPWORD lpText;
    LPWORD lpWidths;
};
```

Following are the members in the **EXTTEXT_STRUCT** structure:

x	Specifies the x-coordinate of the upper-left corner of the string's starting point.
y	Specifies the y-coordinate of the upper-left corner of the string's starting point.
lpText	Points to an array of *cch* character codes, where *cch* is the number of bytes in the string (*cch* is also the number of words in the width array).
lpWidths	Points to an array of *cch* character widths to use when printing the string. The first character appears at (**x**,**y**), the second at (**x** + **lpWidths**[0],**y**), the third at (**x** + **lpWidths**[0] + **lpWidths**[1],**y**), and so on. These character widths are specified in the font units of the currently selected font. (The character widths are always equal to device units, unless the application has enabled relative character widths.) The units contained in the width array are specified as font units of the device.

FLUSHOUTPUT

short Escape(*hdc,* **FLUSHOUTPUT, NULL, NULL, NULL)**

The **FLUSHOUTPUT** printer escape clears all output from the device's buffer.

Parameter	Description
hdc	**HDC** Identifies the device context.

Returns

The return value specifies the outcome of the escape. This value is greater than zero if the escape is successful. Otherwise, it is less than zero.

GETCOLORTABLE

short Escape(*hdc,* **GETCOLORTABLE, sizeof(int),** *lpIndex, lpColor***)**

The **GETCOLORTABLE** printer escape retrieves an **RGB** color-table entry and copies it to the location specified by the *lpColor* parameter.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpIndex	**LPINT** Points to a short integer that specifies the index of a color-table entry. Color-table indexes start at zero for the first table entry.
lpColor	**LPDWORD** Points to the long integer that will receive the **RGB** color value for the given entry.

Returns

The return value specifies the outcome of the escape. This value is positive if the escape is successful. Otherwise, it is negative.

GETEXTENDEDTEXTMETRICS

short Escape(*hdc,* **GETEXTENDEDTEXTMETRICS, sizeof(WORD),** *lpInData, lpOutData***)**

The **GETEXTENDEDTEXTMETRICS** printer escape fills the buffer pointed to by the *lpOutData* parameter with the extended text metrics for the selected font.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**LPWORD** Points to an unsigned 16-bit integer that specifies the number of bytes pointed to by the *lpOutData* parameter.
lpOutData	**EXTTEXTMETRIC FAR *** Points to an **EXTTEXTMETRIC** structure. For more information about this structure, see the following Comments section.

Returns

The return value specifies the number of bytes copied to the buffer pointed to by the *lpOutData* parameter. This value will never exceed that specified in the *nSize* member pointed to by the *lpInData* parameter. The return value is zero if the selected font does not have the extended text metrics or if the escape fails or is not implemented.

Comments

The *lpOutData* parameter points to an **EXTTEXTMETRIC** structure, which has the following form:

```
struct EXTTEXTMETRIC {
    short etmSize;
    short etmPointSize;
    short etmOrientation;
    short etmMasterHeight;
    short etmMinScale;
    short etmMaxScale;
    short etmMasterUnits;
    short etmCapHeight;
    short etmXHeight;
    short etmLowerCaseAscent;
    short etmLowerCaseDescent;
    short etmSlant;
    short etmSuperScript;
    short etmSubScript;
    short etmSuperScriptSize;
    short etmSubScriptSize;
    short etmUnderlineOffset;
    short etmUnderlineWidth;
    short etmDoubleUpperUnderlineOffset;
    short etmDoubleLowerUnderlineOffset;
    short etmDoubleUpperUnderlineWidth;
    short etmDoubleLowerUnderlineWidth;
    short etmStrikeOutOffset;
    short etmStrikeOutWidth;
    WORD  etmKernPairs;
    WORD  etmKernTracks;
};
```

Following are the members in the **EXTTEXTMETRIC** structure:

etmSize	Specifies the size of the structure, in bytes.
etmPointSize	Specifies the nominal point size of this font, in twips (1/20 of a point, or 1/1440 inch). This is the intended size of the font; the

actual size may differ slightly depending on the resolution of the device.

etmOrientation Specifies the orientation of the font. The **etmOrientation** member may be any of the following values:

Value	Meaning
0	Either orientation
1	Portrait
2	Landscape

These values refer to the ability of this font to be placed on a page with the given orientation. A portrait page has a height that is greater than its width. A landscape page has a width that is greater than its height.

etmMasterHeight Specifies the font size, in device units, for which the values in this font's extent table are exact.

etmMinScale Specifies the minimum valid size for this font. The following equation illustrates how the minimum point size is determined:

smallest point size =
(**etmMinScale** * 72) / **dfVertRes**

The value 72 represents the number of points per inch. The *dfVertRes* value is the number of dots per inch.

etmMaxScale Specifies the maximum valid size for this font. The following equation illustrates how the maximum point size is determined:

largest point size =
(**etmMaxScale** * 72) / **dfVertRes**

The value 72 represents the number of points per inch. The *dfVertRes* value is the number of dots per inch.

etmMasterUnits Specifies the integer number of units per em where an em equals the value of the **etmMasterHeight** member. (That is, **etmMasterUnits** is **emtMasterHeight** expressed in font units instead of device units.)

etmCapHeight Specifies the height, in font units, of uppercase characters in the font. Typically, this is the height of capital *H.*

etmXHeight Specifies the height, in font units, of lowercase characters in the font. Typically, this is the height of lowercase *x.*

etmLowerCaseAscent Specifies the distance, in font units, that the ascender of lowercase letters extends above the base line. Typically, this is the height of lowercase *d.*

etmLowerCaseDescent Specifies the distance, in font units, that the descender of lowercase letters extends below the base line. Typically, this is specified for the descender of lowercase *p.*

etmSlant Specifies, for an italic or slanted font, the angle of the slant measured in tenths of a degree clockwise from the upright version of the font.

etmSuperScript Specifies, in font units, the recommended amount to offset superscript characters from the base line. This is typically a negative value.

etmSubScript Specifies, in font units, the recommended amount to offset subscript characters from the base line. This is typically a positive value.

etmSuperScriptSize	Specifies, in font units, the recommended size of superscript characters for this font.
etmSubScriptSize	Specifies, in font units, the recommended size of subscript characters for this font.
etmUnderlineOffset	Specifies, in font units, the offset downward from the base line where the top of a single underline bar should appear.
etmUnderlineWidth	Specifies, in font units, the thickness of the underline bar.
etmDoubleUpperUnderlineOffset	Specifies the offset, in font units, downward from the base line where the top of the upper double-underline bar should appear.
etmDoubleLowerUnderlineOffset	Specifies the offset, in font units, downward from the base line where the top of the lower double-underline bar should appear.
etmDoubleUpperUnderlineWidth	Specifies, in font units, the thickness of the upper underline bar.
etmDoubleLowerUnderlineWidth	Specifies, in font units, the thickness of the lower underline bar.
etmStrikeOutOffset	Specifies, in font units, the offset upward from the base line where the top of a strikeout bar should appear.
etmStrikeOutWidth	Specifies the thickness, in font units, of the strikeout bar.
etmKernPairs	Specifies the number of character kerning pairs defined for this font. An application can use this value to calculate the size of the pair-kern table returned by the **GETPAIRKERNTABLE** escape. It will not be greater than 512 kerning pairs.
etmKernTracks	Specifies the number of kerning tracks defined for this font. An application can use this value to calculate the size of the track-kern table returned by the **GETTRACKKERNTABLE** escape. It will not be greater than 16 kerning tracks.

The values returned in many of the members of the **EXTTEXTMETRIC** structure are affected by whether relative character widths are enabled or disabled. For more information, see the description of the **ENABLERELATIVEWIDTHS** escape earlier in this topic.

GETEXTENTTABLE

short Escape(*hdc,* **GETEXTENTTABLE, sizeof(CHAR_RANGE_STRUCT),** *lpInData, lpOutData***)**

The **GETEXTENTTABLE** printer escape retrieves the width (extent) of individual characters from a group of consecutive characters in the character set for the selected font.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**LPSTR** Points to a **CHAR_RANGE_STRUCT** structure that defines the range of characters for which the width is to be retrieved. For more information about this structure, see the following Comments section.
lpOutData	**LPINT** Points to an array of short integers that receives the character widths. The size of the array must be at least (**chLast** - **chFirst** + 1).

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful. It is zero if the escape is not successful. If the escape is not implemented, the return value is zero.

Comments

The *lpInData* parameter points to a **CHAR_RANGE_STRUCT** structure that defines the range of characters for which the width is to be retrieved. This structure has the following form:

```
struct CHAR_RANGE_STRUCT {
    CHAR chFirst;
    CHAR chLast;
};
```

Following are the members in the **CHAR_RANGE_STRUCT** structure:

chFirst Specifies the character code of the first character whose width is to be retrieved.

chLast Specifies the character code of the last character whose width is to be retrieved.

How an application uses the retrieved values depends upon whether relative character widths are enabled or disabled. For more information, see the description of the **ENABLERELATIVEWIDTHS** escape, earlier in this topic.

GETFACENAME

short Escape(*hdc,* **GETFACENAME, NULL, NULL,** *lpFaceName***)**

The **GETFACENAME** printer escape retrieves the face name of the current physical font.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpFaceName	**LPSTR** Points to a buffer of characters to receive the face name. This buffer must be at least 60 bytes in length.

Returns

The return value is positive if the escape was successful. This value is zero if the escape is not implemented or negative if an error occurred.

Comments

This escape is used only by PostScript printer drivers.

GETPAIRKERNTABLE

short Escape(*hdc,* **GETPAIRKERNTABLE, NULL, NULL,** *lpOutData***)**

The **GETPAIRKERNTABLE** printer escape fills the buffer pointed to by the *lpOutData* parameter with the character-pair kerning table for the selected font.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpOutData	**KERNPAIR FAR *** Points to an array of **KERNPAIR** structures. This array must be large enough to accommodate the entire character-pair kerning table for the font. The number of character-kerning pairs in the font can be obtained from the **EXTTEXTMETRIC** structure returned by the **GETEXTENDEDTEXTMETRICS** escape. For more information about this structure, see the following Comments section.

Returns

The return value specifies the number of **KERNPAIR** structures copied to the buffer. This value is zero if the font does not have kerning pairs defined or the escape fails or is not implemented.

Comments

The **KERNPAIR** structure has the following form:

```
struct KERNPAIR {
    union {
           BYTE each  [2];  /* 'each' and 'both' share same memory */
           WORD both;
         } kpPair;
    short kpKernAmount;
};
```

Following are the members in the **KERNPAIR** structure:

each	Specifies the character codes for the kerning pair.
both	Specifies a 16-bit value in which the first character in the kerning pair is in the low-order byte and the second character is in the high-order byte.
kpKernAmount	Specifies the signed amount that this pair will be kerned if they appear side by side in the same font and size. This value is typically negative because pair-kerning usually results in two characters being set tighter than normal.

The array of **KERNPAIR** structures is sorted in increasing order by the **kpPair.both** member.

The values returned in **KERNPAIR** structures are affected by whether relative character widths are enabled or disabled. For more information, see the description of the **ENABLERELATIVEWIDTHS** escape earlier in this topic.

GETPHYSPAGESIZE

short Escape(*hdc,* **GETPHYSPAGESIZE, NULL, NULL,** *lpDimensions***)**

The **GETPHYSPAGESIZE** printer escape retrieves the physical page size and copies it to the location pointed to by the *lpDimensions* parameter.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpDimensions	**LPPOINT** Points to a **POINT** structure that will receive the physical page dimensions (in the current orientation). The **x** member of the **POINT** structure receives the horizontal size, in device units, and the **y** member receives the vertical size, in device units.

Returns

The return value specifies the outcome of the escape. This value is positive if the escape is successful. Otherwise, it is zero or negative.

GETPRINTINGOFFSET

short Escape(*hdc,* **GETPRINTINGOFFSET, NULL, NULL,** *lpOffset***)**

The **GETPRINTINGOFFSET** printer escape retrieves the offset from the upper-left corner of the physical page where the actual printing or drawing begins. This escape is generally not useful for devices that allow the user to set the origin of the printable area directly.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpOffset	**LPPOINT** Points to a **POINT** structure that will receive the printing offset (in the current orientation). The **x** member of the **POINT** structure receives the horizontal coordinate of the printing offset, in device units, and the **y** member receives the vertical coordinate of the printing offset, in device units.

Returns

The return value specifies the outcome of the escape. This value is positive if the escape is successful. Otherwise, it is zero or negative.

GETSCALINGFACTOR

short Escape(*hdc,* **GETSCALINGFACTOR, NULL, NULL,** *lpFactors***)**

The **GETSCALINGFACTOR** printer escape retrieves the scaling factors for the x-axis and y-axis of a printing device. For each scaling factor, the escape copies an exponent of 2 to the location pointed to by the *lpFactors* parameter. For example, the value 3 is copied to *lpFactors* if the scaling factor is 8.

Scaling factors are used by printing devices that support graphics at a smaller resolution than text.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpFactors	**LPPOINT** Points to the **POINT** structure that will receive the scaling factor. The **x** member of the **POINT** structure receives the scaling factor for the x-axis and the **y** member receives the scaling factor for the y-axis.

Returns

The return value specifies the outcome of the escape. This value is positive if the escape is successful. Otherwise, it is zero or negative.

GETSETPAPERBINS

short Escape(*hdc,* **GETSETPAPERBINS,** *nCount, lpInData, lpOutData***)**

The **GETSETPAPERBINS** printer escape is maintained for backwards compatibility. Applications written for Windows 3.1 should call the **DeviceCapabilities** function with the **DC_BINS** index to retrieve the number of available paper bins and use the **ExtDeviceMode** function to set the current paper bin.

This escape retrieves the number of paper bins available on a printer and sets the current paper bin. For more information about actions performed by this escape, see the following Comments section.

Parameter	Description
hdc	**HDC** Identifies the device context.
nCount	**int** Specifies the number of bytes pointed to by the *lpInData* parameter.
lpInData	**BinInfo FAR *** Points to a **BinInfo** structure that specifies the new paper bin. It may be set to NULL. For more information about this structure, see the following Comments section.
lpOutData	**BinInfo FAR *** Points to a **BinInfo** structure that contains information about the current or previous paper bin and the number of bins available. For more information about this structure, see the following comments section.

Returns

The return value is positive if the escape is successful. Otherwise, this value is zero or negative.

Comments

There are three possible actions for this escape, depending on the values passed in the *lpInData* and *lpOutData* parameters:

lpInData	lpOutData	Action
NULL	**BinInfo**	Retrieves the number of bins and the number of the current bin.
BinInfo	**BinInfo**	Sets the current bin to the number specified in the **BinNumber** member of the structure to which the *lpInData* parameter points and retrieves the number of the previous bin.
BinInfo	NULL	Sets the current bin to the number specified in the **BinNumber** member of the structure to which the *lpInData* parameter points.

The **BinInfo** structure has the following form:

```
struct BinInfo {
    int BinNumber;
    int cBins;
    int Reserved;
    int Reserved;
    int Reserved;
    int Reserved;
};
```

Following are the members of the **BinInfo** structure:

BinNumber Identifies the current or previous paper bin.

cBins Specifies the number of paper bins available.

Once a new bin is set, the selection takes effect immediately; the next page printed comes from the new bin.

GETSETPAPERMETRICS

short Escape(*hdc,* **GETSETPAPERMETRICS, sizeof(RECT),** *lpNewPaper, lpPrevPaper***)**

The **GETSETPAPERMETRICS** printer escape sets the paper type according to the given paper metrics information. It also retrieves the paper metrics information for the current printer.

This escape is obsolete. Printer drivers written for Windows version 3.0 and later may not support this escape. Applications can use the **DeviceCapabilities** and **ExtDeviceMode** functions to achieve the same functionality.

This escape expects a **RECT** structure representing the imageable area of the physical page and assumes the origin is situated in the upper-left corner.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpNewPaper	**LPRECT** Points to a **RECT** structure that defines the new imageable area.
lpPrevPaper	**LPRECT** Points to a **RECT** structure that receives the previous imageable area.

Returns

The return value is positive if the escape is successful. The value is zero if the escape is not implemented and negative if an error occurs.

GETSETPRINTORIENT

short Escape(*hdc,* **GETSETPRINTORIENT,** *nCount, lpInData,* **NULL)**

The **GETSETPRINTORIENT** printer escape returns or sets the current paper orientation. This escape is obsolete. Printer drivers written for Windows version 3.0 and later may not support this escape. An application should call the **ExtDeviceMode** function instead.

Parameter	Description
hdc	**HDC** Identifies the device context.
nCount	**short** Specifies the number of bytes pointed to by the *lpInData* parameter.
lpInData	**ORIENT FAR *** Points to an **ORIENT** structure that specifies the new paper orientation. For a description of this structure, see the following Comments section. It may be set to NULL, in which case the **GETSETPRINTORIENT** escape returns the current paper orientation.

Returns

The return value specifies the current orientation if *lpInData* is NULL. Otherwise, this value is the previous orientation. This value is -1 if the escape fails.

Comments

This escape is provided only for backward compatibility. New applications should use the graphics device interface (GDI) **DeviceCapabilities** and **ExtDeviceMode** functions instead.

The **ORIENT** structure has the following form:

```
struct ORIENT {
    DWORD Orientation;
    DWORD Reserved;
    DWORD Reserved;
    DWORD Reserved;
    DWORD Reserved;
};
```

The **Orientation** member can be one of these values:

Value	Meaning
1	New orientation is portrait.
2	New orientation is landscape.

GETSETSCREENPARAMS

short Escape(*hdc,* **GETSETSCREENPARAMS, sizeof(SCREENPARAMS),** *lpInData, lpOutData***)**

The **GETSETSCREENPARAMS** printer escape retrieves or sets the current screen information for rendering halftones.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**SCREENPARAMS FAR *** Points to a **SCREENPARAMS** structure that contains the new screen information. For more information about this structure, see the following Comments section. This parameter may be NULL.
lpOutData	**SCREENPARAMS FAR *** Points to a **SCREENPARAMS** structure that retrieves the previous screen information. For more information about this structure, see the following Comments section. This parameter may be NULL.

Returns

The return value specifies the outcome of the escape. This value is positive if the escape is successful. Otherwise, it is negative.

Comments

This escape affects how device-independent bitmaps (DIBs) are rendered and how color objects are filled.

The **SCREENPARAMS** structure has the following form:

```
typedef struct tagSCREENPARAMS {
  int   angle;
  int   frequency;
} SCREENPARAMS;
```

Following are the members of the **SCREENPARAMS** structure:

angle	Specifies, in degrees, the angle of the halftone screen.
frequency	Specifies, in dots per inch, the screen frequency.

GETTECHNOLOGY

short Escape(*hdc,* **GETTECHNOLOGY, NULL, NULL,** *lpTechnology***)**

The **GETTECHNOLOGY** printer escape retrieves the general technology type for a printer, which allows an application to perform technology-specific actions.

Applications should avoid using this escape. Printer drivers written for Windows version 3.0 and later may not support this escape.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpTechnology	**LPSTR** Points to a buffer to which the driver copies a null-terminated string containing the printer technology type, such as "PostScript".

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful. It is zero if the escape is not successful or is not implemented.

GETTRACKKERNTABLE

short Escape(*hdc,* **GETTRACKKERNTABLE, NULL, NULL,** *lpOutData***)**

The **GETTRACKKERNTABLE** printer escape fills the buffer pointed to by the *lpOutData* parameter with the track-kerning table for the currently selected font.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpOutdata	**KERNTRACK FAR *** Points to an array of **KERNTRACK** structures. This array must be large enough to accommodate all the kerning tracks for the font. The number of tracks in the font can be obtained from the **EXTTEXTMETRIC** structure which is returned by the **GETEXTENDEDTEXTMETRICS** escape. For more information about this structure, see the following Comments section.

Returns

The return value specifies the number of **KERNTRACK** structures copied to the buffer. This value is zero if the font does not have kerning tracks defined or if the escape fails or is not implemented.

Comments

The **KERNTRACK** structure has the following form:

```
struct KERNTRACK {
    short Degree;
    short MinSize;
    short MinAmount;
    short MaxSize;
    short MaxAmount;
};
```

Following are the members in the **KERNTRACK** structure:

Degree	Specifies the amount of track kerning. Increasingly negative values represent tighter track kerning, and increasingly positive values represent looser track kerning.
MinSize	Specifies, in device units, the minimum font size for which linear track kerning applies.
MinAmount	Specifies, in font units, the amount of track kerning to apply to font sizes less than or equal to the size specified by the **MinSize** member.
MaxSize	Specifies, in device units, the maximum font size for which linear track kerning applies.
MaxAmount	Specifies, in font units, the amount of track kerning to apply to font sizes greater than or equal to the size specified by the **MaxSize** member.

Between the **MinSize** and **MaxSize** font sizes, track kerning is a linear function from **MinAmount** to **MaxAmount**. The values returned in the **KERNTRACK** structures are affected by whether relative character widths are enabled or disabled. For more information, see the description of the **ENABLERELATIVEWIDTHS** escape earlier in this topic.

GETVECTORBRUSHSIZE

short Escape(*hdc,* **GETVECTORBRUSHSIZE, sizeof(LOGBRUSH),** *lpInData, lpOutData***)**

The **GETVECTORBRUSHSIZE** printer escape retrieves, in device units, the size of a plotter pen used to fill closed figures. Graphics device interface (GDI) uses this information to prevent the plotter pen from writing over the borders of the figure when filling closed figures.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**LOGBRUSH FAR *** Points to a **LOGBRUSH** structure that specifies the brush for which data is to be returned.
lpOutData	**LPPOINT** Points to a **POINT** structure whose **y** member contains the width of the pen, in device units.

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful. It is zero if the escape is not successful or is not implemented.

GETVECTORPENSIZE

short Escape(*hdc,* **GETVECTORPENSIZE, sizeof(LOGPEN),** *lpInData, lpOutData***)**

The **GETVECTORPENSIZE** printer escape retrieves the size, in device units, of a plotter pen. Graphics device interface (GDI) uses this information to prevent hatched brush patterns from overwriting the border of a closed figure.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**LOGPEN FAR *** Points to a **LOGPEN** structure that specifies the pen for which the width is to be retrieved.
lpOutData	**LPPOINT** Points to a **POINT** structure that contains in its second word the width of the pen, in device units.

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful and zero if the escape is not successful or if it is not implemented.

MFCOMMENT

BOOL Escape(*hdc,* **MFCOMMENT,** *nCount, lpComment,* **NULL)**

The **MFCOMMENT** printer escape adds a comment to a metafile.

Parameter	Description
hdc	**HDC** Identifies the device context for the device on which the metafile appears.
nCount	**short** Specifies the number of characters in the string pointed to by the *lpComment* parameter.
lpComment	**LPSTR** Points to a string that contains the comment that will appear in the metafile.

Returns

The return value specifies the outcome of the escape. This value is -1 if an error, such as insufficient memory or an invalid port specification, occurs. Otherwise, it is positive.

MOUSETRAILS

short Escape(*hdc,* **MOUSETRAILS, sizeof(WORD),** *lpTrailSize,* **NULL)**

The **MOUSETRAILS** escape enables or disables mouse trails for display devices.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpTrailSize	**LPINT** points to a 16-bit variable containing a value specifying the action to take and the number of mouse cursor images to display (trail size). The variable can be one of the following values:

Value	Meaning
1 through 7	Enables mouse trails and sets the trail size to the specified number. A value of 1 requests a single mouse cursor. A value of 2 requests that one extra mouse cursor be drawn behind the current mouse cursor, and so on, up to a maximum of 7 total cursor images. The escape sets the MouseTrails entry in the WIN.INI file to the given value and returns the new trail size.
0	Disables mouse trails. The escape sets the MouseTrails entry to the negative value of the current trail size (if positive) and returns the negative value.
-1	Enables mouse trails. The display driver reads the MouseTrails entry from the [windows] section of the WIN.INI file. If the value of the entry is positive, the escape sets the trail size to the given value. If the entry is negative, the escape sets the trail size to the entry's absolute value and writes the positive value back to WIN.INI. If the MouseTrails entry is not found, the escape sets the trail size to 7 and writes a new MouseTrails entry to the WIN.INI file, setting its value to 7. The escape then returns the new trail size.
-2	Disables mouse trails but does not cause the display driver to update the WIN.INI file.
-3	Enables mouse trails but does not cause the display driver to update the WIN.INI file.

Returns

The return value specifies the new trail size if the escape is successful. The return value is zero if the escape is not supported.

NEWFRAME

short Escape(*hdc,* **NEWFRAME, NULL, NULL, NULL)**

The **NEWFRAME** printer escape is maintained for backwards compatibility. Applications written for Windows 3.1 should use the **StartPage** and **EndPage** functions.

This escape informs the device that the application has finished writing to a page. It is typically used with a printer to direct the device driver to advance to a new page.

Parameter	Description
hdc	**HDC** Identifies the device context.

Returns

The return value specifies the outcome of the escape. This value is positive if the escape is successful. Otherwise, it is one of the following values:

Value	Meaning
SP_APPABORT	Job was terminated because the application's Abort function returned zero.
SP_ERROR	General error.
SP_OUTOFDISK	Not enough disk space is currently available for spooling, and no more space will become available.
SP_OUTOFMEMORY	Not enough memory is available for spooling.
SP_USERABORT	User terminated the job through Print Manager.

Comments

Do not use the **NEXTBAND** escape with the **NEWFRAME** escape. For banding device drivers, graphics device interface (GDI) replays a metafile to the printer, simulating a sequence of **NEXTBAND** escapes.

The **NEWFRAME** escape restores the default values of the device context. Consequently, if a font other than the default font is selected when the application calls the **NEWFRAME** escape, the application must select the font again following the **NEWFRAME** escape.

The **NEWFRAME** escape should not be used inside metafiles.

NEXTBAND

short Escape(*hdc,* **NEXTBAND, NULL, NULL,** *lpBandRect***)**

The **NEXTBAND** printer escape informs the device driver that the application has finished writing to a band, causing the device driver to send the band to Print Manager and return the coordinates of the next band. Applications that process banding themselves use this escape.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpBandRect	**LPRECT** Points to the **RECT** structure that will receive the next band coordinates. The device driver copies the device coordinates of the next band into this structure.

Returns

The return value specifies the outcome of the escape. This value is positive if the escape is successful. A return value of zero indicates that an error occurred. In addition, the following error values are defined:

Value	Meaning
SP_APPABORT	Job was terminated because the application's Abort function returned zero.
SP_ERROR	General error.
SP_OUTOFDISK	Not enough disk space is currently available for spooling, and no more space will become available.
SP_OUTOFMEMORY	Not enough memory is available for spooling.
SP_USERABORT	User terminated the job through Print Manager.

Comments

The **NEXTBAND** escape sets the band rectangle to the empty rectangle when printing reaches the end of a page.

Do not use the **NEWFRAME** escape with the **NEXTBAND** escape.

The **NEXTBAND** escape should not be used inside metafiles.

PASSTHROUGH

short Escape(*hdc,* **PASSTHROUGH, NULL,** *lpInData,* **NULL)**

The **PASSTHROUGH** printer escape allows the application to send data directly to the printer, bypassing the standard print-driver code.

Note: To use this escape, an application must have complete information about how the particular printer operates.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**LPSTR** Points to a structure whose first word (16 bits) contains the number of bytes of input data. The remaining bytes of the structure contain the data itself.

Returns

The return value specifies the number of bytes transferred to the printer if the escape is successful. This value is less than or equal to zero if the escape is not successful or not implemented.

Comments

There may be restrictions on the kinds of device data an application can send to the device without interfering with the operation of the driver. In general, applications must avoid resetting the printer or causing the page to be printed.

It is strongly recommended that applications do not perform actions that consume printer memory, such as downloading a font or a macro.

An application can avoid corrupting its data stream when issuing multiple, consecutive **PASSTHROUGH** escapes by not accessing the printer any other way during the sequence.

An application can guarantee that the **PASSTHROUGH** escape will be successful if it uses a "save" PostScript operator before sending **PASSTHROUGH** data and a "restore" operator after. Avoiding graphics device interface (GDI) functions between calls to the **PASSTHROUGH** escape and avoiding commands that cause a page to eject are other means to ensure that the escape will be successful.

POSTSCRIPT_DATA

The **POSTSCRIPT_DATA** printer escape is identical to the **PASSTHROUGH** escape.

POSTSCRIPT_IGNORE

short Escape(*hdc,* **POSTSCRIPT_IGNORE, NULL,** *lpfOutput,* **NULL)**

The **POSTSCRIPT_IGNORE** printer escape sets a flag indicating whether or not to suppress output.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpfOutput	**BOOL FAR*** Points to a flag indicating whether output should be suppressed. This value is nonzero to suppress output and zero otherwise.

Returns

The return value specifies the previous setting of the output flag.

Comments

Applications that generate their own PostScript code can use the **POSTSCRIPT_IGNORE** escape to prevent the PostScript device driver from generating output.

QUERYESCSUPPORT

short Escape(*hdc,* **QUERYESCSUPPORT, sizeof(int),** *lpEscNum,* **NULL)**

The **QUERYESCSUPPORT** printer escape determines whether a particular escape is implemented by the device driver.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpEscNum	**LPINT** Points to a short integer that specifies the escape function to be checked.

Returns

The return value specifies whether a particular escape is implemented. This value is nonzero for implemented escape functions. Otherwise, it is zero.

If the *lpEscNum* parameter is set to **DRAWPATTERNRECT**, the return value is one of the following values:

Value	Meaning
0	**DRAWPATTERNRECT** is not implemented.
1	**DRAWPATTERNRECT** is implemented for a printer other than the HP LaserJet IIP; this printer supports white rules.
2	**DRAWPATTERNRECT** is implemented for the HP LaserJet IIP.

RESTORE_CTM

short Escape(*hdc,* **RESTORE_CTM, NULL, NULL, NULL)**

The **RESTORE_CTM** printer escape restores the previously saved current transformation matrix.

The current transformation matrix controls the manner in which coordinates are translated, rotated, and scaled by the device. By using matrices, an application can combine these operations in any order to produce the desired mapping for a particular picture.

Parameter	Description
hdc	**HDC** Identifies the device context.

Returns

The return value specifies the number of **SAVE_CTM** escape calls without a corresponding **RESTORE_CTM** call. The return value is -1 if the escape is unsuccessful.

Comments

This escape is used only by PostScript printer drivers.

Applications should not make any assumptions about the initial contents of the current transformation matrix.

SAVE_CTM

short Escape(*hdc,* **SAVE_CTM, NULL, NULL, NULL)**

The **SAVE_CTM** printer escape saves the current transformation matrix.

The current transformation matrix controls the manner in which coordinates are translated, rotated, and scaled by the device. By using matrices, an application can combine these operations in any order to produce the desired mapping for a particular picture.

An application can restore the matrix by using the **RESTORE_CTM** escape.

An application typically saves the current transformation matrix before changing it. This allows the application to restore the previous state upon completion of a particular operation.

Parameter	Description
hdc	**HDC** Identifies the device context.

Returns

The return value specifies the number of **SAVE_CTM** escape calls without a corresponding **RESTORE_CTM** call. The return value is zero if the escape is unsuccessful.

Comments

This escape is used only by PostScript printer drivers.

Applications should not make any assumptions about the initial contents of the current transformation matrix.

Applications are expected to restore the contents of the current transformation matrix.

SELECTPAPERSOURCE

The **SELECTPAPERSOURCE** printer escape has been superseded by the **DeviceCapabilities** function (using the **DC_BINS** value). **SELECTPAPERSOURCE** is provided only for backward compatibility.

SETABORTPROC

short Escape(*hdc,* **SETABORTPROC, NULL,** *lpAbortFunc,* **NULL)**

The **SETABORTPROC** printer escape is maintained for backwards compatibility. Applications written for Windows 3.1 should use the **SetAbortProc** function.

This escape sets the Abort function for the print job.

To allow a print job to be canceled during spooling, an application must set the Abort function before the print job is started with the **STARTDOC** escape. Print Manager calls the Abort function during spooling to allow the application to cancel the print job or to take appropriate action for such errors as running out of disk space. If no Abort function is set, the print job will fail if there is not enough disk space for spooling.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpAbortFunc	**FARPROC** Points to the application-supplied Abort function. For details, see the following Comments section.

Returns

The return value specifies the outcome of the escape. This value is greater than zero if the escape is successful. Otherwise, it is less than zero.

Comments

The address passed as the *lpAbortFunc* parameter must be created by using the **MakeProcInstance** function.

The callback function must use the Pascal calling convention and must be declared **FAR**. The Abort function must have the following form:

short FAR PASCAL *AbortFunc*(*hPr***,***code*)
HDC *hPr;*
short *code;*

AbortFunc is a placeholder for the application-supplied function name. The actual name must be exported by including it in an **EXPORTS** statement in the module-definition (.DEF) file for the application.

Following are the parameters in the Abort function:

hPr Identifies the device context.

code Specifies whether an error has occurred. This parameter is zero if no error has occurred. It is **SP_OUTOFDISK** if Print Manager is currently out of disk space and more disk space will become available if the application waits.

If *code* is **SP_OUTOFDISK**, the application does not have to abort the print job. If it does not abort the print job, it must yield to Print Manager by calling the **PeekMessage** or **GetMessage** function.

Returns

The return value should be nonzero if the print job is to continue and zero if it is canceled.

SETALLJUSTVALUES

short Escape(*hdc,* **SETALLJUSTVALUES, sizeof(EXTTEXTDATA),** *lpInData,* **NULL)**

The **SETALLJUSTVALUES** printer escape is not recommended. Applications should use the **ExtTextOut** function instead of this escape. This escape sets all of the text-justification values that are used for text output in Windows 3.0 and earlier.

Text justification is the process of inserting extra pixels among break characters in a line of text. The space character is normally used as a break character.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**EXTTEXTDATA FAR *** Points to an **EXTTEXTDATA** structure that defines the text-justification values. For more information about this structure, see the Comments section.

Returns

The return value specifies the outcome of the escape. This value is 1 if the escape is successful. Otherwise, it is zero.

Comments

The *lpInData* parameter points to an **EXTTEXTDATA** structure that describes the text-justification values used for text output. The **EXTTEXTDATA** structure has the following form:

```
typedef struct {
    short nSize;
    LPALLJUSTREC lpInData;
    LPFONTINFO lpFont;
    LPTEXTXFORM lpXForm;
    LPDRAWMODE lpDrawMode;
} EXTTEXTDATA;
```

This structure contains a **JUST_VALUE_STRUCT** structure that has the following form:

```
typedef struct {
    short nCharExtra;
    WORD cch;
    short nBreakExtra;
    WORD nBreakCount;
} JUST_VALUE_STRUCT;
```

Following are the members of **JUST_VALUE_STRUCT** structure:

nCharExtra	Specifies the total extra space, in font units, that must be distributed over **cch** characters.
cch	Specifies the number of characters over which the **nCharExtra** member is distributed.
nBreakExtra	Specifies the total extra space, in font units, that is distributed over **nBreakCount** characters.
nBreakCount	Specifies the number of break characters over which the **nBreakExtra** member is distributed.

The units used for the **nCharExtra** and **nBreakExtra** members are the font units of the device and are dependent on whether relative character widths were enabled with the **ENABLERELATIVEWIDTHS** escape.

The values set with this escape apply to subsequent calls to the **TextOut** function. The driver stops

distributing the extra space specified in the **nCharExtra** member when it has output the number of characters specified in the **nCharCount** member. Likewise, it stops distributing the space specified by the **nBreakExtra** member when it has output the number of characters specified by the **nBreakCount** member. A call on the same string to the **GetTextExtent** function made immediately after the call to the **TextOut** function will be processed in the same manner.

To reenable justification with the **SetTextJustification** and **SetTextCharacterExtra** functions, an application should call the **SETALLJUSTVALUES** escape and set the **nCharExtra** and **nBreakExtra** members to zero.

SET_ARC_DIRECTION

short Escape(*hdc,* **SET_ARC_DIRECTION, sizeof(int),** *lpDirection,* **NULL)**

The **SET_ARC_DIRECTION** printer escape specifies the direction in which elliptical arcs are drawn using the graphics device interface (GDI) **Arc** function.

By convention, elliptical arcs are drawn counterclockwise by GDI. This escape lets an application draw paths containing arcs drawn clockwise.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpDirection	**LPINT** Points to a short integer specifying the arc direction. It can be one of the following values: COUNTERCLOCKWISE (0) CLOCKWISE (1)

Returns

The return value is the previous arc direction.

Comments

This escape maps to PostScript language elements and is intended for PostScript line devices.

SET_BACKGROUND_COLOR

short Escape(*hdc,* **SET_BACKGROUND_COLOR,** *nCount, lpNewColor, lpOldColor***)**

The **SET_BACKGROUND_COLOR** printer escape sets and retrieves the current background color for the device.

The background color is the color of the screen surface before an application draws anything on the device. This escape is particularly useful for color printers and film recorders.

This escape should be sent before the application draws anything on the current page.

Parameter	Description
hdc	**HDC** Identifies the device context.
nCount	**int** Specifies the number of bytes pointed to by the *lpNewColor* parameter.
lpNewColor	**LPDWORD** Points to a 32-bit integer specifying the desired background color. This parameter can be NULL if the application is merely retrieving the current background color.
lpOldColor	**LPDWORD** Points to a 32-bit integer that receives the previous background color. This parameter can be NULL if the application does not use the previous background color.

Returns

The return value is nonzero if the escape is successful. This value is zero if it is unsuccessful.

Comments

The default background color is white.

The background color is reset to the default when the device driver receives an **ENDDOC** or **ABORTDOC** escape.

SET_BOUNDS

short Escape(*hdc,* **SET_BOUNDS, sizeof(RECT),** *lpInData,* **NULL)**

The **SET_BOUNDS** printer escape sets the bounding rectangle for the picture being produced by the device driver supporting the given device context. This escape is used when creating images in a file format such as Encapsulated PostScript (EPS) and Hewlett-Packard Graphics Language (HPGL) for which there is a device driver.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**LPRECT** Points to a **RECT** structure that specifies in device coordinates a rectangle that bounds the image to be output.

Returns

The return value is nonzero if the escape was successful. Otherwise, it is zero.

Comments

An application should issue this escape before each page in the image. For single-page images, this escape should be issued immediately before the **STARTDOC** escape.

When an application uses coordinate-transformation escapes, device drivers may not perform bounding box calculations correctly. When an application uses the **SET_BOUNDS** escape, the driver does not have to calculate the bounding box.

Applications should always use this escape to ensure support for the Encapsulated PostScript (EPS) printing capabilities.

SET_CLIP_BOX

short Escape(*hdc,* **SET_CLIP_BOX, sizeof(RECT),** *lpInData,* **(LPSTR) NULL)**

The **SET_CLIP_BOX** printer escape sets the clipping rectangle or restores the previous clipping rectangle. This escape is implemented by printer drivers that use the coordinate-transformation escapes **TRANSFORM_CTM**, **SAVE_CTM**, and **RESTORE_CTM**.

When an application calls a graphics device interface (GDI) output function, GDI calculates a clipping rectangle bounding the primitive and passes both the primitive and the clipping rectangle to the printer driver. The printer driver is expected to clip the primitive to the specified bounding rectangle. However, when an application uses the coordinate-transformation escapes, the clipping rectangle calculated by GDI is usually invalid. An application can use the **SET_CLIP_BOX** escape to specify the correct clipping rectangle when coordinate transformations are used.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpClipBox	**LPRECT** Points to a **RECT** structure containing the bounding rectangle of the clipping region. If *lpClipBox* is not NULL, the previous clipping rectangle is saved and the current clipping rectangle is set to the specified bounds. If *lpClipBox* is NULL, the previous clipping rectangle is restored.

Returns

The return value is nonzero if the clipping rectangle was properly set. Otherwise, it is zero.

Comments

This escape is used only by PostScript printer drivers.

SETCOLORTABLE

short Escape(*hdc,* **SETCOLORTABLE, sizeof(COLORTABLE_STRUCT),** *lpInData, lpColor***)**

The **SETCOLORTABLE** printer escape sets an **RGB** color-table entry. If the device cannot supply the exact color, the function sets the entry to the closest possible approximation of the color.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpInData	**COLORTABLE_STRUCT FAR *** Points to a structure that contains the index and **RGB** value of the color-table entry. For more information about the **COLORTABLE_STRUCT** structure, see the following Comments section.
lpColor	**LPDWORD** Points to the long integer that is to receive the **RGB** color value selected by the device driver to represent the requested color value.

Returns

The return value specifies the outcome of the escape. This value is positive if the escape is successful. Otherwise, it is negative.

Comments

The **COLORTABLE_STRUCT** structure has the following form:

```
struct COLORTABLE_STRUCT {
    WORD  Index;
    DWORD rgb;
};
```

Following are the members of the **COLORTABLE_STRUCT** structure:

Index Specifies the color-table index. Color-table entries start at zero for the first entry.

rgb Specifies the desired **RGB** color value.

The color table for a device is a shared resource; changing the system display color for one window changes it for all windows. Only application developers who have a thorough knowledge of the display driver should use this escape.

The **SETCOLORTABLE** escape has no effect on devices with fixed color tables.

This escape is intended for use by both printer and display drivers. However, the EGA and VGA color drivers do not support it.

This escape changes the palette used by the display driver. However, because the color-mapping algorithms for the driver will probably no longer work with a different palette, an extension has been added to this function.

If the color index pointed to by the *lpInData* parameter is 0XFFFF, the driver is to leave all color-mapping functionality to the calling application. The application must use the proper color-mapping algorithm and take responsibility for passing the correctly mapped physical color to the driver (instead of the logical **RGB** color) in such device-driver functions as **RealizeObject** and **ColorInfo**.

For example, if the device supports 256 colors with palette indexes of 0 through 255, an application determines which index contains the color that it wants to use in a certain brush. It then passes this index in the low-order byte of the doubleword logical color passed to the **RealizeObject** device-driver function. The driver uses this color exactly as passed instead of performing its usual color-mapping algorithm. If the application wants to reactivate the driver's color-mapping algorithm (that is, if it restores the original palette when switching from its window context), then the color index pointed to by *lpInData* should be 0xFFFE.

SETCOPYCOUNT

short Escape(*hdc,* **SETCOPYCOUNT, sizeof(int),** *lpNumCopies, lpActualCopies***)**

The **SETCOPYCOUNT** printer escape is maintained for backwards compatibility. Applications written for Windows 3.1 should use the **ExtDeviceMode** function.

This escape specifies the number of uncollated copies of each page that the printer is to print.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpNumCopies	**LPINT** Points to a short integer that contains the number of uncollated copies to be printed.
lpActualCopies	**LPINT** Points to a short integer that will receive the number of copies to be printed. This may be less than the number requested if the requested number is greater than the maximum copy count for the device.

Returns

The return value specifies the outcome of the escape. It is 1 if the escape is successful and zero if the escape is not successful. The return value is zero if the escape is not implemented.

SETKERNTRACK

short Escape(*hdc,* **SETKERNTRACK, sizeof(int),** *lpNewTrack, lpOldTrack***)**

The **SETKERNTRACK** printer escape specifies which kerning track to use for drivers that support automatic track kerning. A kerning track of zero disables automatic track kerning.

When track kerning is enabled, the driver will automatically kern all characters according to the specified track. The driver will reflect this kerning both on the printer and in **GetTextExtent** function calls.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpNewTrack	**LPINT** Points to a short integer that specifies the kerning track to use. A value of zero disables this feature. Values in the range 1 through the value of the **etmKernTracks** member correspond to positions in the track-kerning table (using 1 as the first item in the table). For more information, see the description of the **EXTTEXTMETRIC** structure provided in the description of the **GETEXTENDEDTEXTMETRICS** escape earlier in this topic.
lpOldTrack	**LPINT** Points to a short integer that will receive the previous kerning track.

Returns

The return value specifies the outcome of the escape. It is 1 if the escape is successful and zero if the escape is not successful or not implemented.

Comments

Automatic track kerning is disabled by default.

A driver does not have to support the **SETKERNTRACK** escape just because it supplies the track-kerning table to the application by using the **GETTRACKKERNTABLE** escape. In a case where **GETTRACKKERNTABLE** is supported but the **SETKERNTRACK** escape is not, the application must properly space the characters on the output device.

SETLINECAP

short Escape(*hdc,* **SETLINECAP, sizeof(int),** *lpNewCap, lpOldCap***)**

The **SETLINECAP** printer escape sets the line end cap.

A line end cap is that portion of a line segment that appears on either end of the segment. The cap may be square or circular. It can extend past or remain flush with the specified segment endpoints.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpNewCap	**LPINT** Points to a short integer that specifies the end-cap type. Following are the possible values and their meanings:

Value	Meaning
-1	Line segments are drawn by using the default graphics device interface (GDI) end cap.
0	Line segments are drawn with a squared end point that does not project past the specified segment length.
1	Line segments are drawn with a rounded end point; the diameter of this semicircular arc is equal to the line width.
2	Line segments are drawn with a squared end point that projects past the specified segment length. The projection is equal to half the line width.

lpOldCap	**LPINT** Points to a short integer that specifies the previous end-cap setting.

Returns

The return value specifies the outcome of the escape. It is positive if the escape is successful. Otherwise, it is negative.

Comments

This escape is used only by PostScript printer drivers.

The interpretation of this escape varies with page-description languages (PDLs). For its exact meaning, consult the PDL documentation.

This escape is also known as **SETENDCAP**.

SETLINEJOIN

short Escape(*hdc,* **SETLINEJOIN, sizeof(int),** *lpNewJoin, lpOldJoin***)**

The **SETLINEJOIN** printer escape specifies how a device driver will join two intersecting line segments. The intersection can form a rounded, squared, or mitered corner.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpNewJoin	**LPINT** Points to a short integer that specifies the type of intersection. Following are the possible values and their meanings:

Value	Meaning
-1	Line segments are joined by using the default graphics device interface (GDI) setting.
0	Line segments are joined with a mitered corner; the outer edges of the lines extend until they meet at an angle. This is referred to as a miter join.
1	Line segments are joined with a rounded corner; a semicircular arc with a diameter equal to the line width is drawn around the point where the lines meet. This is referred to as a round join.
2	Line segments are joined with a squared end point; the outer edges of the lines are not extended. This is referred to as a bevel join.

lpOldJoin	**LPINT** Points to a short integer that specifies the previous line join setting.

Returns

The return value specifies the outcome of the escape. It is positive if the escape is successful. Otherwise, it is negative.

Comments

This escape is used only by PostScript printer drivers.

The interpretation of this escape varies with page-description languages (PDLs). For its exact meaning, consult the PDL documentation.

If an application specifies a miter join but the angle of intersection is too small, the device driver ignores the miter setting and uses a bevel join instead.

SETMITERLIMIT

short Escape(*hdc,* **SETMITERLIMIT, sizeof(int),** *lpNewMiter, lpOldMiter***)**

The **SETMITERLIMIT** printer escape sets the miter limit for a device. The miter limit controls the angle at which a device driver replaces a miter join with a bevel join.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpNewMiter	**LPINT** Points to a short integer that specifies the desired miter limit. Only values greater than or equal to -1 are valid. If the value is -1, the driver will use the default graphics device interface (GDI) miter limit.
lpOldMiter	**LPINT** Points to a short integer that specifies the previous miter-limit setting.

Returns

The return value specifies the outcome of the escape. This value is positive if the escape is successful. Otherwise, it is negative.

Comments

This escape is used only by PostScript printer drivers.

The miter limit is defined as follows:

miter length / line width = 1 / sin(*x*/2)

where *x* is the angle of the line join, in radians.

The interpretation of this escape varies with page-description languages (PDLs). For its exact meaning, consult the PDL documentation.

SET_POLY_MODE

short Escape(*hdc,* **SET_POLY_MODE, sizeof(int),** *lpMode,* **NULL)**

The **SET_POLY_MODE** printer escape sets the poly mode for the device driver. The poly mode is a state variable indicating how to interpret calls to graphics device interface (GDI) **Polygon** and **Polyline** functions.

The **SET_POLY_MODE** escape enables a device driver to draw shapes (such as Bezier curves) not directly supported by GDI. This permits applications that draw complex curves to send the curve description directly to a device without having to simulate the curve as a polygon with a large number of points.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpMode	**LPINT** Points to a short integer specifying the desired poly mode. The poly mode is a state variable indicating how points in **Polygon** or **Polyline** function calls should be interpreted. Device drivers are not required to support all possible modes. A device driver returns zero if it does not support the specified mode. The *lpMode* parameter may be one of the following values:

Value	Meaning
PM_POLYLINE (1)	Points define a conventional polygon or polyline.
PM_BEZIER (2)	Points define a sequence of 4-point Bezier spline curves. The first curve passes through the first four points, with the first and fourth points as endpoints and the second and third points as control points. Each subsequent curve in the sequence has the endpoint of the previous curve as its start point, the next two points as control points, and the third as its endpoint. The last curve in the sequence is permitted to have fewer than four points. If the curve has only one point, it is considered a point. If it has two points, it is a line segment. If it has three points, it is a parabola defined by drawing a Bezier curve with the first and third points as endpoints and the two control points equal to the second point.
PM_POLYLINESEGMENT (3)	Points specify a list of coordinate pairs. Line segments are drawn connecting each successive pair of points.
PM_POLYSCANLINE (4)	Points specify a list of coordinate pairs. Line segments are drawn connecting each successive pair of points. Each line segment is a nominal-width line drawn with the current brush. Each line segment must be strictly vertical or horizontal, and scan lines must be passed in strictly increasing or decreasing order. This mode is only used for polygon calls.

Returns

The return value is the previous poly mode. If the return value is zero, the device driver did not handle the request.

Comments

This escape is used only by PostScript printer drivers.

An application should issue the **SET_POLY_MODE** escape before it draws a complex curve. It should then call the **Polyline** or **Polygon** function with the desired control points defining the curve. After drawing the curve, the application should reset the driver to its previous state by issuing the **SET_POLY_MODE** escape.

Polyline calls draw using the currently selected pen.

Polygon calls draw using the currently selected pen and brush. If the start point and endpoint are not equal, a line is drawn from the start point to the endpoint before the polygon (or curve) is filled.

GDI treats **Polygon** calls using PM_POLYLINESEGMENT mode exactly the same as **Polyline** calls.

Four points define a Bezier curve. GDI generates the curve by connecting the first and second, second and third, and third and fourth points. GDI then connects the midpoints of these consecutive line segments. Finally, GDI connects the midpoints of the lines connecting the midpoints, and so forth.

The line segments drawn in this way converge to a curve defined by the following parametric equations, expressed as a function of the independent variable *t.*

X(*t*) = (1-*t*) ^ 3 *x*1 + 3(1-*t*) ^ 2 *tx*2 + 3(1-*t*)*t* ^ 2 *x*3 + *t* ^ 3 *x*4

Y(*t*) = (1-*t*) ^ 3 *y*1 + 3(1-*t*) ^ 2 *ty*2 + 3(1-*t*)*t* ^ 2 *y*3 + *t* ^ 3 *y*4

The points (*x*1, *y*1), (*x*2, *y*2), (*x*3, *y*3) and (*x*4, *y*4) are the control points defining the curve. The independent variable *t* varies from 0 to 1.

Primitive types other than PM_BEZIER and PM_POLYLINESEGMENT may be added to this escape in the future. Applications should check the return value from this escape to determine whether the driver supports the specified poly mode.

SET_SCREEN_ANGLE

short Escape(*hdc,* **SET_SCREEN_ANGLE, sizeof(int),** *lpAngle,* **NULL)**

The **SET_SCREEN_ANGLE** printer escape sets the current screen angle to the desired angle and enables an application to simulate the tilting of a photographic mask in producing a color separation for a particular primary.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpAngle	**LPINT** Points to a short integer specifying the desired screen angle in tenths of a degree. The angle is measured counterclockwise.

Returns

The return value is the previous screen angle.

Comments

Four-color process separation is the process of separating the colors comprising an image into four component primaries: cyan, magenta, yellow, and black. The image is then reproduced by overprinting each primary.

In traditional four-color process printing, half-tone images for each of the four primaries are photographed against a mask tilted to a particular angle. Tilting the mask in this manner minimizes unwanted moiré patterns caused by overprinting two or more colors.

The device driver defines the default screen angle.

SET_SPREAD

short Escape(*hdc,* **SET_SPREAD, sizeof(int),** *lpSpread,* **NULL)**

The **SET_SPREAD** printer escape sets the amount that nonwhite primitives are expanded for a given device to provide a slight overlap between primitives to compensate for imperfections in the reproduction process.

Spot color separation is the process of separating an image into each distinct color used in the image. The image is reproduced by overprinting each successive color in the image.

When reproducing a spot-separated image, the printing equipment must be calibrated to align each page exactly on each pass. However, differences in temperature, humidity, and so forth between passes often cause images to align imperfectly on subsequent passes. For this reason, lines in spot separations are often widened (spread) slightly to make up for problems in registering subsequent passes through the printer. This process is called trapping. The **SET_SPREAD** escape implements this process.

Parameter	Description
hdc	**HDC** Identifies the device context.
lpSpread	**LPINT** Points to a short integer that specifies the amount, in pixels, by which all nonwhite primitives are to be expanded.

Returns

The return value is the previous spread value.

Comments

The default spread is zero.

The current spread applies to all bordered primitives (whether or not the border is visible) and text.

STARTDOC

short Escape(*hdc,* **STARTDOC,** *nCount, lpDocName,* **NULL)**

The **STARTDOC** printer escape is maintained for backwards compatibility. Applications written for Windows 3.1 should use the **StartDoc** function.

This escape informs the device driver that a new print job is starting and that all subsequent **NEWFRAME** escape calls should be spooled under the same job until an **ENDDOC** escape call occurs. This ensures that documents longer than one page will not be interspersed with other jobs.

Parameter	Description
hdc	**HDC** Identifies the device context.
nCount	**short** Specifies the number of characters in the string pointed to by the *lpDocName* parameter.
lpDocName	**LPSTR** Points to a null-terminated string that specifies the name of the document. The document name is displayed in the Print Manager window. The maximum length of this string is 31 characters plus the terminating null character.

Returns

The return value specifies the outcome of the escape. It is -1 if an error such as insufficient memory or an invalid port specification occurs. Otherwise, it is positive.

Comments

Following is the correct sequence of events in a printing operation:

1 Create the device context.

2 Set the Abort function to keep out-of-disk-space errors from terminating a printing operation.

An Abort procedure that handles these errors must be set by using the **SETABORTPROC** escape.

3 Begin the printing operation with the **STARTDOC** escape.

4 Begin each new page with the **NEWFRAME** escape or each new band with the **NEXTBAND** escape.

5 End the printing operation with the **ENDDOC** escape.

6 Destroy the Cancel dialog box, if any.

7 Free the procedure-instance address of the Abort function.

If an application encounters a printing error or a canceled print operation, it must not attempt to terminate the operation by using the **Escape** function with either the **ENDDOC** or **ABORTDOC** escape. Graphics device interface (GDI) automatically terminates the operation before returning the error value.

The **STARTDOC** escape should not be used inside metafiles.

STRETCHBLT

The **STRETCHBLT** printer escape is provided for backwards compatibility. Applications should use the **StretchBlt** function instead of this escape.

See Also
StretchBlt

TRANSFORM_CTM

short Escape(*hdc,* **TRANSFORM_CTM, 36,** *lpMatrix,* **NULL)**

The **TRANSFORM_CTM** printer escape modifies the current transformation matrix. The current transformation matrix controls the manner in which coordinates are translated, rotated, and scaled by the device. By using matrices, you can combine these operations in any order to produce the desired mapping for a particular picture.

The new current transformation matrix will contain the product of the matrix referenced by the *lpMatrix* parameter and the previous current transformation matrix (CTM = M * CTM).

Parameter	Description
hdc	**HDC** Identifies the device context.
lpMatrix	**LPSTR** Points to a 3-by-3 array of 32-bit integer values specifying the new transformation matrix. Entries in the matrix are scaled to represent fixed-point real numbers. Each matrix entry is scaled by 65,536. The high-order word of the entry contains the whole integer portion, and the low-order word contains the fractional portion.

Returns

The return value is nonzero if the escape was successful and zero if it was unsuccessful.

Comments

This escape is used only by PostScript printer drivers.

When an application modifies the current transformation matrix, it must specify the clipping rectangle by issuing the **SET_CLIP_BOX** escape.

Applications should not make any assumptions about the initial value of the current transformation matrix.

Printer Escapes

ABORTDOC	Superseded: use AbortDoc function
BANDINFO	Obsolete in Windows 3.1
BEGIN_PATH	Opens a path
CLIP_TO_PATH	Defines clip region bounded by path
DEVICEDATA	Same as PASSTHROUGH escape
DRAFTMODE	Superseded: Use **DEVMODE** structure
DRAWPATTERNRECT	Creates pattern on PCL printers
ENABLEDUPLEX	Superseded: use **DEVMODE** structure
ENABLEPAIRKERNING	Enables or disables kerning
ENABLERELATIVEWIDTHS	Enables or disables relative char widths
ENDDOC	Superseded: Use EndDoc function
END_PATH	Ends a path
ENUMPAPERBINS	Superseded: Use DeviceCapabilities function
ENUMPAPERMETRICS	Superseded: Use DeviceCapabilities function
EPSPRINTING	Allows EPS printing only
EXT_DEVICE_CAPS	Superseded: Use GetDeviceCaps function
EXTTEXTOUT	Superseded: Use ExtTextOut function
FLUSHOUTPUT	Obsolete in Windows 3.1
GETCOLORTABLE	Obsolete in Windows 3.1
GETEXTENDEDTEXTMETRICS	Gets extended text metrics
GETEXTENTTABLE	Superseded: Use GetCharWidth function
GETFACENAME	Gets face name of current font
GETPAIRKERNTABLE	Gets kerning-pair structures
GETPHYSPAGESIZE	Gets size of physical page
GETPRINTINGOFFSET	Gets offset where printing starts
GETSCALINGFACTOR	Gets scaling factors for printer
GETSETPAPERBINS	Superseded: Use DeviceCapabilities function
GETSETPAPERMETRICS	Superseded: Use ExtDeviceMode function
GETSETPRINTORIENT	Superseded: Use ExtDeviceMode function
GETSETSCREENPARAMS	Gets or sets halftoning parameters
GETTECHNOLOGY	Gets technology type
GETTRACKKERNTABLE	Gets track-kerning table
GETVECTORBRUSHSIZE	Gets size of plotter brush
GETVECTORPENSIZE	Gets size of plotter pen
MFCOMMENT	Adds comment to metafile
MOUSETRAILS	Enables or disables mouse trails
NEWFRAME	Superseded: Use StartPage and EndPage functions
NEXTBAND	Finished band, get next band
PASSTHROUGH	Sends data directly to printer
POSTSCRIPT_DATA	Same as PASSTHROUGH escape
POSTSCRIPT_IGNORE	Flag for suppressing output
QUERYESCSUPPORT	Queries whether escape is supported
RESTORE_CTM	Restores current transformation matrix
SAVE_CTM	Saves current transformation matrix
SELECTPAPERSOURCE	Superseded: Use DeviceCapabilities function
SETABORTPROC	Superseded: Use SetAbortProc function
SETALLJUSTVALUES	Superseded: Use ExtTextOut function
SET_ARC_DIRECTION	Sets arc-drawing direction
SET_BACKGROUND_COLOR	Sets and gets background color
SET_BOUNDS	Sets bounding rectangle
SET_CLIP_BOX	Sets or restores clipping rectangle
SETCOLORTABLE	Sets **RGB** color-table entry
SETCOPYCOUNT	Superseded: Use ExtDeviceMode function
SETKERNTRACK	Sets kerning track

SETLINECAP	Sets line-end style
SETLINEJOIN	Sets line-intersection style
SETMITERLIMIT	Sets line-intersection bevel angle
SET_POLY_MODE	Sets mode for Polygon and Polyline functions
SET_SCREEN_ANGLE	Sets current screen angle
SET_SPREAD	Sets trapping for spot separations
STARTDOC	Superseded: Use StartDoc function
STRETCHBLT	Superseded: Use StretchBlt function
TRANSFORM_CTM	Modifies current transformation matrix

ACCELERATORS (2.x)

acctablename **ACCELERATORS**

BEGIN
    event, idvalue, [*type*] [*options*]
    .
    .
    .
END

The **ACCELERATORS** statement defines one or more accelerators for an application. An accelerator is a keystroke defined by the application to give the user a quick way to perform a task. The **TranslateAccelerator** function is used to translate accelerator messages from the application queue into **WM_COMMAND** or **WM_SYSCOMMAND** messages.

Parameter	Description
acctablename	Specifies either a unique name or an integer value that identifies the resource.
event	Specifies the keystroke to be used as an accelerator. It can be any one of the following character types:

Type	Description
"char"	A single ASCII character enclosed in double quotation marks. The character can be preceded by a caret (^), meaning that the character is a control character.
ASCII character	An integer value representing an ASCII character. The *type* parameter must be **ASCII**.
Virtual-key character	An integer value representing a virtual key. The virtual key for alphanumeric keys can be specified by placing the uppercase letter or number in double quotation marks (for example, "9" or "C"). The *type* parameter must be **VIRTKEY**.

idvalue	Specifies an integer value that identifies the accelerator.
type	Required only when the *event* parameter is an ASCII character or a virtual-key character. The *type* parameter specifies either **ASCII** or **VIRTKEY**; the integer value of *event* is interpreted accordingly. When **VIRTKEY** is specified and *event* contains a string, *event* must be uppercase.
options	Specifies the options that define the accelerator. This parameter can be one or more of the following values:

Option	Description
NOINVERT	Specifies that no top-level menu item is highlighted when the accelerator is used. This is useful when defining accelerators for actions such as scrolling that do not correspond to a menu item. If **NOINVERT** is omitted, a top-level menu item will be highlighted (if possible) when the accelerator is used.
ALT	Causes the accelerator to be activated only if the ALT key is down.
SHIFT	Causes the accelerator to be activated only if the SHIFT key is down.
CONTROL	Defines the character as a control character (the accelerator is only activated if the **CONTROL** key is down). This has the same effect as using a caret (^) before the accelerator character in the *event* parameter.

The **ALT**, **SHIFT**, and **CONTROL** options apply only to virtual keys.

Example

The following example demonstrates the usage of accelerator keys:

```
1 ACCELERATORS
BEGIN
  "^C",  IDDCLEAR         ; control C
  "K",   IDDCLEAR         ; shift K
  "k",   IDDELLIPSE, ALT  ; alt k
  98,    IDDRECT, ASCII   ; b
  66,    IDDSTAR, ASCII   ; B (shift b)
  "g",   IDDRECT          ; g
  "G",   IDDSTAR          ; G (shift G)
  VK_F1, IDDCLEAR, VIRTKEY                ; F1
  VK_F1, IDDSTAR, CONTROL, VIRTKEY        ; control F1
  VK_F1, IDDELLIPSE, SHIFT, VIRTKEY       ; shift F1
  VK_F1, IDDRECT, ALT, VIRTKEY            ; alt F1
  VK_F2, IDDCLEAR, ALT, SHIFT, VIRTKEY    ; alt shift F2
  VK_F2, IDDSTAR, CONTROL, SHIFT, VIRTKEY ; ctrl shift F2
  VK_F2, IDDRECT, ALT, CONTROL, VIRTKEY   ; alt control F2
END
```

See Also
TranslateAccelerator

BITMAP (3.0)

nameID **BITMAP** [*load-option*] [*mem-option*] *filename*

The **BITMAP** resource-definition statement specifies a custom bitmap that an application uses in its screen display or as an item in a menu.

Parameter	Description
nameID	Specifies either a unique name or an integer value identifying the resource.
load-option	Specifies when the resource is to be loaded. The parameter must be one of the following:

Option	Description
PRELOAD	Resource is loaded immediately.
LOADONCALL	Resource is loaded when called. This is the default option.

mem-option Specifies whether the resource is fixed or movable and whether it is discardable. The parameter must be one of the following:

Option	Description
FIXED	Resource remains at a fixed memory location.
MOVEABLE	Resource can be moved if necessary in order to compact memory.
DISCARDABLE	Resource can be discarded if no longer needed.

The default for bitmap resources is **MOVEABLE**.

filename Specifies the name of the file that contains the resource. The name must be a valid MS-DOS filename; it must be a full path if the file is not in the current working directory. The path can either be a quoted or non-quoted string.

Example

The following example specifies two bitmap resources:

```
disk1   BITMAP disk.bmp
12      BITMAP PRELOAD diskette.bmp
```

See Also

LoadBitmap

CAPTION (2.x)

CAPTION *captiontext*

The **CAPTION** statement defines the title for the dialog box. The title appears in the box's caption bar (if it has one).

The default caption is empty.

Parameter	Description
captiontext	Specifies an ASCII character string enclosed in double quotation marks.

Example

The following example demonstrates the usage of the **CAPTION** statement:

```
CAPTION "Error!"
```

CHECKBOX (2.x)

CHECKBOX *text, id, x, y, width, height,* [*style*]

The **CHECKBOX** statement creates a check box control. The control is a small rectangle (check box) that has the specified text displayed next to it (typically, to the right). When the user selects the control, the control highlights the rectangle and sends a message to its parent window. The **CHECKBOX** statement, which can only be used in a **DIALOG** statement, defines the text, identifier, dimensions, and attributes of the control.

Parameter	Description
text	Specifies text that is displayed to the right of the control. This parameter must contain zero or more characters enclosed in double quotation marks. Character values must be in the range 1 through 255. If a double quotation mark is required in the text, you must include the double quotation mark twice. An ampersand (&) character in the text indicates that the following character is used as a mnemonic character for the control. When the control is displayed, the ampersand is not shown, but the mnemonic character is underlined. The user can choose the control by pressing the key corresponding to the underlined mnemonic character. To use the ampersand as a character in a string, insert two ampersands (&&).
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or a simple expression that evaluates to a value in that range.
x	Specifies the x-coordinate of the left side of the control relative to the left side of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
y	Specifies the y-coordinate of the top side of the control relative to the top of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The width is in 1/4-character units.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The height is in 1/8-character units.
style	Specifies the control styles. This value can be a combination of the button class style **BS_CHECKBOX** and the **WS_TABSTOP** and **WS_GROUP** styles. You can use the bitwise OR (|) operator to combine styles. If you do not specify a style, the default style is **BS_CHECKBOX** and WS_TABSTOP.

Comments

The current dialog units are computed from the height and width of the current system font. The **GetDialogBaseUnits** function returns the dialog units in pixels.

Example

This example creates a check-box control that is labeled "Italic":

```
CHECKBOX "Italic", 3, 10, 10, 40, 10
```

See Also

GetDialogBaseUnits

CLASS (2.x)

CLASS *class*

The **CLASS** statement defines the class of the dialog box. If no statement is given, the Windows standard dialog class will be used as the default.

Parameter	Description
class	Specifies an integer or a string, enclosed in double quotation marks, that identifies the class of the dialog box. If the window procedure for the class does not process a message sent to it, it must call the **DefDlgProc** function to ensure that all messages are handled properly for the dialog box. A private class can use **DefDlgProc** as the default window procedure. The class must be registered with the **cbWndExtra** member of the **WNDCLASS** structure set to DLGWINDOWEXTRA.

Comments

The **CLASS** statement should only be used with special cases, since it overrides the normal processing of a dialog box. The **CLASS** statement converts a dialog box to a window of the specified class; depending on the class, this could give undesirable results. Do not use the predefined control-class names with this statement.

Example

The following example demonstrates the usage of the **CLASS** statement:

```
CLASS "myclass"
```

See Also

DefDlgProc, **WNDCLASS**

COMBOBOX (2.x)

COMBOBOX *id, x, y, width, height*[, *style*]

The **COMBOBOX** statement creates a combination box control (a combo box). A combo box consists of either a static text box or an edit box combined with a list box. The list box can be displayed at all times or pulled down by the user. If the combo box contains a static text box, the text box always displays the selection (if any) in the list box portion of the combo box. If it uses an edit box, the user can type in the desired selection; the list box highlights the first item (if any) that matches what the user has entered in the edit box. The user can then select the item highlighted in the list box to complete the choice. In addition, the combo box can be owner-drawn and of fixed or variable height.

Parameter	Description
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or a simple expression that evaluates to a value in that range.
x	Specifies the x-coordinate of the left side of the control relative to the left side of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
y	Specifies the y-coordinate of the top side of the control relative to the top of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The width is in 1/4-character units.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The height is in 1/8-character units. This value specifies the entire height of the control, regardless of whether the entire control is initially displayed.
style	Specifies the control styles. This value can be a combination of the COMBOBOX class styles (see the Combination-box styles topic) and any of the following styles: **WS_TABSTOP**, **WS_GROUP**, **WS_VSCROLL**, and WS_DISABLED. You can use the bitwise OR (|) operator to combine styles. If you do not specify a style, the default style is **CBS_SIMPLE** and WS_TABSTOP.

Comments

The current dialog units are computed from the height and width of the current system font. The **GetDialogBaseUnits** function returns the dialog units in pixels.

Example

This example creates a combo-box control with a vertical scroll bar:

```
COMBOBOX 777, 10, 10, 50, 54, CBS_SIMPLE | WS_VSCROLL | WS_TABSTOP
```

CONTROL (2.x)

CONTROL *text, id, class, style, x, y, width, height*

The **CONTROL** statement defines a control as belonging to the specified class. The statement defines the position and dimensions of the control within the parent window as well as the control style. The **CONTROL** statement is most often used in a **DIALOG** statement.

Parameter	Description
text	Specifies displayed text. Its position depends on the control class. This parameter must contain zero or more characters enclosed in double quotation marks. Character values must be in the range 1 through 255. If a double quotation mark is required in the text, you must include the double quotation mark twice. In the appropriate styles, an ampersand (&) character in the text indicates that the following character is used as a mnemonic character for the control. When the control is displayed, the ampersand is not shown, but the mnemonic character is underlined. The user can choose the control by pressing the key corresponding to the character.
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or a simple expression that evaluates to a value in that range.
class	Specifies the control class. This value can be a predefined name, character string, or integer value that defines the class. This value can be one of the classes specified in the topic **Control Classes**.
style	Specifies the control style. For a list of possible control styles, see the topic **Control Styles**. You can use the bitwise OR (|) operator to combine styles.
x	Specifies the x-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the parent window.
y	Specifies the y-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the parent window.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The value is in 1/4-character units.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The value is in 1/8-character units.

CTEXT (2.x)

CTEXT *text, id, x, y, width, height*[, *style*]

The **CTEXT** statement creates a centered-text control. The control is a simple rectangle displaying the given text centered in the rectangle. The text is formatted before it is displayed. Words that would extend past the end of a line are automatically wrapped to the beginning of the next line. The **CTEXT** statement, which you can use only in a **DIALOG** statement, defines the text, identifier, dimensions, and attributes of the control.

Parameter	Description
text	Specifies text that is centered in the rectangular area of the control. This parameter must contain zero or more characters enclosed in double quotation marks. Character values must be in the range 1 through 255. If a double quotation mark is required in the text, you must include the double quotation mark twice.
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or a simple expression that evaluates to a value in that range.
x	Specifies the x-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
y	Specifies the y-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The width is in 1/4-character units.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The height is in 1/8-character units.
style	Specifies the control styles. This value can be any combination of the following styles: **SS_CENTER**, **WS_TABSTOP**, and WS_GROUP. You can use the bitwise OR (|) operator to combine styles. If you do not specify a style, the default style is **SS_CENTER** and WS_GROUP.

Example

This example creates a centered-text control that is labeled "Filename":

```
CTEXT "Filename", 101, 10, 10, 100, 100
```

See Also

CONTROL, **DIALOG**, **LTEXT**, **RTEXT**

CURSOR (3.0)

nameID **CURSOR** [*load-option*] [*mem-option*] *filename*

The **CURSOR** statement specifies a bitmap that defines the shape of the cursor on the display screen.

Parameter	Description
nameID	Specifies either a unique name or an integer identifying the resource.
load-option	Specifies when the resource is to be loaded. The parameter must be one of the following:

Option	Description
PRELOAD	Resource is loaded immediately.
LOADONCALL	Resource is loaded when called. This is the default option.

mem-option Specifies whether the resource is fixed or movable and whether it is discardable. The parameter must be one of the following:

Option	Description
FIXED	Resource remains at a fixed memory location.
MOVEABLE	Resource can be moved if necessary in order to compact memory.
DISCARDABLE	Resource can be discarded if no longer needed.

The default is **MOVEABLE** and **DISCARDABLE** for cursor, icon, and font resources. The default for bitmap resources is **MOVEABLE**.

filename Specifies the name of the file that contains the resource. The name must be a valid MS-DOS filename; it must be a full path if the file is not in the current working directory. The path can either be a quoted or non-quoted string.

Comments

Icon and cursor resources can contain more than one image. If the resource is marked with the **PRELOAD** option, Windows loads all images in the resource when the application executes.

Example

The following example specifies two cursor resources; one by name (cursor1) and the other by number (2):

```
cursor1 CURSOR bullseye.cur
2       CURSOR "d:\\cursor\\arrow.cur"
```

#define (2.x)

#define *name value*

The **#define** directive assigns the given value to the specified name. All subsequent occurrences of the name are replaced by the value.

Parameter	Description
name	Specifies the name to be defined. This value is any combination of letters, digits, and punctuation.
value	Specifies any integer, character string, or line of text.

Example

This example assigns values to the names "NONZERO" and "USERCLASS":

```
#define     NONZERO     1
#define     USERCLASS   "MyControlClass"
```

See Also

#ifdef, **#ifndef**, **#undef**

DEFPUSHBUTTON (2.x)

DEFPUSHBUTTON *text, id, x, y, width, height*[, *style*]

The **DEFPUSHBUTTON** statement creates a default push-button control. The control is a small rectangle with a bold outline that represents the default response for the user. The given text is displayed inside the button. The control highlights the button in the usual way when the user clicks the mouse in it and sends a message to its parent window.

Parameter	Description
text	Specifies text that is centered in the rectangular area of the control. This parameter must contain zero or more characters enclosed in double quotation marks. Character values must be in the range 1 through 255. If a double quotation mark is required in the text, you must include the double quotation mark twice. An ampersand (&) character in the text indicates that the following character is used as a mnemonic character for the control. When the control is displayed, the ampersand is not shown but the mnemonic character is underlined. The user can choose the control by pressing the key corresponding to the underlined mnemonic character. To use the ampersand as a character in a string, insert two ampersands (&&).
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or a simple expression that evaluates to a value in that range.
x	Specifies the x-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
y	Specifies the y-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The width is in 1/4-character units.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The height is in 1/8-character units.
style	Specifies the control styles. This value can be a combination of the following styles: **BS_DEFPUSHBUTTON**, **WS_TABSTOP**, **WS_GROUP**, and WS_DISABLED. You can use the bitwise OR (|) operator to combine styles. If you do not specify a style, the default style is **BS_DEFPUSHBUTTON** and WS_TABSTOP.

Example

This example creates a default push-button control that is labeled "Cancel":

```
DEFPUSHBUTTON "Cancel", 101, 10, 10, 24, 50
```

See Also

PUSHBUTTON, **RADIOBUTTON**

DIALOG (2.x)

nameID **DIALOG** [*load-option*] [*mem-option*] *x, y, width, height*

BEGIN
    control-statements
    .
    .
    .
END

The **DIALOG** statement defines a window that an application can use to create dialog boxes. The statement defines the position and dimensions of the dialog box on the screen as well as the dialog box style.

Parameter	Description
nameID	Identifies the dialog box. This is either a unique name or a unique integer value in the range 1 to 65,535.
load-option	Specifies when the resource is to be loaded. This parameter is optional. If it is specified, it must be one of the following:

Option	Description
PRELOAD	Resource is loaded immediately.
LOADONCALL	Resource is loaded when called. This is the default option.

mem-option Specifies whether the resource is fixed or movable and whether it is discardable. This parameter is optional. If it is specified, it must be either **FIXED** or **MOVEABLE**. An additional value, **DISCARDABLE** may also be specified. The following list describes the options in more detail:

Option	Description
FIXED	Resource remains at a fixed memory location.
MOVEABLE	Resource can be moved if necessary in order to compact memory. This is the default option.
DISCARDABLE	Resource can be discarded if no longer needed.

x Specifies the x-coordinate of the left side of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units.

y Specifies the y-coordinate of the top side of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units.

width Specifies the width of the dialog box. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The width is in 1/4-character units.

height Specifies the height of the dialog box. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The height is in 1/8-character units.

style

Specifies the dialog box styles. This parameter can be one of the following values:

Style	Meaning
DS_LOCALEDIT	Specifies that edit controls in the dialog box will use memory in the application's data segment. By default, all edit controls in dialog boxes use memory outside the application's data segment. This feature may be suppressed by adding the **DS_LOCALEDIT** flag to the Style command for the dialog box.

	If this flag is not used, **EM_GETHANDLE** and **EM_SETHANDLE** messages must not be used, because the storage for the control is not in the application's data segment. This feature does not affect edit controls created outside of dialog boxes.
DS_MODALFRAME	Creates a dialog box with a modal dialog box frame that can be combined with a title bar and System menu by specifying the **WS_CAPTION** and **WS_SYSMENU** styles.
DS_NOIDLEMSG	Suppresses **WM_ENTERIDLE** messages that Windows would otherwise send to the owner of the dialog box while the dialog box is displayed.
DS_SYSMODAL	Creates a system-modal dialog box.

Comments

The **GetDialogBaseUnits** function returns the dialog base units in pixels. The exact meaning of the coordinates depends on the style defined by the **STYLE** option statement. For child-style dialog boxes, the coordinates are relative to the origin of the parent window, unless the dialog box has the style DS_ABSALIGN; in that case, the coordinates are relative to the origin of the display screen.

Do not use the **WS_CHILD** style with a modal dialog box. The **DialogBox** function always disables the parent/owner of the newly created dialog box. When a parent window is disabled, its child windows are implicitly disabled. Since the parent window of the child-style dialog box is disabled, the child-style dialog box is too.

If a dialog box has the DS_ABSALIGN style, the dialog coordinates for its upper-left corner are relative to the screen origin instead of to the upper-left corner of the parent window. You would typically use this style when you wanted the dialog box to start in a specific part of the display no matter where the parent window may be on the screen.

The name **DIALOG** can also be used as the class-name parameter to the **CreateWindow** function to create a window with dialog box attributes.

Example

The following demonstrates the usage of the **DIALOG** statement:

```
#include <windows.h>

ErrorDialog DIALOG  10, 10, 300, 110
STYLE WS_POPUP|WS_BORDER
CAPTION "Error!"
BEGIN
    CTEXT "Select One:", 1, 10, 10, 280, 12
    PUSHBUTTON "&Retry", 2, 75, 30, 60, 12
    PUSHBUTTON "&Abort", 3, 75, 50, 60, 12
    PUSHBUTTON "&Ignore", 4, 75, 80, 60, 12
END
```

See Also

CreateDialog, **CreateWindow**, **DialogBox**, **GetDialogBaseUnits**

EDITTEXT (2.x)

EDITTEXT *id, x, y, width, height*[, *style*]

The **EDITTEXT** statement defines an EDIT control belonging to the EDIT class. It creates a rectangular region in which the user can enter and edit text. The control displays a cursor when the user clicks the mouse in it. The user can then use the keyboard to enter text or edit the existing text. Editing keys include the BACKSPACE and DELETE keys. The user can also use the mouse to select characters to be deleted or to select the place to insert new characters.

Parameter	Description
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or a simple expression that evaluates to a value in that range.
x	Specifies the x-coordinate of the left side of the control relative to the left side of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
y	Specifies the y-coordinate of the top side of the control relative to the top of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The width is in 1/4-character units.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The height is in 1/8-character units.
style	Specifies the control styles. This value can be a combination of the edit class styles (see the **Edit-control styles** topic) and the following styles: **WS_TABSTOP**, **WS_GROUP**, **WS_VSCROLL**, **WS_HSCROLL**, and WS_DISABLED. You can use the bitwise OR (|) operator to combine styles. If you do not specify a style, the default style is **ES_LEFT**, **WS_BORDER**, and WS_TABSTOP.

Example

The following example demonstrates the usage of the **EDITTEXT** statement:

```
EDITTEXT  3, 10, 10, 100, 10
```

#elif (2.x)

#elif *constant-expression*

The **#elif** directive marks an optional clause of a conditional-compilation block defined by a **#ifdef**, **#ifndef**, or **#if** directive. The directive controls conditional compilation of the resource file by checking the specified constant expression. If the constant expression is nonzero, **#elif** directs the compiler to continue processing statements up to the next **#endif**, **#else**, or **#elif** directive and then skip to the statement after **#endif**. If the constant expression is zero, **#elif** directs the compiler to skip to the next **#endif**, **#else**, or **#elif** directive. You can use any number of **#elif** directives in a conditional block.

Parameter	Description
constant-expression	Specifies the expression to be checked. This value is a defined name, an integer constant, or an expression consisting of names, integers, and arithmetic and relational operators.

Example

In this example, **#elif** directs the compiler to process the second **BITMAP** statement only if the value assigned to the name "Version" is less than 7. The **#elif** directive itself is processed only if Version is greater than or equal to 3.

```
#if Version < 3
BITMAP 1 errbox.bmp
#elif Version < 7
BITMAP 1 userbox.bmp
#endif
```

See Also

#else, **#endif**, **#if**, **#ifdef**, **#ifndef**

#else (2.x)

#else

The **#else** directive marks an optional clause of a conditional-compilation block defined by a **#ifdef**, **#ifndef**, or **#if** directive. The **#else** directive must be the last directive before the **#endif** directive.

This directive has no arguments.

Example
This example compiles the second **BITMAP** statement only if the name "DEBUG" is not defined:

```
#ifdef DEBUG
    BITMAP 1 errbox.bmp
#else
    BITMAP 1 userbox.bmp
#endif
```

See Also
#elif, **#endif**, **#if**, **#ifdef**, **#ifndef**

#endif (2.x)

#endif

The **#endif** directive marks the end of a conditional-compilation block defined by a **#ifdef** directive. One **#endif** is required for each **#if**, **#ifdef**, or **#ifndef** directive.

This directive has no arguments.

See Also
#elif, **#else**, **#if**, **#ifdef**, **#ifndef**

FONT (2.x)

FONT *pointsize, typeface*

The **FONT** statement defines the font with which Windows will draw text in the dialog box. The font must have been previously loaded, either from the WIN.INI file or by calling the **LoadResource** function.

Parameter	Description
pointsize	Specifies the size, in points, of the font.
typeface	Specifies the name of the typeface. This name must be identical to the name defined in the [fonts] section of WIN.INI. This parameter must be enclosed in double quotes.

Example

The following example demonstrates the usage of the **FONT** statement:

```
FONT 12, "MS Sans Serif"
```

See Also

DIALOG, **LoadResource**

FONT (3.0)

nameID **FONT** [*load-option*] [*mem-option*] *filename*

The **FONT** resource-definition statement specifies a file that contains a font.

For a font resource, *nameID* must be a number; it cannot be a name.

Parameter	Description
nameID	Specifies either a unique name or an integer value identifying the resource.
load-option	Specifies when the resource is to be loaded. The parameter must be one of the following options:

Option	Description
PRELOAD	Resource is loaded immediately.
LOADONCALL	Resource is loaded when called. This is the default option.

mem-option Specifies whether the resource is fixed or movable and whether it is discardable. The parameter must be one of the following options:

Option	Description
FIXED	Resource remains at a fixed memory location.
MOVEABLE	Resource can be moved if necessary in order to compact memory.
DISCARDABLE	Resource can be discarded if no longer needed.

The default is **MOVEABLE** and **DISCARDABLE** for cursor, icon, and font resources. The default for bitmap resources is **MOVEABLE**.

filename Specifies the name of the file that contains the resource. The name must be a valid MS-DOS filename; it must be a full path if the file is not in the current working directory. The path can either be a quoted or non-quoted string.

Example

The following example specifies a single font resource:

```
5 FONT  CMROMAN.FNT
```

GROUPBOX (2.x)

GROUPBOX *text, id, x, y, width, height*[, *style*]

The **GROUPBOX** statement creates a group box control. The control is a rectangle that groups other controls together. The controls are grouped by drawing a border around them and displaying the given text in the upper-left corner. The **GROUPBOX** statement, which you can use only in a **DIALOG** statement, defines the text, identifier, dimensions, and attributes of a control window.

Parameter	Description
text	Specifies text that is displayed to the right of the control. This parameter must contain zero or more characters enclosed in double quotation marks. Character values must be in the range 1 through 255. If a double quotation mark is required in the text, you must include the double quotation mark twice. An ampersand (&) character in the text indicates that the following character is used as a mnemonic character for the control. When the control is displayed, the ampersand is not shown but the mnemonic character is underlined. The user can choose the control by pressing the key corresponding to the underlined mnemonic character. To use the ampersand as a character in a string, insert two ampersands (&&).
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or a simple expression that evaluates to a value in that range.
x	Specifies the x-coordinate of the left side of the control relative to the left side of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
y	Specifies the y-coordinate of the top side of the control relative to the top of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The width is in 1/4-character units.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The height is in 1/8-character units.
style	Specifies the control styles. This value can be a combination of the button class style **BS_GROUPBOX** and the **WS_TABSTOP** and **WS_DISABLED** styles. You can use the bitwise OR (|) operator to combine styles. If you do not specify a style, the default style is BS_GROUPBOX.

Example

This example creates a group-box control that is labeled "Options":

```
GROUPBOX "Options", 101, 10, 10, 100, 100
```

See Also

DIALOG

ICON (2.x)

ICON *text, id, x, y,* [*width, height, style*]

The **ICON** statement creates an icon control. This control is an icon displayed in a dialog box. The **ICON** statement, which you can use only in a **DIALOG** statement, defines the icon-resource identifier, icon-control identifier, position, and attributes of a control.

Parameter	Description
text	Specifies the name of an icon (not a filename) defined elsewhere in the resource file.
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or a simple expression that evaluates to a value in that range.
x	Specifies the x-coordinate of the left side of the control relative to the left side of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
y	Specifies the y-coordinate of the top side of the control relative to the top of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
width	This value is ignored and should be set to zero.
height	This value is ignored and should be set to zero.
style	Specifies the control style. This parameter is optional. The only value that can be specified is the **SS_ICON** style. This is the default style whether this parameter is specified or not.

Example

This example creates an icon control whose icon identifier is 901 and whose name is "myicon":

```
ICON "myicon" 901, 30, 30
```

See Also

DIALOG

ICON (3.0)

nameID **ICON** [*load-option*] [*mem-option*] *filename*

The **ICON** resource-definition statement specifies a bitmap that defines the shape of the icon to be used for a given application.

Parameter	Description
nameID	Specifies either a unique name or an integer value identifying the resource.
load-option	Specifies when the resource is to be loaded. The parameter must be one of the following options:

Option	Description
PRELOAD	Resource is loaded immediately.
LOADONCALL	Resource is loaded when called. This is the default option.

mem-option Specifies whether the resource is fixed or movable and whether it is discardable. The parameter must be one of the following options:

Option	Description
FIXED	Resource remains at a fixed memory location.
MOVEABLE	Resource can be moved if necessary in order to compact memory.
DISCARDABLE	Resource can be discarded if no longer needed.

The default is **MOVEABLE** and **DISCARDABLE** for cursor, icon, and font resources. The default for bitmap resources is **MOVEABLE**.

filename Specifies the name of the file that contains the resource. The name must be a valid MS-DOS filename; it must be a full path if the file is not in the current working directory. The path can either be a quoted or non-quoted string.

Comments

Icon and cursor resources can contain more than one image. If the resource is marked as **PRELOAD**, Windows loads all images in the resource when the application executes.

Example

The following example specifies two icon resources:

```
desk1   ICON desk.ico
11      ICON DISCARDABLE custom.ico
```

#if (2.x)

#if *constant-expression*

The **#if** directive controls conditional compilation of the resource file by checking the specified constant expression. If the constant expression is nonzero, **#if** directs the compiler to continue processing statements up to the next **#endif**, **#else**, or **#elif** directive and then skip to the statement after the **#endif** directive. If the constant expression is zero, **#if** directs the compiler to skip to the next **#endif**, **#else**, or **#elif** directive.

Parameter	Description
constant-expression	Specifies the expression to be checked. This value is a defined name, an integer constant, or an expression consisting of names, integers, and arithmetic and relational operators.

Example

This example compiles the **BITMAP** statement only if the value assigned to the name "Version" is less than 3:

```
#if Version < 3
BITMAP 1 errbox.bmp
#endif
```

See Also

#elif, **#else**, **#endif**, **#ifdef**, **#ifndef**

#ifdef (2.x)

#ifdef *name*

The **#ifdef** directive controls conditional compilation of the resource file by checking the specified name. If the name has been defined by using a **#define** directive or by using the **-d** command-line option with the Resource Compiler, **#ifdef** directs the compiler to continue with the statement immediately after the **#ifdef** directive. If the name has not been defined, **#ifdef** directs the compiler to skip all statements up to the next **#endif** directive.

Parameter	Description
name	Specifies the name to be checked by the directive.

Example

This example compiles the **BITMAP** statement only if the name "Debug" is defined:

```
#ifdef Debug
BITMAP 1 errbox.bmp
#endif
```

See Also

#define, **#endif**, **#if**, **#ifndef**, **#undef**

#ifndef (2.x)

#ifndef *name*

The **#ifndef** directive controls conditional compilation of the resource file by checking the specified name. If the name has not been defined or if its definition has been removed by using the **#undef** directive, **#ifndef** directs the compiler to continue processing statements up to the next **#endif**, **#else**, or **#elif** directive and then skip to the statement after the **#endif** directive. If the name is defined, **#ifndef** directs the compiler to skip to the next **#endif**, **#else**, or **#elif** directive.

Parameter	Description
name	Specifies the name to be checked by the directive.

Example

This example compiles the **BITMAP** statement only if the name "Optimize" is not defined:

```
#ifndef Optimize
BITMAP 1 errbox.bmp
#endif
```

See Also

#elif, **#else**, **#endif**, **#if**, **#ifdef**, **#undef**

#include (2.x)

#include (*filename*)

The **#include** directive causes Resource Compiler to process the file specified in the *filename* parameter. This file should be a header file that defines the constants used in the resource-definition file.

Parameter	Description
filename	Specifies the name of the file to be included. This value must be an ASCII string. If the file is in the current directory, the string must be enclosed in double quotation marks; if the file is in the directory specified by the INCLUDE environment variable, the string must be enclosed in less-than and greater-than characters (<>). You must give a full path enclosed in double quotation marks if the file is not in the current directory or in the directory specified by the INCLUDE environment variable.

Example

This example processes the header files WINDOWS.H and HEADERS\MYDEFS.H while compiling the resource-definition file:

```
#include <windows.h>
#include "headers\mydefs.h"
```

See Also

#define

LISTBOX (2.x)

LISTBOX *id, x, y, width, height*[, *style*]

The **LISTBOX** statement creates commonly used controls for a dialog box or window. The control is a rectangle containing a list of strings (such as filenames) from which the user can select. The **LISTBOX** statement, which can only be used in a **DIALOG** or **WINDOW** statement, defines the identifier, dimensions, and attributes of a control window.

Parameter	Description
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or a simple expression that evaluates to a value in that range.
x	Specifies the x-coordinate of the left side of the control relative to the left side of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
y	Specifies the y-coordinate of the top side of the control relative to the top of the dialog box. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The width is in 1/4-character units.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The height is in 1/8-character units.
style	Specifies the control styles. This value can be a combination of the list-box class styles (see the **List-box styles** topic) and any of the following styles: **WS_BORDER** and WS_VSCROLL. You can use the bitwise OR (|) operator to combine styles. If you do not specify a style, the default style is **LBS_NOTIFY** and WS_BORDER.

Example

This example creates a list-box control whose identifier is 101:

```
LISTBOX 101, 10, 10, 100, 100
```

See Also

COMBOBOX, **DIALOG**

LTEXT (2.x)

LTEXT *text, id, x, y, width, height,* [*style*]

The **LTEXT** statement creates a left-aligned text control. The control is a simple rectangle displaying the given text left-aligned in the rectangle. The text is formatted before it is displayed. Words that would extend past the end of a line are automatically wrapped to the beginning of the next line. The **LTEXT** statement, which can be used only in a **DIALOG** statement, defines the text, identifier, dimensions, and attributes of the control.

Parameter	Description
text	Specifies text that is left-aligned in the rectangular area of the control. This parameter must contain zero or more characters enclosed in double quotation marks. Character values must be in the range 1 through 255. If a double quotation mark is required in the text, you must include the double quotation mark twice.
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or a simple expression that evaluates to a value in that range.
x	Specifies the x-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
y	Specifies the y-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box, window, or control containing the specified control.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The width is in 1/4-character units.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) or subtraction (–) operator. The height is in 1/8-character units.
style	Specifies the control styles. This value can be any combination of the **BS_RADIOBUTTON** style and the following styles: **SS_LEFT**, **WS_TABSTOP**, and WS_GROUP. You can use the bitwise OR (|) operator to combine styles. If you do not specify a style, the default style is **SS_LEFT** and WS_GROUP.

Example

This example creates a left-aligned text control that is labeled "Filename":

```
LTEXT "Filename", 101, 10, 10, 100, 100
```

See Also

CONTROL, **DIALOG**, **CTEXT**, **RTEXT**

MENU (2.x)

MENU *menuname*

The **MENU** statement defines the dialog box's menu. If no statement is given, the dialog box has no menu.

Parameter	Description
menuname	Specifies the menu to use. This value is either the name of the menu or the integer identifier of the menu.

Example

The following example demonstrates the usage of the **MENU** dialog statement:

```
MENU errmenu
```

See Also

MENU statement

MENU (2.x)

menuID **MENU** [*load-option*] [*mem-option*]

BEGIN
    item-definitions
    .
    .
    .
END

The **MENU** statement defines the contents of a menu resource. A menu resource is a collection of information that defines the appearance and function of an application menu. A menu is a special input tool that lets a user select commands from a list of command names.

Parameter	Description
menuID	Identifies the menu. This value is either a unique string or a unique integer value in the range of 1 to 65,535.
load-option	Specifies when the resource is to be loaded. This parameter is optional. If it is specified, it must be one of the following:

Option	Description
PRELOAD	Resource is loaded immediately.
LOADONCALL	Resource is loaded when called. This is the default option.

mem-option Specifies whether the resource is fixed or movable and whether it is discardable. This parameter is optional. If it is specified, it must be either **FIXED** or **MOVEABLE**. An additional value, **DISCARDABLE**, may also be specified. A description of the memory options follows:

Option	Description
FIXED	Resource remains at a fixed memory location.
MOVEABLE	Resource can be moved if necessary in order to compact memory. This is the default option.
DISCARDABLE	Resource can be discarded if no longer needed.

The default is **MOVEABLE** and **DISCARDABLE**.

Example

Following is an example of a complete **MENU** statement:

```
sample MENU
BEGIN
     MENUITEM "&Soup", 100
     MENUITEM "S&alad", 101
     POPUP "&Entree"
     BEGIN
          MENUITEM "&Fish", 200
          MENUITEM "&Chicken", 201, CHECKED
          POPUP "&Beef"
          BEGIN
               MENUITEM "&Steak", 301
               MENUITEM "&Prime Rib", 302
          END
     END
     MENUITEM "&Dessert", 103
END
```

See Also

MENUITEM, **POPUP**, MENU dialog statement

MENUITEM (2.x)

MENUITEM *text, result,* [*optionlist*]

The **MENUITEM** statement, which is optional, defines a menu item.

Parameter	Description
text	Specifies the name of the menu item. This parameter takes an ASCII string, enclosed in double quotation marks. The string can contain the escape characters **\t** and **\a.** The **\t** character inserts a tab in the string and is used to align text in columns. Tab characters should be used only in pop-up menus, not in menu bars. (For information on pop-up menus, see the **POPUP** statement.) The **\a** character aligns all text that follows it flush right to the menu bar or pop-up menu. To insert a double quotation mark in the string, use two double quotation marks. To add a mnemonic to the text string, place the ampersand (&) ahead of the letter that will be the mnemonic. This will cause the letter to appear underlined in the control and to function as the mnemonic. To use the ampersand as a character in a string, insert two ampersands (&&).
result	Specifies the result generated when the user selects the menu item. This parameter takes an integer value. Menu-item results are always integers; when the user clicks the menu-item name, the result is sent to the window that owns the menu.
optionlist	Specifies the appearance of the menu item. This optional parameter takes one or more predefined menu options, separated by commas or spaces. The menu options are as follows:

Option	Description
CHECKED	Item has a check mark next to it.
GRAYED	Item name is initially inactive and appears on the menu in gray or a lightened shade of the menu-text color.
HELP	Identifies a help item.
INACTIVE	Item name is displayed but it cannot be selected.
MENUBARBREAK	Same as **MF_MENUBREAK** except that for pop-up menus, it separates the new column from the old column with a vertical line.
MENUBREAK	Places the menu item on a new line for static menu-bar items. For pop-up menus, it places the menu item in a new column with no dividing line between the columns.

The **INACTIVE** and **GRAYED** options cannot be used together.

Example

The following example demonstrates the usage of the **MENUITEM** statement:

```
MENUITEM  "&Alpha", 1, CHECKED, GRAYED
MENUITEM  "&Beta", 2
```

See Also

MENU, **POPUP**

POPUP (2.x)

POPUP *text,* [*optionlist*]

BEGIN
    item-definitions
    .
    .
    .
END

The **POPUP** statement marks the beginning of the definition of a pop-up menu. A pop-up menu (which is also known as a drop-down menu) is a special menu item that displays a sublist of menu items when it is selected.

Parameter	Description
text	Specifies the name of the pop-up menu. This string must be enclosed in double quotation marks.
optionlist	Specifies one or more predefined menu options that specify the appearance of the menu item. The menu options follow:

Option	Description
CHECKED	Item has a check mark next to it. This option is not valid for a top-level pop-up menu.
GRAYED	Item name is initially inactive and appears on the menu in gray or a lightened shade of the menu-text color.
INACTIVE	Item name is displayed but it cannot be selected.
MENUBARBREAK	Same as **MF_MENUBREAK** except that for pop-up menus, it separates the new column from the old column with a vertical line.
MENUBREAK	Places the menu item on a new line for static menu-bar items. For pop-up menus, it places the menu item in a new column with no dividing line between the columns.

The options can be combined using the bitwise OR operator. The **INACTIVE** and **GRAYED** options cannot be used together.

Example
The following example demonstrates the usage of the **POPUP** statement:

```
chem MENU
BEGIN

    POPUP "&Elements"
    BEGIN
         MENUITEM "&Oxygen", 200
         MENUITEM "&Carbon", 201, CHECKED
         MENUITEM "&Hydrogen", 202
         MENUITEM "&Sulfur", 203
         MENUITEM "Ch&lorine", 204
    END

    POPUP "&Compounds"
    BEGIN
         POPUP "&Sugars"
         BEGIN
            MENUITEM "&Glucose", 301
```

```
            MENUITEM "&Sucrose", 302, CHECKED
            MENUITEM "&Lactose", 303, MENUBREAK
            MENUITEM "&Fructose", 304
         END

         POPUP "&Acids"
         BEGIN
              "&Hydrochloric", 401
              "&Sulfuric", 402
         END

    END

END
```

See Also
MENU, **MENUITEM**

PUSHBUTTON (2.x)

PUSHBUTTON *text, id, x, y, width, height,* [*style*]

The **PUSHBUTTON** statement creates a push-button control. The control is a round-cornered rectangle containing the given text. The control sends a message to its parent whenever the user chooses the control.

Parameter	Description
text	Specifies text that is centered in the rectangular area of the control. This parameter must contain zero or more characters enclosed in double quotation marks. Character values must be in the range 1 through 255. If a double quotation mark is required in the text, you must include the double quotation mark twice. An ampersand (&) character in the text indicates that the following character is used as a mnemonic character for the control. When the control is displayed, the ampersand is not shown but the mnemonic character is underlined. The user can choose the control by pressing the key corresponding to the underlined mnemonic character.
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the additon (+) operator that evaluates to a value in that range.
x	Specifies the x-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box containing the pushbutton.
y	Specifies the y-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box containing the pushbutton.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The width units are 1/4 of the dialog base width unit.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The height units are 1/8 of the dialog base height unit.
style	This optional parameter specifies styles for the pushbutton, which can be a combination of the **BS_PUSHBUTTON** style and the following styles: **WS_TABSTOP**, **WS_DISABLED**, and WS_GROUP.

Comments

The current dialog base units are computed from the height and width of the current system font. The **GetDialogBaseUnits** function returns the dialog base units in pixels. The coordinates are relative to the origin of the dialog box.

The default style for **PUSHBUTTON** is **BS_PUSHBUTTON** and WS_TABSTOP.

Example

The following example demonstrates the usage of the **PUSHBUTTON** statement:

```
PUSHBUTTON "ON", 7, 10, 10, 20, 10
```

See Also

GetDialogBaseUnits

RADIOBUTTON (2.x)

RADIOBUTTON *text, id, x, y, width, height,* [*style*]

The **RADIOBUTTON** statement creates a radio-button control. The control is a small circle that has the given text displayed next to it, typically to its right. The control highlights the circle and sends a message to its parent window when the user selects the button. The control removes the highlight and sends a message when the button is next selected.

Parameter	Description
text	Specifies text that is centered in the rectangular area of the control. This parameter must contain zero or more characters enclosed in double quotation marks. Character values must be in the range 1 through 255. If a double quotation mark is required in the text, you must include the double quotation mark twice. An ampersand (&) character in the text indicates that the following character is used as a mnemonic character for the control. When the control is displayed, the ampersand is not shown, but the mnemonic character is underlined. The user can choose the control by pressing the key corresponding to the underlined mnemonic character.
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the additon (+) operator that evaluates to a value in that range.
x	Specifies the x-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box containing the radio button.
y	Specifies the y-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box containing the radio button.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The width is in dialog units.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The height is in dialog units.
style	This optional parameter specifies styles for the radio button, which can be a combination of BUTTON-class styles (see **Button styles**) and the following styles: **WS_TABSTOP**, **WS_DISABLED**, and WS_GROUP.

Comments

Horizontal dialog units are 1/4 of the dialog base width unit. Vertical units are 1/8 of the dialog base height unit. The current dialog base units are computed from the height and width of the current system font. The **GetDialogBaseUnits** function returns the dialog base units in pixels. The coordinates are relative to the origin of the dialog box.

The default style for **RADIOBUTTON** is **BS_RADIOBUTTON** and WS_TABSTOP.

The following example demonstrates the usage of the **RADIOBUTTON** statement:

```
RADIOBUTTON "Italic", 100, 10, 10, 40, 10
```

See Also

GetDialogBaseUnits

RCDATA (2.x)

nameID **RCDATA** [*load-option*] [*mem-option*]

BEGIN
    raw-data
    .
    .
    .
END

The **RCDATA** statement defines a raw data resource for an application. Raw data resources permit the inclusion of binary data directly in the executable file.

Parameter	Description
nameID	Specifies either a unique name or an integer value that identifies the resource.
load-option	Specifies when the resource is to be loaded. It takes one of the following keywords:

Option	Description
PRELOAD	Resource is loaded immediately.
LOADONCALL	Resource is loaded when called. This is the default option.

mem-option Specifies whether the resource is fixed or movable and whether it is discardable. This optional parameter takes one or more of the following keywords:

Option	Description
FIXED	Resource remains at a fixed memory location.
MOVEABLE	Resource can be moved if necessary in order to compact memory.
DISCARDABLE	Resource can be discarded if no longer needed.

The default memory option is **MOVEABLE** and **DISCARDABLE**.

raw-data Specifies one or more integers and strings. Integers can be in decimal, octal, or hexadecimal format.

Example

The following example demonstrates the usage of the **RCDATA** statement:

```
resname RCDATA
BEGIN
   "Here is a data string\0", /* A string. Note: explicitly
                                 null-terminated */
   1024,                   /* int        */
   0x029a,                 /* hex int    */
   0o733,                  /* octal int  */
   "\07"                   /* octal byte */
END
```

RTEXT (2.x)

RTEXT *text, id, x, y, width, height,* [*style*]

The **RTEXT** statement creates a right-aligned text control. The control is a simple rectangle displaying the given text right-aligned in the rectangle. The text is formatted before it is displayed. Words that would extend past the end of a line are automatically wrapped to the beginning of the next line.

Parameter	Description
text	Specifies text that is aligned on the right side of the rectangular area of the control. This parameter must contain zero or more characters enclosed in double quotation marks. Character values must be in the range 1 through 255. If a double quotation mark is required in the text, you must include the double quotation mark twice. An ampersand (&) character in the text indicates that the following character is used as a mnemonic character for the control. When the control is displayed, the ampersand is not shown but the mnemonic character is underlined. The user can choose the control by pressing the key corresponding to the underlined mnemonic character.
id	Specifies the control identifier. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the additon (+) operator that evaluates to a value in that range.
x	Specifies the x-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box containing the text control.
y	Specifies the y-coordinate of the upper-left corner of the control. This value must be an integer in the range 0 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The coordinate is assumed to be in dialog units and is relative to the origin of the dialog box containing the text control.
width	Specifies the width of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The width is in dialog units.
height	Specifies the height of the control. This value must be an integer in the range 1 through 65,535 or an expression consisting of integers and the addition (+) operator that evaluates to a value in that range. The height is in dialog units.
style	This optional parameter specifies styles for the text control, which can be any combination of the following: **WS_TABSTOP** and WS_GROUP.

Comments

Horizontal dialog units are 1/4 of the dialog base width unit. Vertical units are 1/8 of the dialog base height unit. The current dialog base units are computed from the height and width of the current system font. The **GetDialogBaseUnits** function returns the dialog base units in pixels. The coordinates are relative to the origin of the dialog box.

The default style for **RTEXT** is **SS_RIGHT** and WS_GROUP.

Example

The following example demonstrates the usage of the **RTEXT** statement:

```
RTEXT "Number of Messages", 4, 30, 50, 100, 10
```

See Also

CONTROL, **CTEXT**, **DIALOG**, **LTEXT**

SCROLLBAR (2.x)

SCROLLBAR *id, x, y, width, height,* [*style*]

The **SCROLLBAR** statement creates a scroll-bar control. The control is a rectangle that contains a scroll box and has direction arrows at both ends. The scroll-bar control sends a notification message to its parent whenever the user clicks the mouse in the control. The parent is responsible for updating the scroll-box position. Scroll-bar controls can be positioned anywhere in a window and used whenever needed to provide scrolling input.

Parameter	Description
id	Identifies the control. This parameter takes a unique integer value.
x	Specifies the x-coordinate of the upper-left corner of the control in dialog units relative to the origin of the dialog box. The horizontal units are 1/4 of the dialog base width unit.
y	Specifies the y-coordinate of the upper-left corner of the control in dialog units relative to the origin of the dialog box. The vertical units are 1/8 of the dialog base height unit.
width	Specifies the width of the control. The width units are 1/4 of the dialog base width unit.
height	Specifies the height of the control. The height units are 1/8 of the dialog base height unit.
style	Specifies a combination (or none) of the following styles: **WS_TABSTOP**, **WS_GROUP**, and WS_DISABLED. In addition to these styles, the *style* parameter may contain a combination (or none) of the SCROLLBAR-class styles. Styles can be combined by using the bitwise OR operator.

Comments

The *x, y, width,* and *height* parameters can use the addition operator (**+**) for relative positioning. For example, "15 + 6" can be used for the *x* parameter.

The default style for **SCROLLBAR** is SBS_HORZ.

The current dialog base units are computed from the height and width of the current system font. The **GetDialogBaseUnits** function returns the dialog base units in pixels.

Example

The following example demonstrates the usage of the **SCROLLBAR** statement:

```
SCROLLBAR 999, 25, 30, 10, 100
```

SEPARATOR (2.x)

MENUITEM SEPARATOR

The **MENUITEM SEPARATOR** form of the **MENUITEM** statement creates an inactive menu item that serves as a dividing bar between two active menu items in a pop-up menu.

Example

The following example demonstrates the usage of the **MENUITEM SEPARATOR** statement:

```
MENUITEM "&Roman", 206
MENUITEM SEPARATOR
MENUITEM "&20 Point", 301
```

STRINGTABLE (2.x)

STRINGTABLE [*load-option*] [*mem-option*]

BEGIN
    stringID string
    .
    .
    .
END

The **STRINGTABLE** statement defines one or more string resources for an application. String resources are simply null-terminated ASCII strings that can be loaded when needed from the executable file, using the **LoadString** function.

Parameter	Description
load-option	Specifies when the resource is to be loaded. This optional parameter must be one of the following keywords:

Option	Description
PRELOAD	Resource is loaded immediately.
LOADONCALL	Resource is loaded when called. This is the default option.

mem-option — Specifies whether the resource is fixed or movable and whether or not it is discardable. This optional parameter can be one of the following keywords:

Option	Description
FIXED	Resource remains at a fixed memory location.
MOVEABLE	Resource can be moved if necessary in order to compact memory.
DISCARDABLE	Resource can be discarded if no longer needed.

The default is **MOVEABLE** and **DISCARDABLE**.

stringID — Specifies an integer value that identifies the resource.

string — Specifies one or more ASCII strings, enclosed in double quotation marks. The string must be no longer than 255 characters and must occupy a single line in the source file. To add a carriage return to the string, use this character sequence: \012. For example, "Line one\012Line two" would define a string that would be displayed as follows:

```
Line one
Line two
```

Comments

Grouping strings in separate segments allows all related strings to be read in at one time and discarded together. When possible, an application should make the table movable and discardable. The Resource Compiler allocates 16 strings per segment and uses the identifier value to determine which segment is to contain the string. Strings with the same upper-12 bits in their identifiers are placed in the same segment.

Example

The following example demonstrates the usage of the **STRINGTABLE** statement:

```
#define IDS_HELLO    1
#define IDS_GOODBYE  2

STRINGTABLE
BEGIN
    IDS_HELLO,   "Hello"
```

```
    IDS_GOODBYE, "Goodbye"
END
```

STYLE (2.x)

STYLE *style*

The **STYLE** statement defines the window style of the dialog box. The window style specifies whether the box is a pop-up or a child window. The default style has the following attributes: **WS_POPUP**, **WS_BORDER**, and WS_SYSMENU.

Parameter	Description
style	Specifies the window style. This parameter takes an integer value or predefined name. The following lists the predefined styles:

Style	Meaning
DS_LOCALEDIT	Specifies that edit controls in the dialog box will use memory in the application's data segment. By default, all edit controls in dialog boxes use memory outside the application's data segment. This feature can be suppressed by adding the **DS_LOCALEDIT** flag to the STYLE command for the dialog box. If this flag is not used, **EM_GETHANDLE** and **EM_SETHANDLE** messages must not be used since the storage for the control is not in the application's data segment. This feature does not affect edit controls created outside of dialog boxes.
DS_MODALFRAME	Creates a dialog box with a modal dialog box frame that can be combined with a title bar and System menu by specifying the **WS_CAPTION** and **WS_SYSMENU** styles.
DS_NOIDLEMSG	Suppresses **WM_ENTERIDLE** messages that Windows would otherwise send to the owner of the dialog box while the dialog box is displayed.
DS_SYSMODAL	Creates a system-modal dialog box.
WS_BORDER	Creates a window that has a border.
WS_CAPTION	Creates a window that has a title bar (implies the **WS_BORDER** style).
WS_CHILD	Creates a child window. It cannot be used with the **WS_POPUP** style.
WS_CHILDWINDOW	Creates a child window that has the **WS_CHILD** style.
WS_CLIPCHILDREN	Excludes the area occupied by child windows when drawing within the parent window. Used when creating the parent window.
WS_CLIPSIBLINGS	Clips child windows relative to each other; that is, when a particular child window receives a **WM_PAINT** message, this style clips all other top-level child windows out of the region of the child window to be updated. (If the **WS_CLIPSIBLINGS** style is not given and child windows overlap, it is possible, when drawing in the client area of a child window, to draw in the client area of a neighboring child window.) For use with the **WS_CHILD** style only.
WS_DISABLED	Creates a window that is initially disabled.
WS_DLGFRAME	Creates a window with a modal dialog box frame but

	no title.
WS_GROUP	Specifies the first control of a group of controls in which the user can move from one control to the next by using the arrow keys. All controls defined with the **WS_GROUP** style after the first control belong to the same group. The next control with the WS_GROUP style ends the style group and starts the next group (that is, one group ends where the next begins). This style is valid only for controls.
WS_HSCROLL	Creates a window that has a horizontal scroll bar.
WS_ICONIC	Creates a window that is initially iconic. For use with the **WS_OVERLAPPED** style only.
WS_MAXIMIZE	Creates a window of maximum size.
WS_MAXIMIZEBOX	Creates a window that has a Maximize box.
WS_MINIMIZE	Creates a window of minimum size.
WS_MINIMIZEBOX	Creates a window that has a Minimize box.
WS_OVERLAPPED	Creates an overlapped window. An overlapped window has a caption and a border.
WS_OVERLAPPEDWINDOW	Creates an overlapped window having the **WS_OVERLAPPED**, **WS_CAPTION**, **WS_SYSMENU**, **WS_THICKFRAME**, **WS_MINIMIZEBOX**, and **WS_MAXIMIZEBOX** styles.
WS_POPUP	Creates a pop-up window. It cannot be used with the **WS_CHILD** style.
WS_POPUPWINDOW	Creates a pop-up window that has the **WS_POPUP**, **WS_BORDER**, and **WS_SYSMENU** styles. The **WS_CAPTION** style must be combined with the **WS_POPUPWINDOW** style to make the System menu visible.
WS_SIZEBOX	Creates a window that has a size box. Used only for windows with a title bar or with vertical and horizontal scroll bars.
WS_SYSMENU	Creates a window that has a System-menu box in its title bar. Used only for windows with title bars. If used with a child window, this style creates a Close box instead of a System-menu box.
WS_TABSTOP	Specifies one of any number of controls through which the user can move by using the TAB key. The TAB key moves the user to the next control specified by the **WS_TABSTOP** style. This style is valid only for controls.
WS_THICKFRAME	Creates a window with a thick frame that can be used to size the window.
WS_VISIBLE	Creates a window that is initially visible. This applies to overlapping and pop-up windows. For overlapping windows, the *y* parameter is used as a parameter for the **ShowWindow** function.
WS_VSCROLL	Creates a window that has a vertical scroll bar.

Comments

If the predefined names are used, the **#include** directive must be used so that the WINDOWS.H file will

be included in the resource script.

DS_LOCALEDIT

Specifies that edit controls in the dialog box will use memory in the application's data segment. By default, all edit controls in dialog boxes use memory outside the application's data segment. This feature can be suppressed by adding the DS_LOCALEDIT flag to the **STYLE** command for the dialog box. If this flag is not used, **EM_GETHANDLE** and **EM_SETHANDLE** messages must not be used since the storage for the control is not in the application's data segment. This feature does not affect edit controls created outside of dialog boxes.

DS_MODALFRAME

Creates a dialog box with a modal dialog box frame that can be combined with a title bar and System menu by specifying the **WS_CAPTION** and **WS_SYSMENU** styles.

DS_NOIDLEMSG

Suppresses **WM_ENTERIDLE** messages that Windows would otherwise send to the owner of the dialog box while the dialog box is displayed.

DS_SYSMODAL

Creates a system-modal dialog box.

WS_BORDER

Creates a window that has a border.

WS_CAPTION

Creates a window that has a title bar (implies the **WS_BORDER** style).

WS_CHILD

Creates a child window. It cannot be used with the **WS_POPUP** style.

WS_CHILDWINDOW

Creates a child window that has the **WS_CHILD** style.

WS_CLIPCHILDREN

Excludes the area occupied by child windows when drawing within the parent window. Used when creating the parent window.

WS_CLIPSIBLINGS

Clips child windows relative to each other; that is, when a particular child window receives a **WM_PAINT** message, this style clips all other top-level child windows out of the region of the child window to be updated. (If the WS_CLIPSIBLINGS style is not given and child windows overlap, it is possible, when drawing in the client area of a child window, to draw in the client area of a neighboring child window.) For use with the **WS_CHILD** style only.

WS_DISABLED

Creates a window that is initially disabled.

WS_DLGFRAME

Creates a window with a modal dialog box frame but no title.

WS_GROUP

Specifies the first control of a group of controls in which the user can move from one control to the next by using the arrow keys. All controls defined with the WS_GROUP style after the first control belong to the same group. The next control with the WS_GROUP style ends the style group and starts the next group (that is, one group ends where the next begins). This style is valid only for controls.

WS_HSCROLL

Creates a window that has a horizontal scroll bar.

WS_ICONIC

Creates a window that is initially iconic. For use with the **WS_OVERLAPPED** style only.

WS_MAXIMIZE

Creates a window of maximum size.

WS_MAXIMIZEBOX

Creates a window that has a Maximize box.

WS_MINIMIZE

Creates a window of minimum size.

WS_MINIMIZEBOX

Creates a window that has a Minimize box.

WS_OVERLAPPED

Creates an overlapped window. An overlapped window has a caption and a border.

WS_OVERLAPPEDWINDOW

Creates an overlapped window having the **WS_OVERLAPPED**, **WS_CAPTION**, **WS_SYSMENU**, **WS_THICKFRAME**, **WS_MINIMIZEBOX**, and **WS_MAXIMIZEBOX** styles.

WS_POPUP

Creates a pop-up window. It cannot be used with the **WS_CHILD** style.

WS_POPUPWINDOW

Creates a pop-up window that has the **WS_POPUP**, **WS_BORDER**, and **WS_SYSMENU** styles. The **WS_CAPTION** style must be combined with the WS_POPUPWINDOW style to make the System menu visible.

WS_SIZEBOX

Creates a window that has a size box. Used only for windows with a title bar or with vertical and horizontal scroll bars.

WS_SYSMENU

Creates a window that has a System-menu box in its title bar. Used only for windows with title bars. If used with a child window, this style creates a Close box instead of a System-menu box.

WS_TABSTOP

Specifies one of any number of controls through which the user can move by using the TAB key. The TAB key moves the user to the next control specified by the WS_TABSTOP style. This style is valid only for controls.

WS_THICKFRAME

Creates a window with a thick frame that can be used to size the window.

WS_VISIBLE

Creates a window that is initially visible. This applies to overlapping and pop-up windows. For overlapping windows, the *y* parameter is used as a parameter for the **ShowWindow** function.

WS_VSCROLL

Creates a window that has a vertical scroll bar.

#undef (2.x)

#undef *name*

The **#undef** directive removes the current definition of the specified name. All subsequent occurrences of the name are processed without replacement.

Parameter	Description
name	Specifies the name to be removed. This value is any combination of letters, digits, and punctuation.

Example

This example removes the definitions for the names "nonzero" and "USERCLASS":

```
#undef     nonzero
#undef     USERCLASS
```

See Also

#define

User-Defined (3.0)

nameID typeID [*load-option*] [*mem-option*] *filename*

nameID typeID [*load-option*] [*mem-option*]
BEGIN
raw-data
.
.
.
END

A user-defined resource statement specifies a resource that contains application-specific data. The data can have any format and can be defined either as the content of a given file (if the *filename* parameter is given) or as a series of numbers or strings (if the *raw-data* parameter is given).

Parameter	Description
nameID	Specifies either a unique name or an integer that identifies the resource.
typeID	Specifies either a unique name or an integer that identifies the resource type. If a number is given, it must be greater than 255. The numbers 1 through 255 are reserved for existing and future predefined resource types.
load-option	Specifies when the resource is to be loaded. The parameter must be one of the following options:

Option	Description
PRELOAD	Resource is loaded immediately.
LOADONCALL	Resource is loaded when called. This is the default option.

Parameter	Description
mem-option	Specifies whether the resource is fixed or movable and whether it is discardable. The parameter must be one of the following options:

Option	Description
FIXED	Resource remains at a fixed memory location.
MOVEABLE	Resource can be moved if necessary in order to compact memory.
DISCARDABLE	Resource can be discarded if no longer needed.

The default is **MOVEABLE** and **DISCARDABLE** for cursor, icon, and font resources. The default for bitmap resources is **MOVEABLE**.

Parameter	Description
filename	Specifies the name of the file that contains the resource data. The parameter must be a valid MS-DOS filename; it must be a full path if the file is not in the current working directory.
raw-data	Specifies one or more integers and strings. Integers can be in decimal, octal, or hexadecimal format.

Example
The following example shows several user-defined statements:

```
array   MYRES   data.res
14      300     custom.res
18 MYRES2
BEGIN
  "Here is a data string\0", /* A string. Note: explicitly
                                null-terminated */
   1024,                    /* int        */
   0x029a,                  /* hex int    */
   0o733,                   /* octal int  */
   "\07"                    /* octal byte */
```

END

VERSIONINFO (3.1)

versionID **VERSIONINFO** *fixed-info*

BEGIN
block-statement
.
.
.
END

The **VERSIONINFO** statement creates a version-information resource. The resource contains such information about the file as its version number, its intended operating system, and its original filename. The resource is intended to be used with the File Installation library functions.

Parameter	Description
versionID	Specifies the version-information resource identifier. This value must be 1.
fixed-info	Specifies the version information, such as the file version and the intended operating system. This parameter consists of the following statements:

Statement	Description
FILEVERSION *version*	Specifies the binary version number for the file. The *version* consists of two 32-bit integers, defined by four 16-bit integers. For example, "FILEVERSION 3,10,0,61" is translated into two doublewords: 0x0003000a and 0x0000003d, in that order. Therefore, if *version* is defined by the doublewords dw1 and dw2, they need to appear in the **FILEVERSION** statement as follows: **HIWORD**(dw1), **LOWORD**(dw1), HIWORD(dw2), LOWORD(dw2).
PRODUCTVERSION *version*	Specifies the binary version number for the product with which the file is distributed. The *version* parameter is two 32-bit integers, defined by four 16-bit integers. For more information about *version,* see the **FILEVERSION** description.
FILEFLAGSMASK *fileflagsmask*	Specifies which bits in the **FILEFLAGS** statement are valid. If a bit is set, the corresponding bit in **FILEFLAGS** is valid.
FILEFLAGS *fileflags*	Specifies the Boolean attributes of the file. The *fileflags* parameter must be the combination of all the file flags that are valid at compile time. For Windows 3.1, this value is 0x3f.
FILEOS *fileos*	Specifies the operating system for which this file was designed. The *fileos* parameter can be one of the operating system values given in the Comments section.
FILETYPE *filetype*	Specifies the general type of file. The *filetype* parameter can be one of the file

		type values listed in the Comments section.
	FILESUBTYPE *subtype*	Specifies the function of the file. The *subtype* parameter is zero unless the *type* parameter in the **FILETYPE** statement is VFT_DRV, VFT_FONT, or VFT_VXD. For a list of file subtype values, see the Comments section.

block-statement Specifies one or more version-information blocks. A block can contain string information or variable information.

Comments

To use the constants specified with the **VERSIONINFO** statement, the VER.H file must be included in the resource-definition file.

The following list describes the parameters used in the **VERSIONINFO** statement:

Parameter	Description

fileflags Specifies a combination of the following values:

Value	Meaning
VS_FF_DEBUG	File contains debugging information or is compiled with debugging features enabled.
VS_FF_INFOINFERRED	File contains a dynamically created version-information resource. Some of the blocks for the resource may be empty or incorrect. This value is not intended to be used in version-information resources created by using the **VERSIONINFO** statement.
VS_FF_PATCHED	File has been modified and is not identical to the original shipping file of the same version number.
VS_FF_PRERELEASE	File is a development version, not a commercially released product.
VS_FF_PRIVATEBUILD	File was not built using standard release procedures. If this value is given, the **StringFileInfo** block must contain a **PrivateBuild** string.
VS_FF_SPECIALBUILD	File was built by the original company using standard release procedures but is a variation of the standard file of the same version number. If this value is given, the **StringFileInfo** block must contain a **SpecialBuild** string.

fileos Specifies one of the following values:

Value	Meaning
VOS_UNKNOWN	Operating system for which the file was designed is unknown to Windows.
VOS_DOS	File was designed for MS-DOS.
VOS_NT	File was designed for Windows NT.
VOS_WINDOWS16	File was designed for Windows version 3.0 or later.
VOS_WINDOWS32	File was designed for 32-bit Windows.
VOS_DOS_WINDOWS16	File was designed for Windows version 3.0 or later running with MS-DOS.
VOS_DOS_WINDOWS32	File was designed for 32-bit Windows running with MS-DOS.
VOS_NT_WINDOWS32	File was designed for 32-bit Windows running with Windows NT.

The values 0x00002L, 0x00003L, 0x20000L and 0x30000L are reserved.

filetype Specifies one of the following values:

Value	Meaning
VFT_UNKNOWN	File type is unknown to Windows.
VFT_APP	File contains an application.
VFT_DLL	File contains a dynamic-link library (DLL).
VFT_DRV	File contains a device driver. If the **dwFileType** member is VFT_DRV, the **dwFileSubtype** member contains a more specific description of the driver.
VFT_FONT	File contains a font. If the **dwFileType** member is VFT_FONT, the **dwFileSubtype** member contains a more specific description of the font.
VFT_VXD	File contains a virtual device.
VFT_STATIC_LIB	File contains a static-link library.

All other values are reserved for use by Microsoft.

subtype Specifies additional information about the file type.

If the **FILETYPE** statement specifies VFT_DRV, this parameter can be one of the following values:

Value	Meaning
VFT2_UNKNOWN	Driver type is unknown to Windows.
VFT2_DRV_COMM	File contains a communications driver.
VFT2_DRV_PRINTER	File contains a printer driver.
VFT2_DRV_KEYBOARD	File contains a keyboard driver.
VFT2_DRV_LANGUAGE	File contains a language driver.
VFT2_DRV_DISPLAY	File contains a display driver.
VFT2_DRV_MOUSE	File contains a mouse driver.
VFT2_DRV_NETWORK	File contains a network driver.
VFT2_DRV_SYSTEM	File contains a system driver.
VFT2_DRV_INSTALLABLE	File contains an installable driver.
VFT2_DRV_SOUND	File contains a sound driver.

If the **FILETYPE** statement specifies VFT_FONT, this parameter can be one of the following values:

Value	Meaning
VFT2_UNKNOWN	Font type is unknown to Windows.
VFT2_FONT_RASTER	File contains a raster font.
VFT2_FONT_VECTOR	File contains a vector font.
VFT2_FONT_TRUETYPE	File contains a TrueType font.

If the **FILETYPE** statement specifies VFT_VXD, this parameter must be the virtual-device identifier included in the virtual-device control block.

All *subtype* values not listed here are reserved for use by Microsoft.

langID Specifies one of the following language identifiers:

Value	Language
0x0401	Arabic
0x0402	Bulgarian
0x0403	Catalan
0x0404	Traditional Chinese
0x0405	Czech

0x0406	Danish
0x0407	German
0x0408	Greek
0x0409	U.S. English
0x040A	Castilian Spanish
0x040B	Finnish
0x040C	French
0x040D	Hebrew
0x040E	Hungarian
0x040F	Icelandic
0x0410	Italian
0x0411	Japanese
0x0412	Korean
0x0413	Dutch
0x0414	Norwegian - Bokmål
0x0415	Polish
0x0416	Brazilian Portuguese
0x0417	Rhaeto-Romanic
0x0418	Romanian
0x0419	Russian
0x041A	Croato-Serbian (Latin)
0x041B	Slovak
0x041C	Albanian
0x041D	Swedish
0x041E	Thai
0x041F	Turkish
0x0420	Urdu
0x0421	Bahasa
0x0804	Simplified Chinese
0x0807	Swiss German
0x0809	U.K. English
0x080A	Mexican Spanish
0x080C	Belgian French
0x0810	Swiss Italian
0x0813	Belgian Dutch
0x0814	Norwegian - Nynorsk
0x0816	Portuguese
0x081A	Serbo-Croatian (Cyrillic)
0x0C0C	Canadian French
0x100C	Swiss French

charsetID Specifies one of the following character-set identifiers:

Value	Character set
0	7-bit ASCII
932	Windows, Japan (Shift - JIS X-0208)
949	Windows, Korea (Shift - KSC 5601)

950	Windows, Taiwan (GB5)
1200	Unicode
1250	Windows, Latin-2 (Eastern European)
1251	Windows, Cyrillic
1252	Windows, Multilingual
1253	Windows, Greek
1254	Windows, Turkish
1255	Windows, Hebrew
1256	Windows, Arabic

string-name Specifies one of the following predefined names:

Name	Value
Comments	Specifies additional information that should be displayed for diagnostic purposes.
CompanyName	Specifies the company that produced the file--for example, "Microsoft Corporation" or "Standard Microsystems Corporation, Inc.". This string is required.
FileDescription	Specifies a file description to be presented to users. This string may be displayed in a list box when the user is choosing files to install--for example, "Keyboard Driver for AT-Style Keyboards" or "Microsoft Word for Windows". This string is required.
FileVersion	Specifies the version number of the file--for example, "3.10" or "5.00.RC2". This string is required.
InternalName	Specifies the internal name of the file, if one exists--for example, a module name if the file is a dynamic-link library. If the file has no internal name, this string should be the original filename, without extension. This string is required.
LegalCopyright	Specifies all copyright notices that apply to the file. This should include the full text of all notices, legal symbols, copyright dates, and so on--for example, "Copyright Microsoft Corporation 1990-1991". This string is optional.
LegalTrademarks	Specifies all trademarks and registered trademarks that apply to the file. This should include the full text of all notices, legal symbols, trademark numbers, and so on--for example, "Windows(TM) is a trademark of Microsoft Corporation". This string is optional.
OriginalFilename	Specifies the original name of the file, not including a path. This information enables an application to determine whether a file has been renamed by a user. The format of the name depends on the file system for which the file was created. This string is required.
PrivateBuild	Specifies information about a private version of the file--for example, "Built by TESTER1 on \TESTBED". This string should be present only if the VS_FF_PRIVATEBUILD flag is set in the **dwFileFlags** member of the **VS_FIXEDFILEINFO** structure of the root block.
ProductName	Specifies the name of the product with which the file is distributed--for example, "Microsoft Windows". This string is required.
ProductVersion	Specifies the version of the product with which the file is distributed--for example, "3.10" or "5.00.RC2". This string is

required.

SpecialBuild Specifies how this version of the file differs from the standard version--for example, "Private build for TESTER1 solving mouse problems on M250 and M250E computers". This string should be present only if the VS_FF_SPECIALBUILD flag is set in the **dwFileFlags** member of the **VS_FIXEDFILEINFO** structure in the root block.

A string information block has the following form:

```
BLOCK "StringFileInfo"
BEGIN
    BLOCK "lang-charset"
    BEGIN
        VALUE "string-name", "value"
            .
            .
            .
    END
END
```

Following are the parameters in the **StringFileInfo** block:

lang-charset Specifies a language and character-set identifier pair. It is a hexadecimal string consisting of the concatenation of the language and character-set identifiers listed earlier in this section.

string-name Specifies the name of a value in the block and can be one of the predefined names listed earlier in this section.

value Specifies, as a character string, the value of the corresponding string name. More than one **VALUE** statement can be given.

A variable information block has the following form:

```
BLOCK "VarFileInfo"
BEGIN
    VALUE "Translation",
        langID, charsetID
            .
            .
            .

END
```

Following are the parameters in the variable information block:

langID Specifies one of the language identifiers listed earlier in this section.

charsetID Specifies one of the character-set identifiers listed earlier in this section.

More than one identifier pair can be given, but each pair must be separated from the preceding pair with a comma.

Resource Statements

ACCELERATORS	Defines accelerator keystroke
BITMAP	Defines a bitmap resource
CAPTION	Defines the title for a dialog box
CHECKBOX	Creates a predefined check-box control
CLASS	Defines the class of a dialog box
COMBOBOX	Creates a combination-box control
CONTROL	Creates a control for a dialog box
CTEXT	Creates a centered text control
CURSOR	Specifies a cursor resource
#define	Assigns a value to a name
DEFPUSHBUTTON	Creates a default push-button control
DIALOG	Defines a dialog window
EDITTEXT	Defines an EDIT control
#elif	Compiles conditionally (else if)
#else	Compiles if conditional directive is false
#endif	Marks the end of an #ifdef block
FONT	Specifies the font in a dialog box
FONT	Specifies a font resource
GROUPBOX	Creates a group box
ICON	Creates an icon control
ICON	Specifies an icon resource
#if	Conditionally compiles if an expression is true
#ifdef	Conditionally compiles if a name is defined
#ifndef	Conditionally compiles if a name is not defined
#include	Includes a header file
LISTBOX	Creates a list-box control
LTEXT	Creates a left-aligned text control
MENU	Defines a dialog box's menu
MENU	Creates a menu
MENUITEM	Defines a menu item
POPUP	Creates a pop-up menu
PUSHBUTTON	Creates a pushbutton control
RADIOBUTTON	Creates a radio-button control
RCDATA	Defines a raw-data resource
RTEXT	Creates a right-aligned text control
SCROLLBAR	Creates a scrollbar control
SEPARATOR	Creates inactive dividing bar in menu
STRINGTABLE	Defines string resources
STYLE	Defines window style of dialog box
#undef	Removes a name definition
User-Defined	User-Defined Resources
VERSIONINFO	Creates a version information resource

RegCloseKey (3.1)

#include shellapi.h

LONG RegCloseKey(*hkey***)**

HKEY *hkey;* /* handle of key to close */

The **RegCloseKey** function closes a key. Closing a key releases the key's handle. When all keys are closed, the registration database is updated.

Parameter	Description
hkey	Identifies the open key to close.

Returns

The return value is ERROR_SUCCESS if the function is successful. Otherwise, it is an error value.

Comments

The **RegCloseKey** function should be called only if a key has been opened by either the **RegOpenKey** function or the **RegCreateKey** function. The handle for a given key should not be used after it has been closed, because it may no longer be valid. Key handles should not be left open any longer than necessary.

Example

The following example uses the **RegCreateKey** function to create the handle of a protocol, uses the **RegSetValue** function to set up the subkeys of the protocol, and then calls **RegCloseKey** to save the information in the database:

```
HKEY hkProtocol;

if (RegCreateKey(HKEY_CLASSES_ROOT,             /* root            */
    "NewAppDocument\\protocol\\StdFileEditing", /* protocol string */
    &hkProtocol) != ERROR_SUCCESS)          /* protocol key handle */
        return FALSE;

RegSetValue(hkProtocol,          /* handle of protocol key         */
    "server",                    /* name of subkey                 */
    REG_SZ,                      /* required                       */
    "newapp.exe",                /* command to activate server     */
    10);                         /* text string size               */

RegSetValue(hkProtocol,          /* handle of protocol key         */
    "verb\\0",                   /* name of subkey                 */
    REG_SZ,                      /* required                       */
    "Edit",                      /* server should edit object      */
    4);                          /* text string size               */

RegCloseKey(hkProtocol);     /* closes protocol key and subkeys    */
```

See Also

RegCreateKey, **RegDeleteKey**, **RegOpenKey**, **RegSetValue**

RegCreateKey (3.1)

#include shellapi.h

LONG RegCreateKey(*hkey, lpszSubKey, lphkResult***)**

```
HKEY hkey;              /* handle of an open key                */
LPCSTR lpszSubKey;      /* address of string for subkey to open */
HKEY FAR* lphkResult;   /* address of handle of open key        */
```

The **RegCreateKey** function creates the specified key. If the key already exists in the registration database, **RegCreateKey** opens it.

Parameter	Description
hkey	Identifies an open key (which can be HKEY_CLASSES_ROOT). The key opened or created by the **RegCreateKey** function is a subkey of the key identified by the *hkey* parameter. This value should not be NULL.
lpszSubKey	Points to a null-terminated string specifying the subkey to open or create.
lphkResult	Points to the handle of the key that is opened or created.

Returns

The return value is ERROR_SUCCESS if the function is successful. Otherwise, it is an error value.

Comments

An application can create keys that are subordinate to the top level of the database by specifying HKEY_CLASSES_ROOT for the *hKey* parameter. An application can use the **RegCreateKey** function to create several keys at once. For example, an application could create a subkey four levels deep and the three preceding subkeys by specifying a string of the following form for the *lpszSubKey* parameter:

*subkey1******subkey2******subkey3******subkey4*

Example

The following example uses the **RegCreateKey** function to create the handle of a protocol, uses the **RegSetValue** function to set up the subkeys of the protocol, and then calls **RegCloseKey** to save the information in the database:

```
HKEY hkProtocol;

if (RegCreateKey(HKEY_CLASSES_ROOT,             /* root            */
    "NewAppDocument\\protocol\\StdFileEditing", /* protocol string */
    &hkProtocol) != ERROR_SUCCESS)          /* protocol key handle */
        return FALSE;

RegSetValue(hkProtocol,          /* handle of protocol key         */
    "server",                    /* name of subkey                 */
    REG_SZ,                      /* required                       */
    "newapp.exe",                /* command to activate server     */
    10);                         /* text string size               */

RegSetValue(hkProtocol,          /* handle of protocol key         */
    "verb\\0",                   /* name of subkey                 */
    REG_SZ,                      /* required                       */
    "Edit",                      /* server should edit object      */
    4);                          /* text string size               */

RegCloseKey(hkProtocol);     /* closes protocol key and subkeys    */
```

See Also

RegCloseKey, **RegOpenKey**, **RegSetValue**

RegDeleteKey (3.1)

#include shellapi.h

LONG RegDeleteKey(*hkey, lpszSubKey***)**

HKEY *hkey;* /* handle of an open key */
LPCSTR *lpszSubKey;* /* address of string for subkey to delete */

The **RegDeleteKey** function deletes the specified key. When a key is deleted, its value and all of its subkeys are deleted.

Parameter	Description
hkey	Identifies an open key (which can be HKEY_CLASSES_ROOT). The key deleted by the **RegDeleteKey** function is a subkey of this key.
lpszSubKey	Points to a null-terminated string specifying the subkey to delete. This value should not be NULL.

Returns

The return value is ERROR_SUCCESS if the function is successful. Otherwise, it is an error value.

If the error value is ERROR_ACCESS_DENIED, either the application does not have delete privileges for the specified key or another application has opened the specified key.

Example

The following example uses the **RegQueryValue** function to retrieve the name of an object handler and then calls the **RegDeleteKey** function to delete the key if its value is nwappobj.dll:

```
char szBuff[80];
LONG cb;
HKEY hkStdFileEditing;

if (RegOpenKey(HKEY_CLASSES_ROOT,
        "NewAppDocument\\protocol\\StdFileEditing",
        &hkStdFileEditing) == ERROR_SUCCESS) {

    cb = sizeof(szBuff);
    if (RegQueryValue(hkStdFileEditing,
            "handler",
            szBuff,
            &cb) == ERROR_SUCCESS
            && lstrcmpi("nwappobj.dll", szBuff) == 0)
        RegDeleteKey(hkStdFileEditing, "handler");
    RegCloseKey(hkStdFileEditing);
}
```

See Also

RegCloseKey

RegEnumKey (3.1)

#include shellapi.h

LONG RegEnumKey(*hkey, iSubkey, lpszBuffer, cbBuffer***)**

HKEY *hkey;* /* handle of key to query */
DWORD *iSubkey;* /* index of subkey to query */
LPSTR *lpszBuffer;* /* address of buffer for subkey string */
DWORD *cbBuffer;* /* size of subkey buffer */

The **RegEnumKey** function enumerates the subkeys of a specified key.

Parameter	Description
hkey	Identifies an open key (which can be HKEY_CLASSES_ROOT) for which subkey information is retrieved.
iSubkey	Specifies the index of the subkey to retrieve. This value should be zero for the first call to the **RegEnumKey** function.
lpszBuffer	Points to a buffer that contains the name of the subkey when the function returns. This function copies only the name of the subkey, not the full key hierarchy, to the buffer.
cbBuffer	Specifies the size, in bytes, of the buffer pointed to by the *lpszBuffer* parameter.

Returns

The return value is ERROR_SUCCESS if the function is successful. Otherwise, it is an error value.

Comments

The first parameter of the **RegEnumKey** function must specify an open key. Applications typically precede the call to the **RegEnumKey** function with a call to the **RegOpenKey** function and follow it with a call to the **RegCloseKey** function. Calling **RegOpenKey** and **RegCloseKey** is not necessary when the first parameter is HKEY_CLASSES_ROOT, because this key is always open and available; however, calling **RegOpenKey** and **RegCloseKey** in this case is a time optimization. While an application is using the **RegEnumKey** function, it should not make calls to any registration functions that might change the key being queried.

To enumerate subkeys, an application should initially set the *iSubkey* parameter to zero and then increment it on successive calls.

Example

The following example uses the **RegEnumKey** function to put the values associated with top-level keys into a list box:

```
HKEY hkRoot;
char szBuff[80], szValue[80];
static DWORD dwIndex;
LONG cb;

if (RegOpenKey(HKEY_CLASSES_ROOT, NULL, &hkRoot) == ERROR_SUCCESS) {
    for (dwIndex = 0; RegEnumKey(hkRoot, dwIndex, szBuff,
             sizeof(szBuff)) == ERROR_SUCCESS; ++dwIndex) {
        if (*szBuff == '.')
            continue;
        cb = sizeof(szValue);
        if (RegQueryValue(hkRoot, (LPSTR) szBuff, szValue,
                &cb) == ERROR_SUCCESS)
            SendDlgItemMessage(hDlg, ID_ENUMLIST, LB_ADDSTRING, 0,
                (LONG) (LPSTR) szValue);
    }
    RegCloseKey(hkRoot);
```

```
}
```

See Also
RegQueryValue

RegOpenKey (3.1)

#include shellapi.h

LONG RegOpenKey(*hkey, lpszSubKey, lphkResult***)**

HKEY *hkey;* /* handle of an open key */
LPCSTR *lpszSubKey;* /* address of string for subkey to open */
HKEY FAR* *lphkResult;* /* address of handle of open key */

The **RegOpenKey** function opens the specified key.

Parameter	Description
hkey	Identifies an open key (which can be HKEY_CLASSES_ROOT). The key opened by the **RegOpenKey** function is a subkey of the key identified by this parameter. This value should not be NULL.
lpszSubKey	Points to a null-terminated string specifying the name of the subkey to open.
lphkResult	Points to the handle of the key that is opened.

Returns

The return value is ERROR_SUCCESS if the function is successful. Otherwise, it is an error value.

Comments

Unlike the **RegCreateKey** function, the **RegOpenKey** function does not create the specified key if the key does not exist in the database.

Example

The following example uses the **RegOpenKey** function to retrieve the handle of the StdFileEditing subkey, calls the **RegQueryValue** function to retrieve the name of an object handler, and then calls the **RegDeleteKey** function to delete the key if its value is nwappobj.dll:

```
char szBuff[80];
LONG cb;
HKEY hkStdFileEditing;

if (RegOpenKey(HKEY_CLASSES_ROOT,
        "NewAppDocument\\protocol\\StdFileEditing",
        &hkStdFileEditing) == ERROR_SUCCESS) {

    cb = sizeof(szBuff);
    if (RegQueryValue(hkStdFileEditing,
            "handler",
            szBuff,
            &cb) == ERROR_SUCCESS
            && lstrcmpi("nwappobj.dll", szBuff) == 0)
        RegDeleteKey(hkStdFileEditing, "handler");
    RegCloseKey(hkStdFileEditing);
}
```

See Also

RegCreateKey

RegQueryValue (3.1)

#include shellapi.h

LONG RegQueryValue(*hkey, lpszSubKey, lpszValue, lpcb***)**

```
HKEY hkey;          /* handle of key to query                    */
LPCSTR lpszSubKey;  /* address of string for subkey to query     */
LPSTR lpszValue;    /* address of buffer for returned string     */
LONG FAR* lpcb;     /* address of buffer for size of returned string*/
```

The **RegQueryValue** function retrieves the text string associated with a specified key.

Parameter	Description
hkey	Identifies a currently open key (which can be HKEY_CLASSES_ROOT). This value should not be NULL.
lpszSubKey	Points to a null-terminated string specifying the name of the subkey of the *hkey* parameter for which a text string is retrieved. If this parameter is NULL or points to an empty string, the function retrieves the value of the *hkey* parameter.
lpszValue	Points to a buffer that contains the text string when the function returns.
lpcb	Points to a variable specifying the size, in bytes, of the buffer pointed to by the *lpszValue* parameter. When the function returns, this variable contains the size of the string copied to *lpszValue,* including the null-terminating character.

Returns

The return value is ERROR_SUCCESS if the function is successful. Otherwise, it is an error value.

Example

The following example uses the **RegOpenKey** function to retrieve the handle of the StdFileEditing subkey, calls the **RegQueryValue** function to retrieve the name of an object handler and then calls the **RegDeleteKey** function to delete the key if its value is nwappobj.dll:

```
char szBuff[80];
LONG cb;
HKEY hkStdFileEditing;

if (RegOpenKey(HKEY_CLASSES_ROOT,
        "NewAppDocument\\protocol\\StdFileEditing",
        &hkStdFileEditing) == ERROR_SUCCESS) {

    cb = sizeof(szBuff);
    if (RegQueryValue(hkStdFileEditing,
            "handler",
            szBuff,
            &cb) == ERROR_SUCCESS
            && lstrcmpi("nwappobj.dll", szBuff) == 0)
        RegDeleteKey(hkStdFileEditing, "handler");
    RegCloseKey(hkStdFileEditing);
}
```

See Also

RegEnumKey

RegSetValue (3.1)

#include shellapi.h

LONG RegSetValue(*hkey, lpszSubKey, fdwType, lpszValue, cb***)**

HKEY *hkey;*	/* handle of key	*/
LPCSTR *lpszSubKey;*	/* address of string for subkey	*/
DWORD *fdwType;*	/* must be REG_SZ	*/
LPCSTR *lpszValue;*	/* address of string for key	*/
DWORD *cb;*	/* ignored	*/

The **RegSetValue** function associates a text string with a specified key.

Parameter	Description
hkey	Identifies a currently open key (which can be HKEY_CLASSES_ROOT). This value should not be NULL.
lpszSubKey	Points to a null-terminated string specifying the subkey of the *hkey* parameter with which a text string is associated. If this parameter is NULL or points to an empty string, the function sets the value of the *hkey* parameter.
fdwType	Specifies the string type. For Windows version 3.1, this value must be REG_SZ.
lpszValue	Points to a null-terminated string specifying the text string to set for the given key.
cb	Specifies the size, in bytes, of the string pointed to by the *lpszValue* parameter. For Windows version 3.1, this value is ignored.

Returns

The return value is ERROR_SUCCESS if the function is successful. Otherwise, it is an error value.

Comments

If the key specified by the *lpszSubKey* parameter does not exist, the **RegSetValue** function creates it.

System performance improves when a call to the **RegSetValue** function is made for a key that has been opened using the **RegOpenKey** function and which will be closed with a call to the **RegCloseKey** function.

Example

The following example uses the **RegSetValue** function to register a filename extension and its associated class name:

```
RegSetValue(HKEY_CLASSES_ROOT,   /* root                          */
    ".XXX",                  /* string for filename extension   */
    REG_SZ,                      /* required                    */
    "NewAppDocument",            /* class name for extension    */
    14);                         /* size of text string         */

RegSetValue(HKEY_CLASSES_ROOT,  /* root                          */
    "NewAppDocument",        /* string for class-definition key */
    REG_SZ,                      /* required                    */
    "New Application",           /* text description of class   */
    15);                         /* size of text string         */
```

See Also

RegCloseKey, **RegCreateKey**, **RegOpenKey**, **RegQueryValue**

Registration functions (3.1)

RegCloseKey	Closes a key and releases the key's handle
RegCreateKey	Creates a specified key
RegDeleteKey	Deletes a specified key
RegEnumKey	Enumerates the subkeys of a specified key
RegOpenKey	Opens a specified key
RegQueryValue	Retrieves the text string for a specified key
RegSetValue	Associates a text string with a specified key

DefScreenSaverProc (3.1)

#include <scrnsave.h>

LRESULT DefScreenSaverProc(*hwnd, msg, wParam, lParam***)**

```
HWND hwnd;          /* handle of screen saver window */
UINT msg;           /* message                       */
WPARAM wParam;      /* first message parameter       */
LPARAM lParam;      /* second message parameter      */
```

The **DefScreenSaverProc** function provides default processing for any messages that a screen saver application does not process. All window messages that are not explicitly processed by the screen saver application's **ScreenSaverProc** window procedure must be passed to the **DefScreenSaverProc** function.

Parameter	Description
hwnd	Identifies the screen saver window.
msg	Specifies the message to be processed. The **DefScreenSaverProc** function responds to messages that affect screen saver operation as detailed in the list in the following "Comments" section. If a screen saver application must perform a different action in response to any of these messages, the application's **ScreenSaverProc** window procedure should process the message and not call **DefScreenSaverProc** for that message.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value specifies the result of the message processing and depends on the message sent.

Comments

A screen saver application's **ScreenSaverProc** window procedure should use **DefScreenSaverProc** in place of the **DefWindowProc** function. The **DefScreenSaverProc** function passes any messages that do not affect screen saver operation to **DefWindowProc**.

The **DefScreenSaverProc** function responds to messages that affect screen saver operation as follows:

Message	Response
WM_ACTIVATE, WM_ACTIVATEAPP, WM_NCACTIVATE	Closes the screen saver if *wParam* is FALSE, unless the password option is enabled in the configuration dialog box. If the password option is enabled, these messages are ignored. A *wParam* value of FALSE indicates that the screen saver is losing the input focus. The screen saver is closed by sending a WM_CLOSE message.
WM_SETCURSOR	Removes the cursor from the screen by setting the cursor to NULL.
WM_LBUTTONDOWN, WM_RBUTTONDOWN, WM_MBUTTONDOWN, WM_KEYDOWN, WM_KEYUP,	.2Posts a WM_CLOSE message to close the screen saver window, unless the password option is enabled. If the password option is enabled, a WM_MOUSEMOVE message displays the dialog box created by the **DlgGetPassword** function. WM_DESTROY
WM_SYSCOMMAND	Returns FALSE if the *wParam* parameter of the WM_SYSCOMMAND message is either SC_SCREENSAVE or SC_CLOSE.

See Also

ScreenSaverProc

DlgChangePassword (3.1)

#include <scrnsave.h>

BOOL DlgChangePassword(*hDlg, message, wParam, lParam***)**

```
HWND hDlg;          /* handle of dialog box          */
UINT message;       /* message                       */
WPARAM wParam;      /* first message parameter       */
LPARAM lParam;      /* second message parameter      */
```

The **DlgChangePassword** function receives messages from a dialog box that changes the password for a screen saver.

Parameter	Description
hDlg	Identifies the dialog box that changes the password for a screen saver.
message	Specifies the message.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value is nonzero if the function is successful; otherwise, it is zero.

Comments

This function is called by the **ScreenSaverConfigureDialog** function to change the password for a screen saver. An application uses the **MakeProcInstance** function with **DlgChangePassword** to display a configuration dialog box.

A password applies to all screen savers using SCRNSAVE.LIB. Whether the password is enabled, however, is specific to a particular screen saver.

The dialog box template for the change password dialog box must use the DLG_CHANGEPASSWORD identifier (defined as 2000).

The **DlgChangePassword** function must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

DlgGetPassword, **DlgInvalidPassword**, **ScreenSaverConfigureDialog**

DlgGetPassword (3.1)

#include <scrnsave.h>

BOOL DlgGetPassword(*hDlg, message, wParam, lParam***)**

```
HWND hDlg;          /* handle of dialog box          */
UINT message;       /* message                       */
WPARAM wParam;      /* first message parameter       */
LPARAM lParam;      /* second message parameter      */
```

The **DlgGetPassword** function receives messages from the dialog box that retrieves the user's password.

Parameter	Description
hDlg	Identifies the dialog box that retrieves the user's password.
message	Specifies the message.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value is nonzero if the function is successful; otherwise, it is zero.

Comments

The **DlgGetPassword** function is provided in SCRNSAVE.LIB. Most applications provide a dialog box template and export the function without explicitly calling it in their code. This reference information for **DlgGetPassword** is provided for applications that change the default behavior.

The **DlgGetPassword** function is called by the **DefScreenSaverProc** function to retrieve the password for a screen saver.

A password applies to all screen savers using SCRNSAVE.LIB. Whether the password is enabled, however, is specific to a particular screen saver.

The dialog box template for the dialog box that retrieves the user's password must use the DLG_ENTERPASSWORD identifier (defined as 2001).

The **DlgGetPassword** function must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

DefScreenSaverProc, **DlgChangePassword**, **DlgInvalidPassword**

DlgInvalidPassword (3.1)

#include <scrnsave.h>

BOOL DlgInvalidPassword(*hDlg, message, wParam, lParam***)**

```
HWND hDlg;          /* handle of dialog box          */
UINT message;       /* message                       */
WPARAM wParam;      /* first message parameter       */
LPARAM lParam;      /* second message parameter      */
```

The **DlgInvalidPassword** function displays a dialog box warning that a user's password is invalid.

Parameter	Description
hDlg	Identifies the dialog box that warns that a user's password is invalid.
message	Specifies the message.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value is nonzero if the function is successful; otherwise, it is zero.

Comments

The **DlgInvalidPassword** function is provided in SCRNSAVE.LIB. Most applications provide a dialog box template and export the function without explicitly calling it in their code. This reference information for **DlgInvalidPassword** is provided for applications that change the default behavior.

DlgInvalidPassword is called during processing of the **DlgGetPassword** function when the user types an incorrect password.

A password applies to all screen savers using SCRNSAVE.LIB. Whether the password is enabled, however, is specific to a particular screen saver.

The dialog box template for the dialog box warning that the user's password is invalid must use the DLG_INVALIDPASSWORD identifier (defined as 2002).

The **DlgInvalidPassword** function must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

DlgChangePassword, **DlgGetPassword**

HelpMessageFilterHookFunction (3.1)

#include <scrnsave.h>

DWORD HelpMessageFilterHookFunction(*nCode, wParam, lpMsg***)**

int *nCode;* /* identifier of hook */
WORD *wParam;* /* virtual-key code */
LPMSG *lpMsg;* /* address of message */

The **HelpMessageFilterHookFunction** function posts a message when the user presses the F1 key while using one of the screen saver dialog boxes.

Parameter	Description
nCode	Specifies a code used by the Windows hook function (also called the message-filter function) to determine how to process the message.
wParam	Specifies the virtual-key code pressed by the user.
lpMsg	Points to a message identifying the key event.

Returns

The return value is TRUE if the function posts a message. Otherwise, it specifies the result of the default message processing and is determined by the value of the *nCode* parameter.

Comments

The **HelpMessageFilterHookFunction** function is provided in SCRNSAVE.LIB. Most applications export the function and check for the help message registered by the library without explicitly calling the function in their code. This reference information for **HelpMessageFilterHookFunction** is provided for applications that change the default behavior.

The **HelpMessageFilterHookFunction** function posts a registered message called MyHelpMessage. An application should check for this message in its **ScreenSaverConfigureDialog** function.

The **HelpMessageFilterHookFunction** function must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

ScreenSaverConfigureDialog

RegisterDialogClasses (3.1)

#include <scrnsave.h>

BOOL RegisterDialogClasses(*hInst***)**

HANDLE *hInst;* /* handle of application instance */

The **RegisterDialogClasses** function registers any special or nonstandard window classes needed by a screen saver application's configuration dialog box.

Parameter	**Description**
hInst	Identifies an instance of the module that is registering the window classes.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **RegisterDialogClasses** function should not be exported. It is called by routines defined in the SCRNSAVE.LIB file.

If a screen saver does not register any special window classes for the configuration dialog box, the **RegisterDialogClasses** function can simply return a nonzero value.

See Also

ScreenSaverConfigureDialog

ScreenSaverConfigureDialog (3.1)

#include <scrnsave.h>

BOOL ScreenSaverConfigureDialog(*hdlg, wmsg, wParam, lParam***)**

```
HWND hdlg;      /* handle of dialog box      */
UINT wmsg;      /* message                   */
WPARAM wParam;  /* first message parameter   */
LPARAM lParam;  /* second message parameter  */
```

The **ScreenSaverConfigureDialog** function receives messages sent to a screen saver application's configuration dialog box. A screen saver application that supports user configuration must provide this function.

Parameter	Description
hdlg	Identifies the configuration dialog box.
wmsg	Specifies the message.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value is nonzero if the function processes the message or zero if it does not, except in response to a **WM_INITDIALOG** message. In response to a WM_INITDIALOG message, **ScreenSaverConfigureDialog** should return zero if it calls the **SetFocus** function to set the input focus to one of the controls in the dialog box. Otherwise, it should return nonzero, in which case the system sets the input focus to the first control in the dialog box that can be given the focus.

Comments

An application uses the **MakeProcInstance** function with **ScreenSaverConfigureDialog** to display a configuration dialog box.

The dialog box template for the configuration dialog box must have the **DLG_SCRNSAVECONFIGURE** identifier.

A screen saver application should save its configuration settings in the CONTROL.INI file.

The dialog box procedure is used only if the default window class (WC_DIALOG) is used for the dialog box. The default class is used if no explicit class is given in the dialog box template. Although the dialog box procedure is similar to a window procedure, it must not call the **DefWindowProc** function to process unwanted messages. Unwanted messages are processed internally by the default dialog box procedure.

The **ScreenSaverConfigureDialog** function must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

MakeProcInstance, **RegisterDialogClasses**

ScreenSaverProc (3.1)

#include <scrnsave.h>

LRESULT ScreenSaverProc(*hwnd, wmsg, wParam, lParam***)**

```
HWND hwnd;          /* handle of screen saver window */
unsigned wmsg;      /* message                       */
UINT wParam;        /* first message parameter       */
LPARAM lParam;      /* second message parameter      */
```

The **ScreenSaverProc** function receives messages sent to a screen saver window.

Parameter	Description
hwnd	Identifies the window.
wmsg	Specifies the message.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value is the result of the message processing. It depends on the message that is processed.

Comments

A screen saver application's **ScreenSaverProc** window procedure should use the **DefScreenSaverProc** function instead of the **DefWindowProc** function to provide default message processing. The **DefScreenSaverProc** function passes any messages that do not affect screen saver operations to **DefWindowProc**.

The **ScreenSaverProc** function must be exported by including it in an **EXPORTS** statement in the application's module-definition (.DEF) file.

See Also

DefScreenSaverProc

Screen Saver functions

DefScreenSaverProc	Calls default screen saver window procedure
DlgChangePassword	Changes the password for a screen saver
DlgGetPassword	Retrieves the password for a screen saver
DlgInvalidPassword	Warns of an invalid screen saver password
HelpMessageFilterHookFunction	Posts a screen saver help message
RegisterDialogClasses	Registers screen-saver dialog box classes
ScreenSaverConfigureDialog	Processes config. dialog box messages
ScreenSaverProc	Processes screen saver window messages

ExtractIcon (3.1)

#include shellapi.h

HICON ExtractIcon(*hinst, lpszExeName, iIcon***)**

```
HINSTANCE hinst;        /* instance handle          */
LPCSTR lpszExeName;     /* address of string for file */
UINT iIcon;             /* index of icon to retrieve */
```

The **ExtractIcon** function retrieves the handle of an icon from a specified executable file, dynamic-link library (DLL), or icon file.

Parameter	Description
hinst	Identifies the instance of the application calling the function.
lpszExeName	Points to a null-terminated string specifying the name of an executable file, dynamic-link library, or icon file.
iIcon	Specifies the index of the icon to be retrieved. If this parameter is zero, the function returns the handle of the first icon in the specified file. If the parameter is -1, the function returns the total number of icons in the specified file.

Returns

The return value is the handle of an icon if the function is successful. It is 1 if the file specified in the *lpszExeName* parameter is not an executable file, dynamic-link library, or icon file. Otherwise, it is NULL, indicating that the file contains no icons.

FindExecutable (3.1)

#include shellapi.h

HINSTANCE FindExecutable(*lpszFile, lpszDir, lpszResult***)**

```
LPCSTR lpszFile;      /* address of string for filename                */
LPCSTR lpszDir;       /* address of string for default directory       */
LPSTR lpszResult;     /* address of string for executable file on return */
```

The **FindExecutable** function finds and retrieves the executable filename that is associated with a specified filename.

Parameter	Description
lpszFile	Points to a null-terminated string specifying a filename. This can be a document or executable file.
lpszDir	Points to a null-terminated string specifying the drive letter and path for the default directory.
lpszResult	Points to a buffer that receives the name of an executable file when the function returns. This null-terminated string specifies the application that is started when the Open command is chosen from the File menu in File Manager.

Returns

The return value is greater than 32 if the function is successful. If the return value is less than or equal to 32, it specifies an error code.

Errors

The **FindExecutable** function returns 31 if there is no association for the specified file type. The other possible error values are as follows:

Value	Meaning
0	System was out of memory, executable file was corrupt, or relocations were invalid.
2	File was not found.
3	Path was not found.
5	Attempt was made to dynamically link to a task, or there was a sharing or network-protection error.
6	Library required separate data segments for each task.
8	There was insufficient memory to start the application.
10	Windows version was incorrect.
11	Executable file was invalid. Either it was not a Windows application or there was an error in the .EXE image.
12	Application was designed for a different operating system.
13	Application was designed for MS-DOS 4.0.
14	Type of executable file was unknown.
15	Attempt was made to load a real-mode application (developed for an earlier version of Windows).
16	Attempt was made to load a second instance of an executable file containing multiple data segments that were not marked read-only.
19	Attempt was made to load a compressed executable file. The file must be decompressed before it can be loaded.
20	Dynamic-link library (DLL) file was invalid. One of the DLLs required to run this application was corrupt.
21	Application requires Microsoft Windows 32-bit extensions.

Comments

The filename specified in the *lpszFile* parameter is associated with an executable file when an association has been registered between that file's filename extension and an executable file in the registration database. An application that produces files with a given filename extension typically associates the extension with an executable file when the application is installed.

See Also

RegQueryValue, **ShellExecute**

ShellExecute (3.1)

#include shellapi.h

HINSTANCE ShellExecute(*hwnd, lpszOp, lpszFile, lpszParams, lpszDir, fsShowCmd***)**

HWND *hwnd;*	/* handle of parent window	*/
LPCSTR *lpszOp;*	/* address of string for operation to perform	*/
LPCSTR *lpszFile;*	/* address of string for filename	*/
LPCSTR *lpszParams;*	/* address of string for executable-file parameters	*/
LPCSTR *lpszDir;*	/* address of string for default directory	*/
int *fsShowCmd;*	/* whether file is shown when opened	*/

The **ShellExecute** function opens or prints the specified file.

Parameter	Description
hwnd	Identifies the parent window. This window receives any message boxes an application produces (for example, for error reporting).
lpszOp	Points to a null-terminated string specifying the operation to perform. This string can be "open" or "print". If this parameter is NULL, "open" is the default value.
lpszFile	Points to a null-terminated string specifying the file to open.
lpszParams	Points to a null-terminated string specifying parameters passed to the application when the *lpszFile* parameter specifies an executable file. If *lpszFile* points to a string specifying a document file, this parameter is NULL.
lpszDir	Points to a null-terminated string specifying the default directory.
fsShowCmd	Specifies whether the application window is to be shown when the application is opened. This parameter can be one of the following values:

Value	Meaning
SW_HIDE	Hides the window and passes activation to another window.
SW_MINIMIZE	Minimizes the specified window and activates the top-level window in the system's list.
SW_RESTORE	Activates and displays a window. If the window is minimized or maximized, Windows restores it to its original size and position (same as SW_SHOWNORMAL).
SW_SHOW	Activates a window and displays it in its current size and position.
SW_SHOWMAXIMIZED	Activates a window and displays it as a maximized window.
SW_SHOWMINIMIZED	Activates a window and displays it as an icon.
SW_SHOWMINNOACTIVE	Displays a window as an icon. The window that is currently active remains active.
SW_SHOWNA	Displays a window in its current state. The window that is currently active remains active.
SW_SHOWNOACTIVATE	Displays a window in its most recent size and position. The window that is currently active remains active.
SW_SHOWNORMAL	Activates and displays a window. If the window is minimized or maximized, Windows restores it to its original size and position (same as SW_RESTORE).

Returns

The return value is the instance handle of the application that was opened or printed, if the function is successful. (This handle could also be the handle of a DDE server application.) A return value less than or equal to 32 specifies an error. The possible error values are listed in the following Comments section.

Errors

The **ShellExecute** function returns the value 31 if there is no association for the specified file type or if there is no association for the specified action within the file type. The other possible error values are as follows:

Value	Meaning
0	System was out of memory, executable file was corrupt, or relocations were invalid.
2	File was not found.
3	Path was not found.
5	Attempt was made to dynamically link to a task, or there was a sharing or network-protection error.
6	Library required separate data segments for each task.
8	There was insufficient memory to start the application.
10	Windows version was incorrect.
11	Executable file was invalid. Either it was not a Windows application or there was an error in the .EXE image.
12	Application was designed for a different operating system.
13	Application was designed for MS-DOS 4.0.
14	Type of executable file was unknown.
15	Attempt was made to load a real-mode application (developed for an earlier version of Windows).
16	Attempt was made to load a second instance of an executable file containing multiple data segments that were not marked read-only.
19	Attempt was made to load a compressed executable file. The file must be decompressed before it can be loaded.
20	Dynamic-link library (DLL) file was invalid. One of the DLLs required to run this application was corrupt.
21	Application requires Microsoft Windows 32-bit extensions.

Comments

The file specified by the *lpszFile* parameter can be a document file or an executable file. If it is a document file, this function opens or prints it, depending on the value of the *lpszOp* parameter. If it is an executable file, this function opens it, even if the string "print" is pointed to by *lpszOp.*

See Also

FindExecutable

Shell functions (3.1)

ExtractIcon	Retrieves the handle of an icon from an executable file
FindExecutable	Retrieves executable filename for a specified file
ShellExecute	Opens or prints the specified file

AllocDiskSpace (3.1)

#include stress.h

int AllocDiskSpace(*lLeft, uDrive***)**

```
long lLeft;        /* number of bytes left available */
UINT uDrive;       /* disk partition                 */
```

The **AllocDiskSpace** function creates a file that is large enough to ensure that the specified amount of space or less is available on the specified disk partition. The file, called STRESS.EAT, is created in the root directory of the disk partition.

If STRESS.EAT already exists when **AllocDiskSpace** is called, the function deletes it and creates a new one.

Parameter	Description
lLeft	Specifies the number of bytes to leave available on the disk.
uDrive	Specifies the disk partition on which to create the STRESS.EAT file. This parameter must be one of the following values:

Value	Meaning
EDS_WIN	Creates the file on the Windows partition.
EDS_CUR	Creates the file on the current partition.
EDS_TEMP	Creates the file on the partition that contains the TEMP directory.

Returns

The return value is greater than zero if the function is successful; it is zero if the function could not create a file; or it is -1 if at least one of the parameters is invalid.

Comments

In two situations, the amount of free space left on the disk may be less than the number of bytes specified in the *lLeft* parameter: when the amount of free space on the disk is less than the number in *lLeft* when an application calls **AllocDiskSpace**, or when the value of *lLeft* is not an exact multiple of the disk cluster size.

The **UnAllocDiskSpace** function deletes the file created by **AllocDiskSpace**.

See Also

UnAllocDiskSpace

AllocFileHandles (3.1)

#include stress.h

int AllocFileHandles(*Left***)**

int *Left;* /* number of file handles to leave available */

The **AllocFileHandles** function allocates file handles until only the specified number of file handles is available to the current instance of the application. If this or a smaller number of handles is available when an application calls **AllocFileHandles**, the function returns immediately.

Before allocating new handles, this function frees any handles previously allocates by **AllocFileHandles**.

Parameter	Description
Left	Specifies the number of file handles to leave available.

Returns

The return value is greater than zero if **AllocFileHandles** successfully allocates at least one file handle. The return value is zero if fewer than the specified number of file handles were available when the application called **AllocFileHandles**. The return value is -1 if the *Left* parameter is negative.

Comments

AllocFileHandles will not allocate more than 256 file handles, regardless of the number available to the application.

The **UnAllocFileHandles** function frees all file handles previously allocated by **AllocFileHandles**.

See Also

UnAllocFileHandles

AllocGDIMem (3.1)

#include stress.h

BOOL AllocGDIMem(*uLeft***)**

UINT *uLeft;* /* number of bytes to leave available */

The **AllocGDIMem** function allocates memory in the graphics device interface (GDI) heap until only the specified number of bytes is available. Before making any new memory allocations, this function frees memory previously allocated by **AllocGDIMem**.

Parameter	Description
uLeft	Specifies the amount of memory, in bytes, to leave available in the GDI heap.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **FreeAllGDIMem** function frees all memory allocated by **AllocGDIMem**.

See Also

FreeAllGDIMem

AllocMem (3.1)

#include stress.h

BOOL AllocMem(*dwLeft***)**

DWORD *dwLeft;* /*smallest memory allocation */

The **AllocMem** function allocates global memory until only the specified number of bytes is available in the global heap. Before making any new memory allocations, this function frees memory previously allocated by **AllocMem**.

Parameter	Description
dwLeft	Specifies the smallest size, in bytes, of memory allocations to make.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **FreeAllMem** function frees all memory allocated by **AllocMem**.

See Also

FreeAllMem

AllocUserMem (3.1)

#include stress.h

BOOL AllocUserMem(*uContig***)**

UINT *uContig;* /* smallest memory allocation */

The **AllocUserMem** function allocates memory in the USER heap until only the specified number of bytes is available. Before making any new allocations, this function frees memory previously allocated by **AllocUserMem**.

Parameter	Description
uContig	Specifies the smallest size, in bytes, of memory allocations to make.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **FreeAllUserMem** function frees all memory allocated by **AllocUserMem**.

See Also

FreeAllUserMem

FreeAllGDIMem (3.1)

#include stress.h

void FreeAllGDIMem(void)

The **FreeAllGDIMem** function frees all memory allocated by the **AllocGDIMem** function.

Returns
This function does not return a value.

See Also
AllocGDIMem

FreeAllMem (3.1)

#include stress.h

void FreeAllMem(void)

The **FreeAllMem** function frees all memory allocated by the **AllocMem** function.

Returns
This function does not return a value.

See Also
AllocMem

FreeAllUserMem (3.1)

#include stress.h

void FreeAllUserMem(void)

The **FreeAllUserMem** function frees all memory allocated by the **AllocUserMem** function.

Returns
This function does not return a value.

See Also
AllocUserMem

GetFreeFileHandles (3.1)

#include stress.h

int GetFreeFileHandles(void)

The **GetFreeFileHandles** function returns the number of file handles available to the current instance.

Returns

The return value is the number of file handles available to the current instance.

UnAllocDiskSpace (3.1)

#include stress.h

void UnAllocDiskSpace(*drive***)**

UINT *drive;*

The **UnAllocDiskSpace** function deletes the STRESS.EAT file from the root directory of the specified drive. This frees the disk space previously consumed by the **AllocDiskSpace** function.

Parameter	Description
drive	Specifies the disk partition on which to delete the STRESS.EAT file. This can be one of the following values:

Value	Meaning
EDS_WIN	Deletes the file on the Windows partition.
EDS_CUR	Deletes the file on the current partition.
EDS_TEMP	Deletes the file on the partition that contains the TEMP directory.

Returns

This function does not return a value.

See Also

AllocDiskSpace

UnAllocFileHandles (3.1)

#include stress.h

void UnAllocFileHandles(void)

The **UnAllocFileHandles** function frees all file handles allocated by the **AllocFileHandles** function.

Returns
This function does not return a value.

See Also
AllocFileHandles

Stress Functions (3.1)

AllocDiskSpace	Creates a file to consume space on a disk partition
AllocFileHandles	Allocates up to 256 file handles
AllocGDIMem	Allocates memory in the GDI heap
AllocMem	Allocates global memory
AllocUserMem	Allocates memory in the USER heap
FreeAllGDIMem	Frees all memory allocated by the AllocGDIMem function
FreeAllMem	Frees all memory allocated by the AllocMem function
FreeAllUserMem	Frees all memory allocated by the AllocUserMem function
GetFreeFileHandles	Returns the number of free file handles
UnAllocDiskSpace	Deletes file created by AllocDiskSpace and frees space
UnAllocFileHandles	Frees file handles allocated by AllocFileHandles

ABC (3.1)

```
typedef struct tagABC {   /* abc */
    int   abcA;
    UINT  abcB;
    int   abcC;
} ABC;
```

The **ABC** structure contains the width of a character in a TrueType font.

Member	Description
abcA	Specifies the "A" spacing of the character. A spacing is the distance to add to the current position before drawing the character glyph.
abcB	Specifies the "B" spacing of the character. B spacing is the width of the drawn portion of the character glyph.
abcC	Specifies the "C" spacing of the character. C spacing is the distance to add to the current position to provide white space to the right of the character glyph.

Comments

The total width of a character is the sum of the A, B, and C spaces. Either the A or the C space can be negative, to indicate underhangs or overhangs.

See Also

GetCharABCWidths

BITMAP (2.x)

```
typedef struct tagBITMAP {  /* bm */
    int     bmType;
    int     bmWidth;
    int     bmHeight;
    int     bmWidthBytes;
    BYTE    bmPlanes;
    BYTE    bmBitsPixel;
    void FAR* bmBits;
} BITMAP;
```

The **BITMAP** structure defines the height, width, color format, and bit values of a logical bitmap.

Member	Description
bmType	Specifies the bitmap type. For logical bitmaps, this member must be zero.
bmWidth	Specifies the width of the bitmap, in pixels. The width must be greater than zero.
bmHeight	Specifies the height of the bitmap, in raster lines. The height must be greater than zero.
bmWidthBytes	Specifies the number of bytes in each raster line. This value must be an even number since graphics device interface (GDI) assumes that the bit values of a bitmap form an array of integer (two-byte) values. In other words, **bmWidthBytes** * 8 must be the next multiple of 16 greater than or equal to the value obtained when the **bmWidth** member is multiplied by the **bmBitsPixel** member.
bmPlanes	Specifies the number of color planes in the bitmap.
bmBitsPixel	Specifies the number of adjacent color bits on each plane needed to define a pixel.
bmBits	Points to the location of the bit values for the bitmap. The **bmBits** member must be a long pointer to an array of one-byte values.

Comments

The currently used bitmap formats are monochrome and color. The monochrome bitmap uses a one-bit, one-plane format. Each scan is a multiple of 16 bits.

Scans are organized as follows for a monochrome bitmap of height *n:*

```
Scan 0
Scan 1
.
.
.
Scan n-2
Scan n-1
```

The pixels on a monochrome device are either black or white. If the corresponding bit in the bitmap is 1, the pixel is turned on (white). If the corresponding bit in the bitmap is zero, the pixel is turned off (black).

All devices support bitmaps that have the RC_BITBLT bit set in the RASTERCAPS index of the **GetDeviceCaps** function.

Each device has its own unique color format. In order to transfer a bitmap from one device to another, use the **GetDIBits** and **SetDIBits** functions.

See Also

CreateBitmapIndirect, **GetDIBits**, **GetObject**, **SetDIBits**

BITMAPCOREHEADER (3.0)

```
typedef struct tagBITMAPCOREHEADER {    /* bmch */
    DWORD   bcSize;
    short   bcWidth;
    short   bcHeight;
    WORD    bcPlanes;
    WORD    bcBitCount;
} BITMAPCOREHEADER;
```

The **BITMAPCOREHEADER** structure contains information about the dimensions and color format of a device-independent bitmap (DIB). Windows applications should use the **BITMAPINFOHEADER** structure instead of **BITMAPCOREHEADER** whenever possible.

Member	Description
bcSize	Specifies the number of bytes required by the **BITMAPCOREHEADER** structure.
bcWidth	Specifies the width of the bitmap, in pixels.
bcHeight	Specifies the height of the bitmap, in pixels.
bcPlanes	Specifies the number of planes for the target device. This member must be set to 1.
bcBitCount	Specifies the number of bits per pixel. This value must be 1, 4, 8, or 24.

Comments

The **BITMAPCOREINFO** structure combines the **BITMAPCOREHEADER** structure and a color table to provide a complete definition of the dimensions and colors of a DIB. See the description of the **BITMAPCOREINFO** structure for more information about specifying a DIB.

An application should use the information stored in the **bcSize** member to locate the color table in a **BITMAPCOREINFO** structure with a method such as the following:

```
lpColor = ((LPSTR) pBitmapCoreInfo + (UINT) (pBitmapCoreInfo->bcSize))
```

See Also

BITMAPCOREINFO, **BITMAPINFOHEADER**, **BITMAPINFOHEADER**

BITMAPCOREINFO (3.0)

```
typedef struct tagBITMAPCOREINFO {  /* bmci */
    BITMAPCOREHEADER bmciHeader;
    RGBTRIPLE        bmciColors[1];
} BITMAPCOREINFO;
```

The **BITMAPCOREINFO** structure fully defines the dimensions and color information for a device-independent bitmap (DIB). Windows applications should use the **BITMAPINFO** structure instead of **BITMAPCOREINFO** whenever possible.

Member	Description
bmciHeader	Specifies a **BITMAPCOREHEADER** structure that contains information about the dimensions and color format of a DIB.
bmciColors	Specifies an array of **RGBTRIPLE** structures that define the colors in the bitmap.

Comments

The **BITMAPCOREINFO** structure describes the dimensions and colors of a bitmap. It is followed immediately in memory by an array of bytes which define the pixels of the bitmap. The bits in the array are packed together, but each scan line must be zero-padded to end on a **LONG** boundary. Segment boundaries, however, can appear anywhere in the bitmap. The origin of the bitmap is the lower-left corner.

The **bcBitCount** member of the **BITMAPCOREHEADER** structure determines the number of bits that define each pixel and the maximum number of colors in the bitmap. This member may be set to any of the following values:

Value	Meaning
1	The bitmap is monochrome, and the **bmciColors** member must contain two entries. Each bit in the bitmap array represents a pixel. If the bit is clear, the pixel is displayed with the color of the first entry in the **bmciColors** table. If the bit is set, the pixel has the color of the second entry in the table.
4	The bitmap has a maximum of 16 colors, and the **bmciColors** member contains 16 entries. Each pixel in the bitmap is represented by a four-bit index into the color table. For example, if the first byte in the bitmap is 0x1F, the byte represents two pixels. The first pixel contains the color in the second table entry, and the second pixel contains the color in the sixteenth table entry.
8	The bitmap has a maximum of 256 colors, and the **bmciColors** member contains 256 entries. In this case, each byte in the array represents a single pixel.
24	The bitmap has a maximum of 2^24 colors. The **bmciColors** member is NULL, and each 3-byte sequence in the bitmap array represents the relative intensities of red, green, and blue, respectively, of a pixel.

The colors in the **bmciColors** table should appear in order of importance.

Alternatively, for functions that use DIBs, the **bmciColors** member can be an array of 16-bit unsigned integers that specify an index into the currently realized logical palette instead of explicit **RGB** values. In this case, an application using the bitmap must call DIB functions with the *wUsage* parameter set to DIB_PAL_COLORS.

Note: The **bmciColors** member should not contain palette indexes if the bitmap is to be stored in a file or transferred to another application. Unless the application uses the bitmap exclusively and under its complete control, the bitmap color table should contain explicit **RGB** values.

See Also

BITMAPINFO, **BITMAPCOREHEADER**, **RGBTRIPLE**

BITMAPFILEHEADER (3.0)

```
typedef struct tagBITMAPFILEHEADER {    /* bmfh */
    UINT    bfType;
    DWORD   bfSize;
    UINT    bfReserved1;
    UINT    bfReserved2;
    DWORD   bfOffBits;
} BITMAPFILEHEADER;
```

The **BITMAPFILEHEADER** structure contains information about the type, size, and layout of a device-independent bitmap (DIB) file.

Member	Description
bfType	Specifies the type of file. This member must be BM.
bfSize	Specifies the size of the file, in bytes.
bfReserved1	Reserved; must be set to zero.
bfReserved2	Reserved; must be set to zero.
bfOffBits	Specifies the byte offset from the **BITMAPFILEHEADER** structure to the actual bitmap data in the file.

Comments

A **BITMAPINFO** or **BITMAPCOREINFO** structure immediately follows the **BITMAPFILEHEADER** structure in the DIB file.

See Also

BITMAPCOREINFO, **BITMAPINFO**

Corrections

The previous documentation stated that the **bfSize** member specifies the size of the file in **DWORD**s. This was wrong; **bfSize** specifies the size of the file in bytes.

BITMAPINFO (3.0)

```
typedef struct tagBITMAPINFO {  /* bmi */
    BITMAPINFOHEADER    bmiHeader;
    RGBQUAD             bmiColors[1];
} BITMAPINFO;
```

The **BITMAPINFO** structure fully defines the dimensions and color information for a Windows 3.0 or later device-independent bitmap (DIB).

Member	Description
bmiHeader	Specifies a **BITMAPINFOHEADER** structure that contains information about the dimensions and color format of a DIB.
bmiColors	Specifies an array of **RGBQUAD** structures that define the colors in the bitmap.

Comments

A Windows 3.0 or later DIB consists of two distinct parts: a **BITMAPINFO** structure, which describes the dimensions and colors of the bitmap, and an array of bytes defining the pixels of the bitmap. The bits in the array are packed together, but each scan line must be zero-padded to end on a **LONG** boundary. Segment boundaries, however, can appear anywhere in the bitmap. The origin of the bitmap is the lower-left corner.

The **biBitCount** member of the **BITMAPINFOHEADER** structure determines the number of bits which define each pixel and the maximum number of colors in the bitmap. This member may be set to any of the following values:

Value	Meaning
1	The bitmap is monochrome, and the **bmciColors** member must contain two entries. Each bit in the bitmap array represents a pixel. If the bit is clear, the pixel is displayed with the color of the first entry in the **bmciColors** table. If the bit is set, the pixel has the color of the second entry in the table.
4	The bitmap has a maximum of 16 colors, and the **bmciColors** member contains 16 entries. Each pixel in the bitmap is represented by a four-bit index into the color table. For example, if the first byte in the bitmap is 0x1F, the byte represents two pixels. The first pixel contains the color in the second table entry, and the second pixel contains the color in the sixteenth table entry.
8	The bitmap has a maximum of 256 colors, and the **bmciColors** member contains 256 entries. In this case, each byte in the array represents a single pixel.
24	The bitmap has a maximum of 2^24 colors. The **bmciColors** member is NULL, and each 3-byte sequence in the bitmap array represents the relative intensities of red, green, and blue, respectively, of a pixel.

The **biClrUsed** member of the **BITMAPINFOHEADER** structure specifies the number of color indexes in the color table actually used by the bitmap. If the **biClrUsed** member is set to zero, the bitmap uses the maximum number of colors corresponding to the value of the **biBitCount** member.

The colors in the **bmiColors** table should appear in order of importance.

Alternatively, for functions that use DIBs, the **bmiColors** member can be an array of 16-bit unsigned integers that specify an index into the currently realized logical palette instead of explicit **RGB** values. In this case, an application using the bitmap must call DIB functions with the *wUsage* parameter set to DIB_PAL_COLORS.

Note: The **bmiColors** member should not contain palette indexes if the bitmap is to be stored in a file or transferred to another application. Unless the application uses the bitmap exclusively and under its complete control, the bitmap color table should contain explicit **RGB** values.

See Also

BITMAPINFOHEADER, **RGBQUAD**

BITMAPINFOHEADER (3.0)

```
typedef struct tagBITMAPINFOHEADER {    /* bmih */
    DWORD   biSize;
    LONG    biWidth;
    LONG    biHeight;
    WORD    biPlanes;
    WORD    biBitCount;
    DWORD   biCompression;
    DWORD   biSizeImage;
    LONG    biXPelsPerMeter;
    LONG    biYPelsPerMeter;
    DWORD   biClrUsed;
    DWORD   biClrImportant;
} BITMAPINFOHEADER;
```

The **BITMAPINFOHEADER** structure contains information about the dimensions and color format of a Windows 3.0 or later device-independent bitmap (DIB).

Member	Description
biSize	Specifies the number of bytes required by the **BITMAPINFOHEADER** structure.
biWidth	Specifies the width of the bitmap, in pixels.
biHeight	Specifies the height of the bitmap, in pixels.
biPlanes	Specifies the number of planes for the target device. This member must be set to 1.
biBitCount	Specifies the number of bits per pixel. This value must be 1, 4, 8, or 24.
biCompression	Specifies the type of compression for a compressed bitmap. It can be one of the following values:

Value	Meaning
BI_RGB	Specifies that the bitmap is not compressed.
BI_RLE8	Specifies a run-length encoded format for bitmaps with 8 bits per pixel. The compression format is a 2-byte format consisting of a count byte followed by a byte containing a color index. For more information, see the following Comments section.
BI_RLE4	Specifies a run-length encoded format for bitmaps with 4 bits per pixel. The compression format is a 2-byte format consisting of a count byte followed by two word-length color indexes. For more information, see the following Comments section.

biSizeImage	Specifies the size, in bytes, of the image. It is valid to set this member to zero if the bitmap is in the BI_RGB format.
biXPelsPerMeter	Specifies the horizontal resolution, in pixels per meter, of the target device for the bitmap. An application can use this value to select a bitmap from a resource group that best matches the characteristics of the current device.
biYPelsPerMeter	Specifies the vertical resolution, in pixels per meter, of the target device for the bitmap.
biClrUsed	Specifies the number of color indexes in the color table actually used by the bitmap. If this value is zero, the bitmap uses the maximum number of colors corresponding to the value of the **biBitCount** member. For more information on the maximum sizes of the color table, see the description of the **BITMAPINFO** structure earlier in this topic. If the **biClrUsed** member is nonzero, it specifies the actual number of colors that the graphics engine or device driver will access if the **biBitCount** member is less than 24. If **biBitCount** is set to 24, **biClrUsed** specifies the size of the

	reference color table used to optimize performance of Windows color palettes. If the bitmap is a packed bitmap (that is, a bitmap in which the bitmap array immediately follows the **BITMAPINFO** header and which is referenced by a single pointer), the **biClrUsed** member must be set to zero or to the actual size of the color table.
biClrImportant	Specifies the number of color indexes that are considered important for displaying the bitmap. If this value is zero, all colors are important.

Comments

The **BITMAPINFO** structure combines the **BITMAPINFOHEADER** structure and a color table to provide a complete definition of the dimensions and colors of a Windows 3.0 or later DIB. For more information about specifying a Windows 3.0 DIB, see the description of the **BITMAPINFO** structure.

An application should use the information stored in the **biSize** member to locate the color table in a **BITMAPINFO** structure as follows:

```
pColor = ((LPSTR) pBitmapInfo + (WORD) (pBitmapInfo->bmiHeader.biSize))
```

Windows supports formats for compressing bitmaps that define their colors with 8 bits per pixel and with 4 bits per pixel. Compression reduces the disk and memory storage required for the bitmap. The following paragraphs describe these formats.

BI_RLE8

When the **biCompression** member is set to BI_RLE8, the bitmap is compressed using a run-length encoding format for an 8-bit bitmap. This format may be compressed in either of two modes: encoded and absolute. Both modes can occur anywhere throughout a single bitmap.

Encoded mode consists of two bytes: the first byte specifies the number of consecutive pixels to be drawn using the color index contained in the second byte. In addition, the first byte of the pair can be set to zero to indicate an escape that denotes an end of line, end of bitmap, or a delta. The interpretation of the escape depends on the value of the second byte of the pair. The following list shows the meaning of the second byte:

Value	Meaning
0	End of line.
1	End of bitmap.
2	Delta. The two bytes following the escape contain unsigned values indicating the horizontal and vertical offset of the next pixel from the current position.

Absolute mode is signaled by the first byte set to zero and the second byte set to a value between 0x03 and 0xFF. In absolute mode, the second byte represents the number of bytes that follow, each of which contains the color index of a single pixel. When the second byte is set to 2 or less, the escape has the same meaning as in encoded mode. In absolute mode, each run must be aligned on a word boundary.

The following example shows the hexadecimal values of an 8-bit compressed bitmap:

```
03 04 05 06 00 03 45 56 67 00 02 78 00 02 05 01
02 78 00 00 09 1E 00 01
```

This bitmap would expand as follows (two-digit values represent a color index for a single pixel):

```
04 04 04
06 06 06 06 06
45 56 67
78 78
move current position 5 right and 1 down
78 78
end of line
```

```
1E 1E 1E 1E 1E 1E 1E 1E 1E
end of RLE bitmap
```

BI_RLE4

When the **biCompression** member is set to BI_RLE4, the bitmap is compressed using a run-length encoding (RLE) format for a 4-bit bitmap, which also uses encoded and absolute modes. In encoded mode, the first byte of the pair contains the number of pixels to be drawn using the color indexes in the second byte. The second byte contains two color indexes, one in its high-order nibble (that is, its low-order four bits) and one in its low-order nibble. The first of the pixels is drawn using the color specified by the high-order nibble, the second is drawn using the color in the low-order nibble, the third is drawn with the color in the high-order nibble, and so on, until all the pixels specified by the first byte have been drawn.

In absolute mode, the first byte contains zero, the second byte contains the number of color indexes that follow, and subsequent bytes contain color indexes in their high- and low-order nibbles, one color index for each pixel. In absolute mode, each run must be aligned on a word boundary. The end-of-line, end-of-bitmap, and delta escapes also apply to BI_RLE4.

The following example shows the hexadecimal values of a 4-bit compressed bitmap:

```
03 04 05 06 00 06 45 56 67 00 04 78 00 02 05 01
04 78 00 00 09 1E 00 01
```

This bitmap would expand as follows (single-digit values represent a color index for a single pixel):

```
0 4 0
0 6 0 6 0
4 5 5 6 6 7
7 8 7 8
move current position 5 right and 1 down
7 8 7 8
end of line
1 E 1 E 1 E 1 E 1
end of RLE bitmap
```

See Also
BITMAPINFO

CBT_CREATEWND (3.1)

```
typedef struct tagCBT_CREATEWND {   /* cbtcw */
    CREATESTRUCT FAR* lpcs;
    HWND              hwndInsertAfter;
} CBT_CREATEWND;
```

The **CBT_CREATEWND** structure contains information passed to a **WH_CBT** hook function before a window is created.

Member	Description
lpcs	Points to a **CREATESTRUCT** structure that contains initialization parameters for the window about to be created.
hwndInsertAfter	Identifies a window in the window manager's list that will precede the window being created. If this parameter is NULL, the window being created is the topmost window. If this parameter is 1, the window being created is the bottommost window.

See Also
CBTProc, **SetWindowsHook**

CBTACTIVATESTRUCT (3.1)

```
typedef struct tagCBTACTIVATESTRUCT { /* cas */
    BOOL    fMouse;
    HWND    hWndActive;
} CBTACTIVATESTRUCT;
```

The **CBTACTIVATESTRUCT** structure contains information passed to a **WH_CBT** hook function before a window is activated.

Member	Description
fMouse	Specifies whether the window is being activated as a result of a mouse click. This value is nonzero if a mouse click is causing the activation. Otherwise, this value is zero.
hWndActive	Identifies the currently active window.

See Also
SetWindowsHook

CHOOSECOLOR (3.1)

```
#include <commdlg.h>

typedef struct tagCHOOSECOLOR {    /* cc */
    DWORD   lStructSize;
    HWND    hwndOwner;
    HWND    hInstance;
    COLORREF rgbResult;
    COLORREF FAR* lpCustColors;
    DWORD   Flags;
    LPARAM  lCustData;
    UINT    (CALLBACK* lpfnHook)(HWND, UINT, WPARAM, LPARAM);
    LPCSTR  lpTemplateName;
} CHOOSECOLOR;
```

The **CHOOSECOLOR** structure contains information that the system uses to initialize the system-defined Color dialog box. After the user chooses the OK button to close the dialog box, the system returns information about the user's selection in this structure.

Member	Description
lStructSize	Specifies the length of the structure, in bytes. This member is filled on input.
hwndOwner	Identifies the window that owns the dialog box. This member can be any valid window handle, or it should be NULL if the dialog box is to have no owner. If the CC_SHOWHELP flag is set, **hwndOwner** must identify the window that owns the dialog box. The window procedure for this owner window receives a notification message when the user chooses the Help button. (The identifier for the notification message is the value returned by the **RegisterWindowMessage** function when HELPMSGSTRING is passed as its argument.) This member is filled on input.
hInstance	Identifies a data block that contains the dialog box template specified by the **lpTemplateName** member. This member is used only if the **Flags** member specifies the CC_ENABLETEMPLATE or CC_ENABLETEMPLATEHANDLE flag; otherwise, this member is ignored. This member is filled on input.
rgbResult	Specifies the color that is initially selected when the dialog box is displayed, and specifies the user's color selection after the user has chosen the OK button to close dialog box. If the CC_RGBINIT flag is set in the **Flags** member before the dialog box is displayed and the value of this member is not among the colors available, the system selects the nearest solid color available. If this member is NULL, the first selected color is black. This member is filled on input and output.
lpCustColors	Points to an array of 16 doubleword values, each of which specifies the intensities of the red, green, and blue (**RGB**) components of a custom color box in the dialog box. If the user modifies a color, the system updates the array with the new RGB values. This member is filled on input and output.
Flags	Specifies the dialog box initialization flags. This member may be a combination of the following values:

Value	Meaning
CC_ENABLEHOOK	Enables the hook function specified in the **lpfnHook** member.
CC_ENABLETEMPLATE	Causes the system to use the dialog box template identified by the **hInstance** member and pointed to by the **lpTemplateName** member.

	CC_ENABLETEMPLATEHANDLE	Indicates that the **hInstance** member identifies a data block that contains a pre-loaded dialog box template. If this flag is specified, the system ignores the **lpTemplateName** member.
	CC_FULLOPEN	Causes the entire dialog box to appear when the dialog box is displayed, including the portion that allows the user to create custom colors. Without this flag, the user must select the Define Custom Color button to see that portion of the dialog box.
	CC_PREVENTFULLOPEN	Disables the Define Custom Colors button, preventing the user from creating custom colors.
	CC_RGBINIT	Causes the dialog box to use the color specified in the **rgbResult** member as the initial color selection.
	CC_SHOWHELP	Causes the dialog box to show the Help button. If this flag is specified, the **hwndOwner** member must not be NULL.

These flags are used when the structure is initialized.

lCustData Specifies application-defined data that the system passes to the hook function pointed to by the **lpfnHook** member. The system passes a pointer to the **CHOOSECOLOR** structure in the *lParam* parameter of the **WM_INITDIALOG** message; this pointer can be used to retrieve the **lCustData** member.

lpfnHook Points to a hook function that processes messages intended for the dialog box. To enable the hook function, an application must specify the CC_ENABLEHOOK value in the **Flags** member; otherwise, the system ignores this structure member. The hook function must return zero to pass a message that it didn't process back to the dialog box procedure in COMMDLG.DLL. The hook function must return a nonzero value to prevent the dialog box procedure in COMMDLG.DLL from processing a message it has already processed. This member is filled on input.

lpTemplateName Points to a null-terminated string that specifies the name of the resource file for the dialog box template that is to be substituted for the dialog box template in COMMDLG.DLL. An application can use the **MAKEINTRESOURCE** macro for numbered dialog box resources. This member is used only if the **Flags** member specifies the CC_ENABLETEMPLATE flag; otherwise, this member is ignored. This member is filled on input.

Comments

Some members of this structure are filled only when the dialog box is created, and some have an initialization value that changes when the user closes the dialog box. Whenever a description in the Members section does not specify how the value of a member is assigned, the value is assigned only when the dialog box is created.

See Also

ChooseColor, **MAKEINTRESOURCE**, **RGB**

CHOOSEFONT (3.1)

```
#include <commdlg.h>

typedef struct tagCHOOSEFONT {  /* cf */
    DWORD           lStructSize;
    HWND            hwndOwner;
    HDC             hDC;
    LOGFONT FAR*    lpLogFont;
    int             iPointSize;
    DWORD           Flags;
    COLORREF        rgbColors;
    LPARAM          lCustData;
    UINT (CALLBACK* lpfnHook)(HWND, UINT, WPARAM, LPARAM);
    LPCSTR          lpTemplateName;
    HINSTANCE       hInstance;
    LPSTR           lpszStyle;
    UINT            nFontType;
    int             nSizeMin;
    int             nSizeMax;

} CHOOSEFONT;
```

The **CHOOSEFONT** structure contains information that the system uses to initialize the system-defined Font dialog box. After the user chooses the OK button to close the dialog box, the system returns information about the user's selection in this structure.

Member	Description
lStructSize	Specifies the length of the structure, in bytes. This member is filled on input.
hwndOwner	Identifies the window that owns the dialog box. This member can be any valid window handle, or it should be NULL if the dialog box is to have no owner. If the CF_SHOWHELP flag is set, **hwndOwner** must identify the window that owns the dialog box. The window procedure for this owner window receives a notification message when the user chooses the Help button. (The identifier for the notification message is the value returned by the **RegisterWindowMessage** function when HELPMSGSTRING is passed as its argument.) This member is filled on input.
hDC	Identifies either the device context or the information context of the printer for which fonts are to be listed in the dialog box. This member is used only if the **Flags** member specifies the CF_PRINTERFONTS flag; otherwise, this member is ignored. This member is filled on input.
lpLogFont	Points to a **LOGFONT** structure. If an application initializes the members of this structure before calling **ChooseFont** and sets the CF_INITTOLOGFONTSTRUCT flag, the **ChooseFont** function initializes the dialog box with the font that is the closest possible match. After the user chooses the OK button to close the dialog box, the **ChooseFont** function sets the members of the **LOGFONT** structure based on the user's final selection. This member is filled on input and output.
iPointSize	Specifies the size of the selected font, in tenths of a point. The **ChooseFont** function sets this value after the user chooses the OK button to close the dialog box.
Flags	Specifies the dialog box initialization flags. This member can be a combination

of the following values:

Value	Meaning
CF_APPLY	Specifies that the **ChooseFont** function should enable the Apply button.
CF_ANSIONLY	Specifies that the **ChooseFont** function should limit font selection to those fonts that use the Windows character set. (If this flag is set, the user cannot select a font that contains only symbols.)
CF_BOTH	Causes the dialog box to list the available printer and screen fonts. The **hDC** member identifies either the device context or the information context associated with the printer.
CF_TTONLY	Specifies that the **ChooseFont** function should enumerate and allow the selection of only TrueType fonts.
CF_EFFECTS	Specifies that the **ChooseFont** function should enable strikeout, underline, and color effects. If this flag is set, the **lfStrikeOut** and **lfUnderline** members of the **LOGFONT** structure and the **rgbColors** member of the **CHOOSEFONT** structure can be set before calling **ChooseFont**. And, if this flag is not set, the **ChooseFont** function can set these members after the user chooses the OK button to close the dialog box.
CF_ENABLEHOOK	Enables the hook function specified in the **lpfnHook** member of this structure.
CF_ENABLETEMPLATE	Indicates that the **hInstance** member identifies a data block that contains the dialog box template pointed to by **lpTemplateName**.
CF_ENABLETEMPLATEHANDLE	Indicates that the **hInstance** member identifies a data block that contains a pre-loaded dialog box template. If this flag is specified, the system ignores the **lpTemplateName** member.
CF_FIXEDPITCHONLY	Specifies that the **ChooseFont** function should select only monospace fonts.
CF_FORCEFONTEXIST	Specifies that the **ChooseFont** function should indicate an error condition if the user attempts to select a font or font style that does not exist.

CF_INITTOLOGFONTSTRUCT	Specifies that the **ChooseFont** function should use the **LOGFONT** structure pointed to by **lpLogFont** to initialize the dialog box controls.
CF_LIMITSIZE	Specifies that the **ChooseFont** function should select only font sizes within the range specified by the **nSizeMin** and **nSizeMax** members.
CF_NOFACESEL	Specifies that there is no selection in the Font (face name) combo box. Applications use this flag to support multiple font selections. This flag is set on input and output.
CF_NOOEMFONTS	Specifies that the **ChooseFont** function should not allow vector-font selections. This flag has the same value as CF_NOVECTORFONTS.
CF_NOSIMULATIONS	Specifies that the **ChooseFont** function should not allow graphics-device-interface (GDI) font simulations.
CF_NOSIZESEL	Specifies that there is no selection in the Size combo box. Applications use this flag to support multiple size selections. This flag is set on input and output.
CF_NOSTYLESEL	Specifies that there is no selection in the Font Style combo box. Applications use this flag to support multiple style selections. This flag is set on input and output.
CF_NOVECTORFONTS	Specifies that the **ChooseFont** function should not allow vector-font selections. This flag has the same value as CF_NOOEMFONTS.
CF_PRINTERFONTS	Causes the dialog box to list only the fonts supported by the printer associated with the device context or information context that is identified by the **hDC** member.
CF_SCALABLEONLY	Specifies that the **ChooseFont** function should allow the selection of only scalable fonts. (Scalable fonts include vector fonts, some printer fonts, TrueType fonts, and fonts that are scaled by other algorithms or technologies.)
CF_SCREENFONTS	Causes the dialog box to list only the screen fonts supported by the system.
CF_SHOWHELP	Causes the dialog box to show the Help button. If this option is specified, the **hwndOwner** must not

		be NULL.
	CF_USESTYLE	Specifies that the **lpszStyle** member points to a buffer that contains a style-description string that the **ChooseFont** function should use to initialize the Font Style box. When the user chooses the OK button to close the dialog box, the **ChooseFont** function copies the style description for the user's selection to this buffer.
	CF_WYSIWYG	Specifies that the **ChooseFont** function should allow the selection of only fonts that are available on both the printer and the screen. If this flag is set, the CF_BOTH and CF_SCALABLEONLY flags should also be set.

These flags may be set when the structure is initialized, except where specified.

rgbColors

If the CF_EFFECTS flag is set, this member contains the red, green, and blue (**RGB**) values the **ChooseFont** function should use to set the text color. After the user chooses the OK button to close the dialog box, this member contains the RGB values of the color the user selected.

This member is filled on input and output.

lCustData

Specifies application-defined data that the application passes to the hook function. The system passes a pointer to the **CHOOSEFONT** data structure in the *lParam* parameter of the **WM_INITDIALOG** message; the **lCustData** member can be retrieved using this pointer.

lpfnHook

Points to a hook function that processes messages intended for the dialog box. To enable the hook function, an application must specify the CF_ENABLEHOOK value in the **Flags** member; otherwise, the system ignores this structure member. The hook function must return zero to pass a message that it didn't process back to the dialog box procedure in COMMDLG.DLL. The hook function must return a nonzero value to prevent the dialog box procedure in COMMDLG.DLL from processing a message it has already processed.

This member is filled on input.

lpTemplateName

Points to a null-terminated string that specifies the name of the resource file for the dialog box template to be substituted for the dialog box template in COMMDLG.DLL. An application can use the **MAKEINTRESOURCE** macro for numbered dialog box resources. This member is used only if the **Flags** member specifies the CF_ENABLETEMPLATE flag; otherwise, this member is ignored.

This member is filled on input.

hInstance

Identifies a data block that contains the dialog box template specified by the **lpTemplateName** member. This member is used only if the **Flags** member specifies the CF_ENABLETEMPLATE or the CF_ENABLETEMPLATEHANDLE flag; otherwise, this member is ignored.

This member is filled on input.

lpszStyle

Points to a buffer that contains a style-description string for the font. If the CF_USESTYLE flag is set, the **ChooseFont** function uses the data in this buffer to initialize the Font Style box. When the user chooses the OK button to close the dialog box, the **ChooseFont** function copies the string in the Font Style box into this buffer.

The buffer pointed to by **lpszStyle** must be at least LF_FACESIZE bytes long.

This member is filled on input and output.

nFontType Specifies the type of the selected font. This member can be one or more of the values in the following list:

Value	Meaning
BOLD_FONTTYPE	Specifies that the font is bold. This value applies only to TrueType fonts. This value corresponds to the value of the **ntmFlags** member of the **NEWTEXTMETRIC** structure.
ITALIC_FONTTYPE	Specifies that the font is italic. This value applies only to TrueType fonts. This value corresponds to the value of the **ntmFlags** member of the **NEWTEXTMETRIC** structure.
PRINTER_FONTTYPE	Specifies that the font is a printer font.
REGULAR_FONTTYPE	Specifies that the font is neither bold nor italic. This value applies only to TrueType fonts. This value corresponds to the value of the **ntmFlags** member of the **NEWTEXTMETRIC** structure.
SCREEN_FONTTYPE	Specifies that the font is a screen font.
SIMULATED_FONTTYPE	Specifies that the font is simulated by GDI. This is not set if the CF_NOSIMULATIONS flag is set.

nSizeMin Specifies the minimum point size that a user can select. The **ChooseFont** function will recognize this member only if the CF_LIMITSIZE flag is set.

This member is filled on input.

nSizeMax Specifies the maximum point size that a user can select. The **ChooseFont** function will recognize this member only if the CF_LIMITSIZE flag is set.

This member is filled on input.

See Also

ChooseFont, **LOGFONT**, **MAKEINTRESOURCE**

CLASSENTRY (3.1)

```
#include <toolhelp.h>

typedef struct tagCLASSENTRY {  /* ce */
    DWORD   dwSize;
    HMODULE hInst;
    char    szClassName[MAX_CLASSNAME + 1];
    WORD    wNext;
} CLASSENTRY;
```

The **CLASSENTRY** structure contains the name of a Windows class and a near pointer to the next class in the list. For more information about Windows classes, see the **GetClassInfo** function.

Member	Description
dwSize	Specifies the size of the **CLASSENTRY** structure, in bytes.
hInst	Identifies the instance handle of the task that owns the class. An application needs this handle to call **GetClassInfo**. The **hInst** member is really a handle to a module, since Windows classes are owned by modules. Therefore, this **hInst** will not match the **hInst** passed as a parameter to the **WinMain** function of the owning task.
szClassName	Specifies the null-terminated string that contains the class name. An application needs this name to call **GetClassInfo**.
wNext	Specifies the next class in the list. This member is reserved for internal use by Windows.

See Also
ClassFirst, **ClassNext**, **GetClassInfo**

CLIENTCREATESTRUCT (3.0)

```
typedef struct tagCLIENTCREATESTRUCT {  /* ccs */
    HANDLE  hWindowMenu;
    UINT    idFirstChild;
} CLIENTCREATESTRUCT;
```

The **CLIENTCREATESTRUCT** structure contains information about the menu and first multiple document interface (MDI) child window of an MDI client window. An application passes a long pointer to this structure as the *lpParam* parameter of the **CreateWindow** function when creating an MDI client window.

Member	Description
hWindowMenu	Identifies the menu handle of the application's Window menu. An application can retrieve this handle from the menu of the MDI frame window by using the **GetSubMenu** function.
idFirstChild	Specifies the child window identifier of the first MDI child window created. Windows increments the identifier for each additional MDI child window that the application creates, and reassigns identifiers when the application destroys a window to keep the range of identifiers continuous. These identifiers are used in **WM_COMMAND** messages to the application's MDI frame window when a child window is selected from the Window menu; they should not conflict with any other command identifiers.

See Also
CreateWindow, **GetSubMenu**

COMPAREITEMSTRUCT (3.0)

```
typedef struct tagCOMPAREITEMSTRUCT {   /* cis */
    UINT  CtlType;
    UINT  CtlID;
    HWND  hwndItem;
    UINT  itemID1;
    DWORD itemData1;
    UINT  itemID2;
    DWORD itemData2;
} COMPAREITEMSTRUCT;
```

The **COMPAREITEMSTRUCT** structure supplies the identifiers and application-supplied data for two items in a sorted owner-drawn combo box or list box.

Whenever an application adds a new item to an owner-drawn combo or list box created with the **CBS_SORT** or **LBS_SORT** style, Windows sends the owner a **WM_COMPAREITEM** message. The *lParam* parameter of the message contains a long pointer to a **COMPAREITEMSTRUCT** structure. When the owner receives the message, it compares the two items and returns a value indicating which item sorts before the other.

Member	Description
CtlType	Specifies ODT_LISTBOX (which identifies an owner-drawn list box) or ODT_COMBOBOX (which identifies an owner-drawn combo box).
CtlID	Specifies the identifier of the list box or combo box.
hwndItem	Identifies the control.
itemID1	Specifies the index of the first item in the list box or combo box being compared.
itemData1	Specifies application-supplied data for the first item being compared. (This value was passed as the *lParam* parameter of the message that added the item to the combo box or list box.)
itemID2	Specifies the index of the second item in the list box or combo box being compared.
itemData2	Specifies application-supplied data for the second item being compared. This value was passed as the *lParam* parameter of the message that added the item to the combo box or list box.

See Also
WM_COMPAREITEM

COMSTAT (3.1)

```
typedef struct tagCOMSTAT {    /* cmst                                  */
    BYTE status;
    UINT cbInQue;
    UINT cbOutQue;
} COMSTAT;
```

The **COMSTAT** structure contains information about a communications device.

Member	Description
status	Specifies the status of the transmission. This member can be one or more of the following flags:

Flag	Meaning
CSTF_CTSHOLD	Specifies whether transmission is waiting for the CTS (clear-to-send) signal to be sent.
CSTF_DSRHOLD	Specifies whether transmission is waiting for the DSR (data-set-ready) signal to be sent.
CSTF_RLSDHOLD	Specifies whether transmission is waiting for the RLSD (receive-line-signal-detect) signal to be sent.
CSTF_XOFFHOLD	Specifies whether transmission is waiting as a result of the XOFF character being received.
CSTF_XOFFSENT	Specifies whether transmission is waiting as a result of the XOFF character being transmitted. Transmission halts when the XOFF character is transmitted and used by systems that take the next character as XON, regardless of the actual character.
CSTF_EOF	Specifies whether the end-of-file (EOF) character has been received.
CSTF_TXIM	Specifies whether a character is waiting to be transmitted.

cbInQue	Specifies the number of characters in the receive queue.
cbOutQue	Specifies the number of characters in the transmit queue.

See Also

GetCommError

CONVCONTEXT (3.1)

```
#include <ddeml.h>

typedef struct tagCONVCONTEXT {  /* cc */
    UINT        cb;
    UINT        wFlags;
    UINT        wCountryID;
    int         iCodePage;
    DWORD       dwLangID;
    DWORD       dwSecurity;
} CONVCONTEXT;
```

The **CONVCONTEXT** structure contains information that makes it possible for applications to share data in several different languages.

Member	Description
cb	Specifies the size, in bytes, of the **CONVCONTEXT** structure.
wFlags	Specifies conversation-context flags. Currently, no flags are defined for this member.
wCountryID	Specifies the country-code identifier for topic-name and item-name strings.
iCodePage	Specifies the code page for topic-name and item-name strings. Unilingual clients should set this member to CP_WINANSI. An application that uses the OEM character set should set this member to the value returned by the **GetKBCodePage** function.
dwLangID	Specifies the language identifier for topic-name and item-name strings.
dwSecurity	Specifies a private (application-defined) security code.

See Also
GetKBCodePage

CONVINFO (3.1)

```
#include <ddeml.h>

typedef struct tagCONVINFO { /* ci */
    DWORD   cb;
    DWORD   hUser;
    HCONV   hConvPartner;
    HSZ     hszSvcPartner;
    HSZ     hszServiceReq;
    HSZ     hszTopic;
    HSZ     hszItem;
    UINT    wFmt;
    UINT    wType;
    UINT    wStatus;
    UINT    wConvst;
    UINT    wLastError;
    HCONVLIST hConvList;
    CONVCONTEXT ConvCtxt;
} CONVINFO;
```

The **CONVINFO** structure contains information about a dynamic data exchange (DDE) conversation.

Member	Description
cb	Specifies the length of the structure, in bytes.
hUser	Identifies application-defined data.
hConvPartner	Identifies the partner application in the DDE conversation. If the partner has not registered itself (by using the **DdeInitialize** function) to make DDE Management Library (DDEML) function calls, this member is set to 0. An application should not pass this member to any DDEML function except **DdeQueryConvInfo**.
hszSvcPartner	Identifies the service name of the partner application.
hszServiceReq	Identifies the service name of the server application that was requested for connection.
hszTopic	Identifies the name of the requested topic.
hszItem	Identifies the name of the requested item. This member is transaction-specific.
wFmt	Specifies the format of the data being exchanged. This member is transaction-specific.
wType	Specifies the type of the current transaction. This member is transaction-specific and can be one of the following values:

Value	Meaning
XTYP_ADVDATA	Informs a client that advise data from a server has arrived.
XTYP_ADVREQ	Requests that a server send updated data to the client during an advise loop. This transaction results when the server calls the **DdePostAdvise** function.
XTYP_ADVSTART	Requests that a server begin an advise loop with a client.
XTYP_ADVSTOP	Notifies a server that an advise loop is ending.
XTYP_CONNECT	Requests that a server establish a conversation with a client.
XTYP_CONNECT_CONFIRM	Notifies a server that a conversation with a

	client has been established.
XTYP_DISCONNECT	Notifies a server that a conversation has terminated.
XTYP_ERROR	Notifies a DDEML application that a critical error has occurred. The DDEML may have insufficient resources to continue.
XTYP_EXECUTE	Requests that a server execute a command sent by a client.
XTYP_MONITOR	Notifies an application registered as APPCMD_MONITOR of DDE data being transmitted.
XTYP_POKE	Requests that a server accept unsolicited data from a client.
XTYP_REGISTER	Notifies other DDEML applications that a server has registered a service name.
XTYP_REQUEST	Requests that a server send data to a client.
XTYP_UNREGISTER	Notifies other DDEML applications that a server has unregistered a service name.
XTYP_WILDCONNECT	Requests that a server establish multiple conversations with the same client.
XTYP_XACT_COMPLETE	Notifies a client that an asynchronous data transaction has completed.

wStatus Specifies the status of the current conversation. This member can be a combination of the following values:

ST_ADVISE	ST_INLIST
ST_BLOCKED	ST_ISLOCAL
ST_BLOCKNEXT	ST_ISSELF
ST_CLIENT	ST_TERMINATED
ST_CONNECTED	

wConvst Specifies the conversation state. This member can be one of the following values:

Value	Meaning
XST_ADVACKRCVD	The advise transaction was just completed.
XST_ADVDATAACKRCVD	The advise data transaction was just completed.
XST_ADVDATASENT	Advise data has been sent and is awaiting an acknowledge.
XST_ADVSENT	An advise transaction is awaiting an acknowledge.
XST_CONNECTED	The conversation has no active transactions.
XST_DATARCVD	The requested data has just been received.
XST_EXECACKRCVD	An execute transaction just completed.
XST_EXECSENT	An execute transaction is awaiting an acknowledge.
XST_INCOMPLETE	The last transaction failed.
XST_INIT1	Mid-initiate state 1
XST_INIT2	Mid-initiate state 2
XST_NULL	Pre-initiate state
XST_POKEACKRCVD	A poke transaction was just completed.

	XST_POKESENT	A poke transaction is awaiting an acknowledge.
	XST_REQSENT	A request transaction is awaiting an acknowledge.
	XST_UNADVACKRCVD	An unadvise transaction just completed.
	XST_UNADVSENT	An unadvise transaction is awaiting an acknowledge.
wLastError	Specifies the error value associated with the last transaction.	
hConvList	If the handle of the current conversation is in a conversation list, identifies the conversation list. Otherwise, this member is NULL.	
ConvCtxt	Specifies the conversation context.	

See Also
CONVCONTEXT, **DdeQueryConvInfo**

CPLINFO (3.1)

```
#include <cpl.h>

typedef struct tagCPLINFO { /* cpli */
    int   idIcon;
    int   idName;
    int   idInfo;
    LONG  lData;
} CPLINFO;
```

The **CPLINFO** structure contains resource information and a user-defined value for an extensible Control Panel application.

Member	Description
idIcon	Specifies an icon resource identifier for the application icon. This icon is displayed in the Control Panel window.
idName	Specifies a string resource identifier for the application name. The name is the short string displayed below the application icon in the Control Panel window. The name is also displayed on the Settings menu of Control Panel.
idInfo	Specifies a string resource identifier for the application description. The description is the descriptive string displayed at the bottom of the Control Panel window when the application icon is selected.
lData	Specifies user-defined data for the application.

CREATESTRUCT (2.x)

```
typedef struct tagCREATESTRUCT {    /* cs */
    void FAR* lpCreateParams;
    HINSTANCE hInstance;
    HMENU     hMenu;
    HWND      hwndParent;
    int       cy;
    int       cx;
    int       y;
    int       x;
    LONG      style;
    LPCSTR    lpszName;
    LPCSTR    lpszClass;
    DWORD     dwExStyle;
} CREATESTRUCT;
```

The **CREATESTRUCT** structure defines the initialization parameters passed to the window procedure of an application.

Member	Description
lpCreateParams	Points to data to be used for creating the window.
hInstance	Identifies the module-instance handle of the module that owns the new window.
hMenu	Identifies the menu to be used by the new window.
hwndParent	Identifies the window that owns the new window. This member is NULL if the new window is a top-level window.
cy	Specifies the height of the new window.
cx	Specifies the width of the new window.
y	Specifies the y-coordinate of the upper-left corner of the new window. Coordinates are relative to the parent window if the new window is a child window. Otherwise, the coordinates are relative to the screen origin.
x	Specifies the x-coordinate of the upper-left corner of the new window. Coordinates are relative to the parent window if the new window is a child window. Otherwise, the coordinates are relative to the screen origin.
style	Specifies the style for the new window.
lpszName	Points to a null-terminated string that specifies the name of the new window.
lpszClass	Points to a null-terminated string that specifies the class name of the new window.
dwExStyle	Specifies extended style for the new window.

See Also
CreateWindow

CTLINFO (3.1)

```
#include <custcntl.h>

typedef struct tagCTLINFO {
    UINT    wVersion;
    UINT    wCtlTypes;
    char    szClass[CTLCLASS];
    char    szTitle[CTLTITLE];
    char    szReserved[10];
    CTLTYPE Type[CTLTYPES];
} CTLINFO;
```

The **CTLINFO** structure defines the class name and version number for a custom control. The **CTLINFO** structure also contains an array of **CTLTYPE** structures, each of which lists commonly used combinations of control styles (called variants), with a short description and information about the suggested size.

Member	Description
wVersion	Specifies the control version number. Although you can start your numbering scheme from one digit, most implementations use the lower two digits to represent minor releases.
wCtlTypes	Specifies the number of control types supported by this class. This value should always be greater than zero and less than or equal to the **CTLTYPES** value.
szClass	Specifies a null-terminated string that contains the control class name supported by the dynamic-link library (DLL). This string should be no longer than the **CTLCLASS** value.
szTitle	Specifies a null-terminated string that contains various copyright or author information relating to the control library. This string should be no longer than the **CTLTITLE** value.
Type	Specifies an array of **CTLTYPE** structures containing information that relates to each of the control types supported by the class. There should be no more elements in the array than specified by the **CTLTYPES** value.

Comments

An application calls the *Class***Info** function to retrieve basic information about the control library. Based on the information returned, the application can create instances of a control by using one of the supported styles. For example, Dialog Editor calls this function to query a library about the different control styles it can display.

The return value of the *Class***Info** function identifies a **CTLINFO** structure if the function is successful. This information becomes the property of the caller, which must explicitly release it by using the **GlobalFree** function when the structure is no longer needed.

See Also

CTLSTYLE, **CTLTYPE**

CTLSTYLE (3.1)

```
#include <custcntl.h>

typedef struct tagCTLSTYLE {
    UINT    wX;
    UINT    wY;
    UINT    wCx;
    UINT    wCy;
    UINT    wId;
    DWORD   dwStyle;
    char    szClass[CTLCLASS];
    char    szTitle[CTLTITLE];
} CTLSTYLE;
```

The **CTLSTYLE** structure specifies the attributes of the selected control, including the current style flags, location, dimensions, and associated text.

Member	Description
wX	Specifies the x-origin, in screen coordinates, of the control relative to the client area of the parent window.
wY	Specifies the y-origin, in screen coordinates, of the control relative to the client area of the parent window.
wCx	Specifies the current control width, in screen coordinates.
wCy	Specifies the current control height, in screen coordinates.
wId	Specifies the current control identifier. In most cases, you should not allow the user to change this value because Dialog Editor automatically coordinates it with a header file.
dwStyle	Specifies the current control style. The high-order word contains the control-specific flags, and the low-order word contains the Windows-specific flags. You may let the user change these flags to any values supported by your control library.
szClass	Specifies a null-terminated string representing the name of the current control class. You should not allow the user to edit this member, because it is provided for informational purposes only. This string should be no longer than the **CTLCLASS** value.
szTitle	Specifies with a null-terminated string the text associated with the control. This text is usually displayed inside the control or may be used to store other associated information required by the control. This string should be no longer than the **CTLTITLE** value.

Comments

An application calls the *Class***Style** function to display a dialog box to edit the style of the selected control. When this function is called, it should display a modal dialog box in which the user can edit the **CTLSTYLE** members. The user interface of this dialog box should be consistent with that of the predefined controls that Dialog Editor supports.

See Also

CTLINFO, **CTLTYPE**

CTLTYPE (3.1)

```
#include <custcntl.h>

typedef struct tagCTLTYPE {
    UINT    wType;
    UINT    wWidth;
    UINT    wHeight;
    DWORD   dwStyle;
    char    szDescr[CTLDESCR];
} CTLTYPE;
```

The **CTLTYPE** structure contains information about a control in a particular class. The **CTLINFO** structure includes an array of **CTLTYPE** structures.

Member	Description
wType	Reserved; must be zero.
wWidth	Specifies the suggested width of the control when it is created using Dialog Editor. The width is specified in dialog-box coordinates.
wHeight	Specifies the suggested height of the control when it is created using Dialog Editor. The height is specified in dialog-box coordinates.
dwStyle	Specifies the initial style bits used to obtain this control type. This value includes the control-defined flags in the high-order word and the Windows-defined flags in the low-order word.
szDescr	Defines the name to be used by other development tools when referring to this particular variant of the base control class. Dialog Editor does not refer to this information. This string should not be longer than the **CTLDESCR** value.

See Also
CTLINFO, **CTLSTYLE**

DCB (2.x)

```
typedef struct tagDCB        /* dcb */
{
    BYTE Id;
    UINT BaudRate;
    BYTE ByteSize;
    BYTE Parity;
    BYTE StopBits;
    UINT RlsTimeout;
    UINT CtsTimeout;
    UINT DsrTimeout;

    UINT fBinary        :1;
    UINT fRtsDisable    :1;
    UINT fParity        :1;
    UINT fOutxCtsFlow   :1;
    UINT fOutxDsrFlow   :1;
    UINT fDummy         :2;
    UINT fDtrDisable    :1;

    UINT fOutX          :1;
    UINT fInX           :1;
    UINT fPeChar        :1;
    UINT fNull          :1;
    UINT fChEvt         :1;
    UINT fDtrflow       :1;
    UINT fRtsflow       :1;
    UINT fDummy2        :1;

    char XonChar;
    char XoffChar;
    UINT XonLim;
    UINT XoffLim;
    char PeChar;
    char EofChar;
    char EvtChar;
    UINT TxDelay;
} DCB;
```

The **DCB** structure defines the control setting for a serial communications device.

Member	Description
Id	Specifies the communication device. This value is set by the device driver. If the most significant bit is set, the DCB structure is for a parallel device.
BaudRate	Specifies the baud rate at which the communications device operates. If the value of the high-order byte is equal to 0xFF, the low-order byte specifies a baud-rate index. The index can be one of the following values: CBR_110 CBR_14400 CBR_4400 CBR_19200 CBR_9200 CBR_38400 CBR_8400 CBR_56000 CBR_6000 CBR_128000 CBR_28000 CBR_256000

CBR_9600

If the high-order byte is not equal to 0xFF, this parameter specifies the actual baud rate.

ByteSize Specifies the number of bits in the characters transmitted and received. This member can be any number from 4 through 8.

Parity Specifies the parity scheme to be used. This member can be any one of the following values:

Value	Meaning
EVENPARITY	Even
MARKPARITY	Mark
NOPARITY	No parity
ODDPARITY	Odd

StopBits Specifies the number of stop bits to be used. This member can be any one of the following values:

Value	Meaning
ONESTOPBIT	1 stop bit
ONE5STOPBITS	1.5 stop bits
TWOSTOPBITS	2 stop bits

RlsTimeout Specifies the maximum amount of time, in milliseconds, the device should wait for the RLSD (receive-line-signal-detect) signal. RLSD is also known as the carrier-detect (CD) signal.

CtsTimeout Specifies the maximum amount of time, in milliseconds, the device should wait for the CTS (clear-to-send) signal.

DsrTimeout Specifies the maximum amount of time, in milliseconds, the device should wait for the DSR (data-set-ready) signal.

fBinary Specifies binary mode. In nonbinary mode, the **EofChar** character is recognized on input and remembered as the end of data.

fRtsDisable Specifies whether or not the RTS (request-to-send) signal is disabled. If this member is set, RTS is not used and remains low. If this member is clear, RTS is sent when the device is opened and turned off when the device is closed.

fParity Specifies whether parity checking is enabled. If this member is set, parity checking is performed and errors are reported.

fOutxCtsFlow Specifies that CTS (clear-to-send) signal is to be monitored for output flow control. If this member is set and CTS is turned off, output is suspended until CTS is again sent.

fOutxDsrFlow Specifies that the DSR (data-set-ready) signal is to be monitored for output flow control. If this member is set and DSR is turned off, output is suspended until DSR is again sent.

fDummy Reserved.

fDtrDisable Specifies whether the DTR (data-terminal-ready) signal is disabled. If this member is set, DTR is not used and remains low. If this member is clear, DTR is sent when the device is opened and turned off when the device is closed.

fOutX Specifies that XON/XOFF flow control is used during transmission. If this member is set, transmission stops when the **XoffChar** character is received and starts again when the **XonChar** character is received.

fInX Specifies that XON/XOFF flow control is used during reception. If this member is set, the **XonChar** character is sent when the reception queue comes within **XoffLim** characters of being full and the **XonChar** character is sent when the reception queue comes within **XonLim** characters of being empty.

fPeChar	Specifies that characters received with parity errors are to be replaced with the character specified by this member. This member must be set for the replacement to occur.
fNull	Specifies that received null characters are to be discarded.
fChEvt	Specifies that reception of the **EvtChar** character is to be flagged as an event.
fDtrflow	Specifies that the DTR (data-terminal-ready) signal is to be used for reception flow control. If this member is set, DTR is turned off when the reception queue comes within **XoffLim** characters of being full and sent when the reception queue comes within **XonLim** characters of being empty.
fRtsflow	Specifies that the RTS (ready-to-send) signal is to be used for reception flow control. If this member is set, RTS is turned off when the reception queue comes within **XoffLim** characters of being full, and sent when the reception queue comes within **XonLim** characters of being empty.
fDummy2	Reserved.
XonChar	Specifies the value of the XON character for both transmission and reception.
XoffChar	Specifies the value of the XOFF character for both transmission and reception.
XonLim	Specifies the minimum number of characters allowed in the reception queue before the XON character is sent.
XoffLim	Specifies the maximum number of characters allowed in the reception queue before the XOFF character is sent. The value of the **XoffLim** member is subtracted from the size of the reception queue, in bytes, to calculate the maximum number of characters allowed.
PeChar	Specifies the value of the character used to replace characters received with a parity error.
EofChar	Specifies the value of the character used to signal the end of data.
EvtChar	Specifies the value of the character used to signal an event.
TxDelay	Not currently used.

See Also

BuildCommDCB, **GetCommState**, **SetCommState**

Windows 3.1 changes

The **BaudRate** member can specify either the actual baud rate or a baud-rate index. If the high-order byte is equal to 0xFF, the low-order byte specifies one of the following baud-rate index values:

- CBR_110
- CBR_300
- CBR_600
- CBR_1200
- CBR_2400
- CBR_4800
- CBR_9600
- CBR_14400
- CBR_19200
- CBR_38400
- CBR_56000
- CBR_128000
- CBR_256000

If the high-order byte is not equal to 0xFF, this parameter specifies the actual baud rate.

DDEACK (2.x)

```
#include <dde.h>

typedef struct tagDDEACK {  /* ddeack */
    WORD bAppReturnCode:8,
         reserved:6,
         fBusy:1,
         fAck:1;
} DDEACK;
```

The **DDEACK** structure contains status flags that a DDE application passes to its partner as part of the **WM_DDE_ACK** message. The flags provide details about the application's response to a **WM_DDE_ADVISE**, **WM_DDE_DATA**, **WM_DDE_EXECUTE**, **WM_DDE_REQUEST**, **WM_DDE_POKE**, or **WM_DDE_UNADVISE** message.

Member	Description
bAppReturnCode	Specifies an application-defined return code.
fBusy	Indicates whether the application was busy and unable to respond to the partner's message at the time the message was received. A nonzero value indicates the server was busy and unable to respond. The **fBusy** member is defined only when the **fAck** member is zero.
fAck	Indicates whether the application accepted the message from its partner. A nonzero value indicates the server accepted the message.

See Also

WM_DDE_ACK, **WM_DDE_ADVISE**, **WM_DDE_DATA**, **WM_DDE_EXECUTE**, **WM_DDE_REQUEST**, **WM_DDE_POKE**, **WM_DDE_UNADVISE**, **DDEADVISE**, **DDEDATA**, **DDEPOKE**

DDEADVISE (2.x)

```
#include <dde.h>

typedef struct tagDDEADVISE {  /* ddeadv */
    WORD    reserved:14,
            fDeferUpd:1,
            fAckReq:1;
    short   cfFormat;
} DDEADVISE;
```

The **DDEADVISE** structure contains flags that specify how a server should send data to a client during an advise loop. A client passes the handle of a **DDEADVISE** structure to a server as part of a **WM_DDE_ADVISE** message.

Member	Description
fDeferUpd	Indicates whether the server should defer sending updated data to the client. A nonzero value tells the server to send a **WM_DDE_DATA** message with a NULL data handle whenever the data item changes. In response, the client can post a **WM_DDE_REQUEST** message to the server to obtain a handle to the updated data.
fAckReq	Indicates whether the server should set the **fAckReq** flag in the **WM_DDE_DATA** messages that it posts to the client. A nonzero value tells the server to set the **fAckReq** bit.
cfFormat	Specifies the client application's preferred data format. The format must be a standard or registered clipboard format. The following standard clipboard formats may be used: CF_BITMAP CF_OEMTEXT CF_DCF_OEMTEXT CF_PALETTE CF_DCF_PALETTE CF_PENDATA CF_DCF_PENDATA CF_SYLK CF_DCF_SYLK CF_TEXT CF_DCF_TEXT CF_TIFF CF_METAFILEPICT

See Also
WM_DDE_ADVISE, **WM_DDE_DATA**, **WM_DDE_UNADVISE**, **DDEACK**, **DDEDATA**, **DDEPOKE**

DDEDATA (2.x)

```
#include <dde.h>

typedef struct tagDDEDATA {    /* ddedat */
    WORD    unused:12,
            fResponse:1,
            fRelease:1,
            reserved:1,
            fAckReq:1;
    short   cfFormat;
    BYTE    Value[1];
} DDEDATA;
```

The **DDEDATA** structure contains the data and information about the data sent as part of a **WM_DDE_DATA** message.

Member	Description
fResponse	Indicates whether the application receiving the **WM_DDE_DATA** message should acknowledge receipt of the data by sending a **WM_DDE_ACK** message. A nonzero value indicates the application should send the acknowledgment.
fRelease	Indicates if the application receiving the **WM_DDE_POKE** message should free the data. A nonzero value indicates the data should be freed.
fAckReq	Indicates whether the data was sent in response to a **WM_DDE_REQUEST** message or a **WM_DDE_ADVISE** message. A nonzero value indicates the data was sent in response to a WM_DDE_REQUEST message.
cfFormat	Specifies the format of the data. The format should be a standard or registered clipboard format. The following standard clipboard formats may be used: CF_BITMAP CF_OEMTEXT CF_DCF_OEMTEXT CF_PALETTE CF_DCF_PALETTE CF_PENDATA CF_DCF_PENDATA CF_SYLK CF_DCF_SYLK CF_TEXT CF_DCF_TEXT CF_TIFF CF_METAFILEPICT

See Also

WM_DDE_ACK, **WM_DDE_ADVISE**, **WM_DDE_DATA**, **WM_DDE_POKE**, **WM_DDE_REQUEST**, **DDEACK**, **DDEADVISE**, **DDEPOKE**

DDEPOKE (2.x)

```
#include <dde.h>

typedef struct tagDDEPOKE {  /* ddepok */
    WORD  unused:13,
          fRelease:1,
          fReserved:2;
    short cfFormat;
    BYTE  Value[1];
} DDEPOKE;
```

The **DDEPOKE** structure contains the data and information about the data sent as part of a **WM_DDE_POKE** message.

Member	Description
fRelease	Indicates if the application receiving the **WM_DDE_POKE** message should free the data. A nonzero value specifies the data should be freed.
cfFormat	Specifies the format of the data. The format should be a standard or registered clipboard format. The following standard clipboard formats may be used: CF_BITMAP CF_OEMTEXT CF_DCF_OEMTEXT CF_PALETTE CF_DCF_PALETTE CF_PENDATA CF_DCF_PENDATA CF_SYLK CF_DCF_SYLK CF_TEXT CF_DCF_TEXT CF_TIFF CF_METAFILEPICT
Value	Contains the data. The size of this array depends on the value of the **cfFormat** member.

See Also
WM_DDE_POKE, **DDEACK**, **DDEADVISE**, **DDEDATA**

DEBUGHOOKINFO (3.1)

```
typedef struct tagDEBUGHOOKINFO { /* dh */
    HMODULE hModuleHook;
    LPARAM  reserved;
    LPARAM  lParam;
    WPARAM  wParam;
    int     code;
} DEBUGHOOKINFO;
```

The **DEBUGHOOKINFO** structure contains debugging information.

Member	Description
hModuleHook	Identifies the module containing the filter function.
reserved	Not used.
lParam	Specifies the value to be passed to the hook in the *lParam* parameter of the **DebugProc** callback function.
wParam	Specifies the value to be passed to the hook in the *wParam* parameter of the **DebugProc** callback function.
code	Specifies the value to be passed to the hook in the *code* parameter of the **DebugProc** callback function.

See Also
DebugProc, **SetWindowsHook**

DELETEITEMSTRUCT (3.0)

```
typedef struct tagDELETEITEMSTRUCT {    /* deli */
    UINT  CtlType;
    UINT  CtlID;
    UINT  itemID;
    HWND  hwndItem;
    DWORD itemData;
} DELETEITEMSTRUCT;
```

The **DELETEITEMSTRUCT** structure describes a deleted owner-drawn list-box or combo-box item. When an item is removed from the list box or combo box or when the list box or combo box is destroyed, Windows sends the **WM_DELETEITEM** message to the owner for each deleted item. The *lParam* parameter of the message contains a pointer to this structure.

Member	Description
CtlType	Contains ODT_LISTBOX (which specifies an owner-drawn list box) or ODT_COMBOBOX (which specifies an owner-drawn combo box).
CtlID	Contains the control identifier for the list box or combo box.
itemID	Contains the index of the item in the list box or combo box being removed.
hwndItem	Contains the window handle of the control.
itemData	Contains the value passed to the control in the *lParam* parameter of the **LB_INSERTSTRING**, **LB_ADDSTRING**, **CB_INSERTSTRING**, or **CB_ADDSTRING** message when the item was added to the list box.

See Also
WM_DELETEITEM

DEVMODE (3.0)

```
#include <print.h>

typedef struct tagDEVMODE {   /* dm */
    char  dmDeviceName[CCHDEVICENAME];
    UINT  dmSpecVersion;
    UINT  dmDriverVersion;
    UINT  dmSize;
    UINT  dmDriverExtra;
    DWORD dmFields;
    int   dmOrientation;
    int   dmPaperSize;
    int   dmPaperLength;
    int   dmPaperWidth;
    int   dmScale;
    int   dmCopies;
    int   dmDefaultSource;
    int   dmPrintQuality;
    int   dmColor;
    int   dmDuplex;
    int   dmYResolution;
    int   dmTTOption;
} DEVMODE;
```

The **DEVMODE** structure contains information about a printer driver's initialization and environment data. An application passes this structure to the **DeviceCapabilities** and **ExtDeviceMode** functions.

Member	Description
dmDeviceName	Specifies the name of the device the driver supports--for example, "PCL/**HP** LaserJet" in the case of the Hewlett-Packard LaserJet. Each driver has a unique string.
dmSpecVersion	Specifies the version number of the **DEVMODE** structure. For Windows version 3.1, this value should be 0x30A.
dmDriverVersion	Specifies the printer driver version number assigned by the printer driver developer.
dmSize	Specifies the size, in bytes, of the **DEVMODE** structure. (This value does not include the optional **dmDriverData** member for device-specific data, which can follow the structure.) If an application manipulates only the driver-independent portion of the data, it can use this member to find out the length of the structure without having to account for different versions.
dmDriverExtra	Specifies the size, in bytes, of the optional **dmDriverData** member for device-specific data, which can follow the structure. If an application does not use device-specific information, it should set this member to zero.
dmFields	Specifies a set of flags that indicate which of the remaining members in the **DEVMODE** structure have been initialized. It can be any combination (or it can be none) of the following values:

Constant	Value
DM_ORIENTATION	0x0000001L
DM_PAPERSIZE	0x0000002L
DM_PAPERLENGTH	0x0000004L
DM_PAPERWIDTH	0x0000008L
DM_SCALE	0x0000010L

DM_COPIES	0x0000100L
DM_DEFAULTSOURCE	0x0000200L
DM_PRINTQUALITY	0x0000400L
DM_COLOR	0x0000800L
DM_DUPLEX	0x0001000L
DM_YRESOLUTION	0x0002000L
DM_TTOPTION	0x0004000L

A printer driver supports only those members that are appropriate for the printer technology.

dmOrientation Specifies the orientation of the paper. It can be either DMORIENT_PORTRAIT or DMORIENT_LANDSCAPE.

dmPaperSize Specifies the size of the paper to print on. This member may be set to zero if the length and width of the paper are specified by the **dmPaperLength** and **dmPaperWidth** members, respectively. Otherwise, the **dmPaperSize** member can be set to one of the following predefined values:

Value	Meaning
DMPAPER_FIRST	DMPAPER_LETTER
DMPAPER_LETTER	Letter, 8 1/2 x 11 in.
DMPAPER_LETTERSMALL	Letter Small, 8 1/2 x 11 in.
DMPAPER_TABLOID	Tabloid, 11 x 17 in.
DMPAPER_LEDGER	Ledger, 17 x 11 in.
DMPAPER_LEGAL	Legal, 8 1/2 x 14 in.
DMPAPER_STATEMENT	Statement, 5 1/2 x 8 1/2 in.
DMPAPER_EXECUTIVE	Executive, 7 1/2 x 10 1/2 in.
DMPAPER_A3	A3, 297 x 420 mm
DMPAPER_A4	A4, 210 x 297 mm
DMPAPER_A4SMALL	A4 Small, 210 x 297 mm
DMPAPER_A5	A5, 148 x 210 mm
DMPAPER_B4	B4, 250 x 354 mm
DMPAPER_B5	B5, 182 x 257 mm
DMPAPER_FOLIO	Folio, 8 1/2 x 13 in.
DMPAPER_QUARTO	Quarto, 215 x 275 mm
DMPAPER_10X14	10 x 14 in.
DMPAPER_11X17	11 x 17 in.
DMPAPER_NOTE	Note, 8 1/2 x 11 in.
DMPAPER_ENV_9	Envelope #9, 3 7/8 x 8 7/8 in.
DMPAPER_ENV_10	Envelope #10, 4 1/8 x 9 1/2 in.
DMPAPER_ENV_11	Envelope #11, 4 1/2 x 10 3/8 in.
DMPAPER_ENV_12	Envelope #12, 4 1/2 x 11 in.
DMPAPER_ENV_14	Envelope #14, 5 x 11 1/2 in.
DMPAPER_CSHEET	C size sheet
DMPAPER_DSHEET	D size sheet
DMPAPER_ESHEET	E size sheet
DMPAPER_ENV_DL	Envelope DL, 110 x 220 mm
DMPAPER_ENV_C3	Envelope C3, 324 x 458 mm
DMPAPER_ENV_C4	Envelope C4, 229 x 324 mm

DMPAPER_ENV_C5	Envelope C5, 162 x 229 mm
DMPAPER_ENV_C6	Envelope C6, 114 x 162 mm
DMPAPER_ENV_C65	Envelope C65, 114 x 229 mm
DMPAPER_ENV_B4	Envelope B4, 250 x 353 mm
DMPAPER_ENV_B5	Envelope B5, 176 x 250 mm
DMPAPER_ENV_B6	Envelope B6, 176 x 125 mm
DMPAPER_ENV_ITALY	Envelope, 110 x 230 mm
DMPAPER_ENV_MONARCH	Envelope Monarch, 3 7/8 x 7 1/2 in.
DMPAPER_ENV_PERSONAL	Envelope, 3 5/8 x 6 1/2 in.
DMPAPER_FANFOLD_US	U.S. Standard Fanfold, 14 7/8 x 11 in.
DMPAPER_FANFOLD_STD_GERMAN	German Standard Fanfold, 8 1/2 x 12 in.
DMPAPER_FANFOLD_LGL_GERMAN	German Legal Fanfold, 8 1/2 x 13 in.
DMPAPER_LAST	German Legal Fanfold, 8 1/2 x 13 in.
DMPAPER_USER	User-defined

dmPaperLength Specifies a paper length, in tenths of a millimeter. This parameter overrides the paper length specified by the **dmPaperSize** member, either for custom paper sizes or for such devices as dot-matrix printers that can print on a variety of page sizes.

dmPaperWidth Specifies a paper width, in tenths of a millimeter. This parameter overrides the paper width specified by the **dmPaperSize** member.

dmScale Specifies the factor by which the printed output is to be scaled. The apparent page size is scaled from the physical page size by a factor of **dmScale**/100. For example, a letter-size paper with a **dmScale** value of 50 would contain as much data as a page of size 17 by 22 inches because the output text and graphics would be half their original height and width.

dmCopies Specifies the number of copies printed if the device supports multiple-page copies.

dmDefaultSource Specifies the default bin from which the paper is fed. The application can override this value by using the GETSETPAPERBINS escape. This member can be one of the following values:

DMBIN_AUTO	DMBIN_LOWER
DMBIN_CASSETTE	DMBIN_MANUAL
DMBIN_ENVELOPE	DMBIN_MIDDLE
DMBIN_ENVMANUAL	DMBIN_ONLYONE
DMBIN_FIRST	DMBIN_SMALLFMT
DMBIN_LARGECAPACITY	DMBIN_TRACTOR
DMBIN_LARGEFMT	DMBIN_UPPER
DMBIN_LAST	

A range of values is reserved for device-specific bins. To be consistent with initialization information, the GETSETPAPERBINS and ENUMPAPERBINS escapes use these values.

dmPrintQuality Specifies the printer resolution. Following are the four predefined device-independent values:

DMRES_HIGH (-4)
DMRES_MEDIUM (-3)
DMRES_LOW (-2)
DMRES_DRAFT (-1)

If a positive value is given, it specifies the number of dots per inch (DPI) and is therefore device-dependent.

If the printer initializes the **dmYResolution** member, the **dmPrintQuality** member specifies the x-resolution of the printer, in dots per inch.

dmColor Specifies whether a color printer is to render color or monochrome output. Possible values are:

DMCOLOR_COLOR (1)
DMCOLOR_MONOCHROME (2)

dmDuplex Specifies duplex (double-sided) printing for printers capable of duplex printing. This member can be one of the following values:

DMDUP_SIMPLEX (1)
DMDUP_HORIZONTAL (2)
DMDUP_VERTICAL (3)

dmYResolution Specifies the y-resolution of the printer, in dots per inch. If the printer initializes this member, the **dmPrintQuality** member specifies the x-resolution of the printer, in dots per inch.

dmTTOption Specifies how TrueType fonts should be printed. It can be one of the following values:

Value	Meaning
DMTT_BITMAP	Print TrueType fonts as graphics. This is the default action for dot-matrix printers.
DMTT_DOWNLOAD	Download TrueType fonts as soft fonts. This is the default action for Hewlett-Packard printers that use Printer Control Language (PCL).
DMTT_SUBDEV	Substitute device fonts for TrueType fonts. This is the default action for PostScript printers.

Comments

Only drivers that are fully updated for Windows versions 3.0 and later and that export the **ExtDeviceMode** function use the **DEVMODE** structure.

An application can retrieve the paper sizes and names supported by a printer by calling the **DeviceCapabilities** function with the **DC_PAPERS**, **DC_PAPERSIZE**, and **DC_PAPERNAMES** values.

Before setting the value of the **dmTTOption** member, applications should find out how a printer driver can use TrueType fonts by calling the **DeviceCapabilities** function with the **DC_TRUETYPE** value.

Drivers can add device-specific data immediately following the **DEVMODE** structure.

See Also

DeviceCapabilities, **ExtDeviceMode**

DEVNAMES (3.1)

```
#include <commdlg.h>

typedef struct tagDEVNAMES {    /* dn */
    UINT wDriverOffset;
    UINT wDeviceOffset;
    UINT wOutputOffset;
    UINT wDefault;
    /* optional data may appear here  */
} DEVNAMES;
```

The **DEVNAMES** structure contains offsets to strings that specify the driver, name, and output port of a printer. The **PrintDlg** function uses these strings to initialize controls in the system-defined Print dialog box. When the user chooses the OK button to close the dialog box, information about the selected printer is returned in this structure.

Member	Description
wDriverOffset	Specifies the offset from the beginning of the structure to a null-terminated string that specifies the Microsoft® MS-DOS® filename (without extension) of the device driver. On input, this string is used to set which printer to initially display in the dialog box.
wDeviceOffset	Specifies the offset from the beginning of the structure to the null-terminated string that specifies the name of the device. This string cannot exceed 32 bytes in length, including the null character, and must be identical to the **dmDeviceName** member of the **DEVMODE** structure.
wOutputOffset	Specifies the offset from the beginning of the structure to the null-terminated string that specifies the MS-DOS device name for the physical output medium (output port).
wDefault	Specifies whether the strings specified in the **DEVNAMES** structure identify the default printer. It is used to verify that the default printer has not changed since the last print operation. On input, this member can be set to DN_DEFAULTPRN. If the DN_DEFAULTPRN flag is set, the other values in the **DEVNAMES** structure are checked against the current default printer. On output, the **wDefault** member is changed only if the Print Setup dialog box was displayed and the user chose the OK button to close it. If the default printer was selected, the DN_DEFAULTPRN flag is set. If a printer is specifically selected, the flag is not set. All other bits in this member are reserved for internal use by the dialog box procedure of the Print dialog box.

See Also
PrintDlg, **DEVMODE**

DOCINFO (3.1)

```
typedef struct {    /* di */
    int     cbSize;
    LPCSTR  lpszDocName;
    LPCSTR  lpszOutput;
} DOCINFO;
```

The **DOCINFO** structure contains the input and output filenames used by the **StartDoc** function.

Member	Description
cbSize	Specifies the size of the structure, in bytes.
lpszDocName	Points to a null-terminated string specifying the name of the document. This string must not be longer than 32 characters, including the null terminating character.
lpszOutput	Points to a null-terminated string specifying the name of an output file. This allows a print job to be redirected to a file. If this value is NULL, output goes to the device for the specified device context.

See Also
StartDoc

DRAWITEMSTRUCT (3.0)

```
typedef struct tagDRAWITEMSTRUCT {  /* ditm */
    UINT  CtlType;
    UINT  CtlID;
    UINT  itemID;
    UINT  itemAction;
    UINT  itemState;
    HWND  hwndItem;
    HDC   hDC;
    RECT  rcItem;
    DWORD itemData;
} DRAWITEMSTRUCT;
```

The **DRAWITEMSTRUCT** structure provides information the owner needs to determine how to paint an owner-drawn control. The owner of the owner-drawn control receives a pointer to this structure as the *lParam* parameter of the **WM_DRAWITEM** message.

Member	Description
CtlType	Specifies the control type. The values for control types follow:

Value	Meaning
ODT_BUTTON	Owner-drawn button
ODT_COMBOBOX	Owner-drawn combo box
ODT_LISTBOX	Owner-drawn list box
ODT_MENU	Owner-drawn menu

CtlID Specifies the control identifier for a combo box, list box or button. This member is not used for a menu.

itemID

Specifies the menu-item identifier for a menu or the index of the item in a list box or combo box. For an empty list box or combo box, this member is a negative value. This allows the application to draw only the focus rectangle at the coordinates specified by the **rcItem** member even though there are no items in the control. This indicates to the user whether the list box or combo box has input focus. The setting of the bits in the **itemAction** member determines whether the rectangle is to be drawn as though the list box or combo box has input focus.

itemAction Specifies the drawing action required. This member is one or more of the following values:

Value	Meaning
ODA_DRAWENTIRE	Bit is set when the entire control needs to be drawn.
ODA_FOCUS	Bit is set when the control gains or loses input focus. The **itemState** member should be checked to determine whether the control has focus.
ODA_SELECT	Bit is set when only the selection status has changed. The **itemState** member should be checked to determine the new selection state.

itemState Specifies the visual state of the item after the current drawing action takes place; that is, if a menu item is to be grayed, the state flag ODS_GRAYED will be set. Following are the state flags:

Value	Meaning
ODS_CHECKED	Bit is set if the menu item is to be checked. This bit is used only in a menu.

	ODS_DISABLED	Bit is set if the item is to be drawn as disabled.
	ODS_FOCUS	Bit is set if the item has input focus.
	ODS_GRAYED	Bit is set if the item is to be grayed. This bit is used only in a menu.
	ODS_SELECTED	Bit is set if the item's status is selected.

hwndItem Specifies the window handle of the control for combo boxes, list boxes, and buttons. For menus, it contains the handle of the menu (**HMENU**) containing the item.

hDC Identifies a device context; this device context must be used when performing drawing operations on the control.

rcItem Specifies a rectangle in the device context identified by the **hDC** member that defines the boundaries of the control to be drawn. Windows automatically clips anything the owner draws in the device context for combo boxes, list boxes, and buttons, but it does not clip menu items. When drawing menu items, it must ensure that the owner does not draw outside the boundaries of the rectangle defined by the **rcItem** member.

itemData

Contains the value last assigned to the list box or combo box by an **LB_SETITEMDATA** or **CB_SETITEMDATA** message. If the list box or combo box has the **LBS_HASSTRINGS** or **CBS_HASSTRINGS** style, this value is initially zero. Otherwise, this value is initially the value that was passed to the list box or combo box in the *lParam* parameter of one of the following messages:

CB_ADDSTRING
CB_INSERTSTRING
LB_ADDSTRING
LB_INSERTSTRING

DRIVERINFOSTRUCT (3.1)

```
typedef struct tagDRIVERINFOSTRUCT {     /* drvinfst */
    UINT      length;
    HDRVR     hDriver;
    HINSTANCE hModule;
    char      szAliasName[128];
} DRIVERINFOSTRUCT;
```

The **DRIVERINFOSTRUCT** structure contains basic information about an installable device driver.

Member	Description
length	Specifies the size of the **DRIVERINFOSTRUCT** structure.
hDriver	Identifies an instance of the installable driver.
hModule	Identifies an installable driver module.
szAliasName	Points to a null-terminated string that specifies the driver name or an alias under which the driver was loaded.

See Also
GetDriverInfo

DRVCONFIGINFO (3.1)

```
typedef struct tagDRVCONFIGINFO {    /* drvci */
    DWORD   dwDCISize;
    LPCSTR  lpszDCISectionName;
    LPCSTR  lpszDCIAliasName;
} DRVCONFIGINFO;
```

The **DRVCONFIGINFO** structure contains information about the entries for an installable device driver in the SYSTEM.INI file. This structure is sent in the *lParam* parameter of the **DRV_CONFIGURE** and **DRV_INSTALL** installable-driver messages.

Member	Description
dwDCISize	Specifies the size of the **DRVCONFIGINFO** structure.
lpszDCISectionName	Points to a null-terminated string that specifies the name of the section in the SYSTEM.INI file where driver information is recorded.
lpszDCIAliasName	Points to a null-terminated string that specifies the driver name or an alias under which the driver was loaded.

See Also
DRV_CONFIGURE, **DRV_INSTALL**

EVENTMSG (2.x)

```
typedef struct tagEVENTMSG {    /* em */
    UINT  message;
    UINT  paramL;
    UINT  paramH;
    DWORD time;
} EVENTMSG;
```

The **EVENTMSG** structure contains information from the Windows application queue. This structure is used to store message information for the **JournalPlaybackProc** callback function.

Member	Description
message	Specifies the message.
paramL	Specifies additional information about the message. The exact meaning depends on the **message** value.
paramH	Specifies additional information about the message. The exact meaning depends on the **message** value.
time	Specifies the time at which the message was posted.

See Also

JournalPlaybackProc, **SetWindowsHook**, **MSG**

FINDREPLACE (3.1)

```
#include <commdlg.h>

typedef struct tagFINDREPLACE {    /* fr */
    DWORD     lStructSize;
    HWND      hwndOwner;
    HINSTANCE hInstance;
    DWORD     Flags;
    LPSTR     lpstrFindWhat;
    LPSTR     lpstrReplaceWith;
    UINT      wFindWhatLen;
    UINT      wReplaceWithLen;
    LPARAM    lCustData;
    UINT      (CALLBACK* lpfnHook)(HWND, UINT, WPARAM, LPARAM);
    LPCSTR    lpTemplateName;
} FINDREPLACE;
```

The **FINDREPLACE** structure contains information that the system uses to initialize a system-defined Find dialog box or Replace dialog box. After the user chooses the OK button to close the dialog box, the system returns information about the user's selections in this structure.

Member	Description
lStructSize	Specifies the length of the structure, in bytes. This member is filled on input.
hwndOwner	Identifies the window that owns the dialog box. This member can be any valid window handle, but it must not be NULL. If the FR_SHOWHELP flag is set, **hwndOwner** must identify the window that owns the dialog box. The window procedure for this owner window receives a notification message when the user chooses the Help button. (The identifier for the notification message is the value returned by the **RegisterWindowMessage** function when HELPMSGSTRING is passed as its argument.) This member is filled on input.
hInstance	Identifies a data block that contains a dialog box template specified by the **lpTemplateName** member. This member is only used if the **Flags** member specifies the FR_ENABLETEMPLATE or the FR_ENABLETEMPLATEHANDLE flag; otherwise, this member is ignored. This member is filled on input.
Flags	Specifies the dialog box initialization flags. This member can be a combination of the following values:

Value	Meaning
FR_DIALOGTERM	Indicates the dialog box is closing. The window handle returned by the **FindText** or **ReplaceText** function is no longer valid after this bit is set. This flag is set by the system.
FR_DOWN	Sets the direction of searches through a document. If the flag is set, the search direction is down; if the flag is clear, the search direction is up. Initially, this flag specifies the state of the Up and Down buttons; after the user chooses the OK button to close the dialog box, this flag specifies the user's selection.

FR_ENABLEHOOK	Enables the hook function specified in the **lpfnHook** member of this structure. This flag can be set on input.
FR_ENABLETEMPLATE	Causes the system to use the dialog box template identified by the **hInstance** and **lpTemplateName** members to display the dialog box. This flag is used only to initialize the dialog box.
FR_ENABLETEMPLATEHANDLE	Indicates that the **hInstance** member identifies a data block that contains a pre-loaded dialog box template. The system ignores the **lpTemplateName** member if this flag is specified. This flag can be set on input.
FR_FINDNEXT	Indicates that the application should search for the next occurrence of the string specified by the **lpstrFindWhat** member. This flag is set by the system.
FR_HIDEMATCHCASE	Hides and disables the Match Case check box. This flag can be set on input.
FR_HIDEWHOLEWORD	Hides and disables the Match Only Whole Word check box. This flag can be set on input.
FR_HIDEUPDOWN	Hides the Up and Down radio buttons that control the direction of searches through a document. This flag can be set on input.
FR_MATCHCASE	Specifies that the search is to be case sensitive. This flag is set when the dialog box is created and may be changed by the system in response to user input.
FR_NOMATCHCASE	Disables the Match Case check box. This flag is used only to initialize the dialog box.
FR_NOUPDOWN	Disables the Up and Down buttons. This flag is used only to initialize the dialog box.
FR_NOWHOLEWORD	Disables the Match Whole Word Only check box. This flag is used only to initialize the dialog box.
FR_REPLACE	Indicates that the application should replace the current occurrence of the string specified in the **lpstrFindWhat** member with the string specified in the **lpstrReplaceWith** member. This flag is set by the system.
FR_REPLACEALL	Indicates that the application should

		replace all occurrences of the string specified in the **lpstrFindWhat** member with the string specified in the **lpstrReplaceWith** member. This flag is set by the system.
	FR_SHOWHELP	Causes the dialog box to show the Help button. If this flag is specified, the **hwndOwner** must not be NULL. This flag can be set on input.
	FR_WHOLEWORD	Checks the Match Whole Word Only check box. Only whole words that match the search string will be considered. This flag is set when the dialog box is created and may be changed by the system in response to user input.
lpstrFindWhat	Specifies the string to search for. If a string is specified when the dialog box is created, the dialog box will initialize the Find What edit control with this string. If the FR_FINDNEXT flag is set when the dialog box is created, the application should search for an occurrence of this string (using the FR_DOWN, FR_WHOLEWORD, and FR_MATCHCASE flags to further define the direction and type of search). The application must allocate a buffer for the string. This buffer should be at least 80 bytes long. This flag is set when the dialog box is created and may be changed by the system in response to user input.	
lpstrReplaceWith	Specifies the replacement string for replace operations. The **FindText** function ignores this member. The **ReplaceText** function uses this string to initialize the Replace With edit control. This flag is set when the dialog box is created and may be changed by the system in response to user input.	
wFindWhatLen	Specifies the length, in bytes, of the buffer to which the **lpstrFindWhat** member points. This member is filled on input.	
wReplaceWithLen	Specifies the length, in bytes, of the buffer to which the **lpstrReplaceWith** member points. This member is filled on input.	
lCustData	Specifies application-defined data that the system passes to the hook function identified by the **lpfnHook** member. The system passes a pointer to the **CHOOSECOLOR** structure in the *lParam* parameter of the **WM_INITDIALOG** message; this pointer can be used to retrieve the **lCustData** member.	
lpfnHook	Points to a hook function that processes messages intended for the dialog box. To enable the hook function, an application must specify the FR_ENABLEHOOK flag in the **Flags** member; otherwise, the system ignores this structure member. The hook function must return zero to pass a message that it didn't process back to the dialog box procedure in COMMDLG.DLL. The hook function must return a nonzero value to prevent the dialog box procedure in COMMDLG.DLL from processing a message it has already processed. This member is filled on input.	
lpTemplateName	Points to a null-terminated string that specifies the name of the resource file for the dialog box template that is to be substituted for the dialog box template in COMMDLG.DLL. An application can use the **MAKEINTRESOURCE** macro for numbered dialog box resources. This member is used only if the **Flags** member specifies the FR_ENABLETEMPLATE flag; otherwise, this member is ignored. This member is filled on input.	

Comments

Some members of this structure are filled only when the dialog box is created, some are filled only when the user closes the dialog box, and some have an initialization value that changes when the user closes

the dialog box. Whenever a description in the Members section does not specify how the value of a member is assigned, the value is assigned only when the dialog box is created.

See Also
FindText, **ReplaceText**, **MAKEINTRESOURCE**

FIXED (3.1)

```
typedef struct tagFIXED {  /* fx */
    UINT    fract;
    int     value;
} FIXED;
```

The **FIXED** structure contains the integral and fractional parts of a fixed-point real number.

Member	Description
fract	Specifies the fractional part of the number.
value	Specifies the integer part of the number.

Comments

The **FIXED** structure is used to describe the elements of the **MAT2** and **POINTFX** structures.

See Also

GetGlyphOutline, **MAT2**, **POINTFX**

FMS_GETDRIVEINFO

```
#include <wfext.h>

typedef struct tagFMS_GETDRIVEINFO { /* fmsgdi */
    DWORD dwTotalSpace;
    DWORD dwFreeSpace;
    char  szPath[260];
    char  szVolume[14];
    char  szShare[128];
} FMS_GETDRIVEINFO, FAR *LPFMS_GETDRIVEINFO;
```

The **FMS_GETDRIVEINFO** structure contains information about the drive that is selected in the currently active File Manager window.

Member	Description
dwTotalSpace	Specifies the total amount of storage space, in bytes, on the disk associated with the drive.
dwFreeSpace	Specifies the amount of free storage space, in bytes, on the disk associated with the drive.
szPath	Specifies a null-terminated string that contains the path of the current directory.
szVolume	Specifies a null-terminated string that contains the volume label of the disk associated with the drive.
szShare	Specifies a null-terminated string that contains the name of the sharepoint (if the drive is being accessed through a network).

See Also
FMExtensionProc, **FM_GETDRIVEINFO**

FMS_GETFILESEL

```
#include <wfext.h>

typedef struct tagFMS_GETFILESEL { /* fmsgfs */
    UINT  wTime;
    UINT  wDate;
    DWORD dwSize;
    BYTE  bAttr;
    char  szName[260];
} FMS_GETFILESEL;
```

The **FMS_GETFILESEL** structure contains information about a selected file in File Manager's directory window or Search Results window.

Member	Description
wTime	Specifies the time when the file was created.
wDate	Specifies the date when the file was created.
dwSize	Specifies the size, in bytes, of the file.
bAttr	Specifies the attributes of the file.
szName	Specifies a null-terminated string (an OEM string) that contains the fully-qualified path of the selected file. Before displaying this string, an extension should use the **OemToAnsi** function to convert the string to a Windows ANSI string. If a string is to be passed to the MS-DOS file system, an extension should not convert it.

See Also
FMExtensionProc, **FM_GETFILESEL**

FMS_LOAD

```
#include <wfext.h>

typedef struct tagFMS_LOAD { /* fmsld */
    DWORD dwSize;
    char  szMenuName[MENU_TEXT_LEN];
    HMENU hMenu;
    UINT  wMenuDelta;
} FMS_LOAD;
```

The **FMS_LOAD** structure contains information that File Manager uses to add a custom menu provided by a File Manager extension dynamic-link library (DLL). The structure also provides a delta value that the extension DLL can use to manipulate the custom menu after File Manager has loaded the menu.

Member	Description
dwSize	Specifies the length of the structure, in bytes.
szMenuName	Contains a null-terminated string for a menu item that appears in File Manager's main menu.
hMenu	Identifies the pop-up menu that is added to File Manager's main menu.
wMenuDelta	Specifies the menu-item delta value. To avoid conflicts with its own menu items, File Manager renumbers the menu-item identifiers in the pop-up menu identified by the **hMenu** member by adding this delta value to each identifier. An extension DLL that needs to modify a menu item must identify the item to modify by adding the delta value to the menu item's identifier. The value of this member can vary from session to session.

See Also
FMExtensionProc

GLOBALENTRY (3.1)

```
#include <toolhelp.h>

typedef struct tagGLOBALENTRY {  /* ge */
    DWORD   dwSize;
    DWORD   dwAddress;
    DWORD   dwBlockSize;
    HGLOBAL hBlock;
    WORD    wcLock;
    WORD    wcPageLock;
    WORD    wFlags;
    BOOL    wHeapPresent;
    HGLOBAL hOwner;
    WORD    wType;
    WORD    wData;
    DWORD   dwNext;
    DWORD   dwNextAlt;
} GLOBALENTRY;
```

The **GLOBALENTRY** structure contains information about a memory object on the global heap.

Member	Description
dwSize	Specifies the size of the **GLOBALENTRY** structure, in bytes.
dwAddress	Specifies the linear address of the global-memory object.
dwBlockSize	Specifies the size of the global-memory object, in bytes.
hBlock	Identifies the global-memory object.
wcLock	Specifies the lock count. If this value is zero, the memory object is not locked.
wcPageLock	Specifies the page lock count. If this value is zero, the memory page is not locked.
wFlags	Specifies additional information about the memory object. This member can be the following value:

Value	Meaning
GF_PDB_OWNER	The process data block (PDB) for the task is the owner of the memory object.

wHeapPresent	Indicates whether a local heap exists within the global-memory object.
hOwner	Identifies the owner of the global-memory object.
wType	Specifies the memory type of the object. This type can be one of the following values:

Value	Meaning
GT_UNKNOWN	The memory type is not known.
GT_DGROUP	The object contains the default data segment and the stack segment.
GT_DATA	The object contains program data. (It may also contain stack and local heap data.)
GT_CODE	The object contains program code. If GT_CODE is specified, the **wData** member contains the segment number for the code.
GT_TASK	The object contains the task database.
GT_RESOURCE	The object contains the resource type specified in **wData**.
GT_MODULE	The object contains the module database.

GT_FREE	The object belongs to the free memory pool.
GT_INTERNAL	The object is reserved for internal use by Windows.
GT_SENTINEL	The object is either the first or the last object on the global heap.
GT_BURGERMASTER	The object contains a table that maps selectors to arena handles.

wData If the **wType** member is not GT_CODE or GT_RESOURCE, **wData** is zero.

If **wType** is GT_CODE, GT_DATA, or GT_DGROUP, **wData** contains the segment number for the code.

If **wType** is GT_RESOURCE, **wData** specifies the type of resource. The type can be one of the following values:

Value	Meaning
GD_ACCELERATORS	The object contains data from the accelerator table.
GD_BITMAP	The object contains data describing a bitmap. This includes the bitmap color table and the bitmap bits.
GD_CURSOR	The object contains data describing a group of cursors. This includes the height, width, color count, bit count, and ordinal identifier for the cursors.
GD_CURSORCOMPONENT	The object contains data describing a single cursor. This includes bitmap bits and bitmasks for the cursor.
GD_DIALOG	The object contains data describing controls within a dialog box.
GD_ERRTABLE	The object contains data from the error table.
GD_FONT	The object contains data describing a single font. This data is identical to data in a Windows font file (.FNT).
GD_FONTDIR	The object contains data describing a group of fonts. This includes the number of fonts in the resource and a table of metrics for each of these fonts.
GD_ICON	The object contains data describing a group of icons. This includes the height, width, color count, bit count, and ordinal identifier for the icons.
GD_ICONCOMPONENT	The object contains data describing a single icon. This includes bitmap bits and bitmaps for the icon.
GD_MENU	The object contains menu data for normal and pop-up menu items.
GD_NAMETABLE	The object contains data from the name table.
GD_RCDATA	The object contains data from a user-defined resource.
GD_STRING	The object contains data from the string table.
GD_USERDEFINED	The resource has an unknown resource identifier or is an application-specific named type.

dwNext Reserved for internal use by Windows.

dwNextAlt Reserved for internal use by Windows.

See Also
GlobalEntryHandle, **GlobalEntryModule**, **GlobalFirst**, **GlobalNext**, **GLOBALINFO**

GLOBALINFO (3.1)

```
#include <toolhelp.h>

typedef struct tagGLOBALINFO {  /* gi */
    DWORD dwSize;
    WORD  wcItems;
    WORD  wcItemsFree;
    WORD  wcItemsLRU;
} GLOBALINFO;
```

The **GLOBALINFO** structure contains information about the global heap.

Member	Description
dwSize	Specifies the size of the **GLOBALINFO** structure, in bytes.
wcItems	Specifies the total number of items on the global heap.
wcItemsFree	Specifies the number of free items on the global heap.
wcItemsLRU	Specifies the number of "least recently used" (LRU) items on the global heap.

See Also
GlobalInfo, **GLOBALENTRY**

GLYPHMETRICS (3.1)

```
typedef struct tagGLYPHMETRICS {  /* gm */
    UINT  gmBlackBoxX;
    UINT  gmBlackBoxY;
    POINT gmptGlyphOrigin;
    int   gmCellIncX;
    int   gmCellIncY;
} GLYPHMETRICS;
```

The **GLYPHMETRICS** structure contains information about the placement and orientation of a glyph in a character cell.

Member	Description
gmBlackBoxX	Specifies the width of the smallest rectangle that completely encloses the glyph (its "black box").
gmBlackBoxY	Specifies the height of the smallest rectangle that completely encloses the glyph (its "black box").
gmptGlyphOrigin	Specifies the x- and y-coordinates of the upper-left corner of the smallest rectangle that completely encloses the glyph.
gmCellIncX	Specifies the horizontal distance from the origin of the current character cell to the origin of the next character cell.
gmCellIncY	Specifies the vertical distance from the origin of the current character cell to the origin of the next character cell.

Comments

Values in the **GLYPHMETRICS** structure are specified in logical units.

See Also

GetGlyphOutline, **POINT**

HANDLETABLE (2.x)

```
typedef struct tagHANDLETABLE {      /* ht */
    HGDIOBJ objectHandle[1];
} HANDLETABLE;
```

The **HANDLETABLE** structure is an array of handles, each of which identifies a graphics device interface (GDI) object.

Member	Description
objectHandle	Contains an array of handles.

See Also

EnumMetaFile, **PlayMetaFileRecord**

HARDWAREHOOKSTRUCT (3.1)

```
typedef struct tagHARDWAREHOOKSTRUCT {  /* hhs */
    HWND    hWnd;
    UINT    wMessage;
    WPARAM  wParam;
    LPARAM  lParam;
} HARDWAREHOOKSTRUCT;
```

The **HARDWAREHOOKSTRUCT** contains information about a hardware message placed in the system message queue.

Member	Description
hWnd	Identifies the window that will receive the message.
wMessage	Specifies the message identifier.
wParam	Specifies additional information about the message. The exact meaning depends on the *wMessage* parameter.
lParam	Specifies additional information about the message. The exact meaning depends on the *wMessage* parameter.

HELPWININFO (3.1)

```
typedef struct {    /* hi */
    int  wStructSize;
    int  x;
    int  y;
    int  dx;
    int  dy;
    int  wMax;
    char rgchMember[2];
} HELPWININFO;
```

The **HELPWININFO** structure contains the size and position of a secondary help window. An application can set this size by calling the **WinHelp** function with the HELP_SETWINPOS value.

Member	Description
wStructSize	Specifies the size of the **HELPWININFO** structure.
x	Specifies the x-coordinate of the upper-left corner of the window.
y	Specifies the y-coordinate of the upper-left corner of the window.
dx	Specifies the width of the window.
dy	Specifies the height of the window.
wMax	Specifies whether the window should be maximized or set to the given position and dimensions. If this value is 1, the window is maximized. If it is zero, the size and position of the window are determined by the **x**, **y**, **dx**, and **dy** members.
rgchMember	Specifies the name of the window.

Comments

Microsoft Windows Help divides the display into 1024 units in both the x- and y-directions. To create a secondary window that fills the upper-left quadrant of the display, for example, an application would specify zero for the **x** and **y** members and 512 for the **dx** and **dy** members.

See Also

WinHelp

HSZPAIR (3.1)

```
#include <ddeml.h>

typedef struct tagHSZPAIR {    /* hp */
    HSZ hszSvc;
    HSZ hszTopic;
} HSZPAIR;
```

The **HSZPAIR** structure contains a dynamic data exchange (DDE) service name and topic name. A DDE server application can use this structure during an **XTYP_WILDCONNECT** transaction to enumerate the service/topic name pairs that it supports.

Member	Description
hszSvc	Identifies a service name.
hszTopic	Identifies a topic name.

See Also
XTYP_WILDCONNECT

KERNINGPAIR (3.1)

```
typedef struct tagKERNINGPAIR {    /* kp */
    WORD wFirst;
    WORD wSecond;
    int  iKernAmount;
} KERNINGPAIR;
```

The **KERNINGPAIR** structure defines a kerning pair.

Member	Description
wFirst	Specifies the character code for the first character in the kerning pair.
wSecond	Specifies the character code for the second character in the kerning pair.
iKernAmount	Specifies the amount that this pair will be kerned if they appear side by side in the same font and size. This value is typically negative, because pair-kerning usually results in two characters being set more tightly than normal. The value is given in logical units--that is, it depends on the current mapping mode.

See Also
GetKerningPairs

LOCALENTRY (3.1)

```
#include <toolhelp.h>

typedef struct tagLOCALENTRY {  /* le */
    DWORD   dwSize;
    HLOCAL  hHandle;
    WORD    wAddress;
    WORD    wSize;
    WORD    wFlags;
    WORD    wcLock;
    WORD    wType;
    WORD    hHeap;
    WORD    wHeapType;
    WORD    wNext;
} LOCALENTRY;
```

The **LOCALENTRY** structure contains information about a memory object on the local heap.

Member	Description
dwSize	Specifies the size of the **LOCALENTRY** structure, in bytes.
hHandle	Identifies the local-memory object.
wAddress	Specifies the address of the local-memory object.
wSize	Specifies the size of the local-memory object, in bytes.
wFlags	Specifies whether the memory object is fixed, free, or movable. This member can be one of the following values:

Value	Meaning
LF_FIXED	The object resides in a fixed memory location.
LF_FREE	The object is part of the free memory pool.
LF_MOVEABLE	The object can be moved in order to compact memory.

wcLock	Specifies the lock count. If this value is zero, the memory object is not locked.
wType	Specifies the content of the memory object. This member can be one of the following values:

Value	Meaning
LT_FREE	The object belongs to the free memory pool.
LT_GDI_BITMAP	The object contains a bitmap header.
LT_GDI_BRUSH	The object contains a brush.
LT_GDI_DC	The object contains a device context.
LT_GDI_DISABLED_DC	The object is reserved for internal use by Windows.
LT_GDI_FONT	The object contains a font header.
LT_GDI_MAX	The object is reserved for internal use by Windows.
LT_GDI_METADC	The object contains a metafile device context.
LT_GDI_METAFILE	The object contains a metafile header.
LT_GDI_PALETTE	The object contains a palette.
LT_GDI_PEN	The object contains a pen.
LT_GDI_RGN	The object contains a region.

LT_NORMAL	The object is reserved for internal use by Windows.
LT_USER_ATOMS	The object contains an atom structure.
LT_USER_BWL	The object is reserved for internal use by Windows.
LT_USER_CBOX	The object contains a combo-box structure.
LT_USER_CHECKPOINT	The object is reserved for internal use by Windows.
LT_USER_CLASS	The object contains a class structure.
LT_USER_CLIP	The object is reserved for internal use by Windows.
LT_USER_DCE	The object is reserved for internal use by Windows.
LT_USER_ED	The object contains an edit-control structure.
LT_USER_HANDLETABLE	The object is reserved for internal use by Windows.
LT_USER_HOOKLIST	The object is reserved for internal use by Windows.
LT_USER_HOTKEYLIST	The object is reserved for internal use by Windows.
LT_USER_LBIV	The object contains a list-box structure.
LT_USER_LOCKINPUTSTATE	The object is reserved for internal use by Windows.
LT_USER_MENU	The object contains a menu structure.
LT_USER_MISC	The object is reserved for internal use by Windows.
LT_USER_MWP	The object is reserved for internal use by Windows.
LT_USER_OWNERDRAW	The object is reserved for internal use by Windows.
LT_USER_PALETTE	The object is reserved for internal use by Windows.
LT_USER_POPUPMENU	The object is reserved for internal use by Windows.
LT_USER_PROP	The object contains a window-property structure.
LT_USER_SPB	The object is reserved for internal use by Windows.
LT_USER_STRING	The object is reserved for internal use by Windows.
LT_USER_USERSEEUSERDOALLOC	The object is reserved for internal use by Windows.
LT_USER_WND	The object contains a window structure.

hHeap Identifies the local-memory heap.

wHeapType Specifies the type of local heap. This type can be one of the following values:

Value	Meaning
NORMAL_HEAP	The heap is the default heap.

	USER_HEAP	The heap is used by the USER module.
	GDI_HEAP	The heap is used by the GDI module.
wNext	Specifies the next entry in the local heap. This member is reserved for internal use by Windows.	

Comments

The **wType** values are for informational purposes only. Microsoft reserves the right to change or delete these tags at any time. Applications should never directly change items on the system heaps, as this information will change in future versions. The **wType** values for the USER module are included only in the debugging versions of USER.EXE.

See Also

LocalFirst, **LocalNext**, **LOCALINFO**

LOCALINFO (toolhelp 3.1)

```
#include <toolhelp.h>

typedef struct tagLOCALINFO {  /* li */
    DWORD  dwSize;
    WORD   wcItems;
} LOCALINFO;
```

The **LOCALINFO** structure contains information about the local heap.

Member	Description
dwSize	Specifies the size of the **LOCALINFO** structure, in bytes.
wcItems	Specifies the total number of items on the local heap.

See Also
LocalInfo, **LOCALENTRY**

LOGBRUSH (2.x)

```
typedef struct tagLOGBRUSH {    /* lb */
    UINT     lbStyle;
    COLORREF lbColor;
    int      lbHatch;
} LOGBRUSH;
```

The **LOGBRUSH** structure defines the style, color, and pattern of a physical brush to be created by using the **CreateBrushIndirect** function.

Member	Description

lbStyle Specifies the brush style. This member can be one of the following values:

Value	Meaning
BS_DIBPATTERN	Specifies a pattern brush defined by a device-independent bitmap (DIB) specification.
BS_HATCHED	Specifies a hatched brush.
BS_HOLLOW	Specifies a hollow brush.
BS_PATTERN	Specifies a pattern brush defined by a memory bitmap.
BS_NULL	Equivalent to BS_HOLLOW.
BS_SOLID	Specifies a solid brush.

lbColor Specifies the color in which the brush is to be drawn. If the **lbStyle** member is the BS_HOLLOW or BS_PATTERN value, **lbColor** is ignored.

If **lpStyle** is the BS_DIBPATTERN value, the low-order word of **lbColor** specifies whether the **bmiColors** members of the **BITMAPINFO** structure contain explicit **RGB** values or indexes into the currently realized logical palette. The **lbColor** member must be one of the following values:

Value	Meaning
DIB_PAL_COLORS	Color table consists of an array of 16-bit indexes into the currently realized logical palette.
DIB_RGB_COLORS	Color table contains literal **RGB** values.

lbHatch Specifies a hatch style. The meaning depends on the brush style.

If the **lbStyle** member is the BS_DIBPATTERN style, the **lbHatch** member contains a handle to a packed DIB. To obtain this handle, an application calls the **GlobalAlloc** function to allocate a global memory object and then fills the memory with the packed DIB. A packed DIB consists of a **BITMAPINFO** structure immediately followed by the array of bytes which define the pixels of the bitmap.

If the **lbStyle** member is the BS_HATCHED style, the **lbHatch** member specifies the orientation of the lines used to create the hatch. This member can be one of the following values:

Value	Meaning
HS_BDIAGONAL	45-degree upward hatch (left to right)
HS_CROSS	Horizontal and vertical cross-hatch
HS_DIAGCROSS	45-degree cross-hatch
HS_FDIAGONAL	45-degree downward hatch (left to right)
HS_HORIZONTAL	Horizontal hatch
HS_VERTICAL	Vertical hatch

If the **lbStyle** member is the BS_PATTERN style, **lbHatch** must be a handle to the bitmap that defines the pattern.

If the **lbStyle** member is the BS_SOLID or the BS_HOLLOW style, **lbHatch** is ignored.

See Also
BITMAPINFO, **CreateBrushIndirect**, **CreateBrushIndirect**, **GlobalAlloc**

LOGFONT (2.x)

```
typedef struct tagLOGFONT {     /* lf */
    int   lfHeight;
    int   lfWidth;
    int   lfEscapement;
    int   lfOrientation;
    int   lfWeight;
    BYTE  lfItalic;
    BYTE  lfUnderline;
    BYTE  lfStrikeOut;
    BYTE  lfCharSet;
    BYTE  lfOutPrecision;
    BYTE  lfClipPrecision;
    BYTE  lfQuality;
    BYTE  lfPitchAndFamily;
    BYTE  lfFaceName[LF_FACESIZE];
} LOGFONT;
```

The **LOGFONT** structure defines the attributes of a font, a drawing object used to write text on a display surface.

Member	Description
lfHeight	Specifies the desired height, in logical units, for the font. If this value is greater than zero, it specifies the cell height of the font. If it is less than zero, it specifies the character height of the font. (Character height is the cell height minus the internal leading. Applications that specify font height in points typically use a negative number for this member.) If this value is zero, the font mapper uses a default height. The font mapper chooses the largest physical font that does not exceed the requested size (or the smallest font, if all the fonts exceed the requested size). The absolute value of the **lfHeight** member must not exceed 16,384 after it is converted to device units.
lfWidth	Specifies the average width, in logical units, of characters in the font. If this value is zero, the font mapper chooses a reasonable default width for the specified font height. (The default width is chosen by matching the aspect ratio of the device against the digitization aspect ratio of the available fonts. The closest match is determined by the absolute value of the difference.) The widths of characters in TrueType fonts are scaled by a factor of this member divided by the width of the characters in the physical font (as specified by the **tmAveCharWidth** member of the **TEXTMETRIC** structure).
lfEscapement	Specifies the angle, in tenths of degrees, between the base line of a character and the x-axis. The angle is measured in a counterclockwise direction from the x-axis for left-handed coordinate systems (that is, MM_TEXT, in which the y direction is down) and in a clockwise direction from the x-axis for right-handed coordinate systems (in which the y direction is up).
lfOrientation	Specifies the orientation of the characters. This value is ignored.
lfWeight	Specifies the font weight. This member can be one of the following values:

Constant	Value
FW_DONTCARE	0
FW_THIN	100
FW_EXTRALIGHT	200
FW_ULTRALIGHT	200
FW_LIGHT	300
FW_NORMAL	400

FW_REGULAR	400
FW_MEDIUM	500
FW_SEMIBOLD	600
FW_DEMIBOLD	600
FW_BOLD	700
FW_EXTRABOLD	800
FW_ULTRABOLD	800
FW_BLACK	900
FW_HEAVY	900

The actual appearance of the font depends on the type face. Some fonts have only FW_NORMAL, FW_REGULAR, and FW_BOLD weights. If FW_DONTCARE is specified, a default weight is used.

lfItalic Specifies an italic font if nonzero.

lfUnderline Specifies an underlined font if nonzero.

lfStrikeOut Specifies a strikeout font if nonzero.

lfCharSet Specifies the character set of the font. The following values are predefined:

Constant	Value
ANSI_CHARSET	0
DEFAULT_CHARSET	1
SYMBOL_CHARSET	2
SHIFTJIS_CHARSET	128
OEM_CHARSET	255

The DEFAULT_CHARSET value is not used by the font mapper. An application can use this value to allow the name and size of a font to fully describe the logical font. If the specified font name does not exist, a font from any character set can be substituted for the specified font; applications should use the DEFAULT_CHARSET value sparingly to avoid unexpected results.

The OEM character set is system-dependent.

Fonts with other character sets may exist in the system. If an application uses a font with an unknown character set, it should not attempt to translate or interpret strings that are to be rendered with that font.

lfOutPrecision Specifies the desired output precision. The output precision defines how closely the output must match the height, width, character orientation, escapement, and pitch of the requested font. This member can be one of the following values:

OUT_CHARACTER_PRECIS	OUT_STRING_PRECIS
OUT_DEFAULT_PRECIS	OUT_STROKE_PRECIS
OUT_DEVICE_PRECIS	OUT_TT_PRECIS
OUT_RASTER_PRECIS	OUT_TT_ONLY_PRECIS

Applications can use the values OUT_DEVICE_PRECIS, OUT_RASTER_PRECIS, and OUT_TT_PRECIS to control how the font mapper chooses a font when the system contains more than one font with a given name. For example, if a system contains a font named "Symbol" in raster and TrueType form, specifying OUT_TT_PRECIS would force the font mapper to choose the TrueType version. (Specifying OUT_TT_PRECIS forces the font mapper to choose a TrueType font whenever the specified font name matches a device or raster font, even when there is no TrueType font with the same name.)

An application can use TrueType fonts exclusively by specifying

OUT_TT_ONLY_PRECIS. When this value is specified, the system chooses a TrueType font even when the name specified in the **lfFaceName** member matches a raster or vector font.

lfClipPrecision Specifies the desired clipping precision. The clipping precision defines how to clip characters that are partially outside the clipping region. This member can be any one of the following values:

CLIP_CHARACTER_PRECIS	CLIP_MASK
CLIP_DEFAULT_PRECIS	CLIP_STROKE_PRECIS
CLIP_EMBEDDED	CLIP_TT_ALWAYS
CLIP_LH_ANGLES	

To use an embedded read-only font, applications must specify the CLIP_EMBEDDED value.

To achieve consistent rotation of device, TrueType, and vector fonts, an application can use the OR operator to combine the CLIP_LH_ANGLES value with any of the other **lfClipPrecision** values. If the CLIP_LH_ANGLES bit is set, the rotation for all fonts is dependent on whether the orientation of the coordinate system is left-handed or right-handed. If CLIP_LH_ANGLES is not set, device fonts always rotate counter-clockwise, but the rotation of other fonts is dependent on the orientation of the coordinate system. (For more information about the orientation of coordinate systems, see the description of the **lfEscapement** member.)

lfQuality Specifies the output quality of the font, which defines how carefully the graphics device interface (GDI) must attempt to match the logical-font attributes to those of an actual physical font. This member can be one of the following values:

Value	Meaning
DEFAULT_QUALITY	Appearance of the font does not matter.
DRAFT_QUALITY	Appearance of the font is less important than when the PROOF_QUALITY value is used. For GDI raster fonts, scaling is enabled. Bold, italic, underline, and strikeout fonts are synthesized if necessary.
PROOF_QUALITY	Character quality of the font is more important than exact matching of the logical-font attributes. For GDI raster fonts, scaling is disabled and the font closest in size is chosen. Bold, italic, underline, and strikeout fonts are synthesized if necessary.

lfPitchAndFamily Specifies the pitch and family of the font. The two low-order bits, which specify the pitch of the font, can be one of the following values:

DEFAULT_PITCH	VARIABLE_PITCH
FIXED_PITCH	

The four high-order bits of the member, which specify the font family, can be one of the following values:

Value	Meaning
FF_DECORATIVE	Novelty fonts. Old English is an example.
FF_DONTCARE	Don't care or don't know.
FF_MODERN	Fonts with constant stroke width, with or without serifs. Pica, Elite, and Courier New are examples.
FF_ROMAN	Fonts with variable stroke width and with serifs. Times New Roman and New Century Schoolbook are examples.

	FF_SCRIPT	Fonts designed to look like handwriting. Script and Cursive are examples.
	FF_SWISS	Fonts with variable stroke width and without serifs. **MS** Sans Serif is an example.
	An application can specify a value for the **lfPitchAndFamily** member by using the Boolean OR operator to join a pitch constant with a family constant.	
	Font families describe the look of a font in a general way. They are intended for specifying fonts when the exact typeface desired is not available.	
lfFaceName	Specifies the typeface name of the font. The length of this string must not exceed LF_FACESIZE - 1. The **EnumFontFamilies** function can be used to enumerate the typeface names of all currently available fonts. If **lfFaceName** is NULL, GDI uses a device-dependent typeface.	

Comments

Applications can use the default settings for most of these members when creating a logical font. The members that should always be given specific values are **lfHeight** and **lfFaceName**. If **lfHeight** and **lfFaceName** are not set by the application, the logical font that is created is device-dependent.

See Also

CreateFontIndirect, **EnumFontFamilies**

LOGPALETTE (3.0)

```
typedef struct tagLOGPALETTE {  /* lgpl */
    WORD         palVersion;
    WORD         palNumEntries;
    PALETTEENTRY palPalEntry[1];
} LOGPALETTE;
```

The **LOGPALETTE** structure defines a logical color palette.

Member	Description
palVersion	Specifies the Windows version number for the structure. This value should be 0x300 for Windows 3.0 and later.
palNumEntries	Specifies the number of palette color entries.
palPalEntry	Specifies an array of **PALETTEENTRY** structures that define the color and usage of each entry in the logical palette.

Comments

The colors in the palette entry table should appear in order of importance, because entries earlier in the logical palette are most likely to be placed in the system palette.

This structure is passed as a parameter to the **CreatePalette** function.

See Also

CreatePalette, **PALETTEENTRY**

LOGPEN (2.x)

```
typedef struct tagLOGPEN {  /* lgpn */
    UINT     lopnStyle;
    POINT    lopnWidth;
    COLORREF lopnColor;
} LOGPEN;
```

The **LOGPEN** structure defines the style, width, and color of a pen, a drawing object used to draw lines and borders. The **CreatePenIndirect** function uses the **LOGPEN** structure.

Member	Description
lopnStyle	Specifies the pen type. This member can be one of the following values:

Value	Meaning
PS_SOLID	Creates a solid pen.
PS_DASH	Creates a dashed pen. (Valid only when the pen width is 1.)
PS_DOT	Creates a dotted pen. (Valid only when the pen width is 1.)
PS_DASHDOT	Creates a pen with alternating dashes and dots. (Valid only when the pen width is 1.)
PS_DASHDOTDOT	Creates a pen with alternating dashes and double dots. (Valid only when the pen width is 1.)
PS_NULL	Creates a null pen.
PS_INSIDEFRAME	Creates a pen that draws a line inside the frame of closed shapes produced by graphics device interface (GDI) output functions that specify a bounding rectangle (for example, the **Ellipse**, **Rectangle**, **RoundRect**, **Pie**, and **Chord** functions). When this style is used with GDI output functions that do not specify a bounding rectangle (for example, the **LineTo** function), the drawing area of the pen is not limited by a frame.

If a pen has the **PS_INSIDEFRAME** style and a color that does not match a color in the logical color table, the pen is drawn with a dithered color. The **PS_SOLID** pen style cannot be used to create a pen with a dithered color. The PS_INSIDEFRAME style is identical to PS_SOLID if the pen width is less than or equal to 1.

When the **PS_INSIDEFRAME** style is used with GDI objects produced by functions other than **Ellipse**, **Rectangle**, and **RoundRect**, the line may not be completely inside the specified frame.

lopnWidth	Specifies the pen width, in logical units. If the **lopnWidth** member is zero, the pen is one pixel wide on raster devices regardless of the current mapping mode.
lopnColor	Specifies the pen color.

Comments

The *y* value in the **POINT** structure for the **lopnWidth** member is not used.

See Also

CreatePenIndirect, **POINT**

The following shows how the various pens appear when used to draw a rectangle:

MAT2 (3.1)

```
typedef struct tagMAT2 {  /* mat2 */
    FIXED eM11;
    FIXED eM12;
    FIXED eM21;
    FIXED eM22;
} MAT2;
```

The **MAT2** structure contains the values for a transformation matrix.

Member	Description
eM11	Specifies a fixed-point value for the *M11* component of a 2-by-2 transformation matrix.
eM12	Specifies a fixed-point value for the *M12* component of a 2-by-2 transformation matrix.
eM21	Specifies a fixed-point value for the *M21* component of a 2-by-2 transformation matrix.
eM22	Specifies a fixed-point value for the *M22* component of a 2-by-2 transformation matrix.

Comments

The identity matrix produces a transformation in which the transformed graphical object is identical to the source object. In the identity matrix, the value of **eM11** is 1, the value of **eM12** is zero, the value of **eM21** is zero, and the value of **eM22** is 1.

See Also

GetGlyphOutline, **FIXED**

MDICREATESTRUCT (3.0)

```
typedef struct tagMDICREATESTRUCT {     /* mdic */
    LPCSTR    szClass;
    LPCSTR    szTitle;
    HINSTANCE hOwner;
    int       x;
    int       y;
    int       cx;
    int       cy;
    DWORD     style;
    LPARAM    lParam;
} MDICREATESTRUCT;
```

The **MDICREATESTRUCT** structure contains information about the class, title, owner, location, and size of a multiple document interface (MDI) child window.

Member	Description
szClass	Contains a long pointer to the application-defined class of the MDI child window.
szTitle	Contains a long pointer to the window title of the MDI child window.
hOwner	Identifies the instance handle of the application creating the MDI child window.
x	Specifies the initial position of the left side of the MDI child window. If this member is set to CW_USEDEFAULT, the MDI child window is assigned a default horizontal position.
y	Specifies the initial position of the top edge of the MDI child window. If this member is set to CW_USEDEFAULT, the MDI child window is assigned a default vertical position.
cx	Specifies the initial width of the MDI child window. If this member is set to CW_USEDEFAULT, the MDI child window is assigned a default width.
cy	Specifies the initial height of the MDI child window. If this member is set to CW_USEDEFAULT, the MDI child window is assigned a default height.
style	Specifies additional styles for the MDI child window. If the MDI client window was created with the MDIS_ALLCHILDSTYLES window style, the **style** member may be any combination of the window styles documented with the **CreateWindow** function. Otherwise, it may be one or more of the following values:

Value	Meaning
WS_MINIMIZE	MDI child window is created in a minimized state.
WS_MAXIMIZE	MDI child window is created in a maximized state.
WS_HSCROLL	MDI child window is created with a horizontal scroll bar.
WS_VSCROLL	MDI child window is created with a vertical scroll bar.

lParam	Specifies an application-defined 32-bit value.

Comments

When the MDI child window is created, Windows sends the **WM_CREATE** message to the window. The *lParam* parameter of the WM_CREATE message contains a pointer to a **CREATESTRUCT** structure. The **lpCreateParams** member of **CREATESTRUCT** contains a pointer to the **MDICREATESTRUCT** structure passed with the **WM_MDICREATE** message that created the MDI child window.

See Also

CREATESTRUCT

MEASUREITEMSTRUCT (3.0)

```
typedef struct tagMEASUREITEMSTRUCT {    /* mi */
    UINT   CtlType;
    UINT   CtlID;
    UINT   itemID;
    UINT   itemWidth;
    UINT   itemHeight;
    DWORD  itemData;
} MEASUREITEMSTRUCT;
```

The **MEASUREITEMSTRUCT** structure informs Windows of the dimensions of an owner-drawn control. This allows Windows to process user interaction with the control correctly. The owner of an owner-drawn control receives a pointer to this structure as the *lParam* parameter of an **WM_MEASUREITEM** message. The owner-drawn control sends this message to its owner window when the control is created. The owner then fills in the appropriate members in the structure for the control and returns. This structure is common to all owner-drawn controls.

Member	Description
CtlType	Specifies the control type. The values for control types are as follows:

Value	Meaning
ODT_BUTTON	Owner-drawn button
ODT_COMBOBOX	Owner-drawn combo box
ODT_LISTBOX	Owner-drawn list box
ODT_MENU	Owner-drawn menu

CtlID	Specifies the control identifier for a combo box, list box, or button. This member is not used for a menu.
itemID	Specifies the menu-item identifier for a menu or the list-box item identifier for a variable-height combo box or list box. This member is not used for a fixed-height combo box or list box or for a button.
itemWidth	Specifies the width of a menu item. The owner of the owner-drawn menu item must fill this member before returning from the message.
itemHeight	Specifies the height of an individual item in a list box or a menu. Before returning from the message, the owner of the owner-drawn combo box, list box, or menu item must fill out this member. The maximum height of a list box item is 255.
itemData	Contains the value that was passed to the combo box or list box in the *lParam* parameter of one of the following messages: **CB_ADDSTRING** **CB_INSERTSTRING** **LB_ADDSTRING** **LB_INSERTSTRING**

Comments

Failure to fill out the proper members in the **MEASUREITEMSTRUCT** structure will cause improper operation of the control.

See Also

WM_MEASUREITEM

MEMMANINFO (toolhelp 3.1)

```
#include <toolhelp.h>

typedef struct tagMEMMANINFO {  /* mmi */
    DWORD dwSize;
    DWORD dwLargestFreeBlock;
    DWORD dwMaxPagesAvailable;
    DWORD dwMaxPagesLockable;
    DWORD dwTotalLinearSpace;
    DWORD dwTotalUnlockedPages;
    DWORD dwFreePages;
    DWORD dwTotalPages;
    DWORD dwFreeLinearSpace;
    DWORD dwSwapFilePages;
    WORD  wPageSize;
} MEMMANINFO;
```

The **MEMMANINFO** structure contains information about the status and performance of the virtual-memory manager. If the memory manager is running in standard mode, the only valid member of this structure is the **dwLargestFreeBlock** member.

Member	Description
dwSize	Specifies the size of the **MEMMANINFO** structure, in bytes.
dwLargestFreeBlock	Specifies the largest free block of contiguous linear memory in the system, in bytes.
dwMaxPagesAvailable	Specifies the maximum number of pages that could be allocated in the system (the value of **dwLargestFreeBlock** divided by the value of **wPageSize**).
dwMaxPagesLockable	Specifies the maximum number of pages that could be allocated and locked.
dwTotalLinearSpace	Specifies the size of the total linear address space, in pages.
dwTotalUnlockedPages	Specifies the number of unlocked pages in the system. This value includes free pages.
dwFreePages	Specifies the number of pages that are not in use.
dwTotalPages	Specifies the total number of pages the virtual-memory manager manages. This value includes free, locked, and unlocked pages.
dwFreeLinearSpace	Specifies the amount of free memory in the linear address space, in pages.
dwSwapFilePages	Specifies the number of pages in the system swap file.
wPageSize	Specifies the system page size, in bytes.

See Also
MemManInfo

MENUITEMTEMPLATE (3.0)

```
typedef  struct {   /* mit */
    UINT mtOption;
    UINT mtID;
    char mtString[1];
} MENUITEMTEMPLATE;
```

The **MENUITEMTEMPLATE** structure defines a menu item.

Member	Description
mtOption	Specifies a mask of one or more predefined menu options that specify the appearance of the menu item. The menu options follow:

Value	Meaning
MF_CHECKED	Item has a check mark next to it.
MF_GRAYED	Item is initially inactive and drawn with a gray effect.
MF_HELP	Item has a vertical separator to its left.
MF_MENUBARBREAK	Item is placed in a new column. The old and new columns are separated by a bar.
MF_MENUBREAK	Item is placed in a new column.
MF_OWNERDRAW	Owner of the menu is responsible for drawing all visual aspects of the menu item, including highlighted, checked and inactive states. This option is not valid for a top-level menu item.
MF_POPUP	Item displays a sublist of menu items when selected.

mtID	Specifies an identification code for a non-pop-up menu item. The **MENUITEMTEMPLATE** structure for a pop-up menu item does not contain the **mtID** member.
mtString	Specifies a null-terminated string that contains the name of the menu item.

See Also
LoadMenuIndirect, **MENUITEMTEMPLATEHEADER**

MENUITEMTEMPLATEHEADER (3.0)

```
typedef struct {    /* mith */
    UINT    versionNumber;
    UINT    offset;
} MENUITEMTEMPLATEHEADER;
```

A complete menu template consists of a header and one or more menu-item lists.

Member	Description
versionNumber	Specifies the version number. This member should be zero.
offset	Specifies the offset from the end of the header, in bytes, where the menu-item list begins.

Comments

One or more **MENUITEMTEMPLATE** structures are combined to form the menu-item list.

See Also

MENUITEMTEMPLATE

METAFILEPICT (2.x)

```
typedef struct tagMETAFILEPICT {    /* mfp */
   int       mm;
   int       xExt;
   int       yExt;
   HMETAFILE hMF;
} METAFILEPICT;
```

The **METAFILEPICT** structure defines the metafile picture format used for exchanging metafile data through the clipboard.

Member	Description
mm	Specifies the mapping mode in which the picture is drawn.
xExt	Specifies the size of the metafile picture for all modes except the MM_ISOTROPIC and MM_ANISOTROPIC modes. The x-extent specifies the width of the rectangle within which the picture is drawn. The coordinates are in units that correspond to the mapping mode.
yExt	Specifies the size of the metafile picture for all modes except the MM_ISOTROPIC and MM_ANISOTROPIC modes. The y-extent specifies the height of the rectangle within which the picture is drawn. The coordinates are in units that correspond to the mapping mode. For MM_ISOTROPIC and MM_ANISOTROPIC modes, which can be scaled, the **xExt** and **yExt** members contain an optional suggested size in MM_HIMETRIC units. For MM_ANISOTROPIC pictures, **xExt** and **yExt** can be zero when no suggested size is supplied. For MM_ISOTROPIC pictures, an aspect ratio must be supplied even when no suggested size is given. (If a suggested size is given, the aspect ratio is implied by the size.) To give an aspect ratio without implying a suggested size, set **xExt** and **yExt** to negative values whose ratio is the appropriate aspect ratio. The magnitude of the negative **xExt** and **yExt** values will be ignored; only the ratio will be used.
hMF	Identifies a memory metafile.

See Also
SetClipboardData

METAHEADER (3.1)

```
typedef struct tagMETAHEADER {  /* mh */
    UINT  mtType;
    UINT  mtHeaderSize;
    UINT  mtVersion;
    DWORD mtSize;
    UINT  mtNoObjects;
    DWORD mtMaxRecord;
    UINT  mtNoParameters;
} METAHEADER;
```

The **METAHEADER** structure contains information about a metafile.

Member	Description
mtType	Specifies whether the metafile is in memory or recorded in a disk file. This member can be one of the following values:
	Value **Meaning** 1 Metafile is in memory. 2 Metafile is in a disk file.
mtHeaderSize	Specifies the size, in words, of the metafile header.
mtVersion	Specifies the Windows version number. The version number for metafiles that support device-independent bitmaps (DIBs) is 0x0300. Otherwise, the version number is 0x0100.
mtSize	Specifies the size, in words, of the file.
mtNoObjects	Specifies the maximum number of objects that exist in the metafile at the same time.
mtMaxRecord	Specifies the size, in words, of the largest record in the metafile.
mtNoParameters	Reserved.

See Also
METARECORD

METARECORD (3.1)

```
typedef struct tagMETARECORD {  /* mr */
    DWORD rdSize;
    UINT  rdFunction;
    UINT  rdParm[1];
} METARECORD;
```

The **METARECORD** structure contains a metafile record.

Member	Description
rdSize	Specifies the size, in words, of the record.
rdFunction	Specifies the function number.
rdParm	Specifies an array of words containing the function parameters, in the reverse order in which they are passed to the function.

See Also
METAHEADER

MINMAXINFO (3.1)

```
typedef struct tagMINMAXINFO {  /* mmi */
    POINT ptReserved;
    POINT ptMaxSize;
    POINT ptMaxPosition;
    POINT ptMinTrackSize;
    POINT ptMaxTrackSize;
} MINMAXINFO;
```

The **MINMAXINFO** structure contains information about a window's maximized size and position and its minimum and maximum tracking size.

Member	Description
ptReserved	Reserved for internal use.
ptMaxSize	Specifies the maximized width (*point***.x**) and the maximized height (*point***.y**) of the window.
ptMaxPosition	Specifies the position of the left side of the maximized window (*point***.x**) and the position of the top of the maximized window (*point***.y**).
ptMinTrackSize	Specifies the minimum tracking width (*point***.x**) and the minimum tracking height (*point***.y**) of the window.
ptMaxTrackSize	Specifies the maximum tracking width (*point***.x**) and the maximum tracking height (*point***.y**) of the window.

See Also
POINT, **WM_GETMINMAXINFO**

MODULEENTRY (3.1)

```
#include <toolhelp.h>

typedef struct tagMODULEENTRY {  /* me */
    DWORD   dwSize;
    char    szModule[MAX_MODULE_NAME + 1];
    HMODULE hModule;
    WORD    wcUsage;
    char    szExePath[MAX_PATH + 1];
    WORD    wNext;
} MODULEENTRY;
```

The **MODULEENTRY** structure contains information about one module in the module list.

Member	Description
dwSize	Specifies the size of the **MODULEENTRY** structure, in bytes.
szModule	Specifies the null-terminated string that contains the module name.
hModule	Identifies the module handle.
wcUsage	Specifies the reference count of the module. This is the same number returned by the **GetModuleUsage** function.
szExePath	Specifies the null-terminated string that contains the fully-qualified executable path for the module.
wNext	Specifies the next module in the module list. This member is reserved for internal use by Windows.

See Also
ModuleFindHandle, **ModuleFindName**, **ModuleFirst**, **ModuleNext**

MONCBSTRUCT (3.1)

```
#include <ddeml.h>

typedef struct tagMONCBSTRUCT {    /* mcbst */
    UINT     cb;
    WORD     wReserved;
    DWORD    dwTime;
    HANDLE   hTask;
    DWORD    dwRet;
    UINT     wType;
    UINT     wFmt;
    HCONV    hConv;
    HSZ      hsz1;
    HSZ      hsz2;
    HDDEDATA hData;
    DWORD    dwData1;
    DWORD    dwData2;
} MONCBSTRUCT;
```

The **MONCBSTRUCT** structure contains information about the current dynamic data exchange (DDE) transaction. A DDE debugging application can use this structure when monitoring transactions that the system passes to the DDE callback functions of other applications.

Member	Description
cb	Specifies the length, in bytes, of the structure.
wReserved	Reserved.
dwTime	Specifies the Windows time at which the transaction occurred. Windows time is the number of milliseconds that have elapsed since the system was started.
hTask	Identifies the task (application instance) containing the DDE callback function that received the transaction.
dwRet	Specifies the value returned by the DDE callback function that processed the transaction.
wType	Specifies the transaction type.
wFmt	Specifies the format of the data (if any) exchanged during the transaction.
hConv	Identifies the conversation in which the transaction took place.
hsz1	Identifies a string.
hsz2	Identifies a string.
hData	Identifies the data (if any) exchanged during the transaction.
dwData1	Specifies additional data.
dwData2	Specifies additional data.

See Also

MONERRSTRUCT, **MONHSZSTRUCT**, **MONLINKSTRUCT**, **MONMSGSTRUCT**, **XTYP_MONITOR**

MONCONVSTRUCT (3.1)

```
#include <ddeml.h>

typedef struct tagMONCONVSTRUCT { /* mcvst */
    UINT    cb;
    BOOL    fConnect;
    DWORD   dwTime;
    HANDLE  hTask;
    HSZ     hszSvc;
    HSZ     hszTopic;
    HCONV   hConvClient;
    HCONV   hConvServer;
} MONCONVSTRUCT;
```

The **MONCONVSTRUCT** structure contains information about a conversation. A dynamic data exchange (DDE) monitoring application can use this structure to obtain information about an advise loop that has been established or terminated.

Member	Description
cb	Specifies the length, in bytes, of the structure.
fConnect	Indicates whether the conversation is currently established. A value of TRUE indicates the conversation is established; FALSE indicates it is not.
dwTime	Specifies the Windows time at which the conversation was established or terminated. Windows time is the number of milliseconds that have elapsed since the system was started.
hTask	Identifies a task (application instance) that is a partner in the conversation.
hszSvc	Identifies the service name on which the conversation is established.
hszTopic	Identifies the topic name on which the conversation is established.
hConvClient	Identifies the client conversation.
hConvServer	Identifies the server conversation.

See Also

MONCBSTRUCT, **MONERRSTRUCT**, **MONHSZSTRUCT**, **MONLINKSTRUCT**, **MONMSGSTRUCT**, **XTYP_MONITOR**

MONERRSTRUCT (3.1)

```
#include <ddeml.h>

typedef struct tagMONERRSTRUCT {  /* mest */
    UINT    cb;
    UINT    wLastError;
    DWORD   dwTime;
    HANDLE  hTask;
} MONERRSTRUCT;
```

The **MONERRSTRUCT** structure contains information about the current dynamic data exchange (DDE) error. A DDE monitoring application can use this structure to monitor errors returned by DDE Management Library functions.

Member	Description
cb	Specifies the length, in bytes, of the structure.
wLastError	Specifies the current error.
dwTime	Specifies the Windows time at which the error occurred. Windows time is the number of milliseconds that have elapsed since the system was started.
hTask	Identifies the task (application instance) that called the DDE function that caused the error.

See Also
MONCBSTRUCT, **MONCONVSTRUCT**, **MONHSZSTRUCT**, **MONLINKSTRUCT**, **MONMSGSTRUCT**, **XTYP_MONITOR**

MONHSZSTRUCT (3.1)

```
#include <ddeml.h>

typedef struct tagMONHSZSTRUCT { /* mhst */
    UINT   cb;
    BOOL   fsAction;
    DWORD  dwTime;
    HSZ    hsz;
    HANDLE hTask;
    WORD   wReserved;
    char   str[1];
} MONHSZSTRUCT;
```

The **MONHSZSTRUCT** structure contains information about a dynamic data exchange (DDE) string handle. A DDE monitoring application can use this structure when monitoring the activity of the string-manager component of the DDE Management Library (DDEML).

Member	Description
cb	Specifies the length, in bytes, of the structure.
fsAction	Specifies the action being performed on the string handle identified by the **hsz** member.

Value	Meaning
MH_CLEANUP	An application is freeing its DDE resources, causing the system to delete string handles that the application had created. (The application called the **DdeUninitialize** function.)
MH_CREATE	An application is creating a string handle. (The application called the **DdeCreateStringHandle** function.)
MH_DELETE	An application is deleting a string handle. (The application called the **DdeFreeStringHandle** function.)
MH_KEEP	An application is increasing the use count of a string handle. (The application called the **DdeKeepStringHandle** function.)

dwTime	Specifies the Windows time at which the action specified by the **fsAction** member takes place. Windows time is the number of milliseconds that have elapsed since the system was booted.
hsz	Identifies the string.
hTask	Identifies the task (application instance) performing the action on the string handle.
wReserved	Reserved.
str	Points to the string identified by the **hsz** member.

See Also

MONCBSTRUCT, **MONCONVSTRUCT**, **MONERRSTRUCT**, **MONLINKSTRUCT**, **MONMSGSTRUCT**, **DdeCreateStringHandle**, **DdeFreeStringHandle**, **DdeKeepStringHandle**, **DdeUninitialize**

MONLINKSTRUCT (3.1)

```
#include <ddeml.h>

typedef struct tagMONLINKSTRUCT {  /* mlst */
    UINT    cb;
    DWORD   dwTime;
    HANDLE  hTask;
    BOOL    fEstablished;
    BOOL    fNoData;
    HSZ     hszSvc;
    HSZ     hszTopic;
    HSZ     hszItem;
    UINT    wFmt;
    BOOL    fServer;
    HCONV   hConvServer;
    HCONV   hConvClient;
} MONLINKSTRUCT;
```

The **MONLINKSTRUCT** structure contains information about a dynamic data exchange (DDE) advise loop. A DDE monitoring application can use this structure to obtain information about an advise loop that has started or ended.

Member	Description
cb	Specifies the length, in bytes, of the structure.
dwTime	Specifies the Windows time at which the advise loop was started or ended. Windows time is the number of milliseconds that have elapsed since the system was started.
hTask	Identifies a task (application instance) that is a partner in the advise loop.
fEstablished	Indicates whether an advise loop was successfully established. A value of TRUE indicates an advise loop was established; FALSE indicates an advise loop was not established.
fNoData	Indicates whether the XTYPF_NODATA flag was set for the advise loop. A value of TRUE indicates the flag is set; FALSE indicates the flag was not set.
hszSvc	Identifies the service name of the server in the advise loop.
hszTopic	Identifies the topic name on which the advise loop is established.
hszItem	Identifies the item name that is the subject of the advise loop.
wFmt	Specifies the format of the data exchanged (if any) during the advise loop.
fServer	Indicates whether the link notification came from the server. If the notification came from the server, this value is TRUE. Otherwise, it is FALSE.
hConvServer	Identifies the server conversation.
hConvClient	Identifies the client conversation.

See Also

MONCBSTRUCT, **MONERRSTRUCT**, **MONHSZSTRUCT**, **MONMSGSTRUCT**, **XTYP_MONITOR**

MONMSGSTRUCT (3.1)

```
#include <ddeml.h>

typedef struct tagMONMSGSTRUCT { /* mmst */
    UINT    cb;
    HWND    hwndTo;
    DWORD   dwTime;
    HANDLE  hTask;
    UINT    wMsg;
    WPARAM  wParam;
    LPARAM  lParam;
} MONMSGSTRUCT;
```

The **MONMSGSTRUCT** structure contains information about a dynamic data exchange (DDE) message. A DDE monitoring application can use this structure to obtain information about a DDE message that was sent or posted.

Member	Description
cb	Specifies the length, in bytes, of the structure.
hwndTo	Identifies the window that receives the DDE message.
dwTime	Specifies the Windows time at which the message was sent or posted. Windows time is the number of milliseconds that have elapsed since the system was started.
hTask	Identifies the task (application instance) containing the window that receives the DDE message.
wMsg	Specifies the identifier of the DDE message.
wParam	Specifies the *wParam* parameter of the DDE message.
lParam	Specifies the *lParam* parameter of the DDE message.

See Also

MONCBSTRUCT, **MONCONVSTRUCT**, **MONERRSTRUCT**, **MONHSZSTRUCT**, **MONLINKSTRUCT**, **XTYP_MONITOR**

MOUSEHOOKSTRUCT (3.1)

```
typedef struct tagMOUSEHOOKSTRUCT { /* ms */
    POINT   pt;
    HWND    hwnd;
    UINT    wHitTestCode;
    DWORD   dwExtraInfo;
} MOUSEHOOKSTRUCT;
```

The **MOUSEHOOKSTRUCT** structure contains information about a mouse event.

Member	Description
pt	Specifies a **POINT** structure that contains the x- and y-coordinates of the mouse cursor, in screen coordinates.
hwnd	Identifies the window that will receive the mouse message that corresponds to the mouse event.
wHitTestCode	Specifies the hit-test code.
dwExtraInfo	Specifies extra information associated with the mouse event. An application can set this extra information by calling the **hardware_event** function and retrieve it by calling the **GetMessageExtraInfo** function.

See Also
hardware_event, **GetMessageExtraInfo**, **SetWindowsHook**

MSG (2.x)

```
typedef struct tagMSG {     /* msg */
    HWND   hwnd;
    UINT   message;
    WPARAM wParam;
    LPARAM lParam;
    DWORD  time;
    POINT  pt;
} MSG;
```

The **MSG** structure contains information from the Windows application queue.

Member	Description
hwnd	Identifies the window that receives the message.
message	Specifies the message number.
wParam	Specifies additional information about the message. The exact meaning depends on the **message** value.
lParam	Specifies additional information about the message. The exact meaning depends on the **message** value.
time	Specifies the time at which the message was posted.
pt	Specifies the position of the cursor, in screen coordinates, when the message was posted.

See Also
EVENTMSG, **GetMessage**

MULTIKEYHELP (3.0)

```
typedef struct tagMULTIKEYHELP {    /* mkh */
    UINT  mkSize;
    BYTE  mkKeylist;
    BYTE  szKeyphrase[1];
} MULTIKEYHELP;
```

The **MULTIKEYHELP** structure specifies a keyword table and an associated keyword to be used by the Windows Help application.

Member	Description
mkSize	Specifies the length, in bytes, of the **MULTIKEYHELP** structure.
mkKeylist	Contains a single character that identifies the keyword table to be searched.
szKeyphrase	Contains a null-terminated text string that specifies the keyword to be located in the keyword table.

See Also
WinHelp

NCCALCSIZE_PARAMS (3.1)

```
typedef struct tagNCCALCSIZE_PARAMS {
    RECT           rgrc[3];
    WINDOWPOS FAR* lppos;
} NCCALCSIZE_PARAMS;
```

The **NCCALCSIZE_PARAMS** structure contains information that an application can use while processing the **WM_NCCALCSIZE** message to calculate the size, position, and valid contents of the client area of a window.

Member	Description
rgrc	Specifies an array of rectangles. The first contains the new coordinates of a window that has been moved or resized. The second contains the coordinates of the window before it was moved or resized. The third contains the coordinates of the client area of a window before it was moved or resized. If the window is a child window, the coordinates are relative to the client area of the parent window. If the window is a top-level window, the coordinates are relative to the screen.
lppos	Points to a **WINDOWPOS** structure that contains the size and position values specified in the operation that caused the window to be moved or resized.

See Also
MoveWindow, **SetWindowPos**, **RECT**, **WINDOWPOS**, **WM_NCCALCSIZE**

NEWCPLINFO (3.1)

```
#include <cpl.h>

typedef struct tagNEWCPLINFO {  /* ncpli */
    DWORD   dwSize;
    DWORD   dwFlags;
    DWORD   dwHelpContext;
    LONG    lData;
    HICON   hIcon;
    char    szName[32];
    char    szInfo[64];
    char    szHelpFile[128];
} NEWCPLINFO;
```

The **NEWCPLINFO** structure contains resource information and a user-defined value for a Control Panel application.

Member	Description
dwSize	Specifies the length of the structure, in bytes.
dwFlags	Specifies Control Panel flags.
dwHelpContext	Specifies the context number for the topic in the help project (.HPJ) file that displays when the user selects help for the application.
lData	Specifies data defined by the application.
hIcon	Identifies an icon resource for the application icon. This icon is displayed in the Control Panel window.
szName	Specifies a null-terminated string that contains the application name. The name is the short string displayed below the application icon in the Control Panel window. The name is also displayed in the Settings menu of Control Panel.
szInfo	Specifies a null-terminated string containing the application description. The description displayed at the bottom of the Control Panel window when the application icon is selected.
szHelpFile	Specifies a null-terminated string that contains the path of the help file, if any, for the application.

NEWTEXTMETRIC (3.1)

```
typedef struct tagNEWTEXTMETRIC {    /* ntm */
    int   tmHeight;
    int   tmAscent;
    int   tmDescent;
    int   tmInternalLeading;
    int   tmExternalLeading;
    int   tmAveCharWidth;
    int   tmMaxCharWidth;
    int   tmWeight;
    BYTE  tmItalic;
    BYTE  tmUnderlined;
    BYTE  tmStruckOut;
    BYTE  tmFirstChar;
    BYTE  tmLastChar;
    BYTE  tmDefaultChar;
    BYTE  tmBreakChar;
    BYTE  tmPitchAndFamily;
    BYTE  tmCharSet;
    int   tmOverhang;
    int   tmDigitizedAspectX;
    int   tmDigitizedAspectY;
    DWORD ntmFlags;
    UINT  ntmSizeEM;
    UINT  ntmCellHeight;
    UINT  ntmAvgWidth;
} NEWTEXTMETRIC;
```

The **NEWTEXTMETRIC** structure contains basic information about a physical font. The last four members of the **NEWTEXTMETRIC** structure are not included in the **TEXTMETRIC** structure; in all other respects, the structures are identical. The additional members are used for information about TrueType fonts.

Member	Description
tmHeight	Specifies the height of character cells. (The height is the sum of the **tmAscent** and **tmDescent** members.)
tmAscent	Specifies the ascent of character cells. (The ascent is the space between the base line and the top of the character cell.)
tmDescent	Specifies the descent of character cells. (The descent is the space between the bottom of the character cell and the base line.)
tmInternalLeading	Specifies the difference between the point size of a font and the physical size of the font. For TrueType fonts, this value is equal to **tmHeight** minus (*s* * **ntmSizeEM**), where *s* is the scaling factor for the TrueType font. For bitmap fonts, this value is used to determine the point size of a font; when an application specifies a negative value in the **lfHeight** member of the **LOGFONT** structure, the application is requesting a font whose height equals **tmHeight** minus **tmInternalLeading**.
tmExternalLeading	Specifies the amount of extra leading (space) that the application adds between rows. Since this area is outside the character cell, it contains no marks and will not be altered by text output calls in either opaque or transparent mode. The font designer sometimes sets this member to zero.
tmAveCharWidth	Specifies the average width of characters in the font. For ANSI_CHARSET fonts, this is a weighted average of the characters "a" through "z" and the space character. For other character sets, this value is an unweighted

average of all characters in the font.

tmMaxCharWidth

Specifies the "B" spacing of the widest character in the font. For more information about "B" spacing, see the description of the **ABC** structure.

tmWeight

Specifies the weight of the font. This member can be one of the following values:

Constant	Value
FW_DONTCARE	0
FW_THIN	100
FW_EXTRALIGHT	200
FW_ULTRALIGHT	200
FW_LIGHT	300
FW_NORMAL	400
FW_REGULAR	400
FW_MEDIUM	500
FW_SEMIBOLD	600
FW_DEMIBOLD	600
FW_BOLD	700
FW_EXTRABOLD	800
FW_ULTRABOLD	800
FW_BLACK	900
FW_HEAVY	900

tmItalic

Specifies an italic font if it is nonzero.

tmUnderlined

Specifies an underlined font if it is nonzero.

tmStruckOut

Specifies a "struckout" font if it is nonzero.

tmFirstChar

Specifies the value of the first character defined in the font.

tmLastChar

Specifies the value of the last character defined in the font.

tmDefaultChar

Specifies the value of the character that will be substituted for characters not in the font.

tmBreakChar

Specifies the value of the character that will be used to define word breaks for text justification.

tmPitchAndFamily

Specifies the pitch and family of the selected font. The four low-order bits identify the type of font, as follows:

Value	Meaning
TMPF_FIXED_PITCH	Designates a fixed-pitch font.
TMPF_VECTOR	Designates a vector or TrueType font.
TMPF_TRUETYPE	Designates a TrueType font.
TMPF_DEVICE	Designates a device font.

Some fonts are identified by several of these bits--for example, the TMPF_FIXED_PITCH, TMPF_VECTOR, and TMPF_TRUETYPE bits would be set for the monospace TrueType font, Courier New®. The TMPF_DEVICE bit could be set for a TrueType font as well, because this bit is set both for downloaded and device-resident fonts.

When the TMPF_TRUETYPE bit is set, the font is usable on all output devices. For example, if a TrueType font existed on a printer but could not be used on the display, the TMPF_TRUETYPE bit would not be set for that font.

The four high-order bits specify the font family. The **tmPitchAndFamily** member can be combined with the hexadecimal value 0xF0 by using the bitwise AND operator and can then be compared with the font family names for an identical match. The following font families are defined:

Value	Meaning
FF_DECORATIVE	Novelty fonts. Old English is an example.
FF_DONTCARE	Don't care or don't know.
FF_MODERN	Fonts with constant stroke width, with or without serifs. Pica, Elite, and Courier New are examples.
FF_ROMAN	Fonts with variable stroke width and with serifs. Times New Roman and New Century Schoolbook are examples.
FF_SCRIPT	Fonts designed to look like handwriting. Script and Cursive are examples.
FF_SWISS	Fonts with variable stroke width and without serifs. **MS** Sans Serif is an example.

tmCharSet

Specifies the character set of the font. The following values are defined:

Constant	Value
ANSI_CHARSET	0
DEFAULT_CHARSET	1
SYMBOL_CHARSET	2
SHIFTJIS_CHARSET	128
OEM_CHARSET	255

tmOverhang

Specifies the extra width that is added to some synthesized fonts. When synthesizing some attributes, such as bold or italic, graphics-device interface (GDI) or a device adds width to a string on both a per-character and per-string basis. For example, GDI makes a string bold by expanding the intracharacter spacing and overstriking by an offset value and italicizes a font by skewing the string. In either case, the string is wider after the attribute is synthesized. For bold strings, the overhang is the distance by which the overstrike is offset. For italic strings, the overhang is the amount the top of the font is skewed past the bottom of the font.

The **tmOverhang** member is zero for many italic and bold TrueType fonts because many TrueType fonts include italic and bold faces that are not synthesized. For example, the overhang for Courier New® Italic is zero.

An application that uses raster fonts can use the overhang value to determine the spacing between words that have different attributes.

tmDigitizedAspectX

Specifies the horizontal aspect of the device for which the font was designed.

tmDigitizedAspectY

Specifies the vertical aspect of the device for which the font was designed. The ratio of the **tmDigitizedAspectX** and **tmDigitizedAspectY** members is the aspect ratio of the device for which the font was designed.

ntmFlags

Specifies some elements of the font style. This member can be one or more of the following values:

NTM_REGULAR
NTM_BOLD
NTM_ITALIC

The NTM_BOLD and NTM_ITALIC flags could be combined with the OR operator to specify a bold italic font.

ntmSizeEM	Specifies the size of the em square for the font, in the units for which the font was designed (notional units).
ntmCellHeight	Specifies the height of the font, in the units for which the font was designed (notional units). This value should be compared against the value of the **ntmSizeEM** member.
ntmAvgWidth	Specifies the average width of characters in the font, in the units for which the font was designed (notional units). This value should be compared against the value of the **ntmSizeEM** member.

Comments

The sizes in the **NEWTEXTMETRIC** structure are typically given in logical units; that is, they depend on the current mapping mode of the display context.

See Also

EnumFontFamilies, **EnumFonts**, **GetDeviceCaps**, **GetTextMetrics**, **TEXTMETRIC**

NFYLOADSEG (3.1)

```
#include <toolhelp.h>

typedef struct tagNFYLOADSEG {  /* nfyls */
    DWORD   dwSize;
    WORD    wSelector;
    WORD    wSegNum;
    WORD    wType;
    WORD    wcInstance;
    LPCSTR  lpstrModuleName;
} NFYLOADSEG;
```

The **NFYLOADSEG** structure contains information about the segment being loaded when the kernel sends a load-segment notification.

Member	Description
dwSize	Specifies the size of the **NFYLOADSEG** structure, in bytes.
wSelector	Contains the selector of the segment being loaded.
wSegNum	Contains the executable-file segment number.
wType	Indicates the type of information in the segment. Only the low bit of **wType** is used. This type can be one of the following values:

Value	Meaning
0	The segment contains code.
1	The segment contains data.

wcInstance	Specifies the number of instances that share this segment. This value is valid only for data segments.
lpstrModuleName	Points to a null-terminated string containing the name of the module that owns the segment being loaded.

See Also
NotifyRegister

NFYLOGERROR (3.1)

```
#include <toolhelp.h>

typedef struct tagNFYLOGERROR {  /* nfyle */
    DWORD     dwSize;
    UINT      wErrCode;
    void FAR* lpInfo;
} NFYLOGERROR;
```

The **NFYLOGERROR** structure contains information about a validation error that caused the kernel to send an NFY_LOGERROR notification.

Member	Description
dwSize	Specifies the size of the **NFYLOGERROR** structure, in bytes.
wErrCode	Identifies the error value that caused the notification to be sent.
lpInfo	Points to additional information, dependent on the error value.

See Also
NotifyRegister

NFYLOGPARAMERROR (3.1)

```
#include <toolhelp.h>

typedef struct tagNFYLOGPARAMERROR {  /* nfylpe */
    DWORD          dwSize;
    UINT           wErrCode;
    FARPROC        lpfnErrorAddr;
    void FAR* FAR* lpBadParam;
} NFYLOGPARAMERROR;
```

The **NFYLOGPARAMERROR** structure contains information about a parameter-validation error that caused the kernel to send an NFY_LOGPARAMERROR notification.

Member	Description
dwSize	Specifies the size of the **NFYLOGPARAMERROR** structure, in bytes.
wErrCode	Identifies the error value that caused the notification to be sent.
lpfnErrorAddr	Points to the address of the function with the invalid parameter.
lpBadParam	Points to the name of the invalid parameter.

See Also
NotifyRegister

NFYRIP (3.1)

```
#include <toolhelp.h>

typedef struct tagNFYRIP {  /* nfyr */
    DWORD dwSize;
    WORD wIP;
    WORD wCS;
    WORD wSS;
    WORD wBP;
    WORD wExitCode;
} NFYRIP;
```

The **NFYRIP** structure contains information about the system when a system debugging error (RIP) occurs.

Member	Description
dwSize	Specifies the size of the **NFYRIP** structure, in bytes.
wIP	Contains the value in the IP register at the time of the RIP.
wCS	Contains the value in the **CS** register at the time of the RIP.
wSS	Contains the value in the SS register at the time of the RIP.
wBP	Contains the value in the BP register at the time of the RIP.
wExitCode	Contains an exit code that describes why the RIP occurred.

Comments

The **StackTraceCSIPFirst** function uses the **CS**:IP and SS:BP values presented in this structure. The first frame in the stack identified by these values points to the **FatalExit** function. The next frame points to the routine that called **FatalExit**, usually in USER.EXE, GDI.EXE, or either KRNL286.EXE or KRNL386.EXE.

See Also

FatalExit, **NotifyRegister**, **StackTraceCSIPFirst**

NFYSTARTDLL (3.1)

```
#include <toolhelp.h>

typedef struct tagNFYSTARTDLL {  /* nfysd */
    DWORD   dwSize;
    HMODULE hModule;
    WORD    wCS;
    WORD    wIP;
} NFYSTARTDLL;
```

The **NFYSTARTDLL** structure contains information about the dynamic-link library (DLL) being loaded when the kernel sends a load-DLL notification.

Member	Description
dwSize	Specifies the size of the **NFYSTARTDLL** structure, in bytes.
hModule	Identifies the library module being loaded.
wCS	Contains the value in the **CS** register at load time. This value is used with the value of the **wIP** member to determine the load address of the library.
wIP	Contains the value in the IP register at load time. This value is used with the **wCS** value to determine the load address of the library.

See Also
NotifyRegister

OFSTRUCT (2.x)

```
typedef struct tagOFSTRUCT {    /* of */
   BYTE  cBytes;
   BYTE  fFixedDisk;
   UINT  nErrCode;
   BYTE  reserved[4];
   BYTE  szPathName[128];
} OFSTRUCT;
```

The **OFSTRUCT** structure contains file information which results from opening that file.

Member	Description
cBytes	Specifies the length, in bytes, of the **OFSTRUCT** structure.
fFixedDisk	Specifies whether the file is on a fixed disk. The **fFixedDisk** member is nonzero if the file is on a fixed disk.
nErrCode	Specifies the MS-DOS error value if the **OpenFile** function returns -1 (that is, **OpenFile** fails). For a list of possible error values, see the following Comments section.
reserved	Reserved member. Four bytes reserved for future use.
szPathName	Specifies 128 bytes that contain the path of the file. This string consists of characters from the OEM character set.

Comments

The error values that may be specified in the **nErrCode** parameter follow:

Value	Meaning
0x0001	Invalid function
0x0002	File not found
0x0003	Path not found
0x0004	Too many open files
0x0005	Access denied
0x0006	Invalid handle
0x0007	Arena trashed
0x0008	Not enough memory
0x0009	Invalid block
0x000A	Bad environment
0x000B	Bad format
0x000C	Invalid access
0x000D	Invalid data
0x000F	Invalid drive
0x0010	Current directory
0x0011	Not same device
0x0012	No more files
0x0013	Write protect error
0x0014	Bad unit
0x0015	Not ready
0x0016	Bad command
0x0017	CRC error
0x0018	Bad length
0x0019	Seek error

0x001A	Not MS-DOS disk
0x001B	Sector not found
0x001C	Out of paper
0x001D	Write fault
0x001E	Read fault
0x001F	General failure
0x0020	Sharing violation
0x0021	Lock violation
0x0022	Wrong disk
0x0023	File control block unavailable
0x0024	Sharing buffer exceeded
0x0032	Not supported
0x0033	Remote not listed
0x0034	Duplicate name
0x0035	Bad netpath
0x0036	Network busy
0x0037	Device does not exist
0x0038	Too many commands
0x0039	Adaptor hardware error
0x003A	Bad network response
0x003B	Unexpected network error
0x003C	Bad remote adaptor
0x003D	Print queue full
0x003E	No spool space
0x003F	Print canceled
0x0040	Netname deleted
0x0041	Network access denied
0x0042	Bad device type
0x0043	Bad network name
0x0044	Too many names
0x0045	Too many sessions
0x0046	Sharing paused
0x0047	Request not accepted
0x0048	Redirection paused
0x0050	File exists
0x0051	Duplicate file control block
0x0052	Cannot make
0x0053	Interrupt 24 failure
0x0054	Out of structures
0x0055	Already assigned
0x0056	Invalid password
0x0057	Invalid parameter
0x0058	Net write fault

See Also

OpenFile

OLECLIENT (3.1)

```
#include <ole.h>

typedef struct _OLECLIENT { /* oc */
    LPOLECLIENTVTBL lpvtbl;
    .
    .  /* any client-supplied state information */
    .
} OLECLIENT;
```

The **OLECLIENT** structure points to an **OLECLIENTVTBL** structure and can store state information for use by the client application.

Member	Description
lpvtbl	Points to a table of function pointers for the client.

Comments

Servers and object handlers should not attempt to use any state information supplied in the **OLECLIENT** structure. The use and meaning of this information is entirely dependent on the client application. Because a pointer to this structure is supplied as a parameter to the client's callback function, this is the preferred method for the client application to store private object-state information.

See Also

OLECLIENTVTBL

OLECLIENTVTBL (3.1)

```
#include <ole.h>

typedef struct _OLECLIENTVTBL {     /* ocv */
    int (CALLBACK* CallBack)(LPOLECLIENT, OLE_NOTIFICATION, LPOLEOBJECT);
} OLECLIENTVTBL;
```

The **OLECLIENTVTBL** structure contains a pointer to a callback function for the client application.

Member	Description
ClientCallback	Points to a callback function for the client application.

Comments

The address passed as the **CallBack** member must be created by using the **MakeProcInstance** function.

Function

See Also

OLECLIENT

OLECLIENT (1.x)

INT ClientCallback(*lpclient, notification, lpobject***)**

LPOLECLIENT *lpclient;*
OLE_NOTIFICATION *notification;*
LPOLEOBJECT *lpobject;*

The **ClientCallback** function must use the Pascal calling convention and must be declared **FAR**.

Parameter	Description
lpclient	Points to the client structure associated with the object. The library retrieves this pointer from its object structure when a notification occurs, uses it to locate the callback function, and passes the pointer to the client structure for the client application's use.
notification	Specifies the reason for the notification. This parameter can be one of the following values:

Value	Meaning
OLE_CHANGED	The linked object has changed. (This notification is not sent for embedded objects.) A typical action to take with this notification is either to redraw or to save the object.
OLE_CLOSED	The object has been closed in its server. When the client receives this notification, it should not call any function that causes an asynchronous operation until it regains control of program execution.
OLE_QUERY_PAINT	A lengthy drawing operation is occurring. This notification allows the drawing to be interrupted.
OLE_QUERY_RETRY	The server has responded to a request by indicating that it is busy. This notification requests the client to determine whether the library should continue to make the request. If the callback function returns FALSE, the transaction with the server is discontinued.
OLE_RELEASE	The object has been released because an asynchronous operation has finished. The client should not quit until all objects have been released. The client application can call the **OleQueryReleaseError** function to determine whether the operation succeeded. It can also call the **OleQueryReleaseMethod** function, if necessary, to verify that that operation has ended.
OLE_RENAMED	The linked object has been renamed in its server. This notification is for information only, because the library automatically updates its link information.
OLE_SAVED	The linked object has been saved in its server. The client receives this notification when the server calls the **OleSavedServerDoc** function in response to the user choosing the Update command in the server's File menu.

When the client receives the **OLE_CLOSED** notification, it typically stores the condition and returns to the client library, taking action only when the client library returns control of program execution to the client application. If the client application must take action before regaining control, it should not call any functions that could result in an asynchronous operation.

lpobject	Points to the object that caused the notification to be sent. Applications that use the same client structure for more than one object use the *lpobject* parameter to distinguish between notifications.

Returns

When the *notification* parameter specifies either OLE_QUERY_PAINT or OLE_QUERY_RETRY, the client should return TRUE if the library should continue, or FALSE to terminate the painting operation or discontinue the server transaction. When the *notification* parameter does not specify either OLE_QUERY_PAINT or OLE_QUERY_RETRY, the return value is ignored.

Comments

The client application should act on these notifications at the next appropriate time; for example, as part of the main event loop or when closing the object. The updating of an object can be deferred until the user requests the update, if the client provides that functionality. The client may call the library from a notification callback function (the library is reentrant). The client should not attempt an asynchronous operation while certain other operations are in progress (for example, opening or deleting an object). The client also should not enter a message-dispatch loop inside the callback function. When the client application calls a function that would cause an asynchronous operation, the client library returns OLE_WAIT_FOR_RELEASE when the function is called, notifies the application when the operation completes by using OLE_RELEASE, and returns OLE_BUSY if the client attempts to invoke a conflicting operation while the previous one is in progress. The client can determine if an asynchronous operation is in progress by calling **OleQueryReleaseStatus**, which returns OLE_BUSY if the operation has not yet completed.

See Also

OleQueryReleaseStatus, **OLECLIENT**

OLEOBJECT (3.1)

```
#include <ole.h>

typedef struct _OLEOBJECT {      /* oo */
    LPOLEOBJECTVTBL lpvtbl;
    .
    .  /* any server-supplied state information */
    .
} OLEOBJECT;
```

The **OLEOBJECT** structure points to a table of function pointers for an object. This structure is initialized and maintained by servers for the server library.

Member	Description
lpvtbl	Points to a table of function pointers for the object.

See Also
OLEOBJECTVTBL

OLEOBJECTVTBL (3.1)

```
#include <ole.h>

typedef struct _OLEOBJECTVTBL {   /* oov */
    void FAR* (CALLBACK* QueryProtocol)(LPOLEOBJECT, OLE_LPCSTR);
    OLESTATUS (CALLBACK* Release)(LPOLEOBJECT);
    OLESTATUS (CALLBACK* Show)(LPOLEOBJECT, BOOL);
    OLESTATUS (CALLBACK* DoVerb)(LPOLEOBJECT, UINT, BOOL, BOOL);
    OLESTATUS (CALLBACK* GetData)(LPOLEOBJECT, OLECLIPFORMAT,
        HANDLE FAR*);
    OLESTATUS (CALLBACK* SetData)(LPOLEOBJECT, OLECLIPFORMAT, HANDLE);
    OLESTATUS (CALLBACK* SetTargetDevice)(LPOLEOBJECT, HGLOBAL);
    OLESTATUS (CALLBACK* SetBounds)(LPOLEOBJECT, OLE_CONST RECT FAR*);
    OLECLIPFORMAT (CALLBACK* EnumFormats)(LPOLEOBJECT, OLECLIPFORMAT);
    OLESTATUS (CALLBACK* SetColorScheme)(LPOLEOBJECT,
        OLE_CONST LOGPALETTE FAR*);

    /*
     * Server applications implement only the functions listed above.
     * Object handlers can use any of the functions in this structure
     * to modify default server behavior.
     */

    OLESTATUS (CALLBACK* Delete)(LPOLEOBJECT);
    OLESTATUS (CALLBACK* SetHostNames)(LPOLEOBJECT, OLE_LPCSTR,
        OLE_LPCSTR);
    OLESTATUS (CALLBACK* SaveToStream)(LPOLEOBJECT, LPOLESTREAM);
    OLESTATUS (CALLBACK* Clone)(LPOLEOBJECT, LPOLECLIENT, LHCLIENTDOC,
        OLE_LPCSTR, LPOLEOBJECT FAR*);
    OLESTATUS (CALLBACK* CopyFromLink)(LPOLEOBJECT, LPOLECLIENT,
        LHCLIENTDOC, OLE_LPCSTR, LPOLEOBJECT FAR*);
    OLESTATUS (CALLBACK* Equal)(LPOLEOBJECT, LPOLEOBJECT);
    OLESTATUS (CALLBACK* CopyToClipboard)(LPOLEOBJECT);
    OLESTATUS (CALLBACK* Draw)(LPOLEOBJECT, HDC, OLE_CONST RECT FAR*,
        OLE_CONST RECT FAR*, HDC);
    OLESTATUS (CALLBACK* Activate)(LPOLEOBJECT, UINT, BOOL, BOOL, HWND,
        OLE_CONST RECT FAR*);
    OLESTATUS (CALLBACK* Execute)(LPOLEOBJECT, HGLOBAL, UINT);
    OLESTATUS (CALLBACK* Close)(LPOLEOBJECT);
    OLESTATUS (CALLBACK* Update)(LPOLEOBJECT);
    OLESTATUS (CALLBACK* Reconnect)(LPOLEOBJECT);
    OLESTATUS (CALLBACK* ObjectConvert)(LPOLEOBJECT, OLE_LPCSTR,
        LPOLECLIENT, LHCLIENTDOC, OLE_LPCSTR, LPOLEOBJECT FAR*);
    OLESTATUS (CALLBACK* GetLinkUpdateOptions)(LPOLEOBJECT,
        OLEOPT_UPDATE FAR*);
    OLESTATUS (CALLBACK* SetLinkUpdateOptions)(LPOLEOBJECT,
        OLEOPT_UPDATE);
    OLESTATUS (CALLBACK* Rename)(LPOLEOBJECT, OLE_LPCSTR);
    OLESTATUS (CALLBACK* QueryName)(LPOLEOBJECT, LPSTR, UINT FAR*);
    OLESTATUS (CALLBACK* QueryType)(LPOLEOBJECT, LONG FAR*);
    OLESTATUS (CALLBACK* QueryBounds)(LPOLEOBJECT, RECT FAR*);
    OLESTATUS (CALLBACK* QuerySize)(LPOLEOBJECT, DWORD FAR*);
    OLESTATUS (CALLBACK* QueryOpen)(LPOLEOBJECT);
    OLESTATUS (CALLBACK* QueryOutOfDate)(LPOLEOBJECT);
    OLESTATUS (CALLBACK* QueryReleaseStatus)(LPOLEOBJECT);
```

```
    OLESTATUS (CALLBACK* QueryReleaseError)(LPOLEOBJECT);
    OLE_RELEASE_METHOD (CALLBACK* QueryReleaseMethod)(LPOLEOBJECT);
    OLESTATUS (CALLBACK* RequestData)(LPOLEOBJECT, OLECLIPFORMAT);
    OLESTATUS (CALLBACK* ObjectLong)(LPOLEOBJECT, UINT, LONG FAR*);
} OLEOBJECTVTBL;
```

The **OLEOBJECTVTBL** structure points to functions that manipulate an object. A server application creates this structure and an **OLEOBJECT** structure to give the server library access to an object.

Server applications do not need to implement functions beyond the **SetColorScheme** function. Object handlers can provide specialized treatment for some or all of the functions in the **OLEOBJECTVTBL** structure.

The following list of structure members does not document all the functions pointed to by the **OLEOBJECTVTBL** structure. For information about the functions not documented here, see the documentation for the corresponding function for object linking and embedding (OLE). For example, for more information about the **QueryProtocol** member, see the **OleQueryProtocol** function.

Member	Description
Release	Causes the server to free the resources associated with the specified **OLEOBJECT** structure.
Show	Causes the server to show an object.
DoVerb	Specifies what kind of action the server should take when a user opens an object.
GetData	Retrieves data from an object in a specified format.
SetData	Stores data in an object in a specified format.
SetTargetDevice	Communicates information about the client's target device for the object.
SetColorScheme	Sends the server application the color palette recommended by the client application.
ObjectLong	Allows the calling application to store data with an object. This function is typically used by object handlers.

Comments

The following functions in **OLEOBJECTVTBL** should return OLE_BUSY when appropriate:

Activate	**SetBounds**
Close	**SetColorScheme**
CopyFromLink	**SetData**
Delete	**SetHostNames**
DoVerb	**SetLinkUpdateOptions**
Execute	**SetTargetDevice**
ObjectConvert	**Show**
Reconnect	**Update**
RequestData	
Function	

See Also

OLEOBJECT

Release (OLE 1.x)

OLESTATUS (FAR PASCAL *Release)(*lpObject***)**

LPOLEOBJECT *lpObject;*

The **Release** function causes the server to free the resources associated with the specified **OLEOBJECT** structure.

Parameter	Description
lpObject	Points to the **OLEOBJECT** structure to be released.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

The server application should not destroy data when the library calls the **Release** function. The library calls the **Release** function when no clients are connected to the object.

Function

Show (OLE 1.x)

OLESTATUS (FAR PASCAL *Show)(*lpObject, fTakeFocus***)**

LPOLEOBJECT *lpObject;*
BOOL *fTakeFocus;*

The **Show** function causes the server to show an object, displaying its window and scrolling (if necessary) to make the object visible.

Parameter	Description
lpObject	Points to the **OLEOBJECT** structure to show.
fTakeFocus	Specifies whether the server window gets the focus. If the server window is to get the focus, this value is TRUE. Otherwise, this value is FALSE.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

The library calls the **Show** function when the server application should show the document to the user for editing or to request the server to scroll the document to bring the object into view.

Function

DoVerb (OLE 1.x)

OLESTATUS (FAR PASCAL *DoVerb)(*lpObject, iVerb, fShow, fTakeFocus***);**

LPOLEOBJECT *lpObject;*
UINT *iVerb;*
BOOL *fShow;*
BOOL *fTakeFocus;*

The **DoVerb** function specifies what kind of action the server should take when a user activates an object.

Parameter	Description
lpObject	Points to the object to activate.
iVerb	Specifies the action to take. The meaning of this parameter is determined by the server application.
fShow	Specifies whether to show the server window. This value is TRUE to show the window; otherwise, it is FALSE.
fTakeFocus	Specifies whether the server window gets the focus. If the server window is to get the focus, this value is TRUE. Otherwise, it is FALSE. This parameter is relevant only if the *fShow* parameter is TRUE.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

All servers must support the editing of objects. If a server does not support any verbs except Edit, it should edit the object no matter what value is specified by the *iVerb* parameter.

Function

GetData (OLE 1.x)

OLESTATUS (FAR PASCAL *GetData)(*lpObject, cfFormat, lphdata***)**

LPOLEOBJECT *lpObject;*
OLECLIPFORMAT *cfFormat;*
HANDLE FAR* *lphdata;*

The **GetData** function retrieves data from an object in a specified format. The server application should allocate memory, fill it with the data, and return the data through the *lphdata* parameter.

Parameter	Description
lpObject	Points to the **OLEOBJECT** structure from which data is requested.
cfFormat	Specifies the format in which the data is requested.
lphdata	Points to the handle of the allocated memory that the server application returns. The library frees the memory when it is no longer needed.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value, which may be one of the following:

OLE_ERROR_BLANK
OLE_ERROR_FORMAT
OLE_ERROR_OBJECT

Function

SetData (OLE 1.x)

OLESTATUS (FAR PASCAL *SetData)(*lpObject, cfFormat, hdata***)**

LPOLEOBJECT *lpObject;*
OLECLIPFORMAT *cfFormat;*
HANDLE *hdata;*

The **SetData** function stores data in an object in a specified format. This function is called (with the Native data format) when a client opens an embedded object for editing. This function is also used if the client calls the **OleSetData** function with some other format.

Parameter	Description
lpObject	Points to the **OLEOBJECT** structure in which data is stored.
cfFormat	Specifies the format of the data.
hdata	Identifies a place in memory from which the server application should extract the data. The server should delete this handle after it uses the data.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

The server application is responsible for the memory identified by the *hdata* parameter. The server must delete this data even if it returns OLE_BUSY or if an error occurs.

Function

SetTargetDevice (OLE 1.x)

OLESTATUS (FAR PASCAL *SetTargetDevice)(*lpObject, hotd***)**

LPOLEOBJECT *lpObject;*
HGLOBAL *hotd;*

The **SetTargetDevice** function communicates information about the client's target device for the object. The server can use this information to customize output for the target device.

Parameter	Description
lpObject	Points to the **OLEOBJECT** structure for which the target device is specified.
hotd	Identifies an **OLETARGETDEVICE** structure.

Returns
The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments
The server application is responsible for the memory identified by the *hotd* parameter. The server must delete this data even if it returns OLE_BUSY or if an error occurs.

The library passes NULL for the *hotd* parameter to indicate that the rendering is necessary for the screen.

See Also
OleSetTargetDevice, **OLETARGETDEVICE Function**

ObjectLong (OLE 1.x)

OLESTATUS (FAR PASCAL *ObjectLong)(*lpObject, wFlags, lpData***)**

LPOLEOBJECT *lpObject;*
UINT *wFlags;*
LONG FAR* *lpData;*

The **ObjectLong** function allows the calling application to store data with an object. This function is typically used by object handlers.

Parameter	Description
lpObject	Points to the **OLEOBJECT** structure for which the data is stored.
wFlags	Specifies the method used for setting and retrieving data. It can be one or more of the following values:

Value	Meaning
OF_SET	Data is written to the location specified by the *lpData* parameter, replacing any data already there.
OF_GET	Data is read from the location specified by the *lpData* parameter.
OF_HANDLER	Data is written or read by an object handler. This value prevents data from an object handler from being replaced by other applications.

If the calling application specifies OF_SET and OF_GET, the function returns a pointer to the previous data and replaces the data pointed to by the *lpData* parameter with the data specified by the calling application.

lpData	Points to data to be written or read.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Function

SetColorScheme (OLEOBJECTVTBL 1.x)

OLESTATUS SetColorScheme(*lpObject, lpPal***)**

LPOLEOBJECT *lpObject;*
OLE_CONST LOGPALETTE FAR* *lpPal;*

The **SetColorScheme** function sends the server application the color palette recommended by the client application.

Parameter	Description
lpObject	Points to an **OLEOBJECT** structure for which the client application recommends a palette.
lpPal	Points to a **LOGPALETTE** structure specifying the recommended palette.

Returns
The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments
Server applications are not required to use the palette recommended by the client application.

Before returning from the **SetColorScheme** function, the server application should use the palette pointed to by the *lpPal* parameter in a call to the CreatePalette function to create the handle of the palette:

```
hpal = CreatePalette(lpPal);
```

The server can then use the palette handle to refer to the palette.

The first palette entry in the **LOGPALETTE** structure specifies the foreground color recommended by the client application. The second palette entry specifies the background color. The first half of the remaining palette entries are fill colors, and the second half are colors for lines and text.

Client applications typically specify an even number of palette entries. When there is an uneven number of entries, the server should interpret the odd entry as a fill color; that is, if there are five entries, three should be interpreted as fill colors and two as line and text colors.

OLESERVER (3.1)

```
#include <ole.h>

typedef struct _OLESERVER {     /* os */
    LPOLESERVERVTBL lpvtbl;
    .
    .  /* any server-supplied state information */
    .
} OLESERVER;
```

The **OLESERVER** structure points to a table of function pointers for the server. This structure is initialized and maintained by servers for the server library.

Member	Description
lpvtbl	Points to a table of function pointers for the server.

See Also
OLESERVERVTBL

OLESERVERDOC (3.1)

```
#include <ole.h>

typedef struct _OLESERVERDOC {  /* osd */
    LPOLESERVERDOCVTBL lpvtbl;
    .
    .  /* any server-supplied document-state information */
    .

} OLESERVERDOC;
```

The **OLESERVERDOC** structure points to a table of function pointers for a document. This structure is initialized and maintained by servers for the server library.

Member	Description
lpvtbl	Points to a table of function pointers for the document.

See Also
OLESERVERDOCVTBL

OLESERVERDOCVTBL (3.1)

```
#include <ole.h>

typedef struct _OLESERVERDOCVTBL {   /* odv */
    OLESTATUS (CALLBACK* Save)(LPOLESERVERDOC);
    OLESTATUS (CALLBACK* Close)(LPOLESERVERDOC);
    OLESTATUS (CALLBACK* SetHostNames)(LPOLESERVERDOC, OLE_LPCSTR,
        OLE_LPCSTR);
    OLESTATUS (CALLBACK* SetDocDimensions)(LPOLESERVERDOC,
        OLE_CONST RECT FAR*);
    OLESTATUS (CALLBACK* GetObject)(LPOLESERVERDOC, OLE_LPCSTR,
        LPOLEOBJECT FAR*, LPOLECLIENT);
    OLESTATUS (CALLBACK* Release)(LPOLESERVERDOC);
    OLESTATUS (CALLBACK* SetColorScheme)(LPOLESERVERDOC,
        OLE_CONST LOGPALETTE FAR*);
    OLESTATUS (CALLBACK* Execute)(LPOLESERVERDOC, HGLOBAL);
} OLESERVERDOCVTBL;
```

The **OLESERVERDOCVTBL** structure points to functions that manipulate a document. A server application creates this structure and an **OLESERVERDOC** structure to give the server library access to a document.

Documents opened or created on request from the library should not be shown to the user for editing until the library requests that they be shown.

Every function except **Release** can return OLE_BUSY.

Member	Description
Save	Instructs the server to save the document.
Close	Instructs the server application to unconditionally close the document.
SetHostNames	Sets the names that should be used for window titles.
SetDocDimensions	Gives the server the rectangle on the target device for which the object should be formatted.
GetObject	Requests the server to create an **OLEOBJECT** structure.
Release	Notifies the server when a revoked document has terminated conversations and may be destroyed.
SetColorScheme	Specifies the color palette preferred by the client application.
Execute	Specifies DDE execute strings.

See Also
OLESERVERDOC

Save (OLE 1.x)

OLESTATUS Save(*lpDoc***)**

LPOLESERVERDOC *lpDoc;*

The **Save** function instructs the server to save the document.

Parameter	Description
lpDoc	Points to an **OLESERVERDOC** structure corresponding to the document to save.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Function

Close (OLE 1.x)

OLESTATUS Close(*lpDoc***)**

LPOLESERVERDOC *lpDoc;*

The **Close** function instructs the server application to unconditionally close the document. The library calls this function when the client application initiates the closure.

Parameter	Description
lpDoc	Points to an **OLESERVERDOC** structure corresponding to the document to close.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

The library always calls the **Close** function before calling the **Release** function in the **OLESERVERVTBL** structure.

The server application should not prompt the user to save the document or take other actions; messages of this kind are handled by the client application.

When the library calls the **Close** function, the server should respond by calling the **OleRevokeServerDoc** function. The resources for the document are freed when the library calls the **Release** function. The server should not wait for the **Release** function by entering a message-dispatch loop after calling **OleRevokeServerDoc**. (A server should never enter message-dispatch loops while processing any of these functions.)

When a document is closed, the server should free the memory for the **OLESERVERDOCVTBL** structure and associated resources.

Function

SetHostNames (OLE 1.x)

OLESTATUS SetHostNames(*lpDoc, lpszClient, lpszDoc***)**

LPOLESERVERDOC *lpDoc;*
OLE_LPCSTR *lpszClient;*
OLE_LPCSTR *lpszDoc;*

The **SetHostNames** function sets the name that should be used for a window title. This name is used only for an embedded object, because a linked object has its own title. This function is used only for documents that are embedded objects.

Parameter	Description
lpDoc	Points to an **OLESERVERDOC** structure corresponding to a document that is the embedded object for which a name is specified.
lpszClient	Points to a null-terminated string specifying the name of the client.
lpszDoc	Points to a null-terminated string specifying the client's name for the object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Function

SetDocDimensions (OLE 1.x)

OLESTATUS SetDocDimensions(*lpDoc, lpRect***)**

LPOLESERVERDOC *lpDoc;*
OLE_CONST RECT FAR* *lpRect;*

The **SetDocDimensions** function gives the server the rectangle on the target device for which the object should be formatted. This function is relevant only for documents that are embedded objects.

Parameter	Description
lpDoc	Points to the **OLESERVERDOC** structure corresponding to the document that is the embedded object for which the target size is specified.
lpRect	Points to a **RECT** structure containing the target size of the object, in MM_HIMETRIC units. (In the MM_HIMETRIC mapping mode, the positive y-direction is up.)

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Function

GetObject (OLE 1.x)

OLESTATUS GetObject(*lpDoc, lpszItem, lplpObject, lpClient***)**

LPOLESERVERDOC *lpDoc;*
OLE_LPCSTR *lpszItem;*
LPOLEOBJECT FAR* *lplpObject;*
LPOLECLIENT *lpClient;*

The **GetObject** function requests the server to create an **OLEOBJECT** structure.

Parameter	Description
lpDoc	Points to an **OLESERVERDOC** structure corresponding to this document.
lpszItem	Points to a null-terminated string specifying the name of an item in the specified document for which an object structure is requested. If this string is set to NULL, the entire document is requested. This string cannot contain a slash mark (/).
lplpObject	Points to a variable of type **LPOLEOBJECT** in which the server application should return a long pointer to the allocated **OLEOBJECT** structure.
lpClient	Points to an **OLECLIENT** structure allocated by the library. The server should associate the **OLECLIENT** structure with the object and use it to notify the library of changes to the object.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

The server application should allocate and initialize the **OLEOBJECT** structure, associate it with the **OLECLIENT** structure pointed to by the *lpClient* parameter, and return a pointer to the **OLEOBJECT** structure through the *lplpObject* argument.

The library calls the **GetObject** function to associate a client with the part of the document identified by the *lpszItem* parameter. When a client has been associated with an object by this function, the server can send notifications to the client.

Applications should be prepared to handle multiple calls to **GetObject** for a given object. This entails creating multiple **OLECLIENT** structures and sending notifications to each of these structures when appropriate. Multiple calls to **GetObject** are possible because some client applications that implement object linking and embedding (OLE) by using dynamic data exchange (DDE) rather than the OLE dynamic-link libraries may use both NULL and an actual item name for the *lpszItem* parameter.

Function

Release (OLE 1.x)

OLESTATUS Release(*lpDoc***)**

LPOLESERVERDOC *lpDoc;*

The **Release** function notifies the server when a revoked document has terminated conversations and can be destroyed.

Parameter	Description
lpDoc	Points to an **OLESERVERDOC** structure for which the handle was revoked and which can now be released.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Function

SetColorScheme (OLESERVERDOCVTBL 1.x)

OLESTATUS SetColorScheme(*lpDoc, lpPal***)**

LPOLESERVERDOC *lpDoc;*
OLE_CONST LOGPALETTE FAR* *lpPal;*

The **SetColorScheme** function sends the server application the color palette recommended by the client application.

Parameter	Description
lpDoc	Points to an **OLESERVERDOC** structure for which the client application recommends a palette.
lpPal	Points to a **LOGPALETTE** structure specifying the recommended palette.

Returns
The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments
Server applications are not required to use the palette recommended by the client application.

Before returning from the **SetColorScheme** function, the server application should create a handle to the palette. To do this, the server application should use the palette pointed to by the *lpPal* parameter in a call to the **CreatePalette** function, as shown in the following example.

```
hpal = CreatePalette(lpPal);
```

The server can then use the palette handle to refer to the palette.

The first palette entry in the **LOGPALETTE** structure specifies the foreground color recommended by the client application. The second palette entry specifies the background color. The first half of the remaining palette entries are fill colors, and the second half are colors for lines and text.

Client applications typically specify an even number of palette entries. When there is an uneven number of entries, the server should interpret the odd entry as a fill color; that is, if there are five entries, three should be interpreted as fill colors and two as line and text colors.

Function

Execute (OLE 1.x)

OLESTATUS Execute(*lpDoc, hCommands***)**

LPOLESERVERDOC *lpDoc;*
HGLOBAL *hCommands;*

The **Execute** function receives **WM_DDE_EXECUTE** commands sent by client applications. The applications send these commands by calling the **OleExecute** function.

Parameter	Description
lpDoc	Points to an **OLESERVERDOC** structure to which the dynamic data exchange (DDE) commands apply.
hCommands	Identifies memory containing one or more DDE execute commands.

Returns
The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments
The server should never free the handle specified in the *hCommands* parameter.

OLESERVERVTBL (3.1)

```
#include <ole.h>

typedef struct _OLESERVERVTBL {  /* osv */
    OLESTATUS (CALLBACK* Open)(LPOLESERVER, LHSERVERDOC,
        OLE_LPCSTR, LPOLESERVERDOC FAR*);
    OLESTATUS (CALLBACK* Create)(LPOLESERVER, LHSERVERDOC,
        OLE_LPCSTR, OLE_LPCSTR, LPOLESERVERDOC FAR*);
    OLESTATUS (CALLBACK* CreateFromTemplate)(LPOLESERVER,
        LHSERVERDOC, OLE_LPCSTR, OLE_LPCSTR, OLE_LPCSTR,
        LPOLESERVERDOC FAR*);
    OLESTATUS (CALLBACK* Edit)(LPOLESERVER, LHSERVERDOC,
        OLE_LPCSTR, OLE_LPCSTR, LPOLESERVERDOC FAR*);
    OLESTATUS (CALLBACK* Exit)(LPOLESERVER);
    OLESTATUS (CALLBACK* Release)(LPOLESERVER);
    OLESTATUS (CALLBACK* Execute)(LPOLESERVER, HGLOBAL);
} OLESERVERVTBL;
```

The **OLESERVERVTBL** structure points to functions that manipulate a server. After a server application creates this structure and an **OLESERVER** structure, the server library can perform operations on the server application.

Every function except **Release** can return OLE_BUSY.

Member	Description
Open	Opens an existing file and prepares to edit the contents.
Create	Makes a new object of a given class name which will be embedded in the client application.
CreateFromTemplate	Creates a new document that is initialized with the data in a specified file.
Edit	Creates a document that is initialized with data retrieved by a subsequent call to the **SetData** function.
Exit	Instructs the server application to close documents and shut down.
Release	Notifies a server that all connections to it have closed and that it is safe to terminate.
Execute	Specifies DDE execute strings.

Function

See Also
OLESERVER

Open (OLE 1.x)

OLESTATUS Open(*lpServer, lhDoc, lpszDoc, lplpDoc***)**

LPOLESERVER *lpServer;*
LHSERVERDOC *lhDoc;*
OLE_LPCSTR *lpszDoc;*
LPOLESERVERDOC FAR* *lplpDoc;*

The **Open** function opens an existing file and prepares to edit the contents. A server typically uses this function to open a linked object for a client application.

Parameter	Description
lpServer	Points to an **OLESERVER** structure identifying the server.
lhDoc	Identifies the document. The library uses this handle internally.
lpszDoc	Points to a null-terminated string specifying the permanent name of the document to be opened. Typically this string is a path, but for some applications it might be further qualified. For example, the string might specify a particular table in a database.
lplpDoc	Points to a variable of type **LPOLESERVERDOC** in which the server application returns a long pointer to the **OLESERVERDOC** structure it has created in response to this function.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

When the library calls this function, the server application opens a specified document, allocates and initializes an **OLESERVERDOC** structure, associates the library's handle with the document, and returns the address of the structure. The server does not show the document or its window.

Function

Create (OLE 1.x)

OLESTATUS Create(*lpServer, lhDoc, lpszClass, lpszDoc, lplpDoc***)**

LPOLESERVER *lpServer;*
LHSERVERDOC *lhDoc;*
OLE_LPCSTR *lpszClass;*
OLE_LPCSTR *lpszDoc;*
LPOLESERVERDOC FAR* *lplpDoc;*

The **Create** function makes a new object that is to be embedded in the client application. The *lpszDoc* parameter identifies the object but should not be used to create a file for the object.

Parameter	Description
lpServer	Points to an **OLESERVER** structure identifying the server.
lhDoc	Identifies the document. The library uses this handle internally.
lpszClass	Points to a null-terminated string specifying the class of document to create.
lpszDoc	Points to a null-terminated string specifying a name for the document to be created. This name can be used to identify the document in window titles.
lplpDoc	Points to a variable of type **LPOLESERVERDOC** in which the server application should return a long pointer to the created **OLESERVERDOC** structure.

Returns
The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments
When the library calls this function, the server application creates a document of a specified class, allocates and initializes an **OLESERVERDOC** structure, associates the library's handle with the document, and returns the address of the structure. This function opens the created document for editing and embeds it in the client when it is updated or closed.

Server applications often track changes to the document specified in this function, so that the user can be prompted to save changes when necessary.

Function

CreateFromTemplate (OLE 1.x)

OLESTATUS CreateFromTemplate(*lpServer, lhDoc, lpszClass, lpszDoc, lpszTemplate, lplpDoc***)**

LPOLESERVER *lpServer;*
LHSERVERDOC *lhDoc;*
OLE_LPCSTR *lpszClass;*
OLE_LPCSTR *lpszDoc;*
OLE_LPCSTR *lpszTemplate;*
LPOLESERVERDOC FAR* *lplpDoc;*

The **CreateFromTemplate** function creates a new document that is initialized with the data in a specified file. The new document is opened for editing by this function and embedded in the client when it is updated or closed.

Parameter	Description
lpServer	Points to an **OLESERVER** structure identifying the server.
lhDoc	Identifies the document. The library uses this handle internally.
lpszClass	Points to a null-terminated string specifying the class of document to create.
lpszDoc	Points to a null-terminated string specifying a name for the document to be created. This name need not be used by the server application but can be used in window titles.
lpszTemplate	Points to a null-terminated string specifying the permanent name of the document to use to initialize the new document. Typically this string is a path, but for some applications it might be further qualified. For example, the string might specify a particular table in a database.
lplpDoc	Points to a variable of type **LPOLESERVERDOC** in which the server application should return a long pointer to the created **OLESERVERDOC** structure.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

When the library calls this function, the server application creates a document of a specified class, allocates and initializes an **OLESERVERDOC** structure, associates the library's handle with the document, and returns the address of the structure.

A server application often tracks changes to the document specified in this function, so that the user can be prompted to save changes when necessary.

Function

Edit (OLE 1.x)

OLESTATUS Edit(*lpServer, lhDoc, lpszClass, lpszDoc, lplpDoc***)**

LPOLESERVER *lpServer;*
LHSERVERDOC *lhDoc;*
OLE_LPCSTR *lpszClass;*
OLE_LPCSTR *lpszDoc;*
LPOLESERVERDOC FAR* *lplpDoc;*

The **Edit** function creates a document that is initialized with data retrieved by a subsequent call to the **SetData** function. The object is embedded in the client application. The server does not show the document or its window.

Parameter	Description
lpServer	Points to an **OLESERVER** structure identifying the server.
lhDoc	Identifies the document. The library uses this handle internally.
lpszClass	Points to a null-terminated string specifying the class of document to create.
lpszDoc	Points to a null-terminated string specifying a name for the document to be created. This name need not be used by the server application but may be used--for example, in a window title.
lplpDoc	Points to a variable of type **LPOLESERVERDOC** in which the server application should return a long pointer to the created **OLESERVERDOC** structure.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

When the library calls this function, the server application creates a document of a specified class, allocates and initializes an **OLESERVERDOC** structure, associates the library's handle with the document, and returns the address of the structure.

The document created by the **Edit** function retrieves the initial data from the client in a subsequent call to the **SetData** function. The user can edit the document after the data has been retrieved and the library has used either the **Show** function in the **OLEOBJECTVTBL** structure or the **DoVerb** function with an Edit verb to show the document to the user.

Function

Exit (OLE 1.x)

OLESTATUS Exit(*lpServer***)**

LPOLESERVER *lpServer;*

The **Exit** function instructs the server application to close documents and quit.

Parameter	Description
lpServer	Points to an **OLESERVER** structure identifying the server.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

The server library calls the **Exit** function to instruct a server application to terminate. If the server application has no open documents when the **Exit** function is called, it should call the **OleRevokeServer** function.

Function

Release (OLE 1.x)

OLESTATUS Release(*lpServer***)**

LPOLESERVER *lpServer;*

The **Release** function notifies a server that all connections to it have closed and that it is safe to quit.

Parameter	Description
lpServer	Points to an **OLESERVER** structure identifying the server.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

The server library calls the **Release** function when it is safe for a server to quit. When a server application calls the **OleRevokeServer** function, the application must continue to dispatch messages and wait for the library to call the **Release** function before quitting.

When the server is invisible and the library calls **Release**, the server must exit. (The only exception is when an application supports multiple servers; in this case, an invisible server is sometimes not revocable when the library calls **Release**.) If the server has no open documents and it was started with the **/Embedding** option (indicating that it was started by a client application), the server should exit when the library calls the **Release** function. If the user has explicitly loaded a document into a single-instance multiple document interface server, however, the server should not exit when the library calls **Release**. Typically, a single-instance server is a multiple document interface (MDI) server.

All registered server structures must be released before a server can quit.

A server can call the **PostQuitMessage** function inside the **Release** function.

Function

See Also

PostQuitMessage

Execute (OLE 1.x)

OLESTATUS Execute(*lpServer, hCommands***)**

LPOLESERVER *lpServer;*
HGLOBAL *hCommands;*

The **Execute** function receives **WM_DDE_EXECUTE** commands sent by client applications. The applications send these commands by calling the **OleExecute** function.

Parameter	Description
lpServer	Points to an **OLESERVER** structure identifying the server.
hCommands	Identifies memory containing one or more dynamic data exchange (DDE) execute commands.

Returns

The return value is OLE_OK if the function is successful. Otherwise, it is an error value.

Comments

The server should never free the handle specified in the *hCommands* parameter.

OLESTREAM (3.1)

```
#include <ole.h>

typedef struct _OLESTREAM {     /* ostr */
    LPOLESTREAMVTBL lpstbl;
} OLESTREAM;
```

The **OLESTREAM** structure points to an **OLESTREAMVTBL** structure that provides stream input and output functions. These functions are used by the client library for stream operations on objects. The **OLESTREAM** structure is allocated and initialized by client applications.

Member	Description
lpstbl	Points to an **OLESTREAMVTBL** structure.

See Also
OLESTREAMVTBL

OLESTREAMVTBL (3.1)

```
#include <ole.h>

typedef struct _OLESTREAMVTBL {   /* ostrv */
    DWORD (CALLBACK* Get)(LPOLESTREAM, void FAR*, DWORD);
    DWORD (CALLBACK* Put)(LPOLESTREAM, OLE_CONST void FAR*, DWORD);
} OLESTREAMVTBL;
```

The **OLESTREAMVTBL** structure points to functions the client library uses for stream operations on objects. This structure is allocated and initialized by client applications.

Member	Description
Get	Gets data from the stream.
Put	Puts data into the stream.

Comments

The stream is valid only for the duration of the function to which it is passed. The library obtains everything it requires while the stream is valid.

The return values for the stream functions may indicate that an error has occurred, but these values do not indicate the nature of the error. The client application is responsible for any required error-recovery operations.

A client application can use these functions to provide variations on the standard stream procedures; for example, the client could change the permanent storage of some objects so that they were stored in a database instead of the client document.

Function

See Also

OLESTREAM

Get (OLE 1.x)

DWORD Get(*lpstream, lpszBuf, cbbuf***)**

LPOLESTREAM *lpstream;*
void FAR* *lpszBuf;*
DWORD *cbbuf;*

The **Get** function gets data from the specified stream.

Parameter	Description
lpstream	Points to an **OLESTREAM** structure allocated by the client.
lpszBuf	Points to a buffer to fill with data from the stream.
cbbuf	Specifies the number of bytes to read into the buffer.

Returns

The return value is the number of bytes actually read into the buffer if the function is successful. If the end of the file is encountered, the return value is zero. A negative return value indicates that an error occurred.

Comments

The value specified by the *cbbuf* parameter can be larger than 64K. If the client application uses a stream-reading function that is limited to 64K, it should call that function repeatedly until it has read the number of bytes specified by *cbbuf.* Whenever the data size is larger than 64K, the pointer to the data buffer is always at the beginning of the segment.

Function

Put (OLE 1.x)

DWORD Put(*lpstream, lpszBuf, cbbuf***)**

LPOLESTREAM *lpstream;*
OLE_CONST void FAR* *lpszBuf;*
DWORD *cbbuf;*

The **Put** function puts data into the specified stream.

Parameter	Description
lpstream	Points to an **OLESTREAM** structure allocated by the client.
lpszBuf	Points to a buffer from which to write data into the stream.
cbbuf	Specifies the number of bytes to write into the stream.

Returns

The return value is the number of bytes actually written to the stream. A return value less than the number specified in the *cbbuf* parameter indicates that either there was insufficient space in the stream or an error occurred.

Comments

The value specified by the *cbbuf* parameter can be greater than 64K. If the client application uses a stream-writing function that is limited to 64K, it should call that function repeatedly until it has written the number of bytes specified by *cbbuf.* Whenever the data size is greater than 64K, the pointer to the data buffer is always at the beginning of the segment.

OLETARGETDEVICE (3.1)

```
#include <ole.h>

typedef struct _OLETARGETDEVICE {    /* otd */
    UINT otdDeviceNameOffset;
    UINT otdDriverNameOffset;
    UINT otdPortNameOffset;
    UINT otdExtDevmodeOffset;
    UINT otdExtDevmodeSize;
    UINT otdEnvironmentOffset;
    UINT otdEnvironmentSize;
    BYTE otdData[1];
} OLETARGETDEVICE;
```

The **OLETARGETDEVICE** structure contains information about the target device that a client application is using. Server applications can use the information in this structure to change the rendering of an object, if necessary. A client application provides a handle to this structure in a call to the **OleSetTargetDevice** function.

Member	Description
otdDeviceNameOffset	Specifies the offset from the beginning of the array to the name of the device.
otdDriverNameOffset	Specifies the offset from the beginning of the array to the name of the device driver.
otdPortNameOffset	Specifies the offset from the beginning of the array to the name of the port.
otdExtDevmodeOffset	Specifies the offset from the beginning of the array to a **DEVMODE** structure retrieved by the **ExtDeviceMode** function.
otdExtDevmodeSize	Specifies the size of the **DEVMODE** structure whose offset is specified by the **otdExtDevmodeOffset** member.
otdEnvironmentOffset	Specifies the offset from the beginning of the array to the device environment.
otdEnvironmentSize	Specifies the size of the environment whose offset is specified by the **otdEnvironmentOffset** member.
otdData	Specifies an array of bytes containing data for the target device.

Comments

The **otdDeviceNameOffset**, **otdDriverNameOffset**, and **otdPortNameOffset** members should be NULL-terminated.

In Windows 3.1, the ability to connect multiple printers to one port has made the environment obsolete. The environment information retrieved by the **GetEnvironment** function can occasionally be incorrect. To ensure that the **OLETARGETDEVICE** structure is initialized correctly, the application should copy information from the **DEVMODE** structure retrieved by a call to the **ExtDeviceMode** function to the environment position of the **OLETARGETDEVICE** structure.

See Also

OleSetTargetDevice

OPENFILENAME (3.1)

```
#include <commdlg.h>

typedef struct tagOPENFILENAME { /* ofn */
    DWORD     lStructSize;
    HWND      hwndOwner;
    HINSTANCE hInstance;
    LPCSTR    lpstrFilter;
    LPSTR     lpstrCustomFilter;
    DWORD     nMaxCustFilter;
    DWORD     nFilterIndex;
    LPSTR     lpstrFile;
    DWORD     nMaxFile;
    LPSTR     lpstrFileTitle;
    DWORD     nMaxFileTitle;
    LPCSTR    lpstrInitialDir;
    LPCSTR    lpstrTitle;
    DWORD     Flags;
    UINT      nFileOffset;
    UINT      nFileExtension;
    LPCSTR    lpstrDefExt;
    LPARAM    lCustData;
    UINT      (CALLBACK* lpfnHook) (HWND, UINT, WPARAM, LPARAM);
    LPCSTR    lpTemplateName;
} OPENFILENAME;
```

The **OPENFILENAME** structure contains information that the system uses to initialize the system-defined Open dialog box or Save dialog box. After the user chooses the OK button to close the dialog box, the system returns information about the user's selection in this structure.

Member	Description
lStructSize	Specifies the length of the structure, in bytes. This member is filled on input.
hwndOwner	Identifies the window that owns the dialog box. This member can be any valid window handle, or it should be NULL if the dialog box is to have no owner. If the **OFN_SHOWHELP** flag is set, **hwndOwner** must identify the window that owns the dialog box. The window procedure for this owner window receives a notification message when the user chooses the Help button. (The identifier for the notification message is the value returned by the **RegisterWindowMessage** function when HELPMSGSTRING is passed as its argument.) This member is filled on input.
hInstance	Identifies a data block that contains a dialog box template specified by the **lpTemplateName** member. This member is used only if the **Flags** member specifies the **OFN_ENABLETEMPLATE** or the **OFN_ENABLETEMPLATEHANDLE** flag; otherwise, this member is ignored. This member is filled on input.
lpstrFilter	Points to a buffer containing one or more pairs of null-terminated strings specifying filters. The first string in each pair describes a filter (for example, "Text Files"); the second specifies the filter pattern (for example, "*.txt"). Multiple filters can be specified for a single item; in this case, the semicolon (;) is used to separate filter pattern strings--for example, "*.txt;*.doc;*.bak". The last string in the buffer must be terminated by two null characters. If this parameter is NULL, the dialog box does not display any filters. The filter strings must be in the proper order--the system does not change the order.

This member is filled on input.

lpstrCustomFilter Points to a buffer containing a pair of user-defined strings that specify a filter. These strings should be formatted in the same way as is described for the **lpstrFilter** member. The first string describes the filter and the second specifies the filter pattern (for example, "WinWord", "*.doc"). The buffer is terminated by two null characters. The system copies the strings from the File Name edit control to the buffer when the user chooses the OK button to close the dialog box.

If the **nFilterIndex** member is zero, the system uses the **lpstrCustomFilter** strings as the initial filter description and filter pattern for the dialog box. If the first string in the pair pointed to by **lpstrCustomFilter** is NULL (for example, "", "*.doc"), only the strings pointed to by **lpstrFilter** are displayed in the List Files of Type listbox, but the last specified filter pattern is still passed to the second string location of **lpstrCustomFilter**.

nMaxCustFilter Specifies the size, in bytes, of the buffer identified by the **lpstrCustomFilter** member. This buffer should be at least 40 bytes long. This parameter is ignored if the **lpstrCustomFilter** member is NULL.

This member is filled on input.

nFilterIndex Specifies an index into the buffer pointed to by the **lpstrFilter** member. The system uses the index value to obtain a pair of strings to use as the initial filter description and filter pattern for the dialog box. The first pair of strings has an index value of 1. When the user chooses the OK button to close the dialog box, the system copies the index of the selected filter strings into this location. If the **nFilterIndex** member is 0, the filter in the buffer pointed to by the **lpstrCustomFilter** member is used. If the **nFilterIndex** member is 0 and the **lpstrCustomFilter** member is NULL, the system uses the first filter in the buffer pointed to by the **lpstrFilter** member. If each of the three members is either 0 or NULL, the system does not use any filters and does not show any files in the File Name list box of the dialog box.

lpstrFile Points to a buffer that specifies a filename used to initialize the File Name edit control. If initialization is not necessary, the first character of this buffer must be NULL. When the **GetOpenFileName** or **GetSaveFileName** function returns, this buffer contains the complete location and name of the selected file.

If the buffer is too small, the dialog box procedure copies the required size into this member and returns 0. To retrieve the required size, cast the **lpstrFile** member to type **LPWORD**. The buffer must be at least three bytes to receive the required size. When the buffer is too small, the **CommDlgExtendedError** function returns the **FNERR_BUFFERTOOSMALL** value.

nMaxFile Specifies the size, in bytes, of the buffer pointed to by the **lpstrFile** member. The **GetOpenFileName** and **GetSaveFileName** functions return FALSE if the buffer is too small to contain the file information. The buffer does not need to be larger than 128 bytes; **lpstrFile** entries longer than 128 bytes are truncated. If the **lpstrFile** member is NULL, this member is ignored.

This member is filled on input.

lpstrFileTitle Points to a buffer that receives the title of the selected file. This buffer receives the filename and extension but no path information. An application should use this string to display the file title. If this member is NULL, the function does not copy the file title. This member is filled on output.

nMaxFileTitle Specifies the maximum length, in bytes, of the string that can be copied into the **lpstrFileTitle** buffer. This member is ignored if **lpstrFileTitle** is NULL. This member is filled on input.

lpstrInitialDir Points to a string that specifies the initial file directory. If this member is NULL, the system uses the current directory as the initial directory. (If the **lpstrFile**

member contains a string that specifies a valid path, the common dialog box procedure will use the path specified by this string *instead of* the path specified by the string to which **lpstrInitialDir** points.)

This member is filled on input.

lpstrTitle Points to a string to be placed in the title bar of the dialog box. If this member is NULL, the system uses the default title (that is, Save As or Open). This member is filled on input.

Flags Specifies the dialog box initialization flags. This member may be a combination of the following values:

Value Meaning

OFN_ALLOWMULTISELECT
: Specifies that the File Name list box is to allow multiple selections. When this flag is set, the **lpstrFile** member points to a buffer containing the path to the current directory and all filenames in the selection. The first filename is separated from the path by a space. Each subsequent filename is separated by one space from the preceding filename. Some of the selected filenames may be preceded by relative paths; for example, the buffer could contain something like this:

  c:\files file1.txt file2.txt ..\bin\file3.txt

OFN_CREATEPROMPT
: Causes the dialog box procedure to generate a message box to notify the user when a specified file does not currently exist and to make it possible for the user to specify that the file should be created. (This flag automatically sets the **OFN_PATHMUSTEXIST** and **OFN_FILEMUSTEXIST** flags.)

OFN_ENABLEHOOK
: Enables the hook function specified in the **lpfnHook** member.

OFN_ENABLETEMPLATE
: Causes the system to use the dialog box template identified by the **hInstance** and **lpTemplateName** members to create the dialog box.

OFN_ENABLETEMPLATEHANDLE
: Indicates that the **hInstance** member identifies a data block that contains a pre-loaded dialog box template. The system ignores the **lpTemplateName** member if this flag is specified.

OFN_EXTENSIONDIFFERENT
: Indicates that the extension of the returned filename is different from the extension specified by the **lpstrDefExt** member. This flag is not set if **lpstrDefExt** is NULL, if the extensions match, or if the file has no extension. This flag can be set on output.

OFN_FILEMUSTEXIST
: Specifies that the user can type only the names of existing files in the File Name edit control. If this flag is set and the user types an invalid filename in the File Name edit control, the dialog box procedure displays a warning in a message box. (This flag also causes the **OFN_PATHMUSTEXIST** flag to be set.)

OFN_HIDEREADONLY
: Hides the Read Only check box.

OFN_NOCHANGEDIR
: Forces the dialog box to reset the current directory to what it was when the dialog box was created.

OFN_NOREADONLYRETURN

Specifies that the file returned will not have the Read Only attribute set and will not be in a write-protected directory.

OFN_NOTESTFILECREATE
Specifies that the file will not be created before the dialog box is closed. This flag should be set if the application saves the file on a create-no-modify network share point. When an application sets this flag, the library does not check against write protection, a full disk, an open drive door, or network protection. Therefore, applications that use this flag must perform file operations carefully--a file cannot be reopened once it is closed.

OFN_NOVALIDATE
Specifies that the common dialog boxes will allow invalid characters in the returned filename. Typically, the calling application uses a hook function that checks the filename using the FILEOKSTRING registered message. If the text in the edit control is empty or contains nothing but spaces, the lists of files and directories are updated. If the text in the edit control contains anything else, the **nFileOffset** and **nFileExtension** members are set to values generated by parsing the text. No default extension is added to the text, nor is text copied to the **lpstrFileTitle** buffer.

If the value specified by the **nFileOffset** member is negative, the filename is invalid. If the value specified by **nFileOffset** is not negative, the filename is valid, and **nFileOffset** and **nFileExtension** can be used as if the **OFN_NOVALIDATE** flag had not been set.

OFN_OVERWRITEPROMPT
Causes the Save As dialog box to generate a message box if the selected file already exists. The user must confirm whether to overwrite the file.

OFN_PATHMUSTEXIST
Specifies that the user can type only valid paths. If this flag is set and the user types an invalid path in the File Name edit control, the dialog box procedure displays a warning in a message box.

OFN_READONLY
Causes the Read Only check box to be initially checked when the dialog box is created. When the user chooses the OK button to close the dialog box, the state of the Read Only check box is specified by this member. This flag can be set on input and output.

OFN_SHAREAWARE
Specifies that if a call to the **OpenFile** function has failed because of a network sharing violation, the error is ignored and the dialog box returns the given filename. If this flag is not set, the registered message for SHAREVISTRING is sent to the hook function, with a pointer to a null-terminated string for the path name in the *lParam* parameter. The hook function responds with one of the following values:

Value	Meaning
OFN_SHAREFALLTHROUGH	Specifies that the filename is returned from the dialog box.
OFN_SHARENOWARN	Specifies no further action.
OFN_SHAREWARN	Specifies that the user receives the standard warning message for this error. (This is the same result as if there were no hook function.)

This flag may be set on output.

OFN_SHOWHELP

Causes the dialog box to show the Help push button. The **hwndOwner** must not be NULL if this option is specified.

These flags may be set when the structure is initialized, except where specified.

nFileOffset Specifies a zero-based offset from the beginning of the path to the filename specified by the string in the buffer to which **lpstrFile** points. For example, if **lpstrFile** points to the string, "c:\dir1\dir2\file.ext", this member contains the value 13.

This member is filled on output.

nFileExtension Specifies a zero-based offset from the beginning of the path to the filename extension specified by the string in the buffer to which **lpstrFile** points. For example, if **lpstrFile** points to the following string, "c:\dir1\dir2\file.ext", this member contains the value 18. If the user did not type an extension *and* **lpstrDefExt** is NULL, this member specifies an offset to the terminating null character. If the user typed a period (.) as the last character in the filename, this member is 0.

This member is filled on output.

lpstrDefExt

Points to a buffer that contains the default extension. The **GetOpenFileName** or **GetSaveFileName** function appends this extension to the filename if the user fails to enter an extension. If the filename with the default extension is not found, the **GetOpenFileName** or **GetSaveFileName** function attempts to find the file using the name exactly as the user typed it. This string can be any length, but only the first three characters are appended. The string should not contain a period (.). If this member is NULL and the user fails to type an extension, no extension is appended. This member is filled on input.

lCustData Specifies application-defined data that the system passes to the hook function pointed to by the **lpfnHook** member. The system passes a pointer to the **OPENFILENAME** structure in the *lParam* parameter of the **WM_INITDIALOG** message; this pointer can be used to retrieve the **lCustData** member.

lpfnHook Points to a hook function that processes messages intended for the dialog box. To enable the hook function, an application must specify the **OFN_ENABLEHOOK** flag in the **Flags** member; otherwise, the system ignores this structure member. The hook function must return zero to pass a message that it didn't process back to the dialog box procedure in COMMDLG.DLL. The hook function must return a nonzero value to prevent the dialog box procedure in COMMDLG.DLL from processing a message it has already processed.

This member is filled on input.

lpTemplateName Points to a null-terminated string that specifies the name of the resource file for the dialog box template that is to be substituted for the dialog box template in COMMDLG.DLL. An application can use the **MAKEINTRESOURCE** macro for numbered dialog box resources. This member is used only if the **Flags** member specifies the **OFN_ENABLETEMPLATE** flag; otherwise, this member is ignored.

This member is filled on input.

See Also

GetOpenFileName, **GetSaveFileName**, **MAKEINTRESOURCE**

OFN_ALLOWMULTISELECT 0x00000200

Specifies that the File Name list box is to allow multiple selections. When this flag is set, the **lpstrFile** member points to a buffer containing the path to the current directory and all filenames in the selection. The first filename is separated from the path by a space. Each subsequent filename is separated by one space from the preceding filename. Some of the selected filenames may be preceded by relative paths; for example, the buffer could contain something like this:

OFN_ALLOWMULTISELECT 0x00000200

OFN_CREATEPROMPT 0x00002000

Causes the dialog box procedure to generate a message box to notify the user when a specified file does not currently exist and to make it possible for the user to specify that the file should be created. (This flag automatically sets the **OFN_PATHMUSTEXIST** and **OFN_FILEMUSTEXIST** flags.)

OFN_CREATEPROMPT 0x00002000

OFN_ENABLEHOOK 0x00000020

Enables the hook function specified in the **lpfnHook** member.

OFN_ENABLEHOOK 0x00000020

OFN_ENABLETEMPLATE 0x00000040

Causes the system to use the dialog box template identified by the **hInstance** and **lpTemplateName** members to create the dialog box.

OFN_ENABLETEMPLATE 0x00000040

OFN_ENABLETEMPLATEHANDLE 0x00000080

Indicates that the **hInstance** member identifies a data block that contains a pre-loaded dialog box template. The system ignores the **lpTemplateName** member if this flag is specified.

OFN_ENABLETEMPLATEHANDLE 0x00000080

OFN_EXTENSIONDIFFERENT 0x00000400

Indicates that the extension of the returned filename is different from the extension specified by the **lpstrDefExt** member. This flag is not set if **lpstrDefExt** is NULL, if the extensions match, or if the file has no extension. This flag can be set on output.

OFN_EXTENSIONDIFFERENT 0x00000400

OFN_FILEMUSTEXIST 0x00001000

Specifies that the user can type only the names of existing files in the File Name edit control. If this flag is set and the user types an invalid filename in the File Name edit control, the dialog box procedure displays a warning in a message box. (This flag also causes the **OFN_PATHMUSTEXIST** flag to be set.)

OFN_FILEMUSTEXIST 0x00001000

OFN_HIDEREADONLY 0x00000004

Hides the Read Only check box.

OFN_HIDEREADONLY 0x00000004

OFN_NOCHANGEDIR 0x00000008

Forces the dialog box to reset the current directory to what it was when the dialog box was created.

OFN_NOCHANGEDIR 0x00000008

OFN_NOREADONLYRETURN 0x00008000

Specifies that the file returned will not have the Read Only attribute set and will not be in a write-protected directory.

OFN_NOREADONLYRETURN 0x00008000

OFN_NOTESTFILECREATE 0x00010000

Specifies that the file will not be created before the dialog box is closed. This flag should be set if the application saves the file on a create-no-modify network share point. When an application sets this flag, the library does not check against write protection, a full disk, an open drive door, or network protection. Therefore, applications that use this flag must perform file operations carefully--a file cannot be reopened once it is closed.

OFN_NOTESTFILECREATE 0x00010000

OFN_NOVALIDATE 0x00000100

Specifies that the common dialog boxes will allow invalid characters in the returned filename. Typically, the calling application uses a hook function that checks the filename using the FILEOKSTRING registered message. If the text in the edit control is empty or contains nothing but spaces, the lists of files and directories are updated. If the text in the edit control contains anything else, the **nFileOffset** and **nFileExtension** members are set to values generated by parsing the text. No default extension is added to the text, nor is text copied to the **lpstrFileTitle** buffer. If the value specified by the **nFileOffset** member is negative, the filename is invalid. If the value specified by **nFileOffset** is not negative, the filename is valid, and **nFileOffset** and **nFileExtension** can be used as if the OFN_NOVALIDATE flag had not been set.

OFN_NOVALIDATE 0x00000100

OFN_OVERWRITEPROMPT 0x00000002

Causes the Save As dialog box to generate a message box if the selected file already exists. The user must confirm whether to overwrite the file.

OFN_OVERWRITEPROMPT 0x00000002

OFN_PATHMUSTEXIST 0x00000800

Specifies that the user can type only valid paths. If this flag is set and the user types an invalid path in the File Name edit control, the dialog box procedure displays a warning in a message box.

OFN_PATHMUSTEXIST 0x00000800

OFN_READONLY 0x00000001

Causes the Read Only check box to be initially checked when the dialog box is created. When the user chooses the OK button to close the dialog box, the state of the Read Only check box is specified by this member. This flag can be set on input and output.

OFN_READONLY 0x00000001

OFN_SHAREAWARE 0x00004000

Specifies that if a call to the **OpenFile** function has failed because of a network sharing violation, the error is ignored and the dialog box returns the given filename. If this flag is not set, the registered message for SHAREVISTRING is sent to the hook function, with a pointer to a null-terminated string for the path name in the *lParam* parameter. The hook function responds with one of the following values:

OFN_SHAREAWARE 0x00004000

This
flag may be set on output.

OFN_SHOWHELP 0x00000010

Causes the dialog box to show the Help push button. The **hwndOwner** must not be NULL if this option is specified.

OFN_SHOWHELP 0x00000010

OUTLINETEXTMETRIC (3.1)

```
typedef struct tagOUTLINETEXTMETRIC {    /* otm */
    UINT        otmSize;
    TEXTMETRIC  otmTextMetrics;
    BYTE        otmFiller;
    PANOSE      otmPanoseNumber;
    UINT        otmfsSelection;
    UINT        otmfsType;
    UINT        otmsCharSlopeRise;
    UINT        otmsCharSlopeRun;
    UINT        otmItalicAngle;
    UINT        otmEMSquare;
    INT         otmAscent;
    INT         otmDescent;
    UINT        otmLineGap;
    UINT        otmsXHeight;
    UINT        otmsCapEmHeight;
    RECT        otmrcFontBox;
    INT         otmMacAscent;
    INT         otmMacDescent;
    UINT        otmMacLineGap;
    UINT        otmusMinimumPPEM;
    POINT       otmptSubscriptSize;
    POINT       otmptSubscriptOffset;
    POINT       otmptSuperscriptSize;
    POINT       otmptSuperscriptOffset;
    UINT        otmsStrikeoutSize;
    INT         otmsStrikeoutPosition;
    INT         otmsUnderscorePosition;
    UINT        otmsUnderscoreSize;
    PSTR        otmpFamilyName;
    PSTR        otmpFaceName;
    PSTR        otmpStyleName;
    PSTR        otmpFullName;
} OUTLINETEXTMETRIC;
```

The **OUTLINETEXTMETRIC** structure contains metrics describing a TrueType font.

Member	Description
otmSize	Specifies the size, in bytes, of the **OUTLINETEXTMETRIC** structure.
otmTextMetrics	Specifies a **TEXTMETRIC** structure containing further information about the font.
otmFiller	Specifies a value that causes the structure to be byte-aligned.
otmPanoseNumber	Specifies the Panose number for this font.
otmfsSelection	Specifies the nature of the font pattern. This member can be a combination of the following bits:

Bit	Meaning
0	Italic
1	Underscore
2	Negative
3	Outline
4	Strikeout

	5 Bold
otmfsType	Specifies whether the font is licensed. Licensed fonts may not be modified or exchanged. If bit 1 is set, the font may not be embedded in a document. If bit 1 is clear, the font can be embedded. If bit 2 is set, the embedding is read-only.
otmsCharSlopeRise	Specifies the slope of the cursor. This value is 1 if the slope is vertical. Applications can use this value and the value of the **otmsCharSlopeRun** member to create an italic cursor that has the same slope as the main italic angle (specified by the **otmItalicAngle** member).
otmsCharSlopeRun	Specifies the slope of the cursor. This value is zero if the slope is vertical. Applications can use this value and the value of the **otmsCharSlopeRise** member to create an italic cursor that has the same slope as the main italic angle (specified by the **otmItalicAngle** member).
otmItalicAngle	Specifies the main italic angle of the font, in counterclockwise degrees from vertical. Regular (roman) fonts have a value of zero. Italic fonts typically have a negative italic angle (that is, they lean to the right).
otmEMSquare	Specifies the number of logical units defining the x- or y-dimension of the em square for this font. (The number of units in the x- and y-directions are always the same for an em square.)
otmAscent	Specifies the maximum distance characters in this font extend above the base line. This is the typographic ascent for the font.
otmDescent	Specifies the maximum distance characters in this font extend below the base line. This is the typographic descent for the font.
otmLineGap	Specifies typographic line spacing.
otmsXHeight	Not supported.
otmsCapEmHeight	Not supported.
otmrcFontBox	Specifies the bounding box for the font.
otmMacAscent	Specifies the maximum distance characters in this font extend above the base line for the Macintosh.
otmMacDescent	Specifies the maximum distance characters in this font extend below the base line for the Macintosh.
otmMacLineGap	Specifies line-spacing information for the Macintosh.
otmusMinimumPPEM	Specifies the smallest recommended size for this font, in pixels per em-square.
otmptSubscriptSize	Specifies the recommended horizontal and vertical size for subscripts in this font.
otmptSubscriptOffset	Specifies the recommended horizontal and vertical offset for subscripts in this font. The subscript offset is measured from the character origin to the origin of the subscript character.
otmptSuperscriptSize	Specifies the recommended horizontal and vertical size for superscripts in this font.
otmptSuperscriptOffset	Specifies the recommended horizontal and vertical offset for superscripts in this font. The subscript offset is measured from the character base line to the base line of the superscript character.
otmsStrikeoutSize	Specifies the width of the strikeout stroke for this font. Typically, this is the width of the em-dash for the font.
otmsStrikeoutPosition	Specifies the position of the strikeout stroke relative to the base line for this font. Positive values are above the base line and negative values are below.

otmsUnderscorePosition	Specifies the position of the underscore character for this font.
otmsUnderscoreSize	Specifies the thickness of the underscore character for this font.
otmpFamilyName	Specifies the offset from the beginning of the structure to a string specifying the family name for the font.
otmpFaceName	Specifies the offset from the beginning of the structure to a string specifying the face name for the font. (This face name corresponds to the name specified in the **LOGFONT** structure.)
otmpStyleName	Specifies the offset from the beginning of the structure to a string specifying the style name for the font.
otmpFullName	Specifies the offset from the beginning of the structure to a string specifying the full name for the font. This name is unique for the font and often contains a version number or other identifying information.

Comments

The sizes returned in **OUTLINETEXTMETRIC** are given in logical units; that is, they depend on the current mapping mode of the specified display context.

See Also

GetOutlineTextMetrics, **PANOSE**, **TEXTMETRIC**

PAINTSTRUCT (2.x)

```
typedef struct tagPAINTSTRUCT {     /* ps */
   HDC  hdc;
   BOOL fErase;
   RECT rcPaint;
   BOOL fRestore;
   BOOL fIncUpdate;
   BYTE rgbReserved[16];
} PAINTSTRUCT;
```

The **PAINTSTRUCT** structure contains information for an application. This information can be used to paint the client area of a window owned by that application.

Member	Description
hdc	Identifies the display context to be used for painting.
fErase	Specifies whether the background needs to be redrawn. This value is nonzero if the application should redraw the background. The application is responsible for drawing the background if a window class is created without a background brush. For more information, see the description of the **hbrBackground** member of the **WNDCLASS** structure.
rcPaint	Specifies the upper-left and lower-right corners of the rectangle in which the painting is requested.
fRestore	Reserved; used internally by Windows.
fIncUpdate	Reserved; used internally by Windows.
rgbReserved	Reserved (reserved memory object used internally by Windows)

See Also
BeginPaint, **WNDCLASS**

Corrections

The description of the **fErase** member was reversed. It is nonzero if the application should redraw the background.

PALETTEENTRY (3.0)

```
typedef struct tagPALETTEENTRY {    /* pe */
    BYTE  peRed;
    BYTE  peGreen;
    BYTE  peBlue;
    BYTE  peFlags;
} PALETTEENTRY;
```

The **PALETTEENTRY** structure specifies the color and usage of an entry in a logical color palette. A logical palette is defined by a **LOGPALETTE** structure.

Member	Description
peRed	Specifies the intensity of red for the palette entry color.
peGreen	Specifies the intensity of green for the palette entry color.
peBlue	Specifies the intensity of blue for the palette entry color.
peFlags	Specifies how the palette entry is to be used. The **peFlags** member may be set to NULL or to one of the following values (specifying NULL informs Windows that the palette entry contains an **RGB** value and that it should be mapped normally):

Value	Meaning
PC_EXPLICIT	Specifies that the low-order word of the logical palette entry designates a hardware palette index. This flag allows the application to show the contents of the palette for the display device.
PC_NOCOLLAPSE	Specifies that the color will be placed in an unused entry in the system palette instead of being matched to an existing color in the system palette. Once this color is in the system palette, colors in other logical palettes can be matched to this color. If there are no unused entries in the system palette, the color is matched normally.
PC_RESERVED	Specifies that the logical palette entry will be used for palette animation. Because the color will frequently change, using this flag prevents other windows from matching colors to this palette entry. If an unused system-palette entry is available, this color is placed in that entry. Otherwise, the color will not be available for animation.

See Also
AnimatePalette, **LOGPALETTE**

PANOSE (3.1)

```
typedef struct tagPANOSE {    /* panose */
    BYTE bFamilyType;
    BYTE bSerifStyle;
    BYTE bWeight;
    BYTE bProportion;
    BYTE bContrast;
    BYTE bStrokeVariation;
    BYTE bArmStyle;
    BYTE bLetterform;
    BYTE bMidline;
    BYTE bXHeight;
} PANOSE;
```

The **PANOSE** structure describes the Panose font-classification values for a TrueType font.

Member — **Description**

bFamilyType — Specifies the font family. This member can be one of the following values:

Value	Meaning
0	Any
1	No fit
2	Text and display
3	Script
4	Decorative
5	Pictorial

bSerifStyle — Specifies the style of serifs for the font. This member can be one of the following values:

Value	Meaning
0	Any
1	No fit
2	Cove
3	Obtuse cove
4	Square cove
5	Obtuse square cove
6	Square
7	Thin
8	Bone
9	Exaggerated
10	Triangle
11	Normal sans
12	Obtuse sans
13	Perp sans
14	Flared
15	Rounded

bWeight — Specifies the weight of the font. This member can be one of the following values:

Value	Meaning
0	Any

1	No fit
2	Very light
3	Light
4	Thin
5	Book
6	Medium
7	Demi
8	Bold
9	Heavy
10	Black
11	Nord

bProportion Specifies the proportion of the font. This member can be one of the following values:

Value	Meaning
0	Any
1	No fit
2	Old style
3	Modern
4	Even width
5	Expanded
6	Condensed
7	Very expanded
8	Very condensed
9	Monospaced

bContrast Specifies the contrast of the font. This member can be one of the following values:

Value	Meaning
0	Any
1	No fit
2	None
3	Very low
4	Low
5	Medium low
6	Medium
7	Medium high
8	High
9	Very high

bStrokeVariation Specifies the stroke variation for the font. This member can be one of the following values:

Value	Meaning
0	Any
1	No fit
2	Gradual/diagonal
3	Gradual/transitional
4	Gradual/vertical

5	Gradual/horizontal
6	Rapid/vertical
7	Rapid/horizontal
8	Instant/vertical

bArmStyle Specifies the style for the arms in the font. This member can be one of the following values:

Value	Meaning
0	Any
1	No fit
2	Straight arms/horizontal
3	Straight arms/wedge
4	Straight arms/vertical
5	Straight arms/single serif
6	Straight arms/double serif
7	Non-straight arms/horizontal
8	Non-straight arms/wedge
9	Non-straight arms/vertical
10	Non-straight arms/single serif
11	Non-straight arms/double serif

bLetterform Specifies the letter form for the font. This member can be one of the following values:

Value	Meaning
0	Any
1	No fit
2	Normal/contact
3	Normal/weighted
4	Normal/boxed
5	Normal/flattened
6	Normal/rounded
7	Normal/off-center
8	Normal/square
9	Oblique/contact
10	Oblique/weighted
11	Oblique/boxed
12	Oblique/flattened
13	Oblique/rounded
14	Oblique/off-center
15	Oblique/square

bMidline Specifies the style of the midline for the font. This member can be one of the following values:

Value	Meaning
0	Any
1	No fit
2	Standard/trimmed
3	Standard/pointed

4	Standard/serifed
5	High/trimmed
6	High/pointed
7	High/serifed
8	Constant/trimmed
9	Constant/pointed
10	Constant/serifed
11	Low/trimmed
12	Low/pointed
13	Low/serifed

bXHeight Specifies the X-height of the font. This member can be one of the following values:

Value	Meaning
0	Any
1	No fit
2	Constant/small
3	Constant/standard
4	Constant/large
5	Ducking/small
6	Ducking/standard
7	Ducking/large

See Also

OUTLINETEXTMETRIC

POINT (2.x)

```
typedef struct tagPOINT {    /* pt */
   int x;
   int y;
} POINT;
```

The **POINT** structure defines the x- and y-coordinates of a point.

Member	Description
x	Specifies the x-coordinate of a point.
y	Specifies the y-coordinate of a point.

See Also

ChildWindowFromPoint, **PtInRect**, **WindowFromPoint**

POINTFX (3.1)

```
typedef struct tagPOINTFX {
    FIXED x;
    FIXED y;
} POINTFX;
```

The **POINTFX** structure contains the coordinates of points that describe the outline of a character in a TrueType font. **POINTFX** is a member of the **TTPOLYCURVE** and **TTPOLYGONHEADER** structures.

Member	Description
x	Specifies the x-component of a point on the outline of a TrueType character.
y	Specifies the y-component of a point on the outline of a TrueType character.

See Also

FIXED, **TTPOLYCURVE**, **TTPOLYGONHEADER**, **GetGlyphOutline**

PRINTDLG (3.1)

```
#include <commdlg.h>

typedef struct tagPD {  /* pd */
    DWORD     lStructSize;
    HWND      hwndOwner;
    HGLOBAL   hDevMode;
    HGLOBAL   hDevNames;
    HDC       hDC;
    DWORD     Flags;
    UINT      nFromPage;
    UINT      nToPage;
    UINT      nMinPage;
    UINT      nMaxPage;
    UINT      nCopies;
    HINSTANCE hInstance;
    LPARAM    lCustData;
    UINT    (CALLBACK* lpfnPrintHook)(HWND, UINT, WPARAM, LPARAM);
    UINT    (CALLBACK* lpfnSetupHook)(HWND, UINT, WPARAM, LPARAM);
    LPCSTR    lpPrintTemplateName;
    LPCSTR    lpSetupTemplateName;
    HGLOBAL   hPrintTemplate;
    HGLOBAL   hSetupTemplate;
} PRINTDLG;
```

The **PRINTDLG** structure contains information that the system uses to initialize the system-defined Print dialog box. After the user chooses the OK button to close the dialog box, the system returns information about the user's selections in this structure.

Member	Description
lStructSize	Specifies the length of the structure, in bytes. This member is filled on input.
hwndOwner	Identifies the window that owns the dialog box. This member can be any valid window handle, or it should be NULL if the dialog box is to have no owner. If the PD_SHOWHELP flag is set, **hwndOwner** must identify the window that owns the dialog box. The window procedure for this owner window receives a notification message when the user chooses the Help button. (The identifier for the notification message is the value returned by the **RegisterWindowMessage** function when HELPMSGSTRING is passed as its argument.) This member is filled on input.
hDevMode	Identifies a movable global memory object that contains a **DEVMODE** structure. Before the **PrintDlg** function is called, the members in this structure may contain data used to initialize the dialog box controls. When the **PrintDlg** function returns, the members in this structure specify the state of each of the dialog box controls. If the application uses the structure to initialize the dialog box controls, it must allocate space for and create the **DEVMODE** structure. (The application should allocate a movable memory object.) If the application does not use the structure to initialize the dialog box controls, the **hDevMode** member may be NULL. In this case, the **PrintDlg** function allocates memory for the structure, initializes its members, and returns a handle that identifies it.

If the device driver for the specified printer does not support extended device modes, the **hDevMode** member is NULL when **PrintDlg** returns.

If the device name (specified by the **dmDeviceName** member of the **DEVMODE** structure) does not appear in the [devices] section of WIN.INI, the **PrintDlg** function returns an error.

The value of **hDevMode** may change during the execution of the **PrintDlg** function. If this value changes, the **PrintDlg** function has already freed the original handle and allocated a new one. When the calling application is finished with the handle, it must free it by calling the **GlobalFree** function. This value may change even if the **PrintDlg** function returns zero.

This member is filled on input and output.

hDevNames

Identifies a movable global memory object that contains a **DEVNAMES** structure. This structure contains three strings; these strings specify the driver name, the printer name, and the output-port name. Before the **PrintDlg** function is called, the members of this structure contain strings used to initialize the dialog box controls. When the **PrintDlg** function returns, the members of this structure contain the strings typed by the user. The calling application uses these strings to create a device context or an information context.

If the application uses the structure to initialize the dialog box controls, it must allocate space for and create the **DEVMODE** data structure. (The application should allocate a movable global memory object.)

If the application does not use the structure to initialize the dialog box controls, the **hDevNames** member can be NULL. In this case, the **PrintDlg** function allocates memory for the structure, initializes its members (using the printer name specified in the **DEVMODE** data structure), and returns a handle that identifies it. When the **PrintDlg** function initializes the members of the **DEVNAMES** structure, it uses the first port name that appears in the [devices] section of WIN.INI. For example, the function uses "LPT1" as the port name if the following string appears in the [devices] section:

```
PCL / HP LaserJet=HPPCL,LPT1:,LPT2:
```

If both the **hDevMode** and **hDevNames** members are NULL, **PrintDlg** specifies the current default printer for **hDevNames**.

The value of **hDevNames** may change during the execution of the **PrintDlg** function. If this value changes, the **PrintDlg** function has already freed the original handle and allocated a new one. When the calling application is finished with the handle, it must free it by calling the **GlobalFree** function. This value may change even if the **PrintDlg** function returns zero.

This member is filled on input and output.

hDC

Identifies either a device context or an information context, depending on whether the **Flags** member specifies the PD_RETURNDC or the PC_RETURNIC flag. If neither flag is specified, the value of this member is undefined. If both flags are specified, **hDC** is PD_RETURNDC.

This member is filled on output.

Flags

Specifies the dialog box initialization flags. This member may be a combination of the following values:

Value	Meaning
PD_ALLPAGES	Indicates that the All

	radio button was selected when the user closed the dialog box. (This value is used as a placeholder, to indicate that the PD_PAGENUMS and PD_SELECTION flags are not set. This value can be set on input and output.)
PD_COLLATE	Causes the Collate Copies check box to be checked when the dialog box is created. When the **PrintDlg** function returns, this flag indicates the state in which the user left the Collate Copies check box. This flag can be set on input and output.
PD_DISABLEPRINTTOFILE	Disables the Print to File check box.
PD_ENABLEPRINTHOOK	Enables the hook function specified in the **lpfnPrintHook** member of this structure.
PD_ENABLEPRINTTEMPLATE	Causes the system to use the dialog box template identified by the **hInstance** and **lpPrintTemplateName** members to create the Print dialog box.
PD_ENABLEPRINTTEMPLATEHANDLE	Indicates that the **hPrintTemplate** member identifies a data block that contains a pre-loaded dialog box template. The system ignores the **hInstance** member if this flag is specified.
PD_ENABLESETUPHOOK	Enables the hook function specified in the **lpfnSetupHook** member of this structure.

PD_ENABLESETUPTEMPLATE	Causes the system to use the dialog box template identified by the **hInstance** and **lpSetupTemplateName** members to create the Print Setup dialog box.
PD_ENABLESETUPTEMPLATEHANDLE	Indicates that the **hSetupTemplate** member identifies a data block that contains a pre-loaded dialog box template. The system ignores the **hInstance** member if this flag is specified.
PD_HIDEPRINTTOFILE	Hides and disables the Print to File check box.
PD_NOPAGENUMS	Disables the Pages radio button and the associated edit controls.
PD_NOSELECTION	Disables the Selection radio button.
PD_NOWARNING	Prevents the warning message from being displayed when there is no default printer.
PD_PAGENUMS	Causes the Pages radio button to be selected when the dialog box is created. When the **PrintDlg** function returns, this flag is set if the Pages button is in the selected state. If neither PD_PAGENUMS nor PD_SELECTION is specified, the All radio button is in the selected state. This flag can be set on input and output.
PD_PRINTSETUP	Causes the system to display the Print Setup dialog box rather than the Print dialog box.

PD_PRINTTOFILE	Causes the Print to File check box to be checked when the dialog box is created. This flag can be set on input and output.
PD_RETURNDC	Causes the **PrintDlg** function to return a device context matching the selections that the user made in the dialog box. The handle to the device context is returned in the **hDC** member. If neither PD_RETURNDC nor PD_RETURNIC is specified, the **hDC** parameter is undefined on output.
PD_RETURNDEFAULT	Causes the **PrintDlg** function to return **DEVMODE** and **DEVNAMES** structures that are initialized for the system default printer. **PrintDlg** does this without displaying a dialog box. Both the **hDevNames** and the **hDevMode** members should be NULL; otherwise, the function returns an error. If the system default printer is supported by an old printer driver (earlier than Windows version 3.0), only the **hDevNames** member is returned--the **hDevMode** member is NULL.
PD_RETURNIC	Causes the **PrintDlg** function to return an information context matching the selections that the user made in the dialog box. The

	information context is returned in the **hDC** member. If neither PD_RETURNDC nor PD_RETURNIC is specified, the **hDC** parameter is undefined on output.
PD_SELECTION	Causes the Selection radio button to be selected when the dialog box is created. When the **PrintDlg** function returns, this flag is set if the Selection button is in the selected state. If neither PD_PAGENUMS nor PD_SELECTION is specified, the All radio button is in the selected state. This flag can be set on input and output.
PD_SHOWHELP	Causes the dialog box to show the Help button. If this flag is specified, the **hwndOwner** must not be NULL.
PD_USEDEVMODECOPIES	Disables the Copies edit control if a printer driver does not support multiple copies. If a driver does support multiple copies, setting this flag indicates that the **PrintDlg** function should store the requested number of copies in the **dmCopies** member of the **DEVMODE** structure and store the value 1 in the **nCopies** member of the **PRINTDLG** structure. If this flag is not set, the **PRINTDLG** structure stores the value 1 in the **dmCopies** member

of the **DEVMODE** structure and stores the requested number of copies in the **nCopies** member of the **PRINTDLG** structure.

These flags may be set when the structure is initialized, except where specified.

nFromPage

Specifies the initial value for the starting page in the From edit control. When the **PrintDlg** function returns, this member specifies the page at which to begin printing. This value is valid only if the PD_PAGENUMS flag is specified. The maximum value for this member is 0xFFFE; if 0xFFFF is specified, the From edit control is left blank.

This member is filled on input and output.

nToPage

Specifies the initial value for the ending page in the To edit control. When the **PrintDlg** function returns, this member specifies the last page to print. This value is valid only if the PD_PAGENUMS flag is specified. The maximum value for this member is 0xFFFE; if 0xFFFF is specified, the To edit control is left blank.

This member is filled on input and output.

nMinPage

Specifies the minimum number of pages that can be specified in the From and To edit controls. This member is filled on input.

nMaxPage

Specifies the maximum number of pages that can be specified in the From and To edit controls. This member is filled on input.

nCopies

Before the **PrintDlg** function is called, this member specifies the value to be used to initialize the Copies edit control *if* the **hDevMode** member is NULL; otherwise, the **dmCopies** member of the **DEVMODE** structure contains the value used to initialize the Copies edit control.

When **PrintDlg** returns, the value specified by this member depends on the version of Windows for which the printer driver was written. For printer drivers written for Windows versions earlier than 3.0, this member specifies the number of copies requested by the user in the Copies edit control. For printer drivers written for Windows versions 3.0 and later, this member specifies the number of copies requested by the user *if* the PD_USEDEVMODECOPIES flag was not set; otherwise, this member specifies the value 1 and the actual number of copies requested appears in the **DEVMODE** structure.

This member is filled on input and output.

hInstance

Identifies a data block that contains the pre-loaded dialog box template specified by the **lpPrintTemplateName** or the **lpSetupTemplateName** member. This member is used only if the **Flags** member specifies the PD_ENABLEPRINTTEMPLATE or PD_ENABLESETUPTEMPLATE flag; otherwise, this member is ignored.

This member is filled on input.

lCustData

Specifies application-defined data that the system passes to the hook function identified by the **lpfnPrintHook** or the **lpfnSetupHook** member. The system passes a pointer to the **PRINTDLG** structure in the *lParam* parameter of the **WM_INITDIALOG** message; this pointer can be used to retrieve the **lCustData** member.

lpfnPrintHook

Points to the exported hook function that processes dialog box messages if the application customizes the Print dialog box. This member is ignored unless the PD_ENABLEPRINTHOOK flag is

	specified in the **Flags** member. This member is filled on input.
lpfnSetupHook	Points to the exported hook function that processes dialog box messages if the application customizes the Print Setup dialog box. This member is ignored unless the PD_ENABLESETUPHOOK flag is specified in the **Flags** member. This member is filled on input.
lpPrintTemplateName	Points to a null-terminated string that specifies the dialog box template that is to be substituted for the standard dialog box template in COMMDLG. An application must specify the PD_ENABLEPRINTTEMPLATE constant in the **Flags** member to enable the hook function; otherwise, the system ignores this structure member. This member is filled on input.
lpSetupTemplateName	Points to a null-terminated string that specifies the dialog box template that is to be substituted for the standard dialog box template in COMMDLG. An application must specify the PD_ENABLEPRINTTEMPLATE constant in the **Flags** member to enable the hook function; otherwise, the system ignores this structure member. This member is filled on input.
hPrintTemplate	Identifies the handle of the global memory object that contains the pre-loaded dialog box template to be used instead of the default template in COMMDLG.DLL for the Print dialog box. To use the dialog box template, the PD_ENABLEPRINTTEMPLATEHANDLE flag must be set. This member is filled on input.
hSetupTemplate	Identifies the handle of the global memory object that contains the pre-loaded dialog box template to be used instead of the default template in COMMDLG.DLL for the Print Setup dialog box. To use the dialog box template, the PD_ENABLEPRINTTEMPLATEHANDLE flag must be set. This member is filled on input.

See Also
CreateDC, **CreateIC**, **PrintDlg**, **DEVMODE**, **DEVNAMES**

RASTERIZER_STATUS (3.1)

```
typedef struct  tagRASTERIZER_STATUS {    /* rs */
    int   nSize;
    int   wFlags;
    int   nLanguageID;
} RASTERIZER_STATUS;
```

The **RASTERIZER_STATUS** structure contains information about whether TrueType is installed. This structure is filled when an application calls the **GetRasterizerCaps** function.

Member	Description
nSize	Specifies the size, in bytes, of the **RASTERIZER_STATUS** structure.
wFlags	Specifies whether at least one TrueType font is installed and whether TrueType is enabled. This value is TT_AVAILABLE and/or TT_ENABLED if TrueType is on the system.
nLanguageID	Specifies the language in the system's SETUP.INF file.

See Also
GetRasterizerCaps

RECT (2.x)

```
typedef struct tagRECT {    /* rc */
   int left;
   int top;
   int right;
   int bottom;
} RECT;
```

The **RECT** structure defines the coordinates of the upper-left and lower-right corners of a rectangle.

Member	Description
left	Specifies the x-coordinate of the upper-left corner of a rectangle.
top	Specifies the y-coordinate of the upper-left corner of a rectangle.
right	Specifies the x-coordinate of the lower-right corner of a rectangle.
bottom	Specifies the y-coordinate of the lower-right corner of a rectangle.

Comments

The width of the rectangle defined by the **RECT** structure must not exceed 32,767 units.

When the **RECT** structure is passed to the **FillRect** function, graphics device interface (GDI) fills the rectangle up to, but not including, the right column and bottom row of pixels.

RGBQUAD (3.0)

```
typedef struct tagRGBQUAD {     /* rgbq */
    BYTE    rgbBlue;
    BYTE    rgbGreen;
    BYTE    rgbRed;
    BYTE    rgbReserved;
} RGBQUAD;
```

The **RGBQUAD** structure describes a color consisting of relative intensities of red, green, and blue. The **bmiColors** member of the **BITMAPINFO** structure consists of an array of **RGBQUAD** structures.

Member	Description
rgbBlue	Specifies the intensity of blue in the color.
rgbGreen	Specifies the intensity of green in the color.
rgbRed	Specifies the intensity of red in the color.
rgbReserved	Not used; must be set to zero.

See Also
BITMAPINFO

RGBTRIPLE (3.0)

```
typedef struct tagRGBTRIPLE {   /* rgbt */
    BYTE    rgbtBlue;
    BYTE    rgbtGreen;
    BYTE    rgbtRed;
} RGBTRIPLE;
```

The **RGBTRIPLE** structure describes a color consisting of relative intensities of red, green, and blue. The **bmciColors** member of the **BITMAPCOREINFO** structure consists of an array of **RGBTRIPLE** structures.

Windows applications should use the **BITMAPINFO** structure instead of **BITMAPCOREINFO** whenever possible. The **BITMAPINFO** structure uses an **RGBQUAD** structure instead of the **RGBTRIPLE** structure.

Member	Description
rgbtBlue	Specifies the intensity of blue in the color.
rgbtGreen	Specifies the intensity of green in the color.
rgbtRed	Specifies the intensity of red in the color.

See Also
BITMAPCOREINFO, **BITMAPINFO**, **RGBQUAD**

SEGINFO (3.1)

```
typedef struct tagSEGINFO {    /* segi */
    UINT    offSegment;
    UINT    cbSegment;
    UINT    flags;
    UINT    cbAlloc;
    HGLOBAL h;
    UINT    alignShift;
    UINT    reserved[2];
} SEGINFO;
```

The **SEGINFO** structure contains information about a data or code segment. This structure is filled in by the **GetCodeInfo** function.

Member	Description
offSegment	Specifies the offset, in sectors, to the contents of the segment data, relative to the beginning of the file. (Zero means no file data is available.) The size of the sector is determined by shifting left by 1 the value given in the **alignShift** member.
cbSegment	Specifies the length of the segment in the file, in bytes. Zero means 64K.
flags	Contains flags which specify attributes of the segment. The following list describes these flags:

Bit	Meaning
0-2	Specifies the segment type. If bit 0 is set to 1, the segment is a data segment. Otherwise, the segment is a code segment.
3	Specifies whether segment data is iterated. When this bit is set to 1, the segment data is iterated.
4	Specifies whether the segment is movable or fixed. When this bit is set to 1, the segment is movable. Otherwise, it is fixed.
5-6	Reserved.
7	Specifies whether the segment is a read-only data segment or an execute-only code segment. If this bit is set to 1 and the segment is a code segment, the segment is an execute-only segment. If this bit is set to zero and the segment is a data segment, it is a read-only segment.
8	Specifies whether the segment has associated relocation information. If this bit is set to 1, the segment has relocation information. Otherwise, the segment does not have relocation information.
9	Specifies whether the segment has debugging information. If this bit is set to 1, the segment has debugging information. Otherwise, the segment does not have debugging information.
10-15	Reserved.

cbAlloc	Specifies the total amount of memory allocated for the segment. This amount may exceed the actual size of the segment. Zero means 64K.
h	Identifies the global memory for the segment.
alignShift	Specifies the size of the addressable sector as an exponent of 2. An executable file pads the application's code, data, and resource segments with zero bytes so that the segments are always a multiple of the file-segment size. Windows discards the extra bytes when it loads the segments from the file.
reserved	Specifies two reserved **UINT** values.

See Also
GetCodeInfo

SIZE (3.1)

```
typedef struct tagSIZE {
    int cx;
    int cy;
} SIZE;
```

The **SIZE** structure contains viewport extents, window extents, text extents, bitmap dimensions, and the aspect-ratio filter for some extended functions for Windows 3.1

Member	Description
cx	Specifies the x-extent when a function returns.
cy	Specifies the y-extent when a function returns.

See Also

GetAspectRatioFilterEx, **GetBitmapDimensionEx**, **GetTextExtentPoint**, **GetViewportExtEx**, **GetWindowExtEx**, **ScaleViewportExtEx**, **ScaleWindowExtEx**, **SetBitmapDimensionEx**, **SetViewportExtEx**, **SetWindowExtEx**

STACKTRACEENTRY (3.1)

```
#include <toolhelp.h>

typedef struct tagSTACKTRACEENTRY {  /* ste */
    DWORD   dwSize;
    HTASK   hTask;
    WORD    wSS;
    WORD    wBP;
    WORD    wCS;
    WORD    wIP;
    HMODULE hModule;
    WORD    wSegment;
    WORD    wFlags;
} STACKTRACEENTRY;
```

The **STACKTRACEENTRY** structure contains information about one stack frame. This information enables an application to trace back through the stack of a specific task.

Member	Description
dwSize	Specifies the size of the **STACKTRACEENTRY** structure, in bytes.
hTask	Identifies the task handle for the stack.
wSS	Contains the value in the SS register. This value is used with the value of the **wBP** member to determine the next entry in the stack-trace table.
wBP	Contains the value in the BP register. This value is used with the **wSS** value to determine the next entry in the stack-trace table.
wCS	Contains the value in the **CS** register on return. This value is used with the value of the **wIP** member to determine the return value of the function.
wIP	Contains the value in the IP register on return. This value is used with the **wCS** value to determine the return value of the function.
hModule	Identifies the module that contains the currently executing function.
wSegment	Contains the segment number of the current selector.
wFlags	Indicates the frame type. This type can be one of the following values:

Value	Meaning
FRAME_FAR	The **CS** register contains a valid code segment.
FRAME_NEAR	The **CS** register is null.

See Also

StackTraceCSIPFirst, **StackTraceNext**, **StackTraceFirst**

SYSHEAPINFO (3.1)

```
#include <toolhelp.h>

typedef struct tagSYSHEAPINFO {  /* shi */
    DWORD   dwSize;
    WORD    wUserFreePercent;
    WORD    wGDIFreePercent;
    HGLOBAL hUserSegment;
    HGLOBAL hGDISegment;
} SYSHEAPINFO;
```

The **SYSHEAPINFO** structure contains information about the USER and GDI modules.

Member	Description
dwSize	Specifies the size of the **SYSHEAPINFO** structure, in bytes.
wUserFreePercent	Specifies the percentage of the USER local heap that is free.
wGDIFreePercent	Specifies the percentage of the GDI local heap that is free.
hUserSegment	Identifies the DGROUP segment of the USER local heap.
hGDISegment	Identifies the DGROUP segment of the GDI local heap.

See Also
SystemHeapInfo

TASKENTRY (3.1)

```
#include <toolhelp.h>

typedef struct tagTASKENTRY {  /* te */
    DWORD     dwSize;
    HTASK     hTask;
    HTASK     hTaskParent;
    HINSTANCE hInst;
    HMODULE   hModule;
    WORD      wSS;
    WORD      wSP;
    WORD      wStackTop;
    WORD      wStackMinimum;
    WORD      wStackBottom;
    WORD      wcEvents;
    HGLOBAL   hQueue;
    char      szModule[MAX_MODULE_NAME + 1];
    WORD      wPSPOffset;
    HANDLE    hNext;
} TASKENTRY;
```

The **TASKENTRY** structure contains information about one task.

Member	Description
dwSize	Specifies the size of the **TASKENTRY** structure, in bytes.
hTask	Identifies the task handle for the stack.
hTaskParent	Identifies the parent of the task.
hInst	Identifies the instance handle of the task. This value is equivalent to the task's DGROUP segment selector.
hModule	Identifies the module that contains the currently executing function.
wSS	Contains the value in the SS register.
wSP	Contains the value in the SP register.
wStackTop	Specifies the offset to the top of the stack (lowest address on the stack).
wStackMinimum	Specifies the lowest segment number of the stack during execution of the task.
wStackBottom	Specifies the offset to the bottom of the stack (highest address on the stack).
wcEvents	Specifies the number of pending events.
hQueue	Identifies the task queue.
szModule	Specifies the name of the module that contains the currently executing function.
wPSPOffset	Specifies the offset from the program segment prefix (PSP) to the beginning of the executable code segment.
hNext	Identifies the next entry in the task list. This member is reserved for internal use by Windows.

See Also
TaskFindHandle, **TaskFirst**, **TaskNext**

TEXTMETRIC (2.x)

```
typedef struct tagTEXTMETRIC {  /* tm */
    int  tmHeight;
    int  tmAscent;
    int  tmDescent;
    int  tmInternalLeading;
    int  tmExternalLeading;
    int  tmAveCharWidth;
    int  tmMaxCharWidth;
    int  tmWeight;
    BYTE tmItalic;
    BYTE tmUnderlined;
    BYTE tmStruckOut;
    BYTE tmFirstChar;
    BYTE tmLastChar;
    BYTE tmDefaultChar;
    BYTE tmBreakChar;
    BYTE tmPitchAndFamily;
    BYTE tmCharSet;
    int  tmOverhang;
    int  tmDigitizedAspectX;
    int  tmDigitizedAspectY;
} TEXTMETRIC;
```

The **TEXTMETRIC** structure contains basic information about a physical font. For Windows version 3.1 and later, the **EnumFonts** and **EnumFontFamilies** functions return information about TrueType fonts in a **NEWTEXTMETRIC** structure.

Member	Description
tmHeight	Specifies the height of character cells. (The height is the sum of the **tmAscent** and **tmDescent** members.)
tmAscent	Specifies the ascent of character cells. (The ascent is the space between the base line and the top of the character cell.)
tmDescent	Specifies the descent of character cells. (The descent is the space between the bottom of the character cell and the base line.)
tmInternalLeading	Specifies the difference between the point size of a font and the physical size of the font. For TrueType fonts, this value is equal to **tmHeight** minus (*s* * **ntmSizeEM**), where *s* is the scaling factor for the TrueType font and **ntmSizeEM** is a value from the **NEWTEXTMETRIC** structure. For bitmap fonts, this value is used to determine the point size of a font. When an application specifies a negative value in the **lfHeight** member of the **LOGFONT** structure, the application is requesting a font whose height equals **tmHeight** minus **tmInternalLeading**.
tmExternalLeading	Specifies the amount of extra leading (space) that the application adds between rows. Since this area is outside the character cell, it contains no marks and will not be altered by text output calls in either opaque or transparent mode. The font designer sometimes sets this member to zero.
tmAveCharWidth	Specifies the average width of characters in the font. For ANSI_CHARSET fonts, this is a weighted average of the characters "a" through "z" and the space character. For other character sets, this value is an unweighted average of all characters in the font.
tmMaxCharWidth	Specifies the "B" spacing of the widest character in the font. For more information about "B" spacing, see the description of the **ABC** structure.

tmWeight Specifies the weight of the font. This member can be one of the following values:

Constant	Value
FW_DONTCARE	0
FW_THIN	100
FW_EXTRALIGHT	200
FW_ULTRALIGHT	200
FW_LIGHT	300
FW_NORMAL	400
FW_REGULAR	400
FW_MEDIUM	500
FW_SEMIBOLD	600
FW_DEMIBOLD	600
FW_BOLD	700
FW_EXTRABOLD	800
FW_ULTRABOLD	800
FW_BLACK	900
FW_HEAVY	900

tmItalic Specifies an italic font if it is nonzero.

tmUnderlined Specifies an underlined font if it is nonzero.

tmStruckOut Specifies a "struckout" font if it is nonzero.

tmFirstChar Specifies the value of the first character defined in the font.

tmLastChar Specifies the value of the last character defined in the font.

tmDefaultChar Specifies the value of the character that will be substituted for characters that are not in the font.

tmBreakChar Specifies the value of the character that will be used to define word breaks for text justification.

tmPitchAndFamily Specifies the pitch and family of the selected font.

The four low-order bits identify the type of font, as shown in the following list:

Value	Meaning
TMPF_FIXED_PITCH	Designates a fixed-pitch font.
TMPF_VECTOR	Designates a vector or TrueType font.
TMPF_TRUETYPE	Designates a TrueType font.
TMPF_DEVICE	Designates a device font.

Some fonts are identified by several of these bits--for example, the TMPF_FIXED_PITCH, TMPF_VECTOR, and TMPF_TRUETYPE bits would be set for the monospace TrueType font, Courier New®. The TMPF_DEVICE bit could be set for a TrueType font as well, because this bit is set both for downloaded and device-resident fonts.

When the TMPF_TRUETYPE bit is set, the font is usable on all output devices. For example, if a TrueType font existed on a printer but could not be used on the display, the TMPF_TRUETYPE bit would not be set for that font.

The four high-order bits of this member designate the font family. The **tmPitchAndFamily** member can be combined with the hexadecimal value 0xF0 by using the bitwise AND operator and can then be compared with the

font family names for an identical match. The following font families are defined:

Value	Meaning
FF_DECORATIVE	Novelty fonts. Old English is an example.
FF_DONTCARE	Don't care or don't know.
FF_MODERN	Fonts with constant stroke width, with or without serifs. Pica, Elite, and Courier New are examples.
FF_ROMAN	Fonts with variable stroke width and with serifs. Times New Roman and New Century Schoolbook are examples.
FF_SCRIPT	Fonts designed to look like handwriting. Script and Cursive are examples.
FF_SWISS	Fonts with variable stroke width and without serifs. **MS** Sans Serif is an example.

tmCharSet Specifies the character set of the font. The following values are defined:

Constant	Value
ANSI_CHARSET	0
DEFAULT_CHARSET	1
SYMBOL_CHARSET	2
SHIFTJIS_CHARSET	128
OEM_CHARSET	255

tmOverhang Specifies the extra width that is added to some synthesized fonts. When synthesizing some attributes, such as bold or italic, graphics device interface (GDI) or a device sometimes adds width to a string on both a per-character and per-string basis. For example, graphics device interface (GDI) makes a string bold by expanding the intracharacter spacing and overstriking by an offset value and italicizes a font by skewing the string. In either case, the string is wider after the attribute is synthesized. For bold strings, the overhang is the distance by which the overstrike is offset. For italic strings, the overhang is the amount the top of the font is skewed past the bottom of the font.

The **tmOverhang** member is zero for many italic and bold TrueType fonts because many TrueType fonts include italic and bold faces that are not synthesized. For example, the overhang for Courier New® Italic is zero.

An application that uses raster fonts can use the overhang value to determine the spacing between words that have different attributes.

tmDigitizedAspectX Specifies the horizontal aspect of the device for which the font was designed.

tmDigitizedAspectY Specifies the vertical aspect of the device for which the font was designed. The ratio of the **tmDigitizedAspectX** and **tmDigitizedAspectY** members is the aspect ratio of the device for which the font was designed.

Comments

All sizes are given in logical units; that is, they depend on the current mapping mode of the display context.

See Also

EnumFontFamilies, **EnumFonts**, **GetDeviceCaps**, **GetTextMetrics**, **NEWTEXTMETRIC**

TIMERINFO (3.1)

```
#include <toolhelp.h>

typedef struct tagTIMERINFO {  /* ti */
    DWORD dwSize;
    DWORD dwmsSinceStart;
    DWORD dwmsThisVM;
} TIMERINFO;
```

The **TIMERINFO** structure contains the elapsed time since the current task became active and since the virtual machine (VM) started.

Member	Description
dwSize	Specifies the size of the **TIMERINFO** structure, in bytes.
dwmsSinceStart	Contains the amount of time, in milliseconds, since the current task became active.
dwmsThisVM	Contains the amount of time, in milliseconds, since the current VM started.

Comments

In standard mode, the **dwmsSinceStart** and **dwmsThisVM** values are the same.

See Also

TimerCount

TTPOLYCURVE (3.1)

```
typedef struct tagTTPOLYCURVE {
    UINT    wType;
    UINT    cpfx;
    POINTFX apfx[1];
} TTPOLYCURVE;
```

The **TTPOLYCURVE** structure contains information about a curve in the outline of a TrueType character.

Member	Description
wType	Specifies the type of curve described by the structure. This member can be one of the following values:

Value	Meaning
TT_PRIM_LINE	Curve is a polyline.
TT_PRIM_QSPLINE	Curve is a quadratic spline.

cpfx	Specifies the number of **POINTFX** structures in the array.
apfx	Specifies an array of **POINTFX** structures that define the polyline or quadratic spline.

Comments

When an application calls the **GetGlyphOutline** function, a glyph outline for a TrueType character is returned in a **TTPOLYGONHEADER** structure followed by as many **TTPOLYCURVE** structures as are required to describe the glyph. All points are returned as **POINTFX** structures and represent absolute positions, not relative moves. The starting point given by the **pfxStart** member of the **TTPOLYGONHEADER** structure is the point at which the outline for a contour begins. The **TTPOLYCURVE** structures that follow can be either polyline records or spline records.

Polyline records are a series of points; lines drawn between the points describe the outline of the character. Spline records represent the quadratic curves used by TrueType (that is, quadratic b-splines).

See Also

POINTFX, **TTPOLYGONHEADER**, **GetGlyphOutline**

TTPOLYGONHEADER (3.1)

```
typedef struct tagTTPOLYGONHEADER {
    DWORD   cb;
    DWORD   dwType;
    POINTFX pfxStart;
} TTPOLYGONHEADER;
```

The **TTPOLYGONHEADER** structure specifies the starting position and type of a contour in a TrueType character outline.

Member	Description
cb	Specifies the number of bytes required by the **TTPOLYGONHEADER** structure and **TTPOLYCURVE** structure or structures required to describe the contour.
dwType	Specifies the type of character outline that is returned. Currently, this value must be TT_POLYGON_TYPE.
pfxStart	Specifies the starting point of the contour in the character outline.

Comments

Each **TTPOLYGONHEADER** structure is followed by one or more **TTPOLYCURVE** structures.

See Also

POINTFX, **TTPOLYCURVE**, **GetGlyphOutline**

VS_FIXEDFILEINFO (3.1)

```
#include <ver.h>

typedef struct tagVS_FIXEDFILEINFO {    /* vsffi */
    DWORD dwSignature;
    DWORD dwStrucVersion;
    DWORD dwFileVersionMS;
    DWORD dwFileVersionLS;
    DWORD dwProductVersionMS;
    DWORD dwProductVersionLS;
    DWORD dwFileFlagsMask;
    DWORD dwFileFlags;
    DWORD dwFileOS;
    DWORD dwFileType;
    DWORD dwFileSubtype;
    DWORD dwFileDateMS;
    DWORD dwFileDateLS;
} VS_FIXEDFILEINFO;
```

The **VS_FIXEDFILEINFO** structure contains version information about a file.

Member	Description
dwSignature	Specifies the value 0xFEEFO4BD.
dwStrucVersion	Specifies the binary version number of this structure. The high-order word contains the major version number, and the low-order word contains the minor version number. This value must be greater than 0x00000029.
dwFileVersionMS	Specifies the high-order 32 bits of the binary version number for the file. The value of this member is used with the value of the **dwFileVersionLS** member to form a 64-bit version number.
dwFileVersionLS	Specifies the low-order 32 bits of the binary version number for the file. The value of this member is used with the **dwFileVersionMS** value to form a 64-bit version number.
dwProductVersionMS	Specifies the high-order 32 bits of the binary version number of the product with which the file is distributed. The value of this member is used with the value of the **dwProductVersionLS** member to form a 64-bit version number.
dwProductVersionLS	Specifies the low-order 32 bits of the binary version number of the product with which the file is distributed. The value of this member is used with the **dwProductVersionMS** value to form a 64-bit version number.
dwFileFlagsMask	Specifies which bits in the **dwFileFlags** member are valid. If a bit is set, the corresponding bit in the **dwFileFlags** member is valid.
dwFileFlags	Specifies the Boolean attributes of the file. The attributes can be a combination of the following values:

Value	Meaning
VS_FF_DEBUG	File contains debugging information or is compiled with debugging features enabled.
VS_FF_INFOINFERRED	File contains a dynamically created version-information resource. Some of the blocks for the resource may be empty or incorrect. This value is not intended to be used in version-information resources created by using the **VERSIONINFO**

	statement.
VS_FF_PATCHED	File has been modified and is not identical to the original shipping file of the same version number.
VS_FF_PRERELEASE	File is a development version, not a commercially released product.
VS_FF_PRIVATEBUILD	File was not built using standard release procedures. If this value is given, the **StringFileInfo** block must contain a **PrivateBuild** string.
VS_FF_SPECIALBUILD	File was built by the original company using standard release procedures but is a variation of the standard file of the same version number. If this value is given, the **StringFileInfo** block must contain a **SpecialBuild** string.

dwFileOS

Specifies the operating system for which this file was designed. This member can be one of the following values:

Value	Meaning
VOS_UNKNOWN	Operating system for which the file was designed is unknown to Windows.
VOS_DOS	File was designed for MS-DOS.
VOS_NT	File was designed for Windows NT.
VOS_WINDOWS16	File was designed for Windows version 3.0 or later.
VOS_WINDOWS32	File was designed for 32-bit Windows.
VOS_DOS_WINDOWS16	File was designed for Windows version 3.0 or later running with MS-DOS.
VOS_DOS_WINDOWS32	File was designed for 32-bit Windows running with MS-DOS.
VOS_NT_WINDOWS32	File was designed for 32-bit Windows running with Windows NT.

The values 0x00002L, 0x00003L, 0x20000L and 0x30000L are reserved.

dwFileType

Specifies the general type of file. This type can be one of the following values:

Value	Meaning
VFT_UNKNOWN	File type is unknown to Windows.
VFT_APP	File contains an application.
VFT_DLL	File contains a dynamic-link library (DLL).
VFT_DRV	File contains a device driver. If the **dwFileType** member is VFT_DRV, the **dwFileSubtype** member contains a more specific description of the driver.
VFT_FONT	File contains a font. If the **dwFileType** member is VFT_FONT, the **dwFileSubtype** member contains a more specific description of the font.
VFT_VXD	File contains a virtual device.
VFT_STATIC_LIB	File contains a static-link library.

All other values are reserved for use by Microsoft.

dwFileSubtype

Specifies the function of the file. This member is zero unless the **dwFileType** member is VFT_DRV, VFT_FONT, or VFT_VXD.

If **dwFileType** is VFT_DRV, **dwFileSubtype** may be one of the following values:

Value	Meaning
VFT2_UNKNOWN	Driver type is unknown to Windows.
VFT2_DRV_COMM	File contains a communications driver.
VFT2_DRV_PRINTER	File contains a printer driver.
VFT2_DRV_KEYBOARD	File contains a keyboard driver.
VFT2_DRV_LANGUAGE	File contains a language driver.
VFT2_DRV_DISPLAY	File contains a display driver.
VFT2_DRV_MOUSE	File contains a mouse driver.
VFT2_DRV_NETWORK	File contains a network driver.
VFT2_DRV_SYSTEM	File contains a system driver.
VFT2_DRV_INSTALLABLE	File contains an installable driver.
VFT2_DRV_SOUND	File contains a sound driver.

If **dwFileType** is VFT_FONT, **dwFileSubtype** may be one of the following values:

Value	Meaning
VFT2_UNKNOWN	Font type is unknown to Windows.
VFT2_FONT_RASTER	File contains a raster font.
VFT2_FONT_VECTOR	File contains a vector font.
VFT2_FONT_TRUETYPE	File contains a TrueType font.

If **dwFileType** is VFT_VXD, **dwFileSubtype** contains the virtual-device identifier included in the virtual-device control block.

All **dwFileSubtype** values not listed here are reserved for use by Microsoft.

dwFileDateMS

Specifies the high-order 32 bits of a binary date/time stamp for the file. The value of this member is used with the value of the **dwFileDateLS** member to form a 64-bit number representing the date and time the file was created.

dwFileDateLS

Specifies the low-order 32 bits of a binary date/time stamp for the file. The value of this member is used with the **dwFileDateMS** value to form a 64-bit number representing the date and time the file was created.

Comments

The binary version numbers specified in this structure are intended to be integers rather than character strings. For a file or product that has decimal points or letters in its version number, the corresponding binary version number should be a reasonable numeric representation.

A third-party developer can use the file-version values to reflect a private version-numbering scheme, as long as each new version of the product has a higher number than the previous version. The File Installation library functions use these values when comparing the ages of files.

Microsoft Windows Resource Compiler sets the **dwFileDateMS** and **dwFileDateLS** members to zero.

See Also

VerQueryValue

WINDEBUGINFO (3.1)

```
typedef struct tagWINDEBUGINFO {
    UINT    flags;
    DWORD   dwOptions;
    DWORD   dwFilter;
    char    achAllocModule[8];
    DWORD   dwAllocBreak;
    DWORD   dwAllocCount;
} WINDEBUGINFO;
```

The **WINDEBUGINFO** structure contains current system-debugging information for the debugging version of Windows 3.1.

Member	Description
flags	Specifies which members of the **WINDEBUGINFO** structure are valid. This member can be one or more of the following values:

Value	Meaning
WDI_OPTIONS	**dwOptions** member is valid.
WDI_FILTER	**dwFilter** member is valid.
WDI_ALLOCBREAK	**achAllocModule**, **dwAllocBreak**, and **dwAllocCount** members are valid.

dwOptions Specifies debugging options. This member is valid only if **WDI_OPTIONS** is specified in the **flags** member. It can be one or more of the following values:

Value	Meaning
DBO_CHECKHEAP	Performs local heap checking after all calls to functions that manipulate local memory.
DBO_BUFFERFILL	Fills buffers passed to API functions with 0xF9. This ensures that the supplied buffer is completely writable and helps detect overwrite problems when the supplied buffer size is not large enough.
DBO_DISABLEGPTRAPPING	Disables hooking of the fault interrupt vectors. This option is not typically used by application developers, because parameter validation can cause many spurious traps that are not errors.
DBO_CHECKFREE	Fills all freed local memory with 0xFB. All newly allocated memory is checked to ensure that it is still filled with 0xFB--this ensures that no application has written into a freed memory object. This option has no effect if **DBO_CHECKHEAP** is not specified.
DBO_INT3BREAK	Breaks to the debugger with simple INT 3 rather than a call to the **FatalExit** function. This option does not generate a stack backtrace.
DBO_NOFATALBREAK	Does not break with the "abort, break, ignore" prompt if a **DBF_FATAL** message occurs.
DBO_NOERRORBREAK	Does not break with the "abort, break,

	ignore" prompt if a **DBF_ERROR** message occurs. This option also applies to invalid parameter errors.
DBO_WARNINGBREAK	Breaks with the "abort, break, ignore" prompt if a **DBF_WARNING** message occurs. (Normally, DBF_WARNING messages are displayed but no break occurs). This option also applies to invalid parameter warnings.
DBO_TRACEBREAK	Breaks with the "abort, break, ignore" on any **DBF_TRACE** message that matches the value specified in the **dwFilter** member.
DBO_SILENT	Does not display warning, error, or fatal messages except in cases where a stack trace and "abort, break, ignore" prompt would occur.

dwFilter Specifies filtering options for **DBF_TRACE** messages. (Normally, trace messages are not sent to the debug terminal.) This member can be one or more of the following values:

Value	Meaning
DBF_KRN_MEMMAN	Enables KERNEL messages related to local and global memory management.
DBF_KRN_LOADMODULE	Enables KERNEL messages related to module loading.
DBF_KRN_SEGMENTLOAD	Enables KERNEL messages related to segment loading.
DBF_APPLICATION	Enables trace messages originating from an application.
DBF_DRIVER	Enables trace messages originating from device drivers.
DBF_PENWIN	Enables trace messages originating from PENWIN.
DBF_MMSYSTEM	Enables trace messages originating from MMSYSTEM.
DBF_GDI	Enables trace messages originating from GDI.
DBF_USER	Enables trace messages originating from USER.
DBF_KERNEL	Enables any trace message originating from KERNEL. (This is a combination of **DBF_KRN_MEMMAN**, **DBF_KRN_LOADMODULE**, and DBF_KRN_SEGMENTLOAD.)

achAllocModule Specifies the name of the application module. (This can be different from the name of the executable file.) This cannot be the name of a dynamic-link library (DLL). The name is limited to 8 characters.

dwAllocBreak Specifies the number of global or local memory allocations to allow before failing allocation requests. When the count of allocations reaches the number specified in this member, that allocation and all subsequent allocations fail. If this member is zero, no allocation break is set, but the system counts allocations and reports the current count in the **dwAllocCount** member.

dwAllocCount Current count of allocations. (This information is typically retrieved by calling the **GetWinDebugInfo** function.)

Comments

Developers can use the **achAllocModule**, **dwAllocBreak**, and **dwAllocCount** members to ensure that an application performs correctly in out-of-memory conditions. Because memory allocations made by the system fail once the break count is reached, calls to functions such as **CreateWindow**, **CreateBrush**, and **SelectObject** will fail as well. Only allocations made within the context of the application specified by the **achAllocModule** member are affected by the allocation break count.

See Also

DebugOutput, **GetWinDebugInfo**, **SetWinDebugInfo**

DBO_CHECKHEAP 0x0001

Performs local heap checking after all calls to functions that manipulate local memory.

DBO_CHECKHEAP 0x0001

DBO_BUFFERFILL 0x0004

Fills buffers passed to API functions with 0xF9. This ensures that the supplied buffer is completely writable and helps detect overwrite problems when the supplied buffer size is not large enough.

DBO_BUFFERFILL 0x0004

DBO_DISABLEGPTRAPPING 0x0010

Disables hooking of the fault interrupt vectors. This option is not typically used by application developers, because parameter validation can cause many spurious traps that are not errors.

DBO_DISABLEGPTRAPPING 0x0010

DBO_CHECKFREE 0x0020

Fills all freed local memory with 0xFB. All newly allocated memory is checked to ensure that it is still filled with 0xFB--this ensures that no application has written into a freed memory object. This option has no effect if **DBO_CHECKHEAP** is not specified.

DBO_CHECKFREE 0x0020

DBO_INT3BREAK 0x0100

Breaks to the debugger with simple INT 3 rather than a call to the **FatalExit** function. This option does not generate a stack backtrace.

DBO_INT3BREAK 0x0100

DBO_NOFATALBREAK 0x0400

Does not break with the "abort, break, ignore" prompt if a **DBF_FATAL** message occurs.

DBO_NOFATALBREAK 0x0400

DBO_NOERRORBREAK 0x0800

Does not break with the "abort, break, ignore" prompt if a **DBF_ERROR** message occurs. This option also applies to invalid parameter errors.

DBO_NOERRORBREAK 0x0800

DBO_WARNINGBREAK 0x1000

Breaks with the "abort, break, ignore" prompt if a **DBF_WARNING** message occurs. (Normally, DBF_WARNING messages are displayed but no break occurs). This option also applies to invalid parameter warnings.

DBO_WARNINGBREAK 0x1000

DBO_TRACEBREAK 0x2000

Breaks with the "abort, break, ignore" on any **DBF_TRACE** message that matches the value specified in the **dwFilter** member.

DBO_TRACEBREAK 0x2000

DBO_SILENT 0x8000

Does not display warning, error, or fatal messages except in cases where a stack trace and "abort, break, ignore" prompt would occur.

DBO_SILENT 0x8000

DBF_KRN_MEMMAN 0x0001

Enables KERNEL messages related to local and global memory management.

DBF_KRN_MEMMAN 0x0001

DBF_KRN_LOADMODULE 0x0002

Enables KERNEL messages related to module loading.

DBF_KRN_LOADMODULE 0x0002

DBF_KRN_SEGMENTLOAD 0x0004

Enables KERNEL messages related to segment loading.

DBF_KRN_SEGMENTLOAD 0x0004

DBF_APPLICATION 0x0008

Enables trace messages originating from an application.

DBF_APPLICATION 0x0008

DBF_DRIVER 0x0010

Enables trace messages originating from device drivers.

DBF_DRIVER 0x0010

DBF_PENWIN 0x0020

Enables trace messages originating from PENWIN.

DBF_PENWIN 0x0020

DBF_MMSYSTEM 0x0040

Enables trace messages originating from MMSYSTEM.

DBF_MMSYSTEM 0x0040

DBF_GDI 0x0400

Enables trace messages originating from GDI.

DBF_GDI 0x0400

DBF_USER 0x0800

Enables trace messages originating from USER.

DBF_USER 0x0800

DBF_KERNEL 0x1000

Enables any trace message originating from KERNEL. (This is a combination of **DBF_KRN_MEMMAN**, **DBF_KRN_LOADMODULE**, and DBF_KRN_SEGMENTLOAD.)

DBF_KERNEL 0x1000

WINDOWPLACEMENT (3.1)

```
typedef struct tagWINDOWPLACEMENT {     /* wndpl */
    UINT  length;
    UINT  flags;
    UINT  showCmd;
    POINT ptMinPosition;
    POINT ptMaxPosition;
    RECT  rcNormalPosition;
} WINDOWPLACEMENT;
```

The **WINDOWPLACEMENT** structure contains information about the placement of a window on the screen.

Member	Description
length	Specifies the length, in bytes, of the structure.
flags	Specifies flags that control the position of the minimized window and the method by which the window is restored. This member can be one or both of the following flags:

Value	Meaning
WPF_SETMINPOSITION	Specifies that the x- and y-positions of the minimized window may be specified. This flag must be specified if the coordinates are set in the **ptMinPosition** member.
WPF_RESTORETOMAXIMIZED	Specifies that the restored window will be maximized, regardless of whether it was maximized before it was minimized. This setting is valid only the next time the window is restored. It does not change the default restoration behavior. This flag is valid only when the SW_SHOWMINIMIZED value is specified for the **showCmd** member.

showCmd Specifies the current show state of the window. This member may be one of the following values:

Value	Meaning
SW_HIDE	Hides the window and passes activation to another window.
SW_MINIMIZE	Minimizes the specified window and activates the top-level window in the system's list.
SW_RESTORE	Activates and displays a window. If the window is minimized or maximized, Windows restores it to its original size and position (same as SW_SHOWNORMAL).
SW_SHOW	Activates a window and displays it in its current size and position.
SW_SHOWMAXIMIZED	Activates a window and displays it as a maximized window.
SW_SHOWMINIMIZED	Activates a window and displays it as an icon.
SW_SHOWMINNOACTIVE	Displays a window as an icon. The window that is currently active remains active.

	SW_SHOWNA	Displays a window in its current state. The window that is currently active remains active.
	SW_SHOWNOACTIVATE	Displays a window in its most recent size and position. The window that is currently active remains active.
	SW_SHOWNORMAL	Activates and displays a window. If the window is minimized or maximized, Windows restores it to its original size and position (same as SW_RESTORE).
ptMinPosition	Specifies the position of the window's top-left corner when the window is minimized.	
ptMaxPosition	Specifies the position of the window's top-left corner when the window is maximized.	
rcNormalPosition	Specifies the window's coordinates when the window is in the normal (restored) position.	

See Also

POINT, **RECT**, **ShowWindow**, **GetWindowPlacement**, **SetWindowPlacement**

WINDOWPOS (3.1)

```
typedef struct tagWINDOWPOS { /* wp */
    HWND    hwnd;
    HWND    hwndInsertAfter;
    int     x;
    int     y;
    int     cx;
    int     cy;
    UINT    flags;
} WINDOWPOS;
```

The **WINDOWPOS** structure contains information about the size and position of a window.

Member	Description
hwnd	Identifies the window.
hwndInsertAfter	Identifies the window behind which this window is placed.
x	Specifies the position of the left edge of the window.
y	Specifies the position of the right edge of the window.
cx	Specifies the window width.
cy	Specifies the window height.
flags	Specifies window-positioning options. This member can be one of the following values:

Value	Meaning
SWP_DRAWFRAME	Draws a frame (defined in the class description for the window) around the window. The window receives a **WM_NCCALCSIZE** message.
SWP_HIDEWINDOW	Hides the window.
SWP_NOACTIVATE	Does not activate the window.
SWP_NOMOVE	Retains current position (ignores the **x** and **y** members).
SWP_NOOWNERZORDER	Does not change the owner window's position in the Z order.
SWP_NOSIZE	Retains current size (ignores the **cx** and **cy** members).
SWP_NOREDRAW	Does not redraw changes.
SWP_NOREPOSITION	Same as SWP_NOOWNERZORDER.
SWP_NOZORDER	Retains current ordering (ignores the **hwndInsertAfter** member).
SWP_SHOWWINDOW	Displays the window.

See Also

EndDeferWindowPos, **WM_NCCALCSIZE**, **WM_WINDOWPOSCHANGED**, **WM_WINDOWPOSCHANGING**

WNDCLASS (2.x)

```
typedef struct tagWNDCLASS {    /* wc */
    UINT      style;
    WNDPROC   lpfnWndProc;
    int       cbClsExtra;
    int       cbWndExtra;
    HINSTANCE hInstance;
    HICON     hIcon;
    HCURSOR   hCursor;
    HBRUSH    hbrBackground;
    LPCSTR    lpszMenuName;
    LPCSTR    lpszClassName;
} WNDCLASS;
```

The **WNDCLASS** structure contains the class attributes that are registered by the **RegisterClass** function.

Member	Description
style	Specifies the class style. These styles can be combined by using the bitwise OR operator. This can be any combination of the following values:

Value	Meaning
CS_BYTEALIGNCLIENT	Aligns the client area of a window on the byte boundary (in the x-direction).
CS_BYTEALIGNWINDOW	Aligns a window on the byte boundary (in the x-direction). This flag should be set by applications that perform bitmap operations in windows by using the **BitBlt** function.
CS_CLASSDC	Gives the window class its own display context (shared by instances).
CS_DBLCLKS	Sends double-click messages to a window.
CS_GLOBALCLASS	Specifies that the window class is an application global class. An application global class is created by an application or library and is available to all applications. The class is destroyed when the application or library that created the class exits; it is essential, therefore, that all windows created with the application global class be closed before this occurs.
CS_HREDRAW	Redraws the entire window if the horizontal size changes.
CS_NOCLOSE	Inhibits the close option on the System menu.
CS_OWNDC	Gives each window instance its own display context. Note that although the **CS_OWNDC** style is convenient, it must be used with discretion because each display context occupies approximately 800 bytes of memory.
CS_PARENTDC	Gives the display context of the parent window to the window class.
CS_SAVEBITS	Specifies that the system should try to save the screen image behind a window created from this window class as a bitmap. Later, when the window is removed, the system uses the bitmap to quickly restore the screen image. This style is

		useful for small windows that are displayed briefly and then removed before much other screen activity takes place (for example, menus or dialog boxes). This style increases the time required to display the window since the system must first allocate memory to store the bitmap.
	CS_VREDRAW	Redraws the entire window if the vertical size changes.

lpfnWndProc Points to the window procedure. For more information, see the description of the **WindowProc** callback function.

cbClsExtra Specifies the number of bytes to allocate following the window-class structure. These bytes are initialized to zero.

cbWndExtra Specifies the number of bytes to allocate following the window instance. These bytes are initialized to zero. If an application uses the **WNDCLASS** structure to register a dialog box created with the **CLASS** directive in the resource file, it must set this member to DLGWINDOWEXTRA.

hInstance Identifies the class module. This member must be an instance handle and must not be NULL.

hIcon Identifies the class icon. This member must be a handle to an icon resource. If this member is NULL, the application must draw an icon whenever the user minimizes the application's window.

hCursor Identifies the class cursor. This member must be a handle to a cursor resource. If this member is NULL, the application must explicitly set the cursor shape whenever the mouse moves into the application's window.

hbrBackground Identifies the class background brush. This member can be either a handle to the physical brush that is to be used for painting the background, or it can be a color value. If a color value is given, it must be one of the standard system colors listed below, and the value 1 must be added to the chosen color (for example, **COLOR_BACKGROUND** + 1 specifies the system background color). If a color value is given, it must be converted to one of the following HBRUSH types:

COLOR_ACTIVEBORDER	**COLOR_HIGHLIGHTTEXT**
COLOR_ACTIVECAPTION	**COLOR_INACTIVEBORDER**
COLOR_APPWORKSPACE	**COLOR_INACTIVECAPTION**
COLOR_BACKGROUND	**COLOR_INACTIVECAPTIONTEXT**
COLOR_BTNFACE	**COLOR_MENU**
COLOR_BTNSHADOW	**COLOR_MENUTEXT**
COLOR_BTNTEXT	**COLOR_SCROLLBAR**
COLOR_CAPTIONTEXT	**COLOR_WINDOW**
COLOR_GRAYTEXT	**COLOR_WINDOWFRAME**
COLOR_HIGHLIGHT	**COLOR_WINDOWTEXT**

The system automatically deletes class background brushes when the class is freed. An application should not delete these brushes because a class may be used by multiple instances of the application.

When this member is NULL, the application must paint its own background whenever it is requested to paint in its client area. The application can determine when the background needs painting by processing the **WM_ERASEBKGND** message or by testing the **fErase** member of the **PAINTSTRUCT** structure filled by the **BeginPaint** function.

lpszMenuName Points to a null-terminated string that specifies the resource name of the class menu (as the name appears in the resource file). If an integer is used to identify the menu, the **MAKEINTRESOURCE** macro can be used. If this member is

	NULL, windows belonging to this class have no default menu.
lpszClassName	Points to a null-terminated string that specifies the name of the window class.

See Also

PAINTSTRUCT, **MAKEINTRESOURCE**, **RegisterClass**, **WindowProc**

CS_BYTEALIGNCLIENT 0x1000

Aligns the client area of a window on the byte boundary (in the x-direction).

CS_BYTEALIGNCLIENT 0x1000

CS_BYTEALIGNWINDOW 0x2000

Aligns a window on the byte boundary (in the x-direction). This flag should be set by applications that perform bitmap operations in windows by using the **BitBlt** function.

CS_BYTEALIGNWINDOW 0x2000

CS_CLASSDC 0x0040

Gives the window class its own display context (shared by instances).

CS_CLASSDC 0x0040

CS_DBLCLKS 0x0008

Sends double-click messages to a window.

CS_DBLCLKS 0x0008

CS_GLOBALCLASS 0x4000

Specifies that the window class is an application global class. An application global class is created by an application or library and is available to all applications. The class is destroyed when the application or library that created the class exits; it is essential, therefore, that all windows created with the application global class be closed before this occurs.

CS_GLOBALCLASS 0x4000

CS_HREDRAW 0x0002

Redraws the entire window if the horizontal size changes.

CS_HREDRAW 0x0002

CS_NOCLOSE 0x0200

Inhibits the close option on the System menu.

CS_NOCLOSE 0x0200

CS_OWNDC 0x0020

Gives each window instance its own display context. Note that although the CS_OWNDC style is convenient, it must be used with discretion because each display context occupies approximately 800 bytes of memory.

CS_OWNDC 0x0020

CS_PARENTDC 0x0080

Gives the display context of the parent window to the window class.

CS_PARENTDC 0x0080

CS_SAVEBITS 0x0800

Specifies that the system should try to save the screen image behind a window created from this window class as a bitmap. Later, when the window is removed, the system uses the bitmap to quickly restore the screen image. This style is useful for small windows that are displayed briefly and then removed before much other screen activity takes place (for example, menus or dialog boxes). This style increases the time required to display the window since the system must first allocate memory to store the bitmap.

CS_SAVEBITS 0x0800

CS_VREDRAW 0x0001

Redraws the entire window if the vertical size changes.

CS_VREDRAW 0x0001

Windows structures (3.1)

ABC	Contains width of a character in a TrueType font
BITMAP	Defines characteristics of a logical bitmap
BITMAPCOREHEADER	Defines characteristics of a DIB
BITMAPCOREINFO	Defines characteristics and colors of a DIB
BITMAPFILEHEADER	Defines characteristics of a DIB file
BITMAPINFO	Defines characteristics and colors of a DIB
BITMAPINFOHEADER	Defines characteristics of a DIB
CBT_CREATEWND	Contains data passed to a **WH_CBT** hook function
CBTACTIVATESTRUCT	Contains data passed to a **WH_CBT** hook function
CHOOSECOLOR	Contains data for the color-selection dialog box
CHOOSEFONT	Contains data for the font-selection dialog box
CLASSENTRY	Contains the name of a Windows class
CLIENTCREATESTRUCT	Defines Window menu and first MDI child window
COMPAREITEMSTRUCT	Contains data for a sorted owner-drawn combo box
COMSTAT	Contains data about a communications device
CONVCONTEXT	Contains language data for a DDE conversation
CONVINFO	Contains information about a DDE conversation
CPLINFO	Contains resource data for Control Panel application
CREATESTRUCT	Defines window-initialization parameters
CTLINFO	Defines class name and version of selected control
CTLSTYLE	Specifies attributes of selected control
CTLTYPE	Specifies width, height, and style of control
DCB	Defines settings for serial communications device
DDEACK	Contains status flags sent by a **WM_DDE_ACK** message
DDEADVISE	Contains flags sent by a **WM_DDE_ADVISE** message
DDEDATA	Contains data sent by a **WM_DDE_DATA** message
DDEPOKE	Contains data sent by a **WM_DDE_POKE** message
DEBUGHOOKINFO	Contains data used for debugging
DELETEITEMSTRUCT	Describes a deleted owner-drawn item
DEVMODE	Contains information about the printer environment
DEVNAMES	Contains device data for the Print dialog box
DOCINFO	Contains document input and output filenames
DRAWITEMSTRUCT	Contains painting data for an owner-drawn control
DRIVERINFOSTRUCT	Contains data about an installable driver
DRVCONFIGINFO	Contains data about the configuration of a driver
EVENTMSG	Contains message information for a journaling hook
FINDREPLACE	Contains data for a Find or Replace dialog box
FIXED	Contains integral and fractional parts of a number
FMS_GETDRIVEINFO	Contains drive data for File Manager
FMS_GETFILESEL	Contains file data for File Manager
FMS_LOAD	Contains custom menu data for File Manager
GLOBALENTRY	Describes a memory object on the global heap
GLOBALINFO	Describes the global heap
GLYPHMETRICS	Describes placement of a glyph in a character cell
HANDLETABLE	Contains an array of handles to GDI objects
HARDWAREHOOKSTRUCT	Contains data about a nonstandard hardware message
HELPWININFO	Contains message information for a journaling hook
HSZPAIR	Contains a DDE service name and topic name
KERNINGPAIR	Defines a kerning pair
LOCALENTRY	Describes a memory object on the local heap
LOCALINFO	Describes the local heap
LOGBRUSH	Defines characteristics of a logical brush
LOGFONT	Specifies attributes of a logical font
LOGPALETTE	Defines a logical color palette

LOGPEN	Defines characteristics of a logical pen
MAT2	Contains values for a transformation matrix
MDICREATESTRUCT	Contains initialization data for MDI child window
MEASUREITEMSTRUCT	Contains dimensions of an owner-drawn control
MEMMANINFO	Describes the status of the virtual-memory manager
MENUITEMTEMPLATE	Defines a menu item
MENUITEMTEMPLATEHEADER	Contains header data for a menu template
METAFILEPICT	Defines metafile picture format for clipboard
METAHEADER	Contains information about a metafile
METARECORD	Contains a metafile record
MINMAXINFO	Contains window size and tracking data
MODULEENTRY	Describes a module in the module list
MONCBSTRUCT	Contains data about the current DDE transaction
MONCONVSTRUCT	Contains data about a DDE conversation
MONERRSTRUCT	Contains data about the current DDE error
MONHSZSTRUCT	Contains data about a DDE string handle
MONLINKSTRUCT	Contains data about a DDE advise loop
MONMSGSTRUCT	Contains data about a DDE message
MOUSEHOOKSTRUCT	Contains data about a mouse event
MSG	Contains message information
MULTIKEYHELP	Contains keyword data for Windows Help
NCCALCSIZE_PARAMS	Contains data for calculating client area
NEWCPLINFO	Contains resource data of Control Panel application
NEWTEXTMETRIC	Contains basic information about a physical font
NFYLOADSEG	Describes the segment being loaded
NFYLOGERROR	Describes a validation error
NFYLOGPARAMERROR	Describes a parameter-validation error
NFYRIP	Contains the RIP exit code and relevant registers
NFYSTARTDLL	Describes the dynamic-link library being loaded
OFSTRUCT	Contains data about an open file
OLECLIENT	Points to structure providing state information
OLECLIENTVTBL	Points to client's callback function
OLEOBJECT	Points to table of object-function pointers
OLEOBJECTVTBL	Points to functions for object manipulation
OLESERVER	Points to table of server-function pointers
OLESERVERDOC	Points to table of document-function pointers
OLESERVERDOCVTBL	Points to functions for document manipulation
OLESERVERVTBL	Points to functions for server manipulation
OLESTREAM	Points to structure providing stream functions
OLESTREAMVTBL	Points to functions for stream operations
OLETARGETDEVICE	Contains information about target device for client
OPENFILENAME	Contains data for the Open dialog box
OUTLINETEXTMETRIC	Contains TrueType font metrics
PAINTSTRUCT	Contains painting data for a client area
PALETTEENTRY	Specifies an entry in a logical color palette
PANOSE	Contains Panose values for a TrueType font
POINT	Contains the coordinates of a point
POINTFX	Describes a point in a character outline
PRINTDLG	Contains data for the Print dialog box
RASTERIZER_STATUS	Contains data about TrueType installation
RECT	Defines the coordinates of a rectangle
RGBQUAD	Describes colors for a DIB
RGBTRIPLE	Describes colors for a DIB
SEGINFO	Contains code- or data-segment information
SIZE	Contains extents when a function returns
STACKTRACEENTRY	Describes one stack frame

SYSHEAPINFO	Describes the User and GDI modules
TASKENTRY	Contains information about a task
TEXTMETRIC	Contains information about a physical font
TIMERINFO	Contains elapsed execution times of a task and VM
TTPOLYCURVE	Describes a curve in a character outline
TTPOLYGONHEADER	Specifies starting point for character outline
VS_FIXEDFILEINFO	Contains version information about a file
WINDEBUGINFO	Contains system-debugging information
WINDOWPLACEMENT	Contains window-placement information
WINDOWPOS	Contains window size and position information
WNDCLASS	Defines attributes of a window class

Database Tables (3.1)

Control styles (3.1)

Button styles
Combination box styles
Edit control styles
List box styles
Scroll bar styles
Static control styles

MS Windows Naming Conventions

The following examples show some of the standard prefix and base types you will see in this database:

ABORTPROC	abrtprc
ATOM	atm
BOOL	f
BYTE	b
BYTE FAR*	lpb
char FAR*	lpch
DLGPROC	dlgprc
DWORD	dw
DWORD FAR*	lpdw
EDITWORDBREAKPROC	ewbprc
ENUMPROPPROC	enmprc
FONTENUMPROC	fntenmprc
GNOTIFYPROC	gnprc
GOBJENUMPROC	goenmprc
GRAYSTRINGPROC	gsprc
HACCEL	haccl
HBITMAP	hbm
HBRUSH	hbr
HCURSOR	hcur
HDC	hdc
HDRVR	hdrvr
HDWP	hdwp
HFILE	hf
HFONT	hfont
HGDIOBJ	hgdiobj
HGLOBAL	hglb
HHOOK	hhook
HICON	hicon
HINSTANCE	hinst
HLOCAL	hloc
HMENU	hmenu
HMETAFILE	hmf
HMODULE	hmod
HOOKPROC	hkprc
HPALETTE	hpal
HPEN	hpen
HRGN	hrgn
HRSRC	hrsrc
HSTR	hstr
HTASK	htask
HWND	hwnd

int	n (optional)
LINEDDAPROC	lnddaprc
LNOTIFYPROC	lmprc
LONG	l
LPARAM	lParam
LPBYTE	lpb
LPCSTR	lpsz
LPINT	lpn
LPLONG	lpl
LPSTR	lpsz
LPVOID	lpv
LPWORD	lpw
LRESULT	lResult
MFENUMPROC	mfenmprc
NPSTR	npsz
PBYTE	npb
POINT FAR*	lppt
PROPENUMPROC	prpenmprc
RECT FAR*	lprc
RSRCHDLRPROC	rschldprc
TIMERPROC	tmprc
UINT	u (optional)
WNDENUMPROC	wndenmprc
WNDPROC	wndprc
WORD	u or w
WPARAM	wParam

Clipboard formats (3.1)

Value	Meaning
CF_BITMAP	The data is a bitmap.
CF_DIB	The data is a memory object containing a **BITMAPINFO** structure followed by the bitmap data.
CF_DIF	The data is in Data Interchange Format (DIF).
CF_DSPBITMAP	The data is a bitmap representation of a private format. This data is displayed in bitmap format in lieu of the privately formatted data.
CF_DSPMETAFILEPICT	The data is a metafile representation of a private data format. This data is displayed in metafile-picture format in lieu of the privately formatted data.
CF_DSPTEXT	The data is a textual representation of a private data format. This data is displayed in text format in lieu of the privately formatted data.
CF_METAFILEPICT	The data is a metafile (see the description of the **METAFILEPICT** structure.
CF_OEMTEXT	The data is an array of text characters in the OEM character set. Each line ends with a carriage return–linefeed (CR-LF) combination. A null character signals the end of the data.
CF_OWNERDISPLAY	The data is in a private format that the clipboard owner must display.
CF_PALETTE	The data is a color palette.
CF_PENDATA	The data is for the pen extensions to the Windows operating system.
CF_RIFF	The data is in Resource Interchange File Format (RIFF).
CF_SYLK	The data is in Microsoft Symbolic Link (SYLK) format.
CF_TEXT	The data is an array of text characters. Each line ends with a carriage return–linefeed (CR-LF) combination. A null character signals the end of the data.
CF_TIFF	The data is in Tag Image File Format (TIFF).
CF_WAVE	The data describes a sound wave. This is a subset of the CF_RIFF data format; it can be used only for RIFF WAVE files.

Control classes (3.1)

Class	Description
BUTTON	A button control is a small rectangular child window that represents a "button" the user can turn on or off by clicking it with the mouse. Button controls can be used alone or in groups and can either be labeled or appear without text. Button controls typically change appearance when the user clicks them.
COMBOBOX	A combo box control consists of a text box similar to an edit control, plus a list box. The list box may be displayed at all times or may be dropped down when the user selects a "pop box" next to the text box. The style of the combo box determines whether the user can edit the contents of the text box. If the list box is visible, typing characters into the text box causes the first list box entry that matches the characters typed to be highlighted. Conversely, selecting an item in the list box displays the selected text in the text box.
EDIT	An edit control is a rectangular child window in which the user can enter text from the keyboard. The user selects the control and gives it the input focus by clicking the mouse inside it or pressing the TAB key. The user can enter text when the control displays a flashing caret. The mouse can be used to move the cursor and select characters to be replaced or to position the cursor for inserting characters. The BACKSPACE key can be used to delete characters. Edit controls expand tab characters into as many space characters as are required to move the cursor to the next tab stop. The default for tab stops is eight characters.
LISTBOX	A list box control consists of a list of items. The control is used whenever an application needs to present a list of names, such as filenames, that the user can view and select. The user can select an item by pointing to the name with the mouse and clicking a mouse button. When an item is selected, it is highlighted, and a notification message is passed to the parent window. A scroll bar can be used with a list box control to scroll lists that are too long or too wide for the control window.
SCROLLBAR	A scroll bar control is a rectangle that contains a scroll box and has direction arrows at both ends. The scroll bar sends a notification message to its parent whenever the user clicks the mouse in the control. The parent is responsible for updating the scroll box position, if necessary. Scroll bar controls have the same appearance and function as the scroll bars used in ordinary windows. But unlike scroll bars, scroll bar controls can be positioned anywhere within a window and used whenever needed to provide scrolling input for a window. The scroll bar class also includes size box controls. A size box control is a small rectangle that the user can expand to change the size of the window.
STATIC	A static control is a simple text field, box, or rectangle that can be used to label, box, or separate other controls. Static controls take no input and provide no output.

Virtual Key Codes

The following table shows the symbolic constant names, hexadecimal values, and keyboard equivalents for the virtual-key codes used by the Microsoft Windows operating system version 3.1. The codes are listed in numeric order.

Symbolic name	Value (in hex)	Mouse or keyboard equivalent
VK_LBUTTON	01	Left mouse button
VK_RBUTTON	02	Right mouse button
VK_CANCEL	03	Used for control-break processing
VK_MBUTTON	04	Middle mouse button (three-button mouse)
--	05-07	Undefined
VK_BACK	08	BACKSPACE key
VK_TAB	09	TAB key
--	0A–0B	Undefined
VK_CLEAR	0C	CLEAR key
VK_RETURN	0D	ENTER key
--	0E–0F	Undefined
VK_SHIFT	10	SHIFT key
VK_CONTROL	11	CTRL key
VK_MENU	12	ALT key
VK_PAUSE	13	PAUSE key
VK_CAPITAL	14	CAPS LOCK key
--	15-19	Reserved for Kanji systems
--	1A	Undefined
VK_ESCAPE	1B	ESC key
--	1C–1F	Reserved for Kanji systems
VK_SPACE	20	SPACEBAR
VK_PRIOR	21	PAGE UP key
VK_NEXT	22	PAGE DOWN key
VK_END	23	END key
VK_HOME	24	HOME key
VK_LEFT	25	LEFT ARROW key
VK_UP	26	UP ARROW key
VK_RIGHT	27	RIGHT ARROW key
VK_DOWN	28	DOWN ARROW key
VK_SELECT	29	SELECT key
--	2A	OEM specific
VK_EXECUTE	2B	EXECUTE key
VK_SNAPSHOT	2C	PRINT SCREEN key for Windows 3.0 and later
VK_INSERT	2D	INS key
VK_DELETE	2E	DEL key
VK_HELP	2F	HELP key
VK_0	30	0 key
VK_1	31	1 key
VK_2	32	2 key

VK_3	33	3 key
VK_4	34	4 key
VK_5	35	5 key
VK_6	36	6 key
VK_7	37	7 key
VK_8	38	8 key
VK_9	39	9 key
--	3A–40	Undefined
VK_A	41	A key
VK_B	42	B key
VK_C	43	C key
VK_D	44	D key
VK_E	45	E key
VK_F	46	F key
VK_G	47	G key
VK_H	48	H key
VK_I	49	I key
VK_J	4A	J key
VK_K	4B	K key
VK_L	4C	L key
VK_M	4D	M key
VK_N	4E	N key
VK_O	4F	O key
VK_P	50	P key
VK_Q	51	Q key
VK_R	52	R key
VK_S	53	S key
VK_T	54	T key
VK_U	55	U key
VK_V	56	V key
VK_W	57	W key
VK_X	58	X key
VK_Y	59	Y key
VK_Z	5A	Z key
--	5B–5F	Undefined
VK_NUMPAD0	60	Numeric keypad 0 key
VK_NUMPAD1	61	Numeric keypad 1 key
VK_NUMPAD2	62	Numeric keypad 2 key
VK_NUMPAD3	63	Numeric keypad 3 key
VK_NUMPAD4	64	Numeric keypad 4 key
VK_NUMPAD5	65	Numeric keypad 5 key
VK_NUMPAD6	66	Numeric keypad 6 key
VK_NUMPAD7	67	Numeric keypad 7 key
VK_NUMPAD8	68	Numeric keypad 8 key
VK_NUMPAD9	69	Numeric keypad 9 key

VK_MULTIPLY	6A	Multiply key
VK_ADD	6B	Add key
VK_SEPARATOR	6C	Separator key
VK_SUBTRACT	6D	Subtract key
VK_DECIMAL	6E	Decimal key
VK_DIVIDE	6F	Divide key
VK_F1	70	F1 key
VK_F2	71	F2 key
VK_F3	72	F3 key
VK_F4	73	F4 key
VK_F5	74	F5 key
VK_F6	75	F6 key
VK_F7	76	F7 key
VK_F8	77	F8 key
VK_F9	78	F9 key
VK_F10	79	F10 key
VK_F11	7A	F11 key
VK_F12	7B	F12 key
VK_F13	7C	F13 key
VK_F14	7D	F14 key
VK_F15	7E	F15 key
VK_F16	7F	F16 key
VK_F17	80H	F17 key
VK_F18	81H	F18 key
VK_F19	82H	F19 key
VK_F20	83H	F20 key
VK_F21	84H	F21 key
VK_F22	85H	F22 key
VK_F23	86H	F23 key
VK_F24	87H	F24 key
--	88-8F	Unassigned
VK_NUMLOCK	90	NUM LOCK key
VK_SCROLL	91	SCROLL LOCK key
--	92–B9	Unassigned
--	BA–C0	OEM specific
--	C1–DA	Unassigned
--	DB–E4	OEM specific
--	E5	Unassigned
--	E6	OEM specific
--	E7–E8	Unassigned
--	E9–F5	OEM specific
--	F6–FE	Unassigned

ATOM

16-bit value used as an atom handle.

BOOL

16-bit Boolean value.

BYTE

8-bit unsigned integer. Use **LPBYTE** to create 32-bit pointers. Use **PBYTE** to create pointers that match the compiler memory model.

CATCHBUF[9]

18-byte buffer used by the **Catch** function.

COLORREF

32-bit value used as a color value.

DLGPROC

32-bit pointer to a dialog box procedure.

DWORD

32-bit unsigned integer or a segment:offset address. Use **LPDWORD** to create 32-bit pointers. Use **PDWORD** to create pointers that match the compiler memory model.

FARPROC

32-bit pointer to a function.

FNCALLBACK

32-bit value identifying the **DdeCallback** function. Use **PFNCALLBACK** to create pointers that match the compiler memory model.

FONTENUMPROC

32-bit pointer to an **EnumFontsProc** callback function.

GNOTIFYPROC

32-bit pointer to a **NotifyProc** callback function.

GOBJENUMPROC

32-bit pointer to a **EnumObjectsProc** callback function.

HANDLE

16-bit value used as a general handle. Use **LPHANDLE** to create 32-bit pointers. Use **SPHANDLE** to create 16-bit pointers. Use **PHANDLE** to create pointers that match the compiler memory model.

HCURSOR

16-bit value used as a cursor handle.

HFILE

16-bit value used as a file handle.

HGDIOBJ

16-bit value used as a graphics device interface (GDI) object handle.

HGLOBAL

16-bit value used as a handle to a global memory object.

HHOOK

32-bit value used as a hook handle.

HKEY

32-bit value used as a handle to a key in the registration database. Use **PHKEY** to create 32-bit pointers.

HINSTANCE

16-bit handle to an instance of a module or application.

HLOCAL

16-bit value used as a handle to a local memory object.

HMODULE

16-bit value used as a module handle.

HOBJECT

16-bit value used as a handle to an OLE object.

HWND

16-bit value used as a handle to a window.

HOOKPROC

32-bit pointer to a hook procedure.

HRSRC

16-bit value used as a resource handle.

LHCLIENTDOC

32-bit value used as a handle to an OLE client document.

LHSERVER

32-bit value used as a handle to an OLE server.

LHSERVERDOC

32-bit value used as a handle to an OLE server document.

LONG

32-bit signed integer.

LPABC

32-bit pointer to an **ABC** structure.

LPARAM

32-bit signed value passed as a parameter to a window procedure or callback function.

LPBI

32-bit pointer to a **BANDINFOSTRUCT** structure.

LPBITMAP

32-bit pointer to a **BITMAP** structure. Use **NPBITMAP** to create 16-bit pointers. Use **PBITMAP** to create pointers that match the compiler memory model.

LPBITMAPCOREHEADER

32-bit pointer to a **BITMAPCOREHEADER** structure. Use **PBITMAPCOREHEADER** to create pointers that match the compiler memory model.

LPBITMAPCOREINFO

32-bit pointer to a **BITMAPCOREINFO** structure. Use **PBITMAPCOREINFO** to create pointers that match the compiler memory model.

LPBITMAPFILEHEADER

32-bit pointer to a **BITMAPFILEHEADER** structure. Use **PBITMAPFILEHEADER** to create pointers that match the compiler memory model.

LPBITMAPINFO

32-bit pointer to a **BITMAPINFO** structure. Use **PBITMAPINFO** to create pointers that match the compiler memory model.

LPBITMAPINFOHEADER

32-bit pointer to a **BITMAPINFOHEADER** structure. Use **PBITMAPINFOHEADER** to create pointers that match the compiler memory model.

LPCATCHBUF

32-bit pointer to a **CATCHBUF** array.

LPCBT_CREATEWND

32-bit pointer to a **CBT_CREATEWND** structure.

LPCHOOSECOLOR

32-bit pointer to a **CHOOSECOLOR** structure.

LPCHOOSEFONT

32-bit pointer to a **CHOOSEFONT** structure.

LPCLIENTCREATESTRUCT

32-bit pointer to a **CLIENTCREATESTRUCT** structure.

LPCOMPAREITEMSTRUCT

32-bit pointer to a **COMPAREITEMSTRUCT** structure. Use **PCOMPAREITEMSTRUCT** to create pointers that match the compiler memory model.

LPCPLINFO

32-bit pointer to a **CPLINFO** structure. Use **PCPLINFO** to create pointers that match the compiler memory model.

LPCREATESTRUCT

32-bit pointer to a **CREATESTRUCT** structure.

LPCSTR

32-bit pointer to a nonmodifiable character string.

LPCTLINFO

32-bit pointer to a **CTLINFO** structure. Use **PCTLINFO** to create pointers that match the compiler memory model.

LPCTLSTYLE

32-bit pointer to a **CTLSTYLE** structure. Use **PCTLSTYLE** to create pointers that match the compiler memory model.

LPDCB

32-bit pointer to a **DCB** structure.

LPDEBUGHOOKINFO

32-bit pointer to a **DEBUGHOOKINFO** structure.

LPDELETEITEMSTRUCT

32-bit pointer to a **DELETEITEMSTRUCT** structure. Use **PDELETEITEMSTRUCT** to create pointers that match the compiler memory model.

LPDEVMODE

32-bit pointer to a **DEVMODE** structure. Use **NPDEVMODE** to create 16-bit pointers. Use **PDEVMODE** to create pointers that match the compiler memory model.

LPDEVNAMES

32-bit pointer to a **DEVNAMES** structure.

LPDOCINFO

32-bit pointer to a **DOCINFO** structure.

LPDRAWITEMSTRUCT

32-bit pointer to a **DRAWITEMSTRUCT** structure. Use **PDRAWITEMSTRUCT** to create pointers that match the compiler memory model.

LPDRIVERINFOSTRUCT

32-bit pointer to a **DRIVERINFOSTRUCT** structure.

LPDRVCONFIGINFO

32-bit pointer to a **DRVCONFIGINFO** structure. Use **PDRVCONFIGINFO** to create pointers that match the compiler memory model.

LPEVENTMSG

32-bit pointer to a **EVENTMSG** structure. Use **NPEVENTMSG** to create 16-bit pointers. Use **PEVENTMSG** to create pointers that match the compiler memory model.

LPFINDREPLACE

32-bit pointer to a **FINDREPLACE** structure.

LPFMS_GETDRIVEINFO

32-bit pointer to a **FMS_GETDRIVEINFO** structure.

LPFMS_GETFILESEL

32-bit pointer to a **FMS_GETFILESEL** structure.

LPFMS_LOAD

32-bit pointer to a **FMS_LOAD** structure.

LPHANDLETABLE

32-bit pointer to a **HANDLETABLE** structure. Use **PHANDLETABLE** to create pointers that match the compiler memory model.

LPHELPWININFO

32-bit pointer to a **HELPWININFO** structure. Use **PHELPWININFO** to create pointers that match the compiler memory model.

LPINT

32-bit pointer to a 16-bit signed value. Use **PINT** to create pointers that match the compiler memory model.

LPKERNINGPAIR

32-bit pointer to a **KERNINGPAIR** structure.

LPLOGBRUSH

32-bit pointer to a **LOGBRUSH** structure. Use **NPLOGBRUSH** to create 16-bit pointers. Use **PLOGBRUSH** to create pointers that match the compiler memory model.

LPLOGFONT

32-bit pointer to a **LOGFONT** structure. Use **NPLOGFONT** to create 16-bit pointers. Use **PLOGFONT** to create pointers that match the compiler memory model.

LPLOGPALETTE

32-bit pointer to a **LOGPALETTE** structure. Use **NPLOGPALETTE** to create 16-bit pointers. Use **PLOGPALETTE** to create pointers that match the compiler memory model.

LPLOGPEN

32-bit pointer to a **LOGPEN** structure. Use **NPLOGPEN** to create 16-bit pointers. Use **PLOGPEN** to create pointers that match the compiler memory model.

LPLONG

32-bit pointer to a 32-bit signed integer. Use **PLONG** to create pointers that match the compiler memory model.

LPMAT2

32-bit pointer to a **MAT2** structure.

LPMDICREATESTRUCT

32-bit pointer to an **MDICREATESTRUCT** structure.

LPMEASUREITEMSTRUCT

32-bit pointer to a **MEASUREITEMSTRUCT** structure. Use **PMEASUREITEMSTRUCT** to create pointers that match the compiler memory model.

LPMETAFILEPICT

32-bit pointer to a **METAFILEPICT** structure.

LPMETARECORD

32-bit pointer to a **METARECORD** structure. Use **PMETARECORD** to create pointers that match the compiler memory model.

LPMOUSEHOOKSTRUCT

32-bit pointer to a **MOUSEHOOKSTRUCT** structure.

LPMSG

32-bit pointer to an **MSG** structure. Use **NPMSG** to create 16-bit pointers. Use **PMSG** to create pointers that match the compiler memory model.

LPNCCALCSIZE_PARAMS

32-bit pointer to an **NCCALCSIZE_PARAMS** structure.

LPNEWCPLINFO

32-bit pointer to an **NEWCPLINFO** structure. Use **PNEWCPLINFO** to create pointers that match the compiler memory model.

LPNEWTEXTMETRIC

32-bit pointer to a **NEWTEXTMETRIC** structure. Use **NPNEWTEXTMETRIC** to create 16-bit pointers. Use **PNEWTEXTMETRIC** to create pointers that match the compiler memory model.

LPOFSTRUCT

32-bit pointer to an **OFSTRUCT** structure. Use **NPOFSTRUCT** to create 16-bit pointers. Use **POFSTRUCT** to create pointers that match the compiler memory model.

LPOLECLIENT

32-bit pointer to **OLECLIENT** structure.

LPOLECLIENTVTBL

32-bit pointer to **OLECLIENTVTBL** structure.

LPOLEOBJECT

32-bit pointer to **OLEOBJECT** structure.

LPOLEOBJECTVTBL

32-bit pointer to **OLEOBJECTVTBL** structure.

LPOLESERVER

32-bit pointer to **OLESERVER** structure.

LPOLESERVERDOC

32-bit pointer to **OLESERVERDOC** structure.

LPOLESERVERDOCVTBL

32-bit pointer to **OLESERVERDOCVTBL** structure.

LPOLESERVERVTBL

32-bit pointer to **OLESERVERVTBL** structure.

LPOLESTREAM

32-bit pointer to **OLESTREAM** structure.

LPOLESTREAMVTBL

32-bit pointer to **OLESTREAMVTBL** structure.

LPOLETARGETDEVICE

32-bit pointer to **OLETARGETDEVICE** structure.

LPOPENFILENAME

32-bit pointer to **OPENFILENAME** structure.

LPOUTLINETEXTMETRIC

32-bit pointer to an **OUTLINETEXTMETRIC** structure.

LPPAINTSTRUCT

32-bit pointer to a **PAINTSTRUCT** structure. Use **NPPAINTSTRUCT** to create 16-bit pointers. Use **PPAINTSTRUCT** to create pointers that match the compiler memory model.

LPPALETTEENTRY

32-bit pointer to a **PALETTEENTRY** structure.

LPPOINT

32-bit pointer to a **POINT** structure. Use **NPPOINT** to create 16-bit pointers. Use **PPOINT** to create pointers that match the compiler memory model.

LPPOINTFX

32-bit pointer to a **POINTFX** structure.

LPPRINTDLG

32-bit pointer to a **PRINTDLG** structure.

LPRASTERIZER_STATUS

32-bit pointer to a **RASTERIZER_STATUS** structure.

LPRECT

32-bit pointer to a **RECT** structure. Use **NPRECT** to create 16-bit pointers. Use **PRECT** to create pointers that match the compiler memory model.

LPRGBQUAD

32-bit pointer to a **RGBQUAD** structure.

LPRGBTRIPLE

32-bit pointer to a **RGBTRIPLE** structure.

LPSEGINFO

32-bit pointer to a **SEGINFO** structure.

LPSIZE

32-bit pointer to a **SIZE** structure. Use **NPSIZE** to create 16-bit pointers. Use **PSIZE** to create pointers that match the compiler memory model.

LPSTR

32-bit pointer to a character string. Use **NPSTR** to create 16-bit pointers. Use **PSTR** to create pointers that match the compiler memory model.

LPTEXTMETRIC

32-bit pointer to a **TEXTMETRIC** structure. Use **NPTEXTMETRIC** to create 16-bit pointers. Use **PTEXTMETRIC** to create pointers that match the compiler memory model.

LPTTPOLYCURVE

32-bit pointer to a **TTPOLYCURVE** structure.

LPTTPOLYGONHEADER

32-bit pointer to a **TTPOLYGONHEADER** structure.

LPVOID

32-bit pointer to an unspecified type.

LPWINDOWPLACEMENT

32-bit pointer to a **WINDOWPLACEMENT** structure. Use **PWINDOWPLACEMENT** to create pointers that match the compiler memory model.

LPWINDOWPOS

32-bit pointer to a **WINDOWPOS** structure.

LPWNDCLASS

32-bit pointer to a **WNDCLASS** structure. Use **NPWNDCLASS** to create 16-bit pointers. Use **PWNDCLASS** to create pointers that match the compiler memory model.

LPWORD

32-bit pointer to a 16-bit unsigned value. Use **PWORD** to create pointers that match the compiler memory model.

LRESULT

32-bit signed value returned from a window procedure or callback function.

MFENUMPROC

32-bit pointer to an **EnumMetaFileProc** callback function.

NEARPROC

16-bit pointer to a function.

OLECLIPFORMAT

16-bit value used as a standard clipboard format.

PATTERN

Equivalent to the **LOGBRUSH** structure. Use **LPPATTERN** to create 32-bit pointers. Use **NPPATTERN** to create 16-bit pointers. Use **PPATTERN** to create pointers that match the compiler memory model.

PCONVCONTEXT

32-bit pointer to a **CONVCONTEXT** structure.

PCONVINFO

32-bit pointer to a **CONVINFO** structure.

PHSZPAIR

32-bit pointer to a **HSZPAIR** structure.

PROPENUMPROC

32-bit pointer to an **EnumPropFixedProc** or **EnumPropMovableProc** callback function.

RSRCHDLRPROC

32-bit pointer to a **LoadProc** callback function.

UINT

16-bit unsigned value.

WNDENUMPROC

32-bit pointer to an **EnumWindowsProc** callback function.

WNDPROC

32-bit pointer to a window procedure.

WORD

16-bit unsigned value.

WPARAM

16-bit signed value passed as a parameter to a window procedure or callback function.

Button styles (3.1)

Value	Meaning
BS_3STATE	Creates a button that is the same as a check box, except that the box can be grayed (dimmed) as well as checked. The grayed state is used to show that the state of the check box is not determined.
BS_AUTO3STATE	Creates a button that is the same as a three-state check box, except that the box changes its state when the user selects it. The state cycles through checked, grayed, and normal.
BS_AUTOCHECKBOX	Creates a button that is the same as a check box, except that an X appears in the check box when the user selects the box; the X disappears (is cleared) the next time the user selects the box.
BS_AUTORADIOBUTTON	Creates a button that is the same as a radio button, except that when the user selects it, the button automatically highlights itself and clears (removes the selection from) any other buttons in the same group.
BS_CHECKBOX	Creates a small square that has text displayed to its right (unless this style is combined with the **BS_LEFTTEXT** style).
BS_DEFPUSHBUTTON	Creates a button that has a heavy black border. The user can select this button by pressing the ENTER key. This style is useful for enabling the user to quickly select the most likely option (the default option).
BS_GROUPBOX	Creates a rectangle in which other controls can be grouped. Any text associated with this style is displayed in the rectangle's upper-left corner.
BS_LEFTTEXT	Places text on the left side of the radio button or check box when combined with a radio button or check box style.
BS_OWNERDRAW	Creates an owner-drawn button. The owner window receives a **WM_MEASUREITEM** message when the button is created, and it receives a **WM_DRAWITEM** message when a visual aspect of the button has changed. The **BS_OWNERDRAW** style cannot be combined with any other button styles.
BS_PUSHBUTTON	Creates a push button that posts a **WM_COMMAND** message to the owner window when the user selects the button.
BS_RADIOBUTTON	Creates a small circle that has text displayed to its right (unless this style is combined with the **BS_LEFTTEXT** style). Radio buttons are usually used in groups of related but mutually exclusive choices.

Combination box styles (3.1)

Style	Description
CBS_AUTOHSCROLL	Automatically scrolls the text in the edit control to the right when the user types a character at the end of the line. If this style is not set, only text that fits within the rectangular boundary is allowed.
CBS_DISABLENOSCROLL	Shows a disabled vertical scroll bar in the list box when the box does not contain enough items to scroll. Without this style, the scroll bar is hidden when the list box does not contain enough items.
CBS_DROPDOWN	Similar to **CBS_SIMPLE**, except that the list box is not displayed unless the user selects an icon next to the edit control.
CBS_DROPDOWNLIST	Similar to **CBS_DROPDOWN**, except that the edit control is replaced by a static text item that displays the current selection in the list box.
CBS_HASSTRINGS	Specifies that an owner-drawn combo box contains items consisting of strings. The combo box maintains the memory and pointers for the strings so the application can use the **CB_GETLBTEXT** message to retrieve the text for a particular item.
CBS_NOINTEGRALHEIGHT	Specifies that the size of the combo box is exactly the size specified by the application when it created the combo box. Normally, Windows sizes a combo box so that the combo box does not display partial items.
CBS_OEMCONVERT	Converts text entered in the combo-box edit control from the Windows character set to the OEM character set and then back to the Windows set. This ensures proper character conversion when the application calls the **AnsiToOem** function to convert a Windows string in the combo box to OEM characters. This style is most useful for combo boxes that contain filenames and applies only to combo boxes created with the **CBS_SIMPLE** or **CBS_DROPDOWN** styles.
CBS_OWNERDRAWFIXED	Specifies that the owner of the list box is responsible for drawing its contents and that the items in the list box are all the same height. The owner window receives a **WM_MEASUREITEM** message when the combo box is created and a **WM_DRAWITEM** message when a visual aspect of the combo box has changed.
CBS_OWNERDRAWVARIABLE	Specifies that the owner of the list box is responsible for drawing its contents and that the items in the list box are variable in height. The owner window receives a **WM_MEASUREITEM** message for each item in the combo box when the combo box is created and a **WM_DRAWITEM** message whenever the visual aspect of the combo box changes.
CBS_SIMPLE	Displays the list box at all times. The current selection in the list box is displayed in the edit control.
CBS_SORT	Automatically sorts strings entered into the list box.

Edit control styles (3.1)

Style	Meaning
ES_AUTOHSCROLL	Automatically scrolls text to the right by 10 characters when the user types a character at the end of the line. When the user presses the ENTER key, the control scrolls all text back to position zero.
ES_AUTOVSCROLL	Automatically scrolls text up one page when the user presses ENTER on the last line.
ES_CENTER	Centers text in a multiline edit control.
ES_LEFT	Left aligns text.
ES_LOWERCASE	Converts all characters to lowercase as they are typed into the edit control.
ES_MULTILINE	Designates a multiline edit control. (The default is single-line edit control.) When the multiline edit control is in a dialog box, the default response to pressing the ENTER key is to activate the default button. To use the ENTER key as a carriage return, an application should use the **ES_WANTRETURN** style. When the multiline edit control is not in a dialog box and the **ES_AUTOVSCROLL** style is specified, the edit control shows as many lines as possible and scrolls vertically when the user presses the ENTER key. If ES_AUTOVSCROLL is not specified, the edit control shows as many lines as possible and beeps if the user presses ENTER when no more lines can be displayed. If the **ES_AUTOHSCROLL** style is specified, the multiline edit control automatically scrolls horizontally when the caret goes past the right edge of the control. To start a new line, the user must press ENTER. If ES_AUTOHSCROLL is not specified, the control automatically wraps words to the beginning of the next line when necessary. A new line is also started if the user presses ENTER. The position of the wordwrap is determined by the window size. If the window size changes, the wordwrap position changes and the text is redisplayed. Multiline edit controls can have scroll bars. An edit control with scroll bars processes its own scroll bar messages. Edit controls without scroll bars scroll as described in the previous two paragraphs and process any scroll messages sent by the parent window.
ES_NOHIDESEL	Negates the default behavior for an edit control. The default behavior is to hide the selection when the control loses the input focus and invert the selection when the control receives the input focus.
ES_OEMCONVERT	Converts text entered in the edit control from the Windows character set to the OEM character set and then back to the Windows set. This ensures proper character conversion when the application calls the **AnsiToOem** function to convert a Windows string in the edit control to OEM characters. This style is most useful for edit controls that contain filenames.
ES_PASSWORD	Displays all characters as an asterisk (*) as they are typed into the edit control. An application can use the **EM_SETPASSWORDCHAR** message to change the character that is displayed.
ES_READONLY	Prevents the user from typing or editing text in the edit control.
ES_RIGHT	Right aligns text in a multiline edit control.
ES_UPPERCASE	Converts all characters to uppercase as they are typed into the edit control.
ES_WANTRETURN	Specifies that a carriage return be inserted when the user presses the ENTER key while entering text into a multiline edit control in a dialog box. If this style is not specified, pressing the ENTER key has the same effect as pressing the dialog box's default push button. This style has no effect on a single-line edit control.

List box styles (3.1)

Style	Meaning
LBS_DISABLENOSCROLL	Shows a disabled vertical scroll bar for the list box when the box does not contain enough items to scroll. If this style is not specified, the scroll bar is hidden when the list box does not contain enough items.
LBS_EXTENDEDSEL	Allows multiple items to be selected by using the SHIFT key and the mouse or special key combinations.
LBS_HASSTRINGS	Specifies that a list box contains items consisting of strings. The list box maintains the memory and pointers for the strings so the application can use the **LB_GETTEXT** message to retrieve the text for a particular item. By default, all list boxes except owner-drawn list boxes have this style. An application can create an owner-drawn list box either with or without this style.
LBS_MULTICOLUMN	Specifies a multicolumn list box that is scrolled horizontally. The **LB_SETCOLUMNWIDTH** message sets the width of the columns.
LBS_MULTIPLESEL	Turns string selection on or off each time the user clicks or double-clicks the string. Any number of strings can be selected.
LBS_NOINTEGRALHEIGHT	Specifies that the size of the list box is exactly the size specified by the application when it created the list box. Normally, Windows sizes a list box so that the list box does not display partial items.
LBS_NOREDRAW	Specifies that the list box's appearance is not updated when changes are made. This style can be changed at any time by sending a **WM_SETREDRAW** message.
LBS_NOTIFY	Notifies the parent window with an input message whenever the user clicks or double-clicks a string.
LBS_OWNERDRAWFIXED	Specifies that the owner of the list box is responsible for drawing its contents and that the items in the list box are the same height. The owner window receives a **WM_MEASUREITEM** message when the list box is created and a **WM_DRAWITEM** message when a visual aspect of the list box has changed.
LBS_OWNERDRAWVARIABLE	Specifies that the owner of the list box is responsible for drawing its contents and that the items in the list box are variable in height. The owner window receives a **WM_MEASUREITEM** message for each item in the combo box when the combo box is created and a **WM_DRAWITEM** message whenever the visual aspect of the combo box changes.
LBS_SORT	Sorts strings in the list box alphabetically.
LBS_STANDARD	Sorts strings in the list box alphabetically. The parent window receives an input message whenever the user clicks or double-clicks a string. The list box has borders on all sides.
LBS_USETABSTOPS	Allows a list box to recognize and expand tab characters when drawing its strings. The default tab positions are 32 dialog box units. (A dialog box unit is a horizontal or vertical distance. One horizontal dialog box unit is equal to one-fourth of the current dialog box base width unit. The dialog box base units are computed based on the height and width of the current system font. The **GetDialogBaseUnits** function returns the current dialog box base units in pixels.)

LBS_WANTKEYBOARDINPUT	Specifies that the owner of the list box receives **WM_VKEYTOITEM** or **WM_CHARTOITEM** messages whenever the user presses a key and the list box has the input focus. This allows an application to perform special processing on the keyboard input. If a list box has the **LBS_HASSTRINGS** style, the list box can receive WM_VKEYTOITEM messages but not WM_CHARTOITEM messages. If a list box does not have the LBS_HASSTRINGS style, the list box can receive WM_CHARTOITEM messages but not WM_VKEYTOITEM messages.

Scroll bar styles (3.1)

Style	Meaning
SBS_BOTTOMALIGN	Aligns the bottom edge of the scroll bar with the bottom edge of the rectangle defined by the following **CreateWindow** parameters: *x, y, nWidth,* and *nHeight.* The scroll bar has the default height for system scroll bars. Used with the **SBS_HORZ** style.
SBS_HORZ	Designates a horizontal scroll bar. If neither the **SBS_BOTTOMALIGN** nor **SBS_TOPALIGN** style is specified, the scroll bar has the height, width, and position specified by the **CreateWindow** parameters.
SBS_LEFTALIGN	Aligns the left edge of the scroll bar with the left edge of the rectangle defined by the **CreateWindow** parameters. The scroll bar has the default width for system scroll bars. Used with the **SBS_VERT** style.
SBS_RIGHTALIGN	Aligns the right edge of the scroll bar with the right edge of the rectangle defined by the **CreateWindow** parameters. The scroll bar has the default width for system scroll bars. Used with the **SBS_VERT** style.
SBS_SIZEBOX	Designates a size box. If neither the **SBS_SIZEBOXBOTTOMRIGHTALIGN** nor **SBS_SIZEBOXTOPLEFTALIGN** style is specified, the size box has the height, width, and position specified by the **CreateWindow** parameters.
SBS_SIZEBOXBOTTOMRIGHTALIGN	Aligns the lower-right corner of the size box with the lower-right corner of the rectangle specified by the **CreateWindow** parameters. The size box has the default size for system size boxes. Used with the **SBS_SIZEBOX** style.
SBS_SIZEBOXTOPLEFTALIGN	Aligns the upper-left corner of the size box with the upper-left corner of the rectangle specified by the following **CreateWindow** parameters: *x, y, nWidth,* and *nHeight.* The size box has the default size for system size boxes. Used with the **SBS_SIZEBOX** style.
SBS_TOPALIGN	Aligns the top edge of the scroll bar with the top edge of the rectangle defined by the **CreateWindow** parameters. The scroll bar has the default height for system scroll bars. Used with the **SBS_HORZ** style.
SBS_VERT	Designates a vertical scroll bar. If neither the **SBS_RIGHTALIGN** nor **SBS_LEFTALIGN** style is specified, the scroll bar has the height, width, and position specified by the **CreateWindow** parameters.

Static control styles (3.1)

Style	Meaning
SS_BLACKFRAME	Specifies a box with a frame drawn in the same color as window frames. This color is black in the default Windows color scheme.
SS_BLACKRECT	Specifies a rectangle filled with the color used to draw window frames. This color is black in the default Windows color scheme.
SS_CENTER	Designates a simple rectangle and displays the given text centered in the rectangle. The text is formatted before it is displayed. Words that would extend past the end of a line are automatically wrapped to the beginning of the next centered line.
SS_GRAYFRAME	Specifies a box with a frame drawn with the same color as the screen background (desktop). This color is gray in the default Windows color scheme.
SS_GRAYRECT	Specifies a rectangle filled with the color used to fill the screen background. This color is gray in the default Windows color scheme.
SS_ICON	Designates an icon displayed in the dialog box. The given text is the name of an icon (not a filename) defined elsewhere in the resource file. The *nWidth* and *nHeight* parameters are ignored; the icon automatically sizes itself.
SS_LEFT	Designates a simple rectangle and displays the given text left-aligned in the rectangle. The text is formatted before it is displayed. Words that would extend past the end of a line are automatically wrapped to the beginning of the next left-aligned line.
SS_LEFTNOWORDWRAP	Designates a simple rectangle and displays the given text left-aligned in the rectangle. Tabs are expanded but words are not wrapped. Text that extends past the end of a line is clipped.
SS_NOPREFIX	Prevents interpretation of any & characters in the control's text as accelerator prefix characters (which are displayed with the & removed and the next character in the string underlined). This static control style may be included with any of the defined static controls. You can combine **SS_NOPREFIX** with other styles by using the bitwise OR operator. This is most often used when filenames or other strings that may contain an & need to be displayed in a static control in a dialog box.
SS_RIGHT	Designates a simple rectangle and displays the given text right-aligned in the rectangle. The text is formatted before it is displayed. Words that would extend past the end of a line are automatically wrapped to the beginning of the next right-aligned line.
SS_SIMPLE	Designates a simple rectangle and displays a single line of text left-aligned in the rectangle. The line of text cannot be shortened or altered in any way. (The control's parent window or dialog box must not process the **WM_CTLCOLOR** message.)
SS_WHITEFRAME	Specifies a box with a frame drawn in the same color as window backgrounds. This color is white in the default Windows color scheme.
SS_WHITERECT	Specifies a rectangle filled with the color used to fill window backgrounds. This color is white in the default Windows color scheme.

BS_3STATE

Creates a button that is the same as a check box, except that the box can be grayed (dimmed) as well as checked. The grayed state is used to show that the state of the check box is not determined.

BS_AUTO3STATE

Creates a button that is the same as a three-state check box, except that the box changes its state when the user selects it. The state cycles through checked, grayed, and normal.

BS_AUTOCHECKBOX

Creates a button that is the same as a check box, except that an X appears in the check box when the user selects the box; the X disappears (is cleared) the next time the user selects the box.

BS_AUTORADIOBUTTON

Creates a button that is the same as a radio button, except that when the user selects it, the button automatically highlights itself and clears (removes the selection from) any other buttons in the same group.

BS_CHECKBOX

Creates a small square that has text displayed to its right (unless this style is combined with the **BS_LEFTTEXT** style).

BS_DEFPUSHBUTTON

Creates a button that has a heavy black border. The user can select this button by pressing the ENTER key. This style is useful for enabling the user to quickly select the most likely option (the default option).

BS_GROUPBOX

Creates a rectangle in which other controls can be grouped. Any text associated with this style is displayed in the rectangle's upper-left corner.

BS_LEFTTEXT

Places text on the left side of the radio button or check box when combined with a radio button or check box style.

BS_OWNERDRAW

Creates an owner-drawn button. The owner window receives a **WM_MEASUREITEM** message when the button is created, and it receives a **WM_DRAWITEM** message when a visual aspect of the button has changed. The BS_OWNERDRAW style cannot be combined with any other button styles.

BS_PUSHBUTTON

Creates a push button that posts a **WM_COMMAND** message to the owner window when the user selects the button.

BS_RADIOBUTTON

Creates a small circle that has text displayed to its right (unless this style is combined with the **BS_LEFTTEXT** style). Radio buttons are usually used in groups of related but mutually exclusive choices.

CBS_AUTOHSCROLL

Automatically scrolls the text in the edit control to the right when the user types a character at the end of the line. If this style is not set, only text that fits within the rectangular boundary is allowed.

CBS_DISABLENOSCROLL

Shows a disabled vertical scroll bar in the list box when the box does not contain enough items to scroll. Without this style, the scroll bar is hidden when the list box does not contain enough items.

CBS_DROPDOWN

Similar to **CBS_SIMPLE**, except that the list box is not displayed unless the user selects an icon next to the edit control.

CBS_DROPDOWNLIST

Similar to **CBS_DROPDOWN**, except that the edit control is replaced by a static text item that displays the current selection in the list box.

CBS_HASSTRINGS

Specifies that an owner-drawn combo box contains items consisting of strings. The combo box maintains the memory and pointers for the strings so the application can use the **CB_GETLBTEXT** message to retrieve the text for a particular item.

CBS_NOINTEGRALHEIGHT

Specifies that the size of the combo box is exactly the size specified by the application when it created the combo box. Normally, Windows sizes a combo box so that the combo box does not display partial items.

CBS_OEMCONVERT

Converts text entered in the combo-box edit control from the Windows character set to the OEM character set and then back to the Windows set. This ensures proper character conversion when the application calls the **AnsiToOem** function to convert a Windows string in the combo box to OEM characters. This style is most useful for combo boxes that contain filenames and applies only to combo boxes created with the **CBS_SIMPLE** or **CBS_DROPDOWN** styles.

CBS_OWNERDRAWFIXED

Specifies that the owner of the list box is responsible for drawing its contents and that the items in the list box are all the same height. The owner window receives a **WM_MEASUREITEM** message when the combo box is created and a **WM_DRAWITEM** message when a visual aspect of the combo box has changed.

CBS_OWNERDRAWVARIABLE

Specifies that the owner of the list box is responsible for drawing its contents and that the items in the list box are variable in height. The owner window receives a **WM_MEASUREITEM** message for each item in the combo box when the combo box is created and a **WM_DRAWITEM** message whenever the visual aspect of the combo box changes.

CBS_SIMPLE

Displays the list box at all times. The current selection in the list box is displayed in the edit control.

CBS_SORT

Automatically sorts strings entered into the list box.

ES_AUTOHSCROLL

Automatically scrolls text to the right by 10 characters when the user types a character at the end of the line. When the user presses the ENTER key, the control scrolls all text back to position zero.

ES_AUTOVSCROLL

Automatically scrolls text up one page when the user presses ENTER on the last line.

ES_CENTER

Centers text in a multiline edit control.

ES_LEFT

Left aligns text.

ES_LOWERCASE

Converts all characters to lowercase as they are typed into the edit control.

ES_MULTILINE

Designates a multiline edit control. (The default is single-line edit control.)

When

the multiline edit control is in a dialog box, the default response to pressing the ENTER key is to activate the default button. To use the ENTER key as a carriage return, an application should use the **ES_WANTRETURN** style. When the multiline edit control is not in a dialog box and the **ES_AUTOVSCROLL** style is specified, the edit control shows as many lines as possible and scrolls vertically when the user presses the ENTER key. If ES_AUTOVSCROLL is not specified, the edit control shows as many lines as possible and beeps if the user presses ENTER when no more lines can be displayed.

If

the **ES_AUTOHSCROLL** style is specified, the multiline edit control automatically scrolls horizontally when the caret goes past the right edge of the control. To start a new line, the user must press ENTER. If ES_AUTOHSCROLL is not specified, the control automatically wraps words to the beginning of the next line when necessary. A new line is also started if the user presses ENTER. The position of the wordwrap is determined by the window size. If the window size changes, the wordwrap position changes and the text is redisplayed. Multiline edit controls can have scroll bars. An edit control with scroll bars processes its own scroll bar messages. Edit controls without scroll bars scroll as described in the previous two paragraphs and process any scroll messages sent by the parent window.

ES_NOHIDESEL

Negates the default behavior for an edit control. The default behavior is to hide the selection when the control loses the input focus and invert the selection when the control receives the input focus.

ES_OEMCONVERT

Converts text entered in the edit control from the Windows character set to the OEM character set and then back to the Windows set. This ensures proper character conversion when the application calls the **AnsiToOem** function to convert a Windows string in the edit control to OEM characters. This style is most useful for edit controls that contain filenames.

ES_PASSWORD

Displays all characters as an asterisk (*) as they are typed into the edit control. An application can use the **EM_SETPASSWORDCHAR** message to change the character that is displayed.

ES_READONLY

Prevents the user from typing or editing text in the edit control.

ES_RIGHT

Right aligns text in a multiline edit control.

ES_UPPERCASE

Converts all characters to uppercase as they are typed into the edit control.

ES_WANTRETURN

Specifies that a carriage return be inserted when the user presses the ENTER key while entering text into a multiline edit control in a dialog box. If this style is not specified, pressing the ENTER key has the same effect as pressing the dialog box's default push button. This style has no effect on a single-line edit control.

LBS_DISABLENOSCROLL

Shows a disabled vertical scroll bar for the list box when the box does not contain enough items to scroll. If this style is not specified, the scroll bar is hidden when the list box does not contain enough items.

LBS_EXTENDEDSEL

Allows multiple items to be selected by using the SHIFT key and the mouse or special key combinations.

LBS_HASSTRINGS

Specifies that a list box contains items consisting of strings. The list box maintains the memory and pointers for the strings so the application can use the **LB_GETTEXT** message to retrieve the text for a particular item. By default, all list boxes except owner-drawn list boxes have this style. An application can create an owner-drawn list box either with or without this style.

LBS_MULTICOLUMN

Specifies a multicolumn list box that is scrolled horizontally. The **LB_SETCOLUMNWIDTH** message sets the width of the columns.

LBS_MULTIPLESEL

Turns string selection on or off each time the user clicks or double-clicks the string. Any number of strings can be selected.

LBS_NOINTEGRALHEIGHT

Specifies that the size of the list box is exactly the size specified by the application when it created the list box. Normally, Windows sizes a list box so that the list box does not display partial items.

LBS_NOREDRAW

Specifies that the list box's appearance is not updated when changes are made. This style can be changed at any time by sending a **WM_SETREDRAW** message.

LBS_NOTIFY

Notifies the parent window with an input message whenever the user clicks or double-clicks a string.

LBS_OWNERDRAWFIXED

Specifies that the owner of the list box is responsible for drawing its contents and that the items in the list box are the same height. The owner window receives a **WM_MEASUREITEM** message when the list box is created and a **WM_DRAWITEM** message when a visual aspect of the list box has changed.

LBS_OWNERDRAWVARIABLE

Specifies that the owner of the list box is responsible for drawing its contents and that the items in the list box are variable in height. The owner window receives a **WM_MEASUREITEM** message for each item in the combo box when the combo box is created and a **WM_DRAWITEM** message whenever the visual aspect of the combo box changes.

LBS_SORT

Sorts strings in the list box alphabetically.

LBS_STANDARD

Sorts strings in the list box alphabetically. The parent window receives an input message whenever the user clicks or double-clicks a string. The list box has borders on all sides.

LBS_USETABSTOPS

Allows a list box to recognize and expand tab characters when drawing its strings. The default tab positions are 32 dialog box units. (A dialog box unit is a horizontal or vertical distance. One horizontal dialog box unit is equal to one-fourth of the current dialog box base width unit. The dialog box base units are computed based on the height and width of the current system font. The **GetDialogBaseUnits** function returns the current dialog box base units in pixels.)

LBS_WANTKEYBOARDINPUT

Specifies that the owner of the list box receives **WM_VKEYTOITEM** or **WM_CHARTOITEM** messages whenever the user presses a key and the list box has the input focus. This allows an application to perform special processing on the keyboard input. If a list box has the **LBS_HASSTRINGS** style, the list box can receive WM_VKEYTOITEM messages but not WM_CHARTOITEM messages. If a list box does not have the LBS_HASSTRINGS style, the list box can receive WM_CHARTOITEM messages but not WM_VKEYTOITEM messages.

SBS_BOTTOMALIGN

Aligns the bottom edge of the scroll bar with the bottom edge of the rectangle defined by the following **CreateWindow** parameters: *x, y, nWidth,* and *nHeight.* The scroll bar has the default height for system scroll bars. Used with the **SBS_HORZ** style.

SBS_HORZ

Designates a horizontal scroll bar. If neither the **SBS_BOTTOMALIGN** nor **SBS_TOPALIGN** style is specified, the scroll bar has the height, width, and position specified by the **CreateWindow** parameters.

SBS_LEFTALIGN

Aligns the left edge of the scroll bar with the left edge of the rectangle defined by the **CreateWindow** parameters. The scroll bar has the default width for system scroll bars. Used with the **SBS_VERT** style.

SBS_RIGHTALIGN

Aligns the right edge of the scroll bar with the right edge of the rectangle defined by the **CreateWindow** parameters. The scroll bar has the default width for system scroll bars. Used with the **SBS_VERT** style.

SBS_SIZEBOX

Designates a size box. If neither the **SBS_SIZEBOXBOTTOMRIGHTALIGN** nor **SBS_SIZEBOXTOPLEFTALIGN** style is specified, the size box has the height, width, and position specified by the **CreateWindow** parameters.

SBS_SIZEBOXBOTTOMRIGHTALIGN

Aligns the lower-right corner of the size box with the lower-right corner of the rectangle specified by the **CreateWindow** parameters. The size box has the default size for system size boxes. Used with the **SBS_SIZEBOX** style.

SBS_SIZEBOXTOPLEFTALIGN

Aligns the upper-left corner of the size box with the upper-left corner of the rectangle specified by the following **CreateWindow** parameters: *x, y, nWidth,* and *nHeight.* The size box has the default size for system size boxes. Used with the **SBS_SIZEBOX** style.

SBS_TOPALIGN

Aligns the top edge of the scroll bar with the top edge of the rectangle defined by the **CreateWindow** parameters. The scroll bar has the default height for system scroll bars. Used with the **SBS_HORZ** style.

SBS_VERT

Designates a vertical scroll bar. If neither the **SBS_RIGHTALIGN** nor **SBS_LEFTALIGN** style is specified, the scroll bar has the height, width, and position specified by the **CreateWindow** parameters.

SS_BLACKFRAME

Specifies a box with a frame drawn in the same color as window frames. This color is black in the default Windows color scheme.

SS_BLACKRECT

Specifies a rectangle filled with the color used to draw window frames. This color is black in the default Windows color scheme.

SS_CENTER

Designates a simple rectangle and displays the given text centered in the rectangle. The text is formatted before it is displayed. Words that would extend past the end of a line are automatically wrapped to the beginning of the next centered line.

SS_GRAYFRAME

Specifies a box with a frame drawn with the same color as the screen background (desktop). This color is gray in the default Windows color scheme.

SS_GRAYRECT

Specifies a rectangle filled with the color used to fill the screen background. This color is gray in the default Windows color scheme.

SS_ICON

Designates an icon displayed in the dialog box. The given text is the name of an icon (not a filename) defined elsewhere in the resource file. The *nWidth* and *nHeight* parameters are ignored; the icon automatically sizes itself.

SS_LEFT

Designates a simple rectangle and displays the given text left-aligned in the rectangle. The text is formatted before it is displayed. Words that would extend past the end of a line are automatically wrapped to the beginning of the next left-aligned line.

SS_LEFTNOWORDWRAP

Designates a simple rectangle and displays the given text left-aligned in the rectangle. Tabs are expanded but words are not wrapped. Text that extends past the end of a line is clipped.

SS_NOPREFIX

Prevents interpretation of any & characters in the control's text as accelerator prefix characters (which are displayed with the & removed and the next character in the string underlined). This static control style may be included with any of the defined static controls. You can combine SS_NOPREFIX with other styles by using the bitwise OR operator. This is most often used when filenames or other strings that may contain an & need to be displayed in a static control in a dialog box.

SS_RIGHT

Designates a simple rectangle and displays the given text right-aligned in the rectangle. The text is formatted before it is displayed. Words that would extend past the end of a line are automatically wrapped to the beginning of the next right-aligned line.

SS_SIMPLE

Designates a simple rectangle and displays a single line of text left-aligned in the rectangle. The line of text cannot be shortened or altered in any way. (The control's parent window or dialog box must not process the **WM_CTLCOLOR** message.)

SS_WHITEFRAME

Specifies a box with a frame drawn in the same color as window backgrounds. This color is white in the default Windows color scheme.

SS_WHITERECT

Specifies a rectangle filled with the color used to fill window backgrounds. This color is white in the default Windows color scheme.

Module and Library Names

This topic lists the module and import libraries associated with each Microsoft Windows function.

Function	Module	Import library
AbortDoc	GDI	LIBW.LIB
AccessResource	KERNEL	LIBW.LIB
AddAtom	KERNEL	LIBW.LIB
AddFontResource	GDI	LIBW.LIB
AdjustWindowRect	USER	LIBW.LIB
AdjustWindowRectEx	USER	LIBW.LIB
AllocDiskSpace	STRESS	STRESS.LIB
AllocDStoCSAlias	KERNEL	LIBW.LIB
AllocFileHandles	STRESS	STRESS.LIB
AllocGDIMem	STRESS	STRESS.LIB
AllocMem	STRESS	STRESS.LIB
AllocResource	KERNEL	LIBW.LIB
AllocSelector	KERNEL	LIBW.LIB
AllocUserMem	STRESS	STRESS.LIB
AnimatePalette	GDI	LIBW.LIB
AnsiLower	USER	LIBW.LIB
AnsiLowerBuff	USER	LIBW.LIB
AnsiNext	USER	LIBW.LIB
AnsiPrev	USER	LIBW.LIB
AnsiToOem	KEYBOARD	LIBW.LIB
AnsiToOemBuff	KEYBOARD	LIBW.LIB
AnsiUpper	USER	LIBW.LIB
AnsiUpperBuff	USER	LIBW.LIB
AnyPopup	USER	LIBW.LIB
AppendMenu	USER	LIBW.LIB
Arc	GDI	LIBW.LIB
ArrangeIconicWindows	USER	LIBW.LIB
BeginDeferWindowPos	USER	LIBW.LIB
BeginPaint	USER	LIBW.LIB
BitBlt	GDI	LIBW.LIB
BringWindowToTop	USER	LIBW.LIB
BuildCommDCB	USER	LIBW.LIB
CallMsgFilter	USER	LIBW.LIB
CallNextHookEx	USER	LIBW.LIB
CallWindowProc	USER	LIBW.LIB
Catch	KERNEL	LIBW.LIB
ChangeClipboardChain	USER	LIBW.LIB
ChangeMenu	USER	LIBW.LIB
CheckDlgButton	USER	LIBW.LIB
CheckMenuItem	USER	LIBW.LIB
CheckRadioButton	USER	LIBW.LIB

ChildWindowFromPoint	USER	LIBW.LIB
ChooseColor	COMMDLG	COMMDLG.LIB
ChooseFont	COMMDLG	COMMDLG.LIB
Chord	GDI	LIBW.LIB
ClassFirst	TOOLHELP	TOOLHELP.LIB
ClassNext	TOOLHELP	TOOLHELP.LIB
ClearCommBreak	USER	LIBW.LIB
ClientToScreen	USER	LIBW.LIB
ClipCursor	USER	LIBW.LIB
CloseClipboard	USER	LIBW.LIB
CloseComm	USER	LIBW.LIB
CloseDriver	USER	LIBW.LIB
CloseMetaFile	GDI	LIBW.LIB
CloseWindow	USER	LIBW.LIB
CombineRgn	GDI	LIBW.LIB
CommDlgExtendedError	COMMDLG	COMMDLG.LIB
CopyCursor	USER	LIBW.LIB
CopyIcon	USER	LIBW.LIB
CopyLZFile	LZEXPAND	LZEXPAND.LIB
CopyMetaFile	GDI	LIBW.LIB
CopyRect	USER	LIBW.LIB
CountClipboardFormats	USER	LIBW.LIB
CreateBitmap	GDI	LIBW.LIB
CreateBitmapIndirect	GDI	LIBW.LIB
CreateBrushIndirect	GDI	LIBW.LIB
CreateCaret	USER	LIBW.LIB
CreateCompatibleBitmap	GDI	LIBW.LIB
CreateCompatibleDC	GDI	LIBW.LIB
CreateCursor	USER	LIBW.LIB
CreateDC	GDI	LIBW.LIB
CreateDialog	USER	LIBW.LIB
CreateDialogIndirect	USER	LIBW.LIB
CreateDialogIndirectParam	USER	LIBW.LIB
CreateDialogParam	USER	LIBW.LIB
CreateDIBitmap	GDI	LIBW.LIB
CreateDIBPatternBrush	GDI	LIBW.LIB
CreateDiscardableBitmap	GDI	LIBW.LIB
CreateEllipticRgn	GDI	LIBW.LIB
CreateEllipticRgnIndirect	GDI	LIBW.LIB
CreateFont	GDI	LIBW.LIB
CreateFontIndirect	GDI	LIBW.LIB
CreateHatchBrush	GDI	LIBW.LIB
CreateIC	GDI	LIBW.LIB
CreateIcon	USER	LIBW.LIB
CreateMenu	USER	LIBW.LIB

CreateMetaFile	GDI	LIBW.LIB
CreatePalette	GDI	LIBW.LIB
CreatePatternBrush	GDI	LIBW.LIB
CreatePen	GDI	LIBW.LIB
CreatePenIndirect	GDI	LIBW.LIB
CreatePolygonRgn	GDI	LIBW.LIB
CreatePolyPolygonRgn	GDI	LIBW.LIB
CreatePopupMenu	USER	LIBW.LIB
CreateRectRgn	GDI	LIBW.LIB
CreateRectRgnIndirect	GDI	LIBW.LIB
CreateRoundRectRgn	GDI	LIBW.LIB
CreateScalableFontResource	GDI	LIBW.LIB
CreateSolidBrush	GDI	LIBW.LIB
CreateWindow	USER	LIBW.LIB
CreateWindowEx	USER	LIBW.LIB
DdeAbandonTransaction	DDEML	DDEML.LIB
DdeAccessData	DDEML	DDEML.LIB
DdeAddData	DDEML	DDEML.LIB
DdeClientTransaction	DDEML	DDEML.LIB
DdeCmpStringHandles	DDEML	DDEML.LIB
DdeConnect	DDEML	DDEML.LIB
DdeConnectList	DDEML	DDEML.LIB
DdeCreateDataHandle	DDEML	DDEML.LIB
DdeCreateStringHandle	DDEML	DDEML.LIB
DdeDisconnect	DDEML	DDEML.LIB
DdeDisconnectList	DDEML	DDEML.LIB
DdeEnableCallback	DDEML	DDEML.LIB
DdeFreeDataHandle	DDEML	DDEML.LIB
DdeFreeStringHandle	DDEML	DDEML.LIB
DdeGetData	DDEML	DDEML.LIB
DdeGetLastError	DDEML	DDEML.LIB
DdeInitialize	DDEML	DDEML.LIB
DdeKeepStringHandle	DDEML	DDEML.LIB
DdeNameService	DDEML	DDEML.LIB
DdePostAdvise	DDEML	DDEML.LIB
DdeQueryConvInfo	DDEML	DDEML.LIB
DdeQueryNextServer	DDEML	DDEML.LIB
DdeQueryString	DDEML	DDEML.LIB
DdeReconnect	DDEML	DDEML.LIB
DdeSetUserHandle	DDEML	DDEML.LIB
DdeUnaccessData	DDEML	DDEML.LIB
DdeUninitialize	DDEML	DDEML.LIB
DebugBreak	KERNEL	LIBW.LIB
DebugOutput	KERNEL	LIBW.LIB
DefDlgProc	USER	LIBW.LIB

DefDriverProc	USER	LIBW.LIB
DeferWindowPos	USER	LIBW.LIB
DefFrameProc	USER	LIBW.LIB
DefHookProc	USER	LIBW.LIB
DefMDIChildProc	USER	LIBW.LIB
DefScreenSaverProc	—	SCRNSAVE.LIB
DefWindowProc	USER	LIBW.LIB
DeleteAtom	KERNEL	LIBW.LIB
DeleteDC	GDI	LIBW.LIB
DeleteMenu	USER	LIBW.LIB
DeleteMetaFile	GDI	LIBW.LIB
DeleteObject	GDI	LIBW.LIB
DestroyCaret	USER	LIBW.LIB
DestroyCursor	USER	LIBW.LIB
DestroyIcon	USER	LIBW.LIB
DestroyMenu	USER	LIBW.LIB
DestroyWindow	USER	LIBW.LIB
DialogBox	USER	LIBW.LIB
DialogBoxIndirect	USER	LIBW.LIB
DialogBoxIndirectParam	USER	LIBW.LIB
DialogBoxParam	USER	LIBW.LIB
DirectedYield	KERNEL	LIBW.LIB
DispatchMessage	USER	LIBW.LIB
DlgChangePassword	—	SCRNSAVE.LIB
DlgDirList	USER	LIBW.LIB
DlgDirListComboBox	USER	LIBW.LIB
DlgDirSelect	USER	LIBW.LIB
DlgDirSelectComboBox	USER	LIBW.LIB
DlgDirSelectComboBoxEx	USER	LIBW.LIB
DlgDirSelectEx	USER	LIBW.LIB
DlgGetPassword	—	SCRNSAVE.LIB
DlgInvalidPassword	—	SCRNSAVE.LIB
DOS3Call	KERNEL	LIBW.LIB
DPtoLP	GDI	LIBW.LIB
DragAcceptFiles	SHELL	SHELL.LIB
DragFinish	SHELL	SHELL.LIB
DragQueryFile	SHELL	SHELL.LIB
DragQueryPoint	SHELL	SHELL.LIB
DrawFocusRect	USER	LIBW.LIB
DrawIcon	USER	LIBW.LIB
DrawMenuBar	USER	LIBW.LIB
DrawText	USER	LIBW.LIB
Ellipse	GDI	LIBW.LIB
EmptyClipboard	USER	LIBW.LIB
EnableCommNotification	USER	LIBW.LIB

EnableHardwareInput	USER	LIBW.LIB
EnableMenuItem	USER	LIBW.LIB
EnableScrollBar	USER	LIBW.LIB
EnableWindow	USER	LIBW.LIB
EndDeferWindowPos	USER	LIBW.LIB
EndDialog	USER	LIBW.LIB
EndDoc	GDI	LIBW.LIB
EndPage	GDI	LIBW.LIB
EndPaint	USER	LIBW.LIB
EnumChildWindows	USER	LIBW.LIB
EnumClipboardFormats	USER	LIBW.LIB
EnumFontFamilies	GDI	LIBW.LIB
EnumFonts	GDI	LIBW.LIB
EnumMetaFile	GDI	LIBW.LIB
EnumObjects	GDI	LIBW.LIB
EnumProps	USER	LIBW.LIB
EnumTaskWindows	USER	LIBW.LIB
EnumWindows	USER	LIBW.LIB
EqualRect	USER	LIBW.LIB
EqualRgn	GDI	LIBW.LIB
Escape	GDI	LIBW.LIB
EscapeCommFunction	USER	LIBW.LIB
ExcludeClipRect	GDI	LIBW.LIB
ExcludeUpdateRgn	USER	LIBW.LIB
ExitWindows	USER	LIBW.LIB
ExitWindowsExec	USER	LIBW.LIB
ExtFloodFill	GDI	LIBW.LIB
ExtractIcon	SHELL	SHELL.LIB
ExtTextOut	GDI	LIBW.LIB
FatalAppExit	KERNEL	LIBW.LIB
FatalExit	KERNEL	LIBW.LIB
FillRect	USER	LIBW.LIB
FillRgn	GDI	LIBW.LIB
FindAtom	KERNEL	LIBW.LIB
FindExecutable	SHELL	SHELL.LIB
FindResource	KERNEL	LIBW.LIB
FindText	COMMDLG	COMMDLG.LIB
FindWindow	USER	LIBW.LIB
FlashWindow	USER	LIBW.LIB
FloodFill	GDI	LIBW.LIB
FlushComm	USER	LIBW.LIB
FrameRect	USER	LIBW.LIB
FrameRgn	GDI	LIBW.LIB
FreeAllGDIMem	STRESS	STRESS.LIB
FreeAllMem	STRESS	STRESS.LIB

FreeAllUserMem	STRESS	STRESS.LIB
FreeLibrary	KERNEL	LIBW.LIB
FreeModule	KERNEL	LIBW.LIB
FreeProcInstance	KERNEL	LIBW.LIB
FreeResource	KERNEL	LIBW.LIB
FreeSelector	KERNEL	LIBW.LIB
GetActiveWindow	USER	LIBW.LIB
GetAspectRatioFilter	GDI	LIBW.LIB
GetAspectRatioFilterEx	GDI	LIBW.LIB
GetAsyncKeyState	USER	LIBW.LIB
GetAtomHandle	KERNEL	LIBW.LIB
GetAtomName	KERNEL	LIBW.LIB
GetBitmapBits	GDI	LIBW.LIB
GetBitmapDimension	GDI	LIBW.LIB
GetBitmapDimensionEx	GDI	LIBW.LIB
GetBkColor	GDI	LIBW.LIB
GetBkMode	GDI	LIBW.LIB
GetBoundsRect	GDI	LIBW.LIB
GetBrushOrg	GDI	LIBW.LIB
GetBrushOrgEx	GDI	LIBW.LIB
GetCapture	USER	LIBW.LIB
GetCaretBlinkTime	USER	LIBW.LIB
GetCaretPos	USER	LIBW.LIB
GetCharABCWidths	GDI	LIBW.LIB
GetCharWidth	GDI	LIBW.LIB
GetClassInfo	USER	LIBW.LIB
GetClassLong	USER	LIBW.LIB
GetClassName	USER	LIBW.LIB
GetClassWord	USER	LIBW.LIB
GetClientRect	USER	LIBW.LIB
GetClipboardData	USER	LIBW.LIB
GetClipboardFormatName	USER	LIBW.LIB
GetClipboardOwner	USER	LIBW.LIB
GetClipboardViewer	USER	LIBW.LIB
GetClipBox	GDI	LIBW.LIB
GetClipCursor	USER	LIBW.LIB
GetCodeHandle	KERNEL	LIBW.LIB
GetCodeInfo	KERNEL	LIBW.LIB
GetCommError	USER	LIBW.LIB
GetCommEventMask	USER	LIBW.LIB
GetCommState	USER	LIBW.LIB
GetCurrentPDB	KERNEL	LIBW.LIB
GetCurrentPosition	GDI	LIBW.LIB
GetCurrentPositionEx	GDI	LIBW.LIB
GetCurrentTask	KERNEL	LIBW.LIB

GetCurrentTime	USER	LIBW.LIB
GetCursor	USER	LIBW.LIB
GetCursorPos	USER	LIBW.LIB
GetDC	USER	LIBW.LIB
GetDCEx	USER	LIBW.LIB
GetDCOrg	GDI	LIBW.LIB
GetDesktopWindow	USER	LIBW.LIB
GetDeviceCaps	GDI	LIBW.LIB
GetDialogBaseUnits	USER	LIBW.LIB
GetDIBits	GDI	LIBW.LIB
GetDlgCtrlID	USER	LIBW.LIB
GetDlgItem	USER	LIBW.LIB
GetDlgItemInt	USER	LIBW.LIB
GetDlgItemText	USER	LIBW.LIB
GetDOSEnvironment	KERNEL	LIBW.LIB
GetDoubleClickTime	USER	LIBW.LIB
GetDriverInfo	USER	LIBW.LIB
GetDriverModuleHandle	USER	LIBW.LIB
GetDriveType	KERNEL	LIBW.LIB
GetExpandedName	LZEXPAND	LZEXPAND.LIB
GetFileResource	VER	VER.LIB
GetFileResourceSize	VER	VER.LIB
GetFileTitle	COMMDLG	COMMDLG.LIB
GetFileVersionInfo	VER	VER.LIB
GetFileVersionInfoSize	VER	VER.LIB
GetFocus	USER	LIBW.LIB
GetFontData	GDI	LIBW.LIB
GetFreeFileHandles	STRESS	STRESS.LIB
GetFreeSpace	KERNEL	LIBW.LIB
GetFreeSystemResources	USER	LIBW.LIB
GetGlyphOutline	GDI	LIBW.LIB
GetInputState	USER	LIBW.LIB
GetInstanceData	KERNEL	LIBW.LIB
GetKBCodePage	KEYBOARD	LIBW.LIB
GetKerningPairs	GDI	LIBW.LIB
GetKeyboardState	USER	LIBW.LIB
GetKeyboardType	KEYBOARD	LIBW.LIB
GetKeyNameText	KEYBOARD	LIBW.LIB
GetKeyState	USER	LIBW.LIB
GetLastActivePopup	USER	LIBW.LIB
GetMapMode	GDI	LIBW.LIB
GetMenu	USER	LIBW.LIB
GetMenuCheckMarkDimensions	USER	LIBW.LIB
GetMenuItemCount	USER	LIBW.LIB
GetMenuItemID	USER	LIBW.LIB

GetMenuState	USER	LIBW.LIB
GetMenuString	USER	LIBW.LIB
GetMessage	USER	LIBW.LIB
GetMessageExtraInfo	USER	LIBW.LIB
GetMessagePos	USER	LIBW.LIB
GetMessageTime	USER	LIBW.LIB
GetMetaFile	GDI	LIBW.LIB
GetMetaFileBits	GDI	LIBW.LIB
GetModuleFileName	KERNEL	LIBW.LIB
GetModuleHandle	KERNEL	LIBW.LIB
GetModuleUsage	KERNEL	LIBW.LIB
GetNearestColor	GDI	LIBW.LIB
GetNearestPaletteIndex	GDI	LIBW.LIB
GetNextDlgGroupItem	USER	LIBW.LIB
GetNextDlgTabItem	USER	LIBW.LIB
GetNextDriver	USER	LIBW.LIB
GetNextWindow	USER	LIBW.LIB
GetNumTasks	KERNEL	LIBW.LIB
GetObject	GDI	LIBW.LIB
GetOpenClipboardWindow	USER	LIBW.LIB
GetOpenFileName	COMMDLG	COMMDLG.LIB
GetOutlineTextMetrics	GDI	LIBW.LIB
GetPaletteEntries	GDI	LIBW.LIB
GetParent	USER	LIBW.LIB
GetPixel	GDI	LIBW.LIB
GetPolyFillMode	GDI	LIBW.LIB
GetPriorityClipboardFormat	USER	LIBW.LIB
GetPrivateProfileInt	KERNEL	LIBW.LIB
GetPrivateProfileString	KERNEL	LIBW.LIB
GetProcAddress	KERNEL	LIBW.LIB
GetProfileInt	KERNEL	LIBW.LIB
GetProfileString	KERNEL	LIBW.LIB
GetProp	USER	LIBW.LIB
GetQueueStatus	USER	LIBW.LIB
GetRasterizerCaps	GDI	LIBW.LIB
GetRgnBox	GDI	LIBW.LIB
GetROP2	GDI	LIBW.LIB
GetSaveFileName	COMMDLG	COMMDLG.LIB
GetScrollPos	USER	LIBW.LIB
GetScrollRange	USER	LIBW.LIB
GetSelectorBase	KERNEL	LIBW.LIB
GetSelectorLimit	KERNEL	LIBW.LIB
GetStockObject	GDI	LIBW.LIB
GetStretchBltMode	GDI	LIBW.LIB
GetSubMenu	USER	LIBW.LIB

GetSysColor	USER	LIBW.LIB
GetSysModalWindow	USER	LIBW.LIB
GetSystemDebugState	USER	LIBW.LIB
GetSystemDir	—	VERS.LIB
GetSystemDirectory	KERNEL	LIBW.LIB
GetSystemMenu	USER	LIBW.LIB
GetSystemMetrics	USER	LIBW.LIB
GetSystemPaletteEntries	GDI	LIBW.LIB
GetSystemPaletteUse	GDI	LIBW.LIB
GetTabbedTextExtent	USER	LIBW.LIB
GetTempDrive	KERNEL	LIBW.LIB
GetTempFileName	KERNEL	LIBW.LIB
GetTextAlign	GDI	LIBW.LIB
GetTextCharacterExtra	GDI	LIBW.LIB
GetTextColor	GDI	LIBW.LIB
GetTextExtent	GDI	LIBW.LIB
GetTextExtentPoint	GDI	LIBW.LIB
GetTextFace	GDI	LIBW.LIB
GetTextMetrics	GDI	LIBW.LIB
GetTickCount	USER	LIBW.LIB
GetTimerResolution	USER	LIBW.LIB
GetTopWindow	USER	LIBW.LIB
GetUpdateRect	USER	LIBW.LIB
GetUpdateRgn	USER	LIBW.LIB
GetVersion	KERNEL	LIBW.LIB
GetViewportExt	GDI	LIBW.LIB
GetViewportExtEx	GDI	LIBW.LIB
GetViewportOrg	GDI	LIBW.LIB
GetViewportOrgEx	GDI	LIBW.LIB
GetWinDebugInfo	KERNEL	LIBW.LIB
GetWindow	USER	LIBW.LIB
GetWindowDC	USER	LIBW.LIB
GetWindowExt	GDI	LIBW.LIB
GetWindowExtEx	GDI	LIBW.LIB
GetWindowLong	USER	LIBW.LIB
GetWindowOrg	GDI	LIBW.LIB
GetWindowOrgEx	GDI	LIBW.LIB
GetWindowPlacement	USER	LIBW.LIB
GetWindowRect	USER	LIBW.LIB
GetWindowsDir	—	VERS.LIB
GetWindowsDirectory	KERNEL	LIBW.LIB
GetWindowTask	USER	LIBW.LIB
GetWindowText	USER	LIBW.LIB
GetWindowTextLength	USER	LIBW.LIB
GetWindowWord	USER	LIBW.LIB

GetWinFlags	KERNEL	LIBW.LIB
GetWinMem32Version	WINMEM32	WINMEM32.LIB
Global16PointerAlloc	WINMEM32	WINMEM32.LIB
Global16PointerFree	WINMEM32	WINMEM32.LIB
Global32Alloc	WINMEM32	WINMEM32.LIB
Global32CodeAlias	WINMEM32	WINMEM32.LIB
Global32CodeAliasFree	WINMEM32	WINMEM32.LIB
Global32Free	WINMEM32	WINMEM32.LIB
Global32Realloc	WINMEM32	WINMEM32.LIB
GlobalAddAtom	USER	LIBW.LIB
GlobalAlloc	KERNEL	LIBW.LIB
GlobalCompact	KERNEL	LIBW.LIB
GlobalDeleteAtom	USER	LIBW.LIB
GlobalDosAlloc	KERNEL	LIBW.LIB
GlobalDosFree	KERNEL	LIBW.LIB
GlobalEntryHandle	TOOLHELP	TOOLHELP.LIB
GlobalEntryModule	TOOLHELP	TOOLHELP.LIB
GlobalFindAtom	USER	LIBW.LIB
GlobalFirst	TOOLHELP	TOOLHELP.LIB
GlobalFix	KERNEL	LIBW.LIB
GlobalFlags	KERNEL	LIBW.LIB
GlobalFree	KERNEL	LIBW.LIB
GlobalGetAtomName	USER	LIBW.LIB
GlobalHandle	KERNEL	LIBW.LIB
GlobalHandleToSel	TOOLHELP	TOOLHELP.LIB
GlobalInfo	TOOLHELP	TOOLHELP.LIB
GlobalLock	KERNEL	LIBW.LIB
GlobalLRUNewest	KERNEL	LIBW.LIB
GlobalLRUOldest	KERNEL	LIBW.LIB
GlobalNext	TOOLHELP	TOOLHELP.LIB
GlobalNotify	KERNEL	LIBW.LIB
GlobalPageLock	KERNEL	LIBW.LIB
GlobalPageUnlock	KERNEL	LIBW.LIB
GlobalReAlloc	KERNEL	LIBW.LIB
GlobalSize	KERNEL	LIBW.LIB
GlobalUnfix	KERNEL	LIBW.LIB
GlobalUnlock	KERNEL	LIBW.LIB
GlobalUnWire	KERNEL	LIBW.LIB
GlobalWire	KERNEL	LIBW.LIB
GrayString	USER	LIBW.LIB
hardware_event	USER	LIBW.LIB
HelpMessageFilterHookFunction	—	SCRNSAVE.LIB
HideCaret	USER	LIBW.LIB
HiliteMenuItem	USER	LIBW.LIB
hmemcpy	KERNEL	LIBW.LIB

_hread	KERNEL	LIBW.LIB
_hwrite	KERNEL	LIBW.LIB
InflateRect	USER	LIBW.LIB
InitAtomTable	KERNEL	LIBW.LIB
InSendMessage	USER	LIBW.LIB
InsertMenu	USER	LIBW.LIB
InterruptRegister	TOOLHELP	TOOLHELP.LIB
InterruptUnRegister	TOOLHELP	TOOLHELP.LIB
IntersectClipRect	GDI	LIBW.LIB
IntersectRect	USER	LIBW.LIB
InvalidateRect	USER	LIBW.LIB
InvalidateRgn	USER	LIBW.LIB
InvertRect	USER	LIBW.LIB
InvertRgn	GDI	LIBW.LIB
IsBadCodePtr	KERNEL	LIBW.LIB
IsBadHugeReadPtr	KERNEL	LIBW.LIB
IsBadHugeWritePtr	KERNEL	LIBW.LIB
IsBadReadPtr	KERNEL	LIBW.LIB
IsBadStringPtr	KERNEL	LIBW.LIB
IsBadWritePtr	KERNEL	LIBW.LIB
IsCharAlpha	USER	LIBW.LIB
IsCharAlphaNumeric	USER	LIBW.LIB
IsCharLower	USER	LIBW.LIB
IsCharUpper	USER	LIBW.LIB
IsChild	USER	LIBW.LIB
IsClipboardFormatAvailable	USER	LIBW.LIB
IsDBCSLeadByte	KERNEL	LIBW.LIB
IsDialogMessage	USER	LIBW.LIB
IsDlgButtonChecked	USER	LIBW.LIB
IsGDIObject	GDI	LIBW.LIB
IsIconic	USER	LIBW.LIB
IsMenu	USER	LIBW.LIB
IsRectEmpty	USER	LIBW.LIB
IsTask	KERNEL	LIBW.LIB
IsWindow	USER	LIBW.LIB
IsWindowEnabled	USER	LIBW.LIB
IsWindowVisible	USER	LIBW.LIB
IsZoomed	USER	LIBW.LIB
KillTimer	USER	LIBW.LIB
_lclose	KERNEL	LIBW.LIB
_lcreat	KERNEL	LIBW.LIB
LimitEmsPages	KERNEL	LIBW.LIB
LineDDA	GDI	LIBW.LIB
LineTo	GDI	LIBW.LIB
_llseek	KERNEL	LIBW.LIB

LoadAccelerators	USER	LIBW.LIB
LoadBitmap	USER	LIBW.LIB
LoadCursor	USER	LIBW.LIB
LoadIcon	USER	LIBW.LIB
LoadLibrary	KERNEL	LIBW.LIB
LoadMenu	USER	LIBW.LIB
LoadMenuIndirect	USER	LIBW.LIB
LoadModule	KERNEL	LIBW.LIB
LoadResource	KERNEL	LIBW.LIB
LoadString	USER	LIBW.LIB
LocalAlloc	KERNEL	LIBW.LIB
LocalCompact	KERNEL	LIBW.LIB
LocalFirst	TOOLHELP	TOOLHELP.LIB
LocalFlags	KERNEL	LIBW.LIB
LocalFree	KERNEL	LIBW.LIB
LocalHandle	KERNEL	LIBW.LIB
LocalInfo	TOOLHELP	TOOLHELP.LIB
LocalInit	KERNEL	LIBW.LIB
LocalLock	KERNEL	LIBW.LIB
LocalNext	TOOLHELP	TOOLHELP.LIB
LocalReAlloc	KERNEL	LIBW.LIB
LocalShrink	KERNEL	LIBW.LIB
LocalSize	KERNEL	LIBW.LIB
LocalUnlock	KERNEL	LIBW.LIB
LockInput	USER	LIBW.LIB
LockResource	KERNEL	LIBW.LIB
LockSegment	KERNEL	LIBW.LIB
LockWindowUpdate	USER	LIBW.LIB
LogError	KERNEL	LIBW.LIB
LogParamError	KERNEL	LIBW.LIB
_lopen	KERNEL	LIBW.LIB
LPtoDP	GDI	LIBW.LIB
_lread	KERNEL	LIBW.LIB
lstrcat	KERNEL	LIBW.LIB
lstrcmp	USER	LIBW.LIB
lstrcmpi	USER	LIBW.LIB
lstrcpy	KERNEL	LIBW.LIB
lstrlen	KERNEL	LIBW.LIB
_lwrite	KERNEL	LIBW.LIB
LZClose	LZEXPAND	LZEXPAND.LIB
LZCopy	LZEXPAND	LZEXPAND.LIB
LZDone	LZEXPAND	LZEXPAND.LIB
LZInit	LZEXPAND	LZEXPAND.LIB
LZOpenFile	LZEXPAND	LZEXPAND.LIB
LZRead	LZEXPAND	LZEXPAND.LIB

LZSeek	LZEXPAND	LZEXPAND.LIB
LZStart	LZEXPAND	LZEXPAND.LIB
MakeProcInstance	KERNEL	LIBW.LIB
MapDialogRect	USER	LIBW.LIB
MapVirtualKey	KEYBOARD	LIBW.LIB
MapWindowPoints	USER	LIBW.LIB
MemManInfo	TOOLHELP	TOOLHELP.LIB
MemoryRead	TOOLHELP	TOOLHELP.LIB
MemoryWrite	TOOLHELP	TOOLHELP.LIB
MessageBeep	USER	LIBW.LIB
MessageBox	USER	LIBW.LIB
ModifyMenu	USER	LIBW.LIB
ModuleFindHandle	TOOLHELP	TOOLHELP.LIB
ModuleFindName	TOOLHELP	TOOLHELP.LIB
ModuleFirst	TOOLHELP	TOOLHELP.LIB
ModuleNext	TOOLHELP	TOOLHELP.LIB
MoveTo	GDI	LIBW.LIB
MoveToEx	GDI	LIBW.LIB
MoveWindow	USER	LIBW.LIB
MulDiv	GDI	LIBW.LIB
NetBIOSCall	KERNEL	LIBW.LIB
NotifyRegister	TOOLHELP	TOOLHELP.LIB
NotifyUnRegister	TOOLHELP	TOOLHELP.LIB
OemKeyScan	KEYBOARD	LIBW.LIB
OemToAnsi	KEYBOARD	LIBW.LIB
OemToAnsiBuff	KEYBOARD	LIBW.LIB
OffsetClipRgn	GDI	LIBW.LIB
OffsetRect	USER	LIBW.LIB
OffsetRgn	GDI	LIBW.LIB
OffsetViewportOrg	GDI	LIBW.LIB
OffsetViewportOrgEx	GDI	LIBW.LIB
OffsetWindowOrg	GDI	LIBW.LIB
OffsetWindowOrgEx	GDI	LIBW.LIB
OleActivate	OLECLI	OLECLI.LIB
OleBlockServer	OLESVR	OLESVR.LIB
OleClone	OLECLI	OLECLI.LIB
OleClose	OLECLI	OLECLI.LIB
OleCopyFromLink	OLECLI	OLECLI.LIB
OleCopyToClipboard	OLECLI	OLECLI.LIB
OleCreate	OLECLI	OLECLI.LIB
OleCreateFromClip	OLECLI	OLECLI.LIB
OleCreateFromFile	OLECLI	OLECLI.LIB
OleCreateFromTemplate	OLECLI	OLECLI.LIB
OleCreateInvisible	OLECLI	OLECLI.LIB
OleCreateLinkFromClip	OLECLI	OLECLI.LIB

OleCreateLinkFromFile	OLECLI	OLECLI.LIB
OleDelete	OLECLI	OLECLI.LIB
OleDraw	OLECLI	OLECLI.LIB
OleEnumFormats	OLECLI	OLECLI.LIB
OleEnumObjects	OLECLI	OLECLI.LIB
OleEqual	OLECLI	OLECLI.LIB
OleExecute	OLECLI	OLECLI.LIB
OleGetData	OLECLI	OLECLI.LIB
OleGetLinkUpdateOptions	OLECLI	OLECLI.LIB
OleIsDcMeta	OLECLI	OLECLI.LIB
OleLoadFromStream	OLECLI	OLECLI.LIB
OleLockServer	OLECLI	OLECLI.LIB
OleObjectConvert	OLECLI	OLECLI.LIB
OleQueryBounds	OLECLI	OLECLI.LIB
OleQueryClientVersion	OLECLI	OLECLI.LIB
OleQueryCreateFromClip	OLECLI	OLECLI.LIB
OleQueryLinkFromClip	OLECLI	OLECLI.LIB
OleQueryName	OLECLI	OLECLI.LIB
OleQueryOpen	OLECLI	OLECLI.LIB
OleQueryOutOfDate	OLECLI	OLECLI.LIB
OleQueryProtocol	OLECLI	OLECLI.LIB
OleQueryReleaseError	OLECLI	OLECLI.LIB
OleQueryReleaseMethod	OLECLI	OLECLI.LIB
OleQueryReleaseStatus	OLECLI	OLECLI.LIB
OleQueryServerVersion	OLESVR	OLESVR.LIB
OleQuerySize	OLECLI	OLECLI.LIB
OleQueryType	OLECLI	OLECLI.LIB
OleReconnect	OLECLI	OLECLI.LIB
OleRegisterClientDoc	OLECLI	OLECLI.LIB
OleRegisterServer	OLESVR	OLESVR.LIB
OleRegisterServerDoc	OLESVR	OLESVR.LIB
OleRelease	OLECLI	OLECLI.LIB
OleRename	OLECLI	OLECLI.LIB
OleRenameClientDoc	OLECLI	OLECLI.LIB
OleRenameServerDoc	OLESVR	OLESVR.LIB
OleRequestData	OLECLI	OLECLI.LIB
OleRevertClientDoc	OLECLI	OLECLI.LIB
OleRevertServerDoc	OLESVR	OLESVR.LIB
OleRevokeClientDoc	OLECLI	OLECLI.LIB
OleRevokeObject	OLESVR	OLESVR.LIB
OleRevokeServer	OLESVR	OLESVR.LIB
OleRevokeServerDoc	OLESVR	OLESVR.LIB
OleSavedClientDoc	OLECLI	OLECLI.LIB
OleSavedServerDoc	OLESVR	OLESVR.LIB
OleSaveToStream	OLECLI	OLECLI.LIB

OleSetBounds	OLECLI	OLECLI.LIB
OleSetColorScheme	OLECLI	OLECLI.LIB
OleSetData	OLECLI	OLECLI.LIB
OleSetHostNames	OLECLI	OLECLI.LIB
OleSetLinkUpdateOptions	OLECLI	OLECLI.LIB
OleSetTargetDevice	OLECLI	OLECLI.LIB
OleUnblockServer	OLESVR	OLESVR.LIB
OleUnlockServer	OLECLI	OLECLI.LIB
OleUpdate	OLECLI	OLECLI.LIB
OpenClipboard	USER	LIBW.LIB
OpenComm	USER	LIBW.LIB
OpenDriver	USER	LIBW.LIB
OpenFile	LZEXPAND	LZEXPAND.LIB
OpenIcon	USER	LIBW.LIB
OutputDebugString	KERNEL	LIBW.LIB
PaintRgn	GDI	LIBW.LIB
PatBlt	GDI	LIBW.LIB
PeekMessage	USER	LIBW.LIB
Pie	GDI	LIBW.LIB
PlayMetaFile	GDI	LIBW.LIB
PlayMetaFileRecord	GDI	LIBW.LIB
Polygon	GDI	LIBW.LIB
Polyline	GDI	LIBW.LIB
PolyPolygon	GDI	LIBW.LIB
PostAppMessage	USER	LIBW.LIB
PostMessage	USER	LIBW.LIB
PostQuitMessage	USER	LIBW.LIB
PrestoChangoSelector	KERNEL	LIBW.LIB
PrintDlg	COMMDLG	COMMDLG.LIB
ProfClear	—	LIBW.LIB
ProfFinish	—	LIBW.LIB
ProfFlush	—	LIBW.LIB
ProfInsChk	—	LIBW.LIB
ProfSampRate	—	LIBW.LIB
ProfSetup	—	LIBW.LIB
ProfStart	—	LIBW.LIB
ProfStop	—	LIBW.LIB
PtInRect	USER	LIBW.LIB
PtInRegion	GDI	LIBW.LIB
PtVisible	GDI	LIBW.LIB
QueryAbort	GDI	LIBW.LIB
QuerySendMessage	USER	LIBW.LIB
ReadComm	USER	LIBW.LIB
RealizePalette	USER	LIBW.LIB
Rectangle	GDI	LIBW.LIB

RectInRegion	GDI	LIBW.LIB
RectVisible	GDI	LIBW.LIB
RedrawWindow	USER	LIBW.LIB
RegCloseKey	SHELL	SHELL.LIB
RegCreateKey	SHELL	SHELL.LIB
RegDeleteKey	SHELL	SHELL.LIB
RegEnumKey	SHELL	SHELL.LIB
RegisterClass	USER	LIBW.LIB
RegisterClipboardFormat	USER	LIBW.LIB
RegisterWindowMessage	USER	LIBW.LIB
RegOpenKey	SHELL	SHELL.LIB
RegQueryValue	SHELL	SHELL.LIB
RegSetValue	SHELL	SHELL.LIB
ReleaseCapture	USER	LIBW.LIB
ReleaseDC	USER	LIBW.LIB
RemoveFontResource	GDI	LIBW.LIB
RemoveMenu	USER	LIBW.LIB
RemoveProp	USER	LIBW.LIB
ReplaceText	COMMDLG	COMMDLG.LIB
ReplyMessage	USER	LIBW.LIB
ResetDC	GDI	LIBW.LIB
ResizePalette	GDI	LIBW.LIB
RestoreDC	GDI	LIBW.LIB
RoundRect	GDI	LIBW.LIB
SaveDC	GDI	LIBW.LIB
ScaleViewportExt	GDI	LIBW.LIB
ScaleViewportExtEx	GDI	LIBW.LIB
ScaleWindowExt	GDI	LIBW.LIB
ScaleWindowExtEx	GDI	LIBW.LIB
ScreenSaverProc	—	SCRNSAVE.LIB
ScreenToClient	USER	LIBW.LIB
ScrollDC	USER	LIBW.LIB
ScrollWindow	USER	LIBW.LIB
ScrollWindowEx	USER	LIBW.LIB
SelectClipRgn	GDI	LIBW.LIB
SelectObject	GDI	LIBW.LIB
SelectPalette	USER	LIBW.LIB
SendDlgItemMessage	USER	LIBW.LIB
SendDriverMessage	USER	LIBW.LIB
SendMessage	USER	LIBW.LIB
SetAbortProc	GDI	LIBW.LIB
SetActiveWindow	USER	LIBW.LIB
SetBitmapBits	GDI	LIBW.LIB
SetBitmapDimension	GDI	LIBW.LIB
SetBitmapDimensionEx	GDI	LIBW.LIB

SetBkColor	GDI	LIBW.LIB
SetBkMode	GDI	LIBW.LIB
SetBoundsRect	GDI	LIBW.LIB
SetBrushOrg	GDI	LIBW.LIB
SetCapture	USER	LIBW.LIB
SetCaretBlinkTime	USER	LIBW.LIB
SetCaretPos	USER	LIBW.LIB
SetClassLong	USER	LIBW.LIB
SetClassWord	USER	LIBW.LIB
SetClipboardData	USER	LIBW.LIB
SetClipboardViewer	USER	LIBW.LIB
SetCommBreak	USER	LIBW.LIB
SetCommEventMask	USER	LIBW.LIB
SetCommState	USER	LIBW.LIB
SetCursor	USER	LIBW.LIB
SetCursorPos	USER	LIBW.LIB
SetDIBits	GDI	LIBW.LIB
SetDIBitsToDevice	GDI	LIBW.LIB
SetDlgItemInt	USER	LIBW.LIB
SetDlgItemText	USER	LIBW.LIB
SetDoubleClickTime	USER	LIBW.LIB
SetErrorMode	KERNEL	LIBW.LIB
SetFocus	USER	LIBW.LIB
SetHandleCount	KERNEL	LIBW.LIB
SetKeyboardState	USER	LIBW.LIB
SetMapMode	GDI	LIBW.LIB
SetMapperFlags	GDI	LIBW.LIB
SetMenu	USER	LIBW.LIB
SetMenuItemBitmaps	USER	LIBW.LIB
SetMessageQueue	USER	LIBW.LIB
SetMetaFileBits	GDI	LIBW.LIB
SetMetaFileBitsBetter	GDI	LIBW.LIB
SetPaletteEntries	GDI	LIBW.LIB
SetParent	USER	LIBW.LIB
SetPixel	GDI	LIBW.LIB
SetPolyFillMode	GDI	LIBW.LIB
SetProp	USER	LIBW.LIB
SetRect	USER	LIBW.LIB
SetRectEmpty	USER	LIBW.LIB
SetRectRgn	GDI	LIBW.LIB
SetResourceHandler	KERNEL	LIBW.LIB
SetROP2	GDI	LIBW.LIB
SetScrollPos	USER	LIBW.LIB
SetScrollRange	USER	LIBW.LIB
SetSelectorBase	KERNEL	LIBW.LIB

SetSelectorLimit	KERNEL	LIBW.LIB
SetStretchBltMode	GDI	LIBW.LIB
SetSwapAreaSize	KERNEL	LIBW.LIB
SetSysColors	USER	LIBW.LIB
SetSysModalWindow	USER	LIBW.LIB
SetSystemPaletteUse	GDI	LIBW.LIB
SetTextAlign	GDI	LIBW.LIB
SetTextCharacterExtra	GDI	LIBW.LIB
SetTextColor	GDI	LIBW.LIB
SetTextJustification	GDI	LIBW.LIB
SetTimer	USER	LIBW.LIB
SetViewportExt	GDI	LIBW.LIB
SetViewportExtEx	GDI	LIBW.LIB
SetViewportOrg	GDI	LIBW.LIB
SetViewportOrgEx	GDI	LIBW.LIB
SetWinDebugInfo	KERNEL	LIBW.LIB
SetWindowExt	GDI	LIBW.LIB
SetWindowExtEx	GDI	LIBW.LIB
SetWindowLong	USER	LIBW.LIB
SetWindowOrg	GDI	LIBW.LIB
SetWindowOrgEx	GDI	LIBW.LIB
SetWindowPlacement	USER	LIBW.LIB
SetWindowPos	USER	LIBW.LIB
SetWindowsHook	USER	LIBW.LIB
SetWindowsHookEx	USER	LIBW.LIB
SetWindowText	USER	LIBW.LIB
SetWindowWord	USER	LIBW.LIB
ShellExecute	SHELL	SHELL.LIB
ShowCaret	USER	LIBW.LIB
ShowCursor	USER	LIBW.LIB
ShowOwnedPopups	USER	LIBW.LIB
ShowScrollBar	USER	LIBW.LIB
ShowWindow	USER	LIBW.LIB
SizeofResource	KERNEL	LIBW.LIB
SpoolFile	GDI	LIBW.LIB
StackTraceCSIPFirst	TOOLHELP	TOOLHELP.LIB
StackTraceFirst	TOOLHELP	TOOLHELP.LIB
StackTraceNext	TOOLHELP	TOOLHELP.LIB
StartDoc	GDI	LIBW.LIB
StartPage	GDI	LIBW.LIB
StretchBlt	GDI	LIBW.LIB
StretchDIBits	GDI	LIBW.LIB
SubtractRect	USER	LIBW.LIB
SwapMouseButton	USER	LIBW.LIB
SwapRecording	KERNEL	LIBW.LIB

SwitchStackBack	KERNEL	LIBW.LIB
SwitchStackTo	KERNEL	LIBW.LIB
SystemHeapInfo	TOOLHELP	TOOLHELP.LIB
SystemParametersInfo	USER	LIBW.LIB
TabbedTextOut	USER	LIBW.LIB
TaskFindHandle	TOOLHELP	TOOLHELP.LIB
TaskFirst	TOOLHELP	TOOLHELP.LIB
TaskGetCSIP	TOOLHELP	TOOLHELP.LIB
TaskNext	TOOLHELP	TOOLHELP.LIB
TaskSetCSIP	TOOLHELP	TOOLHELP.LIB
TaskSwitch	TOOLHELP	TOOLHELP.LIB
TerminateApp	TOOLHELP	TOOLHELP.LIB
TextOut	GDI	LIBW.LIB
Throw	KERNEL	LIBW.LIB
TimerCount	TOOLHELP	TOOLHELP.LIB
ToAscii	KEYBOARD	LIBW.LIB
TrackPopupMenu	USER	LIBW.LIB
TranslateAccelerator	USER	LIBW.LIB
TranslateMDISysAccel	USER	LIBW.LIB
TranslateMessage	USER	LIBW.LIB
TransmitCommChar	USER	LIBW.LIB
UnAllocDiskSpace	STRESS	STRESS.LIB
UnAllocFileHandles	STRESS	STRESS.LIB
UngetCommChar	USER	LIBW.LIB
UnhookWindowsHook	USER	LIBW.LIB
UnhookWindowsHookEx	USER	LIBW.LIB
UnionRect	USER	LIBW.LIB
UnlockSegment	KERNEL	LIBW.LIB
UnrealizeObject	GDI	LIBW.LIB
UnregisterClass	USER	LIBW.LIB
UpdateColors	GDI	LIBW.LIB
UpdateWindow	USER	LIBW.LIB
ValidateCodeSegments	KERNEL	LIBW.LIB
ValidateFreeSpaces	KERNEL	LIBW.LIB
ValidateRect	USER	LIBW.LIB
ValidateRgn	USER	LIBW.LIB
VerFindFile	VER	VER.LIB
VerInstallFile	VER	VER.LIB
VerLanguageName	VER	VER.LIB
VerQueryValue	VER	VER.LIB
VkKeyScan	KEYBOARD	LIBW.LIB
WaitMessage	USER	LIBW.LIB
WindowFromPoint	USER	LIBW.LIB
WinExec	KERNEL	LIBW.LIB
WinHelp	USER	LIBW.LIB

WNetAddConnection	USER	LIBW.LIB
WNetCancelConnection	USER	LIBW.LIB
WNetGetConnection	USER	LIBW.LIB
WriteComm	USER	LIBW.LIB
WritePrivateProfileString	KERNEL	LIBW.LIB
WriteProfileString	KERNEL	LIBW.LIB
_wsprintf	USER	LIBW.LIB
wvsprintf	USER	LIBW.LIB
Yield	KERNEL	LIBW.LIB

Binary and Ternary Raster-Operation Codes

This topic lists and describes the binary and ternary raster operations used by graphics device interface (GDI). A binary raster operation involves two operands: a pen and a destination bitmap. A ternary raster operation involves three operands: a source bitmap, a brush, and a destination bitmap. Both binary and ternary raster operations use Boolean operators.

Binary Raster Operations

This section lists the binary raster-operation codes used by the **GetROP2** and **SetROP2** functions. Raster-operation codes define how GDI combines the bits from the selected pen with the bits in the destination bitmap.

Each raster-operation code represents a Boolean operation in which the values of the pixels in the selected pen and the destination bitmap are combined. Following are the two operands used in these operations:

Operand	Meaning
P	Selected pen
D	Destination bitmap

The Boolean operators used in these operations follow:

Operator	Meaning
a	Bitwise AND
n	Bitwise NOT (inverse)
o	Bitwise OR
x	Bitwise exclusive OR (XOR)

All Boolean operations are presented in reverse Polish notation. For example, the following operation replaces the values of the pixels in the destination bitmap with a combination of the pixel values of the pen and the selected brush:

```
DPo
```

Each raster-operation code is a 32-bit integer whose high-order word is a Boolean operation index and whose low-order word is the operation code. The 16-bit operation index is a zero-extended 8-bit value that represents all possible outcomes resulting from the Boolean operation on two parameters (in this case, the pen and destination values). For example, the operation indexes for the DPo and DPan operations are shown in the following list:

P	D	DPo	DPan
0	0	0	1
0	1	1	1
1	0	1	1
1	1	1	0

The following list outlines the drawing modes and the Boolean operations that they represent:

Raster operation	Boolean operation
R2_BLACK	0
R2_COPYPEN	P
R2_MASKNOTPEN	DPna
R2_MASKPEN	DPa
R2_MASKPENNOT	PDna
R2_MERGENOTPEN	DPno
R2_MERGEPEN	DPo

R2_MERGEPENNOT	PDno
R2_NOP	D
R2_NOT	Dn
R2_NOTCOPYPEN	Pn
R2_NOTMASKPEN	DPan
R2_NOTMERGEPEN	DPon
R2_NOTXORPEN	DPxn
R2_WHITE	1
R2_XORPEN	DPx

For a monochrome device, GDI maps the value zero to black and the value 1 to white. If an application attempts to draw with a black pen on a white destination by using the available binary raster operations, the following results occur:

Raster operation	Result
R2_BLACK	Visible black line
R2_COPYPEN	Visible black line
R2_MASKNOTPEN	No visible line
R2_MASKPEN	Visible black line
R2_MASKPENNOT	Visible black line
R2_MERGENOTPEN	No visible line
R2_MERGEPEN	Visible black line
R2_MERGEPENNOT	Visible black line
R2_NOP	No visible line
R2_NOT	Visible black line
R2_NOTCOPYPEN	No visible line
R2_NOTMASKPEN	No visible line
R2_NOTMERGEPEN	Visible black line
R2_NOTXORPEN	Visible black line
R2_WHITE	No visible line
R2_XORPEN	No visible line

For a color device, GDI uses **RGB** values to represent the colors of the pen and the destination. An RGB color value is a long integer that contains a red, a green, and a blue color field, each specifying the intensity of the given color. Intensities range from 0 through 255. The values are packed in the three low-order bytes of the long integer. The color of a pen is always a solid color, but the color of the destination may be a mixture of any two or three colors. If an application attempts to draw with a white pen on a blue destination by using the available binary raster operations, the following results occur:

Raster operation	Result
R2_BLACK	Visible black line
R2_COPYPEN	Visible white line
R2_MASKNOTPEN	Visible black line
R2_MASKPEN	Invisible blue line
R2_MASKPENNOT	Visible red/green line
R2_MERGENOTPEN	Invisible blue line
R2_MERGEPEN	Visible white line
R2_MERGEPENNOT	Visible white line
R2_NOP	Invisible blue line
R2_NOT	Visible red/green line

R2_NOTCOPYPEN	Visible black line
R2_NOTMASKPEN	Visible red/green line
R2_NOTMERGEPEN	Visible black line
R2_NOTXORPEN	Invisible blue line
R2_WHITE	Visible white line
R2_XORPEN	Visible red/green line

Ternary Raster Operations

This section lists the ternary raster-operation codes used by the **BitBlt**, **PatBlt**, and **StretchBlt** functions. Ternary raster-operation codes define how GDI combines the bits in a source bitmap with the bits in the destination bitmap.

Each raster-operation code represents a Boolean operation in which the values of the pixels in the source, the selected brush, and the destination are combined. Following are the three operands used in these operations:

Operand	Meaning
D	Destination bitmap
P	Selected brush (also called pattern)
S	Source bitmap

Boolean operators used in these operations follow:

Operator	Meaning
a	Bitwise AND
n	Bitwise NOT (inverse)
o	Bitwise OR
x	Bitwise exclusive OR (XOR)

All Boolean operations are presented in reverse Polish notation. For example, the following operation replaces the values of the pixels in the destination bitmap with a combination of the pixel values of the source and brush:

```
PSo
```

The following operation combines the values of the pixels in the source and brush with the pixel values of the destination bitmap (there are alternative spellings of the same function, so although a particular spelling may not be in the list, an equivalent form would be):

```
DPSoo
```

Each raster-operation code is a 32-bit integer whose high-order word is a Boolean operation index and whose low-order word is the operation code. The 16-bit operation index is a zero-extended, 8-bit value that represents the result of the Boolean operation on predefined brush, source, and destination values. For example, the operation indexes for the PSo and DPSoo operations are shown in the following list:

P	S	D	PSo	DPSoo
0	0	0	0	0
0	0	1	0	1
0	1	0	1	1
0	1	1	1	1
1	0	0	1	1
1	0	1	1	1
1	1	0	1	1
1	1	1	1	1

Operation index: 00FCh 00FEh

In this case, PSo has the operation index 00FC (read from the bottom up); DPSoo has the operation index 00FE. These values define the location of the corresponding raster-operation codes, as shown in Table A.1, "Raster-Operation Codes." The PSo operation is in line 252 (00FCh) of the table; DPSoo is in line 254 (00FEh).

The most commonly used raster operations have been given special names in the Windows include file, WINDOWS.H. You should use these names whenever possible in your applications.

When the source and destination bitmaps are monochrome, a bit value of zero represents a black pixel and a bit value of 1 represents a white pixel. When the source and the destination bitmaps are color, those colors are represented with **RGB** values. For more information about RGB values, see the **RGB** structure in Chapter 3, "Structures."

Boolean function (hexadecimal)	**Raster operation (hexadecimal)**	**Boolean function in reverse Polish**	**Common name**
00	00000042	0	BLACKNESS
01	00010289	DPSoon	-
02	00020C89	DPSona	-
03	000300AA	PSon	-
04	00040C88	SDPona	-
05	000500A9	DPon	-
06	00060865	PDSxnon	-
07	000702C5	PDSaon	-
08	00080F08	SDPnaa	-
09	00090245	PDSxon	-
0A	000A0329	DPna	-
0B	000B0B2A	PSDnaon	-
0C	000C0324	SPna	-
0D	000D0B25	PDSnaon	-
0E	000E08A5	PDSonon	-
0F	000F0001	Pn	-
10	00100C85	PDSona	-
11	001100A6	DSon	NOTSRCERASE
12	00120868	SDPxnon	-
13	001302C8	SDPaon	-
14	00140869	DPSxnon	-
15	001502C9	DPSaon	-
16	00165CCA	PSDPSanaxx	-
17	00171D54	SSPxDSxaxn	-
18	00180D59	SPxPDxa	-
19	00191CC8	SDPSanaxn	-
1A	001A06C5	PDSPaox	-
1B	001B0768	SDPSxaxn	-
1C	001C06CA	PSDPaox	-
1D	001D0766	DSPDxaxn	-
1E	001E01A5	PDSox	-
1F	001F0385	PDSoan	-
20	00200F09	DPSnaa	-

21	00210248	SDPxon	-
22	00220326	DSna	-
23	00230B24	SPDnaon	-
24	00240D55	SPxDSxa	-
25	00251CC5	PDSPanaxn	-
26	002606C8	SDPSaox	-
27	00271868	SDPSxnox	-
28	00280369	DPSxa	-
29	002916CA	PSDPSaoxxn	-
2A	002A0CC9	DPSana	-
2B	002B1D58	SSPxPDxaxn	-
2C	002C0784	SPDSoax	-
2D	002D060A	PSDnox	-
2E	002E064A	PSDPxox	-
2F	002F0E2A	PSDnoan	-
30	0030032A	PSna	-
31	00310B28	SDPnaon	-
32	00320688	SDPSoox	-
33	00330008	Sn	NOTSRCCOPY
34	003406C4	SPDSaox	-
35	00351864	SPDSxnox	-
36	003601A8	SDPox	-
37	00370388	SDPoan	-
38	0038078A	PSDPoax	-
39	00390604	SPDnox	-
3A	003A0644	SPDSxox	-
3B	003B0E24	SPDnoan	-
3C	003C004A	PSx	-
3D	003D18A4	SPDSonox	-
3E	003E1B24	SPDSnaox	-
3F	003F00EA	PSan	-
40	00400F0A	PSDnaa	-
41	00410249	DPSxon	-
42	00420D5D	SDxPDxa	-
43	00431CC4	SPDSanaxn	-
44	00440328	SDna	SRCERASE
45	00450B29	DPSnaon	-
46	004606C6	DSPDaox	-
47	0047076A	PSDPxaxn	-
48	00480368	SDPxa	-
49	004916C5	PDSPDaoxxn	-
4A	004A0789	DPSDoax	-
4B	004B0605	PDSnox	-
4C	004C0CC8	SDPana	-
4D	004D1954	SSPxDSxoxn	-

4E	004E0645	PDSPxox	-
4F	004F0E25	PDSnoan	-
50	00500325	PDna	-
51	00510B26	DSPnaon	-
52	005206C9	DPSDaox	-
53	00530764	SPDSxaxn	-
54	005408A9	DPSonon	-
55	00550009	Dn	DSTINVERT
56	005601A9	DPSox	-
57	00570389	DPSoan	-
58	00580785	PDSPoax	-
59	00590609	DPSnox	-
5A	005A0049	DPx	PATINVERT
5B	005B18A9	DPSDonox	-
5C	005C0649	DPSDxox	-
5D	005D0E29	DPSnoan	-
5E	005E1B29	DPSDnaox	-
5F	005F00E9	DPan	-
60	00600365	PDSxa	-
61	006116C6	DSPDSaoxxn	-
62	00620786	DSPDoax	-
63	00630608	SDPnox	-
64	00640788	SDPSoax	-
65	00650606	DSPnox	-
66	00660046	DSx	SRCINVERT
67	006718A8	SDPSonox	-
68	006858A6	DSPDSonoxxn	-
69	00690145	PDSxxn	-
6A	006A01E9	DPSax	-
6B	006B178A	PSDPSoaxxn	-
6C	006C01E8	SDPax	-
6D	006D1785	PDSPDoaxxn	-
6E	006E1E28	SDPSnoax	-
6F	006F0C65	PDSxnan	-
70	00700CC5	PDSana	-
71	00711D5C	SSDxPDxaxn	-
72	00720648	SDPSxox	-
73	00730E28	SDPnoan	-
74	00740646	DSPDxox	-
75	00750E26	DSPnoan	-
76	00761B28	SDPSnaox	-
77	007700E6	DSan	-
78	007801E5	PDSax	-
79	00791786	DSPDSoaxxn	-
7A	007A1E29	DPSDnoax	-

7B	007B0C68	SDPxnan	-
7C	007C1E24	SPDSnoax	-
7D	007D0C69	DPSxnan	-
7E	007E0955	SPxDSxo	-
7F	007F03C9	DPSaan	-
80	008003E9	DPSaa	-
81	00810975	SPxDSxon	-
82	00820C49	DPSxna	-
83	00831E04	SPDSnoaxn	-
84	00840C48	SDPxna	-
85	00851E05	PDSPnoaxn	-
86	008617A6	DSPDSoaxx	-
87	008701C5	PDSaxn	-
88	008800C6	DSa	SRCAND
89	00891B08	SDPSnaoxn	-
8A	008A0E06	DSPnoa	-
8B	008B0666	DSPDxoxn	-
8C	008C0E08	SDPnoa	-
8D	008D0668	SDPSxoxn	-
8E	008E1D7C	SSDxPDxax	-
8F	008F0CE5	PDSanan	-
90	00900C45	PDSxna	-
91	00911E08	SDPSnoaxn	-
92	009217A9	DPSDPoaxx	-
93	009301C4	SPDaxn	-
94	009417AA	PSDPSoaxx	-
95	009501C9	DPSaxn	-
96	00960169	DPSxx	-
97	0097588A	PSDPSonoxx	-
98	00981888	SDPSonoxn	-
99	00990066	DSxn	-
9A	009A0709	DPSnax	-
9B	009B07A8	SDPSoaxn	-
9C	009C0704	SPDnax	-
9D	009D07A6	DSPDoaxn	-
9E	009E16E6	DSPDSaoxx	-
9F	009F0345	PDSxan	-
A0	00A000C9	DPa	-
A1	00A11B05	PDSPnaoxn	-
A2	00A20E09	DPSnoa	-
A3	00A30669	DPSDxoxn	-
A4	00A41885	PDSPonoxn	-
A5	00A50065	PDxn	-
A6	00A60706	DSPnax	-
A7	00A707A5	PDSPoaxn	-

A8	00A803A9	DPSoa	-
A9	00A90189	DPSoxn	-
AA	00AA0029	D	-
AB	00AB0889	DPSono	-
AC	00AC0744	SPDSxax	-
AD	00AD06E9	DPSDaoxn	-
AE	00AE0B06	DSPnao	-
AF	00AF0229	DPno	-
B0	00B00E05	PDSnoa	-
B1	00B10665	PDSPxoxn	-
B2	00B21974	SSPxDSxox	-
B3	00B30CE8	SDPanan	-
B4	00B4070A	PSDnax	-
B5	00B507A9	DPSDoaxn	-
B6	00B616E9	DPSDPaoxx	-
B7	00B70348	SDPxan	-
B8	00B8074A	PSDPxax	-
B9	00B906E6	DSPDaoxn	-
BA	00BA0B09	DPSnao	-
BB	00BB0226	DSno	MERGEPAINT
BC	00BC1CE4	SPDSanax	-
BD	00BD0D7D	SDxPDxan	-
BE	00BE0269	DPSxo	-
BF	00BF08C9	DPSano	-
C0	00C000CA	PSa	MERGECOPY
C1	00C11B04	SPDSnaoxn	-
C2	00C21884	SPDSonoxn	-
C3	00C3006A	PSxn	-
C4	00C40E04	SPDnoa	-
C5	00C50664	SPDSxoxn	-
C6	00C60708	SDPnax	-
C7	00C707AA	PSDPoaxn	-
C8	00C803A8	SDPoa	-
C9	00C90184	SPDoxn	-
CA	00CA0749	DPSDxax	-
CB	00CB06E4	SPDSaoxn	-
CC	00CC0020	S	SRCCOPY
CD	00CD0888	SDPono	-
CE	00CE0B08	SDPnao	-
CF	00CF0224	SPno	-
D0	00D00E0A	PSDnoa	-
D1	00D1066A	PSDPxoxn	-
D2	00D20705	PDSnax	-
D3	00D307A4	SPDSoaxn	-
D4	00D41D78	SSPxPDxax	-

D5	00D50CE9	DPSanan	-
D6	00D616EA	PSDPSaoxx	-
D7	00D70349	DPSxan	-
D8	00D80745	PDSPxax	-
D9	00D906E8	SDPSaoxn	-
DA	00DA1CE9	DPSDanax	-
DB	00DB0D75	SPxDSxan	-
DC	00DC0B04	SPDnao	-
DD	00DD0228	SDno	-
DE	00DE0268	SDPxo	-
DF	00DF08C8	SDPano	-
E0	00E003A5	PDSoa	-
E1	00E10185	PDSoxn	-
E2	00E20746	DSPDxax	-
E3	00E306EA	PSDPaoxn	-
E4	00E40748	SDPSxax	-
E5	00E506E5	PDSPaoxn	-
E6	00E61CE8	SDPSanax	-
E7	00E70D79	SPxPDxan	-
E8	00E81D74	SSPxDSxax	-
E9	00E95CE6	DSPDSanaxxn	-
EA	00EA02E9	DPSao	-
EB	00EB0849	DPSxno	-
EC	00EC02E8	SDPao	-
ED	00ED0848	SDPxno	-
EE	00EE0086	DSo	SRCPAINT
EF	00EF0A08	SDPnoo	-
F0	00F00021	P	PATCOPY
F1	00F10885	PDSono	-
F2	00F20B05	PDSnao	-
F3	00F3022A	PSno	-
F4	00F40B0A	PSDnao	-
F5	00F50225	PDno	-
F6	00F60265	PDSxo	-
F7	00F708C5	PDSano	-
F8	00F802E5	PDSao	-
F9	00F90845	PDSxno	-
FA	00FA0089	DPo	-
FB	00FB0A09	DPSnoo	PATPAINT
FC	00FC008A	PSo	-
FD	00FD0A0A	PSDnoo	-
FE	00FE02A9	DPSoo	-
FF	00FF0062	1	WHITENESS

Resource Compiler Diagnostic Messages

This topic contains descriptions of diagnostic messages produced by Microsoft Windows Resource Compiler (RC). Many of these messages appear when RC is not able to compile resources properly. The descriptions in this topic clarify the causes. The messages are listed in alphabetic order.

A capital V in parentheses (V) at the beginning of a message description indicates that the message is displayed only if RC is run with the –**V** (verbose) option. These messages are generally informational and do not necessarily indicate errors.

Accelerator Type required (ASCII or VIRTKEY)
: The *type* parameter in the **ACCELERATORS** statement must contain either the **ASCII** or **VIRTKEY** value.

BEGIN expected in Accelerator Table
: An **ACCELERATORS** statement was not followed by the **BEGIN** keyword.

BEGIN expected in Dialog
: A **DIALOG** satement was not followed by the **BEGIN** keyword.

BEGIN expected in menu
: A **MENU** statement was not followed by the **BEGIN** keyword.

BEGIN expected in RCData
: An **RCDATA** statement was not followed by the **BEGIN** keyword.

BEGIN expected in String Table
: A **STRINGTABLE** statement was not followed by the **BEGIN** keyword.

BEGIN expected in VERSIONINFO resource
: A **VERSIONINFO** statement was not followed by the **BEGIN** keyword.

Bitmap file *resource-file* is not in *version-number* format.
: Use Microsoft Image Editor (IMAGEDIT.EXE) to convert version 2.*x* resource files to the version 3.1 format.

Cannot Re-use String Constants
: You are using the same value twice in a **STRINGTABLE** statement. Make sure that you have not mixed overlapping decimal and hexadecimal values.

Control Character out of range [A - Z]
: A control character in the **ACCELERATORS** statement is invalid. The character following the caret (^) must be in the range A through Z.

Copying segment *id* (*size* bytes)
: (V) Microsoft Windows Resource Compiler (RC) is copying the specified segment to the executable (.EXE) file.

Could not find RCPP.EXE
: The preprocessor (RCPP.EXE) must be in the current directory or in a directory specified in the PATH environment variable.

Could not open *in-file-name*
: Microsoft Windows Resource Compiler (RC) could not open the specified file. Make sure that the file exists and that you typed the filename correctly.

Couldn't open *resource-name*
: Microsoft Windows Resource Compiler (RC) could not open the specified file. Make sure that the file exists and that you typed the filename correctly.

Creating *resource-name*
: (V) Microsoft Windows Resource Compiler (RC) is creating a new binary resource (.RES) file.

Empty menus not allowed
: An **END** keyword appears before any menu items are defined in the **MENU** statement. Empty menus are not permitted by Microsoft Windows Resource Compiler (RC). Make sure that you do not have any opening quotation marks within the **MENU** statement.

END expected in Dialog
: The **END** keyword must appear at the end of a **DIALOG** statement. Make sure that there are no opening quotation marks left from the preceding statement.

END expected in menu

The **END** keyword must appear at the end of a **MENU** statement. Make sure that there are no mismatched **BEGIN** and **END** statements.

Error Creating *resource-name*

Microsoft Windows Resource Compiler (RC) could not create the specified binary resource (.RES) file. Make sure that it is not being created on a read-only drive. Use the –**V** option to find out whether the file is being created.

Errors occurred when linking file.

The linker failed. For more information, see the documentation for your linker.

EXE file too large; relink with higher **/ALIGN** value

The executable (.EXE) file is too large. Relink the .EXE file with a larger value. For more information, see the documentation for your linker.

Expected Comma in Accelerator Table

Microsoft Windows Resource Compiler (RC) requires a comma between the *event* and *idvalue* parameters in the **ACCELERATORS** statement.

Expected control class name

The *class* parameter of a **CONTROL** statement in the **DIALOG** statement must be one of the following control types: **BUTTON**, **COMBOBOX**, **EDIT**, **LISTBOX**, **SCROLLBAR**, **STATIC**, or user-defined. Make sure that the class is spelled correctly.

Expected font face name

The *typeface* parameter of the **FONT** statement in the **DIALOG** statement must be an ASCII character string enclosed in double quotation marks. This parameter specifies the name of a font.

Expected ID value for Menuitem

The **MENU** statement must contain a **MENUITEM** statement, which has either an integer or a symbolic constant in the *MenuID* parameter.

Expected Menu String

Each **MENUITEM** and **POPUP** statement must contain a *text* parameter. This parameter is a string enclosed in double quotation marks that specifies the name of the menu item or pop-up menu. A **MENUITEM SEPARATOR** statement requires no quoted string.

Expected numeric command value

Microsoft Windows Resource Compiler (RC) was expecting a numeric *idvalue* parameter in the **ACCELERATORS** statement. Make sure that you have used a **#define** constant to specify the value and that the constant used is spelled correctly.

Expected numeric constant in string table

A numeric constant, defined in a **#define** statement, must immediately follow the **BEGIN** keyword in a **STRINGTABLE** statement.

Expected numeric point size

The *pointsize* parameter of the **FONT** statement in the **DIALOG** statement must be an integer point-size value.

Expected Numerical Dialog constant

A **DIALOG** statement requires integer values for the *x, y, width,* and *height* parameters. Make sure that these values, which are included after the **DIALOG** keyword, are not negative.

Expected String in STRINGTABLE

A string is expected after each numeric *stringid* parameter in a **STRINGTABLE** statement.

Expected String or Constant Accelerator command

Microsoft Windows Resource Compiler (RC) was not able to determine which key was being set up for the accelerator. The *event* parameter in the **ACCELERATORS** statement might be invalid.

Expected VALUE, BLOCK, or END keyword.

The **VERSIONINFO** structure requires a **VALUE**, **BLOCK**, or **END** keyword.

Expecting number for ID

A number is expected for the *id* parameter of a **CONTROL** statement in the **DIALOG** statement. Make sure that you have a number or a **#define** statement for the control identifier.

Expecting quoted string for key

The key string following the **BLOCK** or **VALUE** keyword should be enclosed in double quotation marks.

Expecting quoted string in dialog class

The *class* parameter of the **CLASS** statement in the **DIALOG** statement must be an integer or a string enclosed in double quotation marks.

Expecting quoted string in dialog title

The *captiontext* parameter of the **CAPTION** statement in the **DIALOG** statement must be an ASCII character string, enclosed in double quotation marks.

Fast-load area is [*size*] bytes at offset 0x[*address*]

(V) This is the size, in bytes, of all the following segments:

- Segments with the **PRELOAD** attribute
- Segments with the **DISCARDABLE** attribute
- Code segments that contain the entry point, **WinMain**
- Data segments (which should not be discardable)

To disable fast loading, use the –**k** option. Fast loading is the placement of segments in a contiguous area in the executable (.EXE) file for quicker loading. The offset is from the the beginning of the file.

File not created by LINK

You must create the executable (.EXE) file with an appropriate version of the linker.

File not found: *filename*

The file specified in the **rc** command was not found. Make sure that the file has not been moved to another directory and that the filename or path is typed correctly.

Font names must be ordinals

The *pointsize* parameter in the **FONT** statement must be an integer, not a string.

Insufficient memory to spawn RCPP.EXE

There wasn't enough memory to run the preprocessor (RCPP.EXE). Try disabling any memory-resident software that might be taking up too much memory. To verify the amount of memory you have, use the **chkdsk** command.

Invalid Accelerator

An *event* parameter in the **ACCELERATORS** statement was not recognized or was more than two characters long.

Invalid Accelerator Type (ASCII or VIRTKEY)

The *type* parameter in the **ACCELERATORS** statement must contain either the **ASCII** or **VIRTKEY** value.

Invalid control character

A control character in the **ACCELERATORS** statement is invalid. A valid control character consists of a caret (^) followed by a single letter.

Invalid Control type

The **CONTROL** statement in a **DIALOG** statement must be one of the following: **CHECKBOX**, **COMBOBOX**, **CONTROL**, **CTEXT**, **DEFPUSHBUTTON**, **EDITTEXT**, **GROUPBOX**, **ICON**, **LISTBOX**, **LTEXT**, **PUSHBUTTON**, **RADIOBUTTON**, **RTEXT**, or **SCROLLBAR**.

Invalid directive in preprocessed RC file

The specified filename has an embedded newline character.

Invalid .EXE file

The executable (.EXE) file is invalid. Make sure that the linker created it correctly and that the file exists.

Invalid switch, *option*

An option used was invalid. For a list of the command-line options, use the **rc -?** command.

Invalid type

The resource type was not among the types defined in the include file.

Invalid usage. Use rc -? for Help

Make sure that you have at least one filename to work with. For a list of the command-line options, use the **rc -?** command.

I/O error reading file.

Read failed. Since this is a generic routine, no specific filename is supplied.

I/O error seeking in file

Seeking in file failed. Since this is a generic routine, no specific filename is supplied.

I/O error writing file.

Write failed. Since this is a generic routine, no specific filename is supplied.

No executable filename specified.

The –**FE** option was used, but no executable (.EXE) file was specified.

No resource binary filename specified.

The –**FO** option was used, but no binary resource (.RES) file was specified.

Not a Microsoft Windows format .EXE file

Make sure that the linker created the executable (.EXE) file correctly and that the file exists.

Old DIB in *resource-name.* Pass it through IMAGEDIT.

The resource file specified is not compatible with Windows version 3.1. Make sure you have read and saved this file using the latest version of Microsoft Image Editor (IMAGEDIT.EXE). (Image Editor has replaced SDK Paint.)

Out of far heap memory

There was not enough memory. Try disabling any memory-resident software that might be taking up too much space. To find out how much memory you have, use the **chkdsk** command.

Out of memory, needed *n* bytes

Microsoft Windows Resource Compiler (RC) was not able to allocate the specified amount of memory.

RC: Invalid swap area size: -S *string*

Invalid swap area size. Check your syntax for the –**S** option on the command line for Microsoft Windows Resource Compiler (RC). The following examples show acceptable command lines:

```
RC  S123
RC  S123K  ; where K is kilobytes
RC  S123p  ; where p is paragraphs
```

RC: Invalid switch: *option*

An option used was invalid. For a list of the command-line options, use the **rc -?** command.

RC: RCPP.ERR not found

The RCPP.ERR file must be in the current directory or in a directory specified in the PATH environment variable.

RC terminated by user

A CTRL+C key combination was pressed, exiting Microsoft Windows Resource Compiler (RC).

RC terminating after preprocessor errors

For information about preprocessor errors, see the documentation for the preprocessor.

RCPP.EXE command line greater than 128 bytes

The command line for the preprocessor (RCPP.EXE) was too long.

RCPP.EXE is not a valid executable

The preprocessor (RCPP.EXE) may have been altered. Try copying the file again from the Microsoft Windows Software Development Kit (SDK) disks.

Resource file *resource-name* is not in *version-number* format.

Make sure your icons and cursors have been read and saved using the latest version of Microsoft Image Editor (IMAGEDIT.EXE).

Resources will be aligned on *number* byte boundaries

(V) The alignment is determined by an option on the command line for the linker.

Sorting preload segments and resources into fast-load section

(V) Microsoft Windows Resource Compiler (RC) is sorting the preloaded segments into a contiguous area in the executable (.EXE) file (the fast-load section) so that they can be loaded quickly.

Text string or ordinal expected in Control

The *text* parameter of a **CONTROL** statement in the **DIALOG** statement must be either a text string or an ordinal reference to the type of control that is expected. If using an ordinal, make sure that you have a **#define** statement for the control.

The EXETYPE of this program is not Windows

The **EXETYPE WINDOWS** statement did not appear in the module-definition (.DEF) file. Since the linker might make optimizations that are not appropriate for Windows, the **EXETYPE WINDOWS** statement must be specified.

Unable to create *destination*

Microsoft Windows Resource Compiler (RC) was not able to create the destination file. Make sure that there is enough disk space.

Unable to open *exe-file*

Microsoft Windows Resource Compiler (RC) could not open the executable (.EXE) file. Make sure that the linker created it correctly and that the file exists.

Unbalanced Parentheses

Make sure that you have closed every opening parenthesis in the **DIALOG** statement.

Unexpected value in RCData

The values for the *raw-data* parameter in the **RCDATA** statement must be integers or strings, separated by commas. Make sure that you did not leave out a comma or a quotation mark around a string.

Unexpected value in value data

A statement contained information with a format or size different from the expected value for that parameter.

Unknown DIB header format

The device-independent bitmap (DIB) header is not a **BITMAPCOREHEADER** or **BITMAPINFOHEADER** structure.

Unknown error spawning RCPP.EXE

For an unknown reason, the preprocessor (RCPP.EXE) has not started. Try copying the file again from the SDK disks and use the **chkdsk** command to verify the amount of available memory.

Unknown Menu SubType

The *item-definitions* parameter of the **MENU** statement can contain only **MENUITEM** and **POPUP** statements.

Unrecognized VERSIONINFO field; BEGIN or comma expected

The format of the information following a **VERSIONINFO** statement is incorrect.

Version WORDs separated by commas expected

Values in an information block for a **VERSIONINFO** statement should be separated by commas.

Warning: ASCII character not equivalent to virtual key code

An invalid virtual-key code exists in the **ACCELERATORS** statement. The ASCII values for some characters (such as *, ^, or &) are not equivalent to the virtual-key codes for the corresponding keys. (In the case of the asterisk [*], the virtual-key code is equivalent to the ASCII value for 8, the numeric character on the same key. Therefore, the statement **VIRTKEY '* '** is invalid.)

Warning: SHIFT or CONTROL used without VIRTKEY

The **ALT**, **SHIFT**, and **CONTROL** options apply only to virtual keys in the **ACCELERATORS** statement. Make sure that the **VIRTKEY** option is used with one of these other options.

Warning: *string* segment *number* set to PRELOAD

Microsoft Windows Resource Compiler (RC) displays this warning when it copies a segment that must be preloaded but is not marked **PRELOAD** in the module-definition (.DEF) file for the linker. All nondiscardable segments should be preloaded, including automatic data segments, fixed

segments, and the entry point of the code (**WinMain**). (The attributes of code segments are set by the .DEF file.)

Writing resource *resource-name or ordinal-id. resource type* (*resource size*)

(V) Microsoft Windows Resource Compiler (RC) is writing the resource name or ordinal identifier, followed by a period and the resource type and size, in bytes.

ClassFirst (3.1)

#include toolhelp.h

BOOL ClassFirst(*lpce***)**

CLASSENTRY FAR* *lpce;* /* address of structure for class info */

The **ClassFirst** function fills the specified structure with general information about the first class in the Windows class list.

Parameter	Description
lpce	Points to a **CLASSENTRY** structure that will receive the class information.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **ClassFirst** function can be used to begin a walk through the Windows class list. To examine subsequent items in the class list, an application can use the **ClassNext** function.

Before calling **ClassFirst**, an application must initialize the **CLASSENTRY** structure and specify its size, in bytes, in the **dwSize** member. An application can examine subsequent entries in the Windows class list by using the **ClassNext** function.

For more specific information about an individual class, use the **GetClassInfo** function, specifying the name of the class and instance handle from the **CLASSENTRY** structure.

See Also

ClassNext, **GetClassInfo**, **CLASSENTRY**

ClassNext (3.1)

#include toolhelp.h

BOOL ClassNext(*lpce***)**

CLASSENTRY FAR* *lpce;* /* address of structure for class info */

The **ClassNext** function fills the specified structure with general information about the next class in the Windows class list.

Parameter	Description
lpce	Points to a **CLASSENTRY** structure that will receive the class information.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **ClassNext** function can be used to continue a walk through the Windows class list started by the **ClassFirst** function.

For more specific information about an individual class, use the **GetClassInfo** function with the name of the class and instance handle from the **CLASSENTRY** structure.

See Also

ClassFirst, **CLASSENTRY**

GlobalEntryHandle (3.1)

#include toolhelp.h

BOOL GlobalEntryHandle(*lpge, hglb***)**

```
GLOBALENTRY FAR* lpge;      /* address of structure for object */
HGLOBAL hglb;               /* handle of item                  */
```

The **GlobalEntryHandle** function fills the specified structure with information that describes the given global memory object.

Parameter	Description
lpge	Points to a **GLOBALENTRY** structure that receives information about the global memory object.
hglb	Identifies the global memory object to be described.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero. The function fails if the *hglb* value is an invalid handle or selector.

Comments

This function retrieves information about a global memory handle or selector. Debuggers use this function to obtain the segment number of a segment loaded from an executable file.

Before calling the **GlobalEntryHandle** function, an application must initialize the **GLOBALENTRY** structure and specify its size, in bytes, in the **dwSize** member.

See Also

GlobalEntryModule, **GlobalFirst**, **GlobalInfo**, **GlobalNext**, **GLOBALENTRY**

GlobalEntryModule (3.1)

#include toolhelp.h

BOOL GlobalEntryModule(*lpge, hmod, wSeg***)**

```
GLOBALENTRY FAR* lpge;      /* address of structure for segment */
HMODULE hmod;               /* handle of module                 */
WORD wSeg;                  /* segment to describe              */
```

The **GlobalEntryModule** function fills the specified structure by *lpge* with information about the specified module segment.

Parameter	Description
lpge	Points to a **GLOBALENTRY** structure that receives information about the segment specified in the *wSeg* parameter.
hmod	Identifies the module that owns the segment.
wSeg	Specifies the segment to be described in the **GLOBALENTRY** structure. The number of the first segment in the module is 1. Segment numbers are always contiguous, so if the last valid segment number is 10, all segment numbers 1 through 10 are also valid.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero. This function fails if the segment in the *wSeg* parameter does not exist in the module specified in the *hmod* parameter.

Comments

Debuggers can use the **GlobalEntryModule** function to retrieve global heap information about a specific segment loaded from an executable file. Typically, the debugger will have symbols that refer to segment numbers; this function translates the segment numbers to heap information.

Before calling **GlobalEntryModule**, an application must initialize the **GLOBALENTRY** structure and specify its size, in bytes, in the **dwSize** member.

See Also

GlobalEntryHandle, **GlobalFirst**, **GlobalInfo**, **GlobalNext**, **GLOBALENTRY**

GlobalFirst (3.1)

#include toolhelp.h

BOOL GlobalFirst(*lpge, wFlags***)**

```
GLOBALENTRY FAR* lpge;      /* address of structure for object */
WORD wFlags;                /* specifies the heap to use       */
```

The **GlobalFirst** function fills the specified structure with information that describes the first object on the global heap.

Parameter	Description
lpge	Points to a **GLOBALENTRY** structure that receives information about the global memory object.
wFlags	Specifies the heap to use. This parameter can be one of the following values:

Value	Meaning
GLOBAL_ALL	Structure pointed to by *lpge* will receive information about the first object on the complete global heap.
GLOBAL_FREE	Structure will receive information about the first object on the free list.
GLOBAL_LRU	Structure will receive information about the first object on the least-recently-used (LRU) list.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **GlobalFirst** function can be used to begin a global heap walk. An application can examine subsequent objects on the global heap by using the **GlobalNext** function. Calls to **GlobalNext** must have the same *wFlags* value as that specified in **GlobalFirst**.

Before calling **GlobalFirst**, an application must initialize the **GLOBALENTRY** structure and specify its size, in bytes, in the **dwSize** member.

See Also

GlobalEntryHandle, **GlobalEntryModule**, **GlobalInfo**, **GlobalNext**, **GLOBALENTRY**

GlobalHandleToSel (3.1)

#include toolhelp.h

WORD GlobalHandleToSel(*hglb***)**

HGLOBAL *hglb;*

The **GlobalHandleToSel** function converts the given handle to a selector.

Parameter	Description
hglb	Identifies the global memory object to be converted.

Returns

The return value is the selector of the given object if the function is successful. Otherwise, it is zero.

Comments

The **GlobalHandleToSel** function converts a global handle to a selector appropriate for Windows, version 3.0 or 3.1, depending on which version is running. A debugging application might use this selector to access a global memory object if the object is not discardable or if the object's attributes are irrelevant.

See Also

GlobalAlloc

GlobalInfo function (3.1)

#include toolhelp.h

BOOL GlobalInfo(*lpgi***)**

GLOBALINFO FAR* *lpgi;* /* address of global-heap structure */

The **GlobalInfo** function fills the specified structure with information that describes the global heap.

Parameter	Description
lpgi	Points to a **GLOBALINFO** structure that receives information about the global heap.

Returns

The return value is nonzero if the function successful. Otherwise, it is zero.

Comments

The information in the structure can be used to determine how much memory to allocate for a global heap walk.

Before calling the **GlobalInfo** function, an application must initialize the **GLOBALINFO** structure and specify its size, in bytes, in the **dwSize** member.

See Also

GlobalEntryHandle, **GlobalEntryModule**, **GlobalFirst**, **GlobalNext**, **GLOBALINFO**, **GLOBALENTRY**

GlobalNext (3.1)

#include toolhelp.h

BOOL GlobalNext(*lpge, flags***)**

GLOBALENTRY FAR* *lpge;* /* address of structure for object */
WORD *flags;* /* heap to use */

The **GlobalNext** function fills the specified structure with information that describes the next object on the global heap.

Parameter	Description
lpge	Points to a **GLOBALENTRY** structure that receives information about the global memory object.
flags	Specifies heap to use. This parameter can be one of the following values:

Value	Meaning
GLOBAL_ALL	Structure pointed by the *lpge* parameter will receive information about the first object on the complete global heap.
GLOBAL_FREE	Structure will receive information about the first object on the free list.
GLOBAL_LRU	Structure will receive information about the first object on the least-recently-used (LRU) list.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The **GlobalNext** function can be used to continue a global heap walk started by the **GlobalFirst**, **GlobalEntryHandle**, or **GlobalEntryModule** functions.

If **GlobalFirst** starts a heap walk, the *flags* value used in **GlobalNext** must be the same as the value used in **GlobalFirst**.

See Also
GlobalEntryHandle, **GlobalEntryModule**, **GlobalFirst**, **GlobalInfo**, **GLOBALENTRY**

InterruptRegister (3.1)

#include toolhelp.h

BOOL InterruptRegister(*htask, lpfnIntCallback***)**

HTASK *htask;* /* handle of task */
FARPROC *lpfnIntCallback;* /* address of callback function */

The **InterruptRegister** function installs a callback function to handle all system interrupts.

Parameter	Description
htask	Identifies the task that is registering the callback function. The *htask* value is for registration purposes, not for filtering interrupts. Typically, this value is NULL, indicating the current task. The only time this value is not NULL is when an application requires more than one interrupt handler.
lpfnIntCallback	Points to the interrupt callback function that will handle interrupts. The Tool Helper library calls this function whenever a task receives an interrupt. The *lpfnIntCallback* value is normally the return value of a call to the **MakeProcInstance** function. This causes the interrupt callback function to be entered with the AX register set to the selector of the application's data segment. Usually, an exported function prolog contains the following code: `mov  ds,ax`

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The syntax of the function pointed to by *lpfnIntCallback* is as follows:

void InterruptRegisterCallback(void**)**

InterruptRegisterCallback is a placeholder for the application-defined function name. The actual name must be exported by including it an **EXPORTS** in the application's module-definition file.

An interrupt callback function must be reentrant, must be page-locked, and must explicitly preserve all register values.

```
|           .           |
|           .           |
|           .           |
|-----------------------|
|   SS (fault)          |  SP + 12h
|-----------------------|
|   SP (fault)          |  SP + 10h
|-----------------------|
|   Flags (fault)       |  SP + 0Eh
|-----------------------|
|   CS (fault)          |  SP + 0Ch
|-----------------------|
|   IP (fault)          |  SP + 0Ah
|-----------------------|
|   handle (internal)   |  SP + 08h
|-----------------------|
|   interrupt number    |  SP + 06h
|-----------------------|
|   AX                  |  SP + 04h
|-----------------------|
```

```
|   CS (toolhelp.dll)   |  SP + 02h
|-----------------------|
|   IP (toolhelp.dll)   |  SP + 00h
+-----------------------+
```

The SS and SP values will not be on the stack unless a low-stack fault occurred. This fault is indicated by the high bit of the interrupt number being set.

When Windows calls a callback function, the AX register contains the DS value for the instance of the application that contains the callback function. For more information about this process, see the **MakeProcInstance** function.

Typically, an interrupt callback function is exported. If it is not exported, the developer should verify that the appropriate stack frame is generated, including the correct DS value.

An interrupt callback function must save and restore all register values. The function must also do one of the following:

- Execute an **retf** instruction if it does not handle the interrupt. The Tool Helper library will pass the interrupt to the next appropriate handler in the interrupt handler list.
- Terminate the application by using the **TerminateApp** function.
- Correct the problem that caused the interrupt, clear the first 10 bytes of the stack, and execute an **iret** instruction. This action will restart execution at the specified address. An application may change this address, if necessary.
- Execute a nonlocal goto to a known position in the application by using the **Catch** and **Throw** functions. This type of interrupt handling can be hazardous; the system may be in an unstable state and another fault may occur. Applications that handle interrupts in this way must verify that the fault was a result of the application's code.

The Tool Helper library supports the following interrupts:

Name	Number	Meaning
INT_DIV0	0	Divide-error exception
INT_1	1	Debugger interrupt
INT_3	3	Breakpoint interrupt
INT_UDINSTR	6	Invalid-opcode exception
INT_STKFAULT	12	Stack exception
INT_GPFAULT	13	General protection violation
INT_BADPAGEFAULT	14	Page fault not caused by normal virtual-memory operation
INT_CTLALTSYS RQ	256	User pressed CTRL+ALT+SYS RQ

The Tool Helper library returns interrupt numbers as word values. Normal software interrupts and processor faults are represented by numbers in the range 0 through 255. Interrupts specific to Tool Helper are represented by numbers greater than 255.

Some developers may wish to use CTRL+ALT+SYS RQ (Interrupt 256) to break into the debugger. Be cautious about implementing this interrupt, because the point at which execution stops will probably be in a sensitive part of the Windows kernel. All **InterruptRegisterCallback** functions must be page-locked to prevent problems when this interrupt is used. In addition, the debugger probably will not be able to perform user-interface functions. However, the debugger can use Tool Helper functions to set breakpoints and gather information. The debugger may also be able to use a debugging terminal or secondary screen to display information.

Low-stack Faults

A low-stack fault occurs when inadequate stack space is available on the faulting application's stack. For example, if any fault occurs when there is less than 128 bytes of stack space available or if runaway recursion depletes the stack, a low-stack fault occurs. The Tool Helper library processes a low-stack fault differently than it processes other faults.

A low-stack fault is indicated by the high-order bit of the interrupt number being set. For example, if a stack fault occurs and the SP value becomes invalid, the Tool Helper library will return the fault number as 0x800C rather than 0x000C.

Interrupt handlers designed to process low-stack faults must be aware that the Tool Helper library has passed a fault frame on a stack other that the faulting application's stack. The SS:SP value is on the stack because it was pushed before the rest of the information in the stack frame. The SS:SP value is available only for advisory purposes.

An interrupt handler should never restart the faulting instruction, because this will cause the system to crash. The handler may terminate the application with **TerminateApp** or pass the fault to the next handler in the interrupt-handler list.

Interrupt handlers should not assume that all stack faults are low-stack faults. For example, if an application accesses a stack-relative variable that is out of range, a stack fault will occur. This type of fault can be processed in the same manner as any general protection (GP) fault. If the high-order bit of the interrupt number is not set, the instruction can be restarted.

Interrupt handlers also should not assume that all low-stack faults are stack faults. Any fault that occurs when there is less than 128 bytes of stack available will cause a low-stack fault.

Interrupt callback functions that are not designed to process low-stack faults should execute an **retf** instruction so that the Tool Helper library will pass the fault to the next appropriate handler in the interrupt-handler list.

See Also
Catch, **InterruptUnRegister**, **NotifyRegister**, **NotifyUnRegister**, **TerminateApp**, **Throw**

InterruptUnRegister (3.1)

#include toolhelp.h

BOOL InterruptUnRegister(*htask***)**

HTASK *htask;* /* handle of task */

The **InterruptUnRegister** function restores the default interrupt handle for system interrupts.

Parameter	Description
htask	Identifies the task. If this value is NULL, it identifies the current task.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

After this function is executed, the Tool Helper library will pass all interrupts it receives to the system's default interrupt handler.

See Also

InterruptRegister, **NotifyRegister**, **NotifyUnRegister**, **TerminateApp**

LocalFirst (3.1)

#include toolhelp.h

BOOL LocalFirst(*lple, hglbHeap***)**

```
LOCALENTRY FAR* lple;       /* address of LOCALENTRY structure   */
HGLOBAL hglbHeap;           /* handle of local heap              */
```

The **LocalFirst** function fills the specified structure with information that describes the first object on the local heap.

Parameter	Description
lple	Points to a **LOCALENTRY** structure that will receive information about the local memory object.
hglbHeap	Identifies the local heap.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **LocalFirst** function can be used to begin a local heap walk. An application can examine subsequent objects on the local heap by using the **LocalNext** function.

Before calling **LocalFirst**, an application must initialize the **LOCALENTRY** structure and specify its size, in bytes, in the **dwSize** member.

See Also

LocalInfo, **LocalNext**, **LOCALENTRY**

LocalInfo function (3.1)

#include toolhelp.h

BOOL LocalInfo(*lpli, hglbHeap***)**

LOCALINFO FAR* *lpli;* /* address of LOCALINFO structure */
HGLOBAL *hglbHeap;* /* handle of local heap */

The **LocalInfo** function fills the specified structure with information that describes the local heap.

Parameter	Description
lpli	Points to a **LOCALINFO** structure that will receive information about the local heap.
hglbHeap	Identifies the local heap to be described.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The information in the **LOCALINFO** structure can be used to determine how much memory to allocate for a local heap walk.

Before calling **LocalInfo**, an application must initialize the **LOCALINFO** structure and specify its size, in bytes, in the **dwSize** member.

See Also

LocalFirst, **LocalNext**, **LOCALINFO**, **LOCALENTRY**

LocalNext (3.1)

#include toolhelp.h

BOOL LocalNext(*lple***)**

LOCALENTRY FAR* *lple;* /* address of LOCALENTRY structure */

The **LocalNext** function fills the specified structure with information that describes the next object on the local heap.

Parameter	Description
lple	Points to a **LOCALENTRY** structure that will receive information about the local memory object.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **LocalNext** function can be used to continue a local heap walk started by the **LocalFirst** function.

See Also

LocalFirst, **LocalInfo**, **LOCALENTRY**

MemManInfo function (3.1)

#include toolhelp.h

BOOL MemManInfo(*lpmmi***)**

MEMMANINFO FAR* *lpmmi;* /* address of MEMMANINFO structure */

The **MemManInfo** function fills the specified structure with status and performance information about the memory manager. This function is most useful in 386 enhanced mode but can also be used in standard mode.

Parameter	Description
lpmmi	Points to a **MEMMANINFO** structure that will receive information about the memory manager.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

This function is included for advisory purposes.

Before calling **MemManInfo**, an application must initialize the **MEMMANINFO** structure and specify its size, in bytes, in the **dwSize** member.

See Also

MEMMANINFO

MemoryRead (3.1)

#include toolhelp.h

DWORD MemoryRead(*wSel, dwOffset, lpvBuf, dwcb***)**

```
WORD wSel;          /* selector of global heap object  */
DWORD dwOffset;     /* offset to object                */
void FAR* lpvBuf;   /* address of buffer to read to    */
DWORD dwcb;         /* number of bytes to read         */
```

The **MemoryRead** function copies memory from the specified global heap object to the specified buffer.

Parameter	Description
wSel	Specifies the global heap object from which to read. This value must be a selector on the global heap; if the value is an alias selector or a selector in a tiled selector array, **MemoryRead** will fail.
dwOffset	Specifies the offset in the object specified in the *wSel* parameter at which to begin reading. The *dwOffset* value may point anywhere within the object; it may be greater than 64K if the object is larger than 64K.
lpvBuf	Points to the buffer to which **MemoryRead** will copy the memory from the object. This buffer must be large enough to contain the entire amount of memory copied to it. If the application is running under low memory conditions, *lpvBuf* should be in a fixed object while **MemoryRead** copies data to it.
dwcb	Specifies the number of bytes to copy from the object to the buffer pointed to by *lpvBuf.*

Returns

The return value is the number of bytes copied from *wSel* to *lpvBuf.* If *wSel* is invalid or if *dwOffset* is out of the selector's range, the return value is zero.

Comments

The **MemoryRead** function enables developers to examine memory without consideration for selector tiling and aliasing. **MemoryRead** reads memory in read-write or read-only objects. This function can be used in any size object owned by any task. It is not necessary to compute selector array offsets.

The **MemoryRead** and **MemoryWrite** functions are designed to read and write objects loaded by the **LoadModule** function or allocated by the **GlobalAlloc** function. Developers should *not* split off the selector portion of a far pointer and use this as the value for *wSel,* unless the selector is known to be on the global heap.

See Also

MemoryWrite

MemoryWrite (3.1)

#include toolhelp.h

DWORD MemoryWrite(*wSel, dwOffset, lpvBuf, dwcb***)**

```
WORD wSel;          /* selector of global heap object  */
DWORD dwOffset;     /* offset to object                */
void FAR* lpvBuf;   /* address of buffer to write from */
DWORD dwcb;         /* number of bytes to write        */
```

The **MemoryWrite** function copies memory from the specified buffer to the specified global heap object.

Parameter	Description
wSel	Specifies the global heap object to which **MemoryWrite** will write. This value must be a selector on the global heap; if the value is an alias selector or a selector in a tiled selector array, **MemoryWrite** will fail.
dwOffset	Specifies the offset in the object at which to begin writing. The *dwOffset* value may point anywhere within the object; it may be greater than 64K if the object is larger than 64K.
lpvBuf	Points to the buffer from which **MemoryWrite** will copy the memory to the object. If the application is running under low memory conditions, *lpvBuf* should be in a fixed object while **MemoryWrite** copies data from it.
dwcb	Specifies the number of bytes to copy to the object from the buffer pointed to by *lpvBuf.*

Returns

The return value is the number of bytes copied from *lpvBuf* to *wSel.* If the selector is invalid or if *dwOffset* is out of the selector's range, the return value is zero.

Comments

The **MemoryWrite** function enables developers to modify memory without consideration for selector tiling and aliasing. **MemoryWrite** writes memory in read-write or read-only objects. This function can be used in any size object owned by any task. It is not necessary to make alias objects writable or to compute selector array offsets.

The **MemoryRead** and **MemoryWrite** functions are designed to read and write objects loaded by the **LoadModule** function or allocated by the **GlobalAlloc** function. Developers should *not* split off the selector portion of a far pointer and use this as the value for *wSel,* unless the selector is known to be on the global heap.

See Also

MemoryRead

ModuleFindHandle (3.1)

#include toolhelp.h

HMODULE ModuleFindHandle(*lpme, hmod***)**

```
MODULEENTRY FAR* lpme;      /* address of MODULEENTRY structure */
HMODULE hmod;               /* handle of module                 */
```

The **ModuleFindHandle** function fills the specified structure with information that describes the given module.

Parameter	Description
lpme	Points to a **MODULEENTRY** structure that will receive information about the module.
hmod	Identifies the module to be described.

Returns

The return value is the handle of the given module if the function is successful. Otherwise, it is NULL.

Comments

The **ModuleFindHandle** function returns information about a currently loaded module whose module handle is known.

This function can be used to begin a walk through the list of all currently loaded modules. An application can examine subsequent items in the module list by using the **ModuleNext** function.

Before calling **ModuleFindHandle**, an application must initialize the **MODULEENTRY** structure and specify its size, in bytes, in the **dwSize** member.

See Also

ModuleFindName, **ModuleFirst**, **ModuleNext**, **MODULEENTRY**

ModuleFindName (3.1)

#include toolhelp.h

HMODULE ModuleFindName(*lpme, lpszName***)**

MODULEENTRY FAR* *lpme;* /* address of MODULEENTRY structure */
LPCSTR *lpszName;* /* address of module name */

The **ModuleFindName** function fills the specified structure with information that describes the module with the specified name.

Parameter	Description
lpme	Points to a **MODULEENTRY** structure that will receive information about the module.
lpszName	Specifies the name of the module to be described.

Returns

The return value is the handle named in the **lpszName** parameter, if the function is successful. Otherwise, it is NULL.

Comments

The **ModuleFindName** function returns information about a currently loaded module by looking up the module's name in the module list.

This function can be used to begin a walk through the list of all currently loaded modules. An application can examine subsequent items in the module list by using the **ModuleNext** function.

Before calling **ModuleFindName**, an application must initialize the **MODULEENTRY** structure and specify its size, in bytes, in the **dwSize** member.

See Also

ModuleFindHandle, **ModuleFirst**, **ModuleNext**, **MODULEENTRY**

ModuleFirst (3.1)

#include toolhelp.h

BOOL ModuleFirst(*lpme***)**

MODULEENTRY FAR* *lpme;* /* address of MODULEENTRY structure */

The **ModuleFirst** function fills the specified structure with information that describes the first module in the list of all currently loaded modules.

Parameter	Description
lpme	Points to a **MODULEENTRY** structure that will receive information about the first module.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **ModuleFirst** function can be used to begin a walk through the list of all currently loaded modules. An application can examine subsequent items in the module list by using the **ModuleNext** function.

Before calling **ModuleFirst**, an application must initialize the **MODULEENTRY** structure and specify its size, in bytes, in the **dwSize** member.

See Also

ModuleFindHandle, **ModuleFindName**, **ModuleNext**, **MODULEENTRY**

ModuleNext (3.1)

#include toolhelp.h

BOOL ModuleNext(*lpme***)**

MODULEENTRY FAR* *lpme;* /* address of MODULEENTRY structure */

The **ModuleNext** function fills the specified structure with information that describes the next module in the list of all currently loaded modules.

Parameter	Description
lpme	Points to a **MODULEENTRY** structure that will receive information about the next module.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **ModuleNext** function can be used to continue a walk through the list of all currently loaded modules. The walk must have been started by the **ModuleFirst**, **ModuleFindName**, or **ModuleFindHandle** function.

See Also

ModuleFindHandle, **ModuleFindName**, **ModuleFirst**, **MODULEENTRY**

NotifyRegister (3.1)

#include toolhelp.h

BOOL NotifyRegister(*htask, lpfnCallback, wFlags***)**

```
HTASK htask;                        /* handle of task                */
LPFNNOTIFYCALLBACK lpfnCallback;    /* address of callback function  */
WORD wFlags;                        /* notification flags            */
```

The **NotifyRegister** function installs a notification callback function for the given task.

Parameter	Description
htask	Identifies the task associated with the callback function. If this parameter is NULL, it identifies the current task.
lpfnCallback	Points to the notification callback function that is installed for the task. The kernel calls this function whenever it sends a notification to the task. The callback-function address is normally the return value of a call to **MakeProcInstance**. This causes the callback function to be entered with the AX register set to the selector of the application's data segment. Usually, an exported function prolog contains the following code: `mov ds,ax`
wFlags	Specifies the optional notifications that the application will receive, in addition to the default notifications. This parameter can be NF_NORMAL or any combination of the following values:

Value	Meaning
NF_NORMAL	The application will receive the default notifications but none of the notifications of task switching, system debugging errors, or debug strings.
NF_TASKSWITCH	The application will receive task-switching notifications. To avoid poor performance, an application should not receive these notifications unless absolutely necessary.
NF_RIP	The application will receive notifications of system debugging errors.

Returns

The return value is nonzero if the function was successful. Otherwise, it is zero.

Callback Function

The syntax of the function pointed to by *lpfnCallback* is as follows:

BOOL NotifyRegisterCallback(*wID***,** *dwData***)**
WORD *wID***;**
DWORD *dwData***;**

Parameter	Description
wID	Indicates the type of notification and the value of the *dwData* parameter. The *wID* parameter may be one of the following values in Windows versions 3.0 and later:

Value	Meaning
NFY_DELMODULE	The low-order word of *dwData* is the handle of the module to be freed.
NFY_EXITTASK	The low-order byte of *dwData* contains the program exit code.
NFY_FREESEG	The low-order word of *dwData* is the selector of the segment

	to be freed.
NFY_INCHAR	The *dwData* parameter is not used. The notification callback function should return either the ASCII value for the keystroke or NULL.
NFY_LOADSEG	The *dwData* parameter points to an **NFYLOADSEG** structure.
NFY_OUTSTR	The *dwData* parameter points to the string to be displayed.
NFY_STARTDLL	The *dwData* parameter points to an **NFYSTARTDLL** structure.
NFY_STARTTASK	The *dwData* parameter is the CS:IP of the starting address of the task.
NFY_UNKNOWN	The kernel returned an unknown notification.

In Windows version 3.1, *wID* may be one of the following values:

Value	Meaning
NFY_LOGERROR	The *dwData* parameter points to an **NFYLOGERROR** structure.
NFY_LOGPARAMERROR	The *dwData* parameter points to an **NFYLOGPARAMERROR** structure.
NFY_RIP	The *dwData* parameter points to an **NFYRIP** structure.
NFY_TASKIN	The *dwData* parameter is undefined. The callback function should call the **GetCurrentTask** function.
NFY_TASKOUT	The *dwData* parameter is undefined. The callback function should call **GetCurrentTask**.

dwData Specifies data, or specifies a pointer to data, or is undefined, depending on the value of *wID.*

Returns

The return value of the callback function is nonzero if the callback function handled the notification. Otherwise, it is zero and the notification is passed to other callback functions.

Comments

A notification callback function must be able to ignore any unknown notification value. Typically, the notification callback function cannot use any Windows function, with the exception of the Tool Helper functions and **PostMessage**.

NotifyRegisterCallback is a placeholder for the application-defined function name. The actual name must be exported by including it in an **EXPORTS** statement in the application's module-definition file.

See Also

InterruptRegister, **InterruptUnRegister**, **MakeProcInstance**, **NotifyUnRegister**, **TerminateApp**, **NFYLOADSEG**, **NFYLOGERROR**, **NFYLOGPARAMERROR**, **NFYRIP**, **NFYSTARTDLL**

NotifyUnRegister (3.1)

#include toolhelp.h

BOOL NotifyUnRegister(*htask***)**

HTASK *htask;* /* handle of task */

The **NotifyUnRegister** function restores the default notification handler.

Parameter	Description
htask	Identifies the task. If *htask* is NULL, it identifies the current task.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

After this function is executed, the given task no longer receives notifications from the kernel.

See Also

InterruptRegister, **InterruptUnRegister**, **NotifyRegister**, **TerminateApp**

StackTraceCSIPFirst (3.1)

#include toolhelp.h

BOOL StackTraceCSIPFirst(*lpste, wSS, wCS, wIP, wBP***)**

```
STACKTRACEENTRY FAR* lpste;     /* address of stack-frame structure */
WORD wSS;                       /* value of SS register             */
WORD wCS;                       /* value of CS register             */
WORD wIP;                       /* value of IP register             */
WORD wBP;                       /* value of BP register             */
```

The **StackTraceCSIPFirst** function fills the specified structure with information that describes the specified stack frame.

Parameter	Description
lpste	Points to a **STACKTRACEENTRY** structure to receive information about the stack.
wSS	Contains the value in the SS register. This value is used with the *wBP* value to determine the next entry in the stack trace.
wCS	Contains the value in the CS register of the first stack frame.
wIP	Contains the value in the IP register of the first stack frame.
wBP	Contains the value in the BP register. This value is used with the *wSS* value to determine the next entry in the stack trace.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **StackTraceFirst** function can be used to begin a stack trace of any task except the current task. When a task is inactive, the kernel maintains its state, including its current stack, stack pointer, CS and IP values, and BP value. The kernel does not maintain these values for the current task. Therefore, when a stack trace is done on the current task, the application must use **StackTraceCSIPFirst** to begin a stack trace. An application can continue to trace through the stack by using the **StackTraceNext** function.

Before calling **StackTraceCSIPFirst**, an application must initialize the **STACKTRACEENTRY** structure and specify its size, in bytes, in the **dwSize** member.

See Also

StackTraceNext, **StackTraceFirst**, **STACKTRACEENTRY**

StackTraceFirst (3.1)

#include toolhelp.h

BOOL StackTraceFirst(*lpste, htask***)**

```
STACKTRACEENTRY FAR* lpste;     /* address of stack-frame structure */
HTASK htask;                    /* handle of task                   */
```

The **StackTraceFirst** function fills the specified structure with information that describes the first stack frame for the given task.

Parameter	Description
lpste	Points to a **STACKTRACEENTRY** structure to receive information about the task's first stack frame.
htask	Identifies the task whose stack information is to be described.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **StackTraceFirst** function can be used to begin a stack trace of any task except the current task. When a task is inactive, the kernel maintains its state, including its current stack, stack pointer, CS and IP values, and BP value. The kernel does not maintain these values for the current task. Therefore, when a stack trace is done on the current task, the application must use the **StackTraceCSIPFirst** function to begin a stack trace. An application can continue to trace through the stack by using the **StackTraceNext** function.

Before calling **StackTraceFirst**, an application must initialize the **STACKTRACEENTRY** structure and specify its size, in bytes, in the **dwSize** member.

See Also

StackTraceCSIPFirst, **StackTraceNext**, **STACKTRACEENTRY**

StackTraceNext (3.1)

#include toolhelp.h

BOOL StackTraceNext(*lpste***)**

STACKTRACEENTRY FAR* *lpste;* /* address of stack-frame structure */

The **StackTraceNext** function fills the specified structure with information that describes the next stack frame in a stack trace.

Parameter	Description
lpste	Points to a **STACKTRACEENTRY** structure to receive information about the next stack frame.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **StackTraceNext** function can be used to continue a stack trace started by using the **StackTraceFirst** or **StackTraceCSIPFirst** function.

See Also

StackTraceCSIPFirst, **StackTraceFirst**, **STACKTRACEENTRY**

SystemHeapInfo (3.1)

#include toolhelp.h

BOOL SystemHeapInfo(*lpshi***)**

SYSHEAPINFO FAR* *lpshi;* /* address of heap-info structure */

The **SystemHeapInfo** function fills the specified structure with information that describes the USER.EXE and GDI.EXE heaps.

Parameter	Description
lpshi	Points to a **SYSHEAPINFO** structure to receive information about the USER and GDI heaps.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

This function is included for advisory purposes. Before calling **SystemHeapInfo**, an application must initialize the **SYSHEAPINFO** structure and specify its size, in bytes, in the **dwSize** member.

See Also

SYSHEAPINFO

TaskFindHandle (3.1)

#include toolhelp.h

BOOL TaskFindHandle(*lpte, htask***)**

```
TASKENTRY FAR* lpte;      /* address of TASKENTRY structure   */
HTASK htask;              /* handle of task                   */
```

The **TaskFindHandle** function fills the specified structure with information that describes the given task.

Parameter	Description
lpte	Points to a **TASKENTRY** structure to receive information about the task.
htask	Identifies the task to be described.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **TaskFindHandle** function can be used to begin a walk through the task queue. An application can examine subsequent entries in the task queue by using the **TaskNext** function.

Before calling **TaskFindHandle**, an application must initialize the **TASKENTRY** structure and specify its size, in bytes, in the **dwSize** member.

See Also

TaskFirst, **TaskNext**, **TASKENTRY**

TaskFirst (3.1)

#include toolhelp.h

BOOL TaskFirst(*lpte***)**

TASKENTRY FAR* *lpte;* /* address of TASKENTRY structure */

The **TaskFirst** function fills the specified structure with information about the first task on the task queue.

Parameter	Description
lpte	Points to a **TASKENTRY** structure to receive information about the first task.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **TaskFirst** function can be used to begin a walk through the task queue. An application can examine subsequent entries in the task queue by using the **TaskNext** function.

Before calling **TaskFirst**, an application must initialize the **TASKENTRY** structure and specify its size, in bytes, in the **dwSize** member.

See Also

TaskFindHandle, **TaskNext**, **TASKENTRY**

TaskGetCSIP (3.1)

#include toolhelp.h

DWORD TaskGetCSIP(*htask***)**

HTASK *htask;* /* handle of task */

The **TaskGetCSIP** function returns the next CS:IP value of a sleeping task. This function is useful for applications that must "know" where a sleeping task will begin execution upon awakening.

Parameter	Description
htask	Identifies the task whose CS:IP value is being examined. This task must be sleeping when the application calls **TaskGetCSIP**.

Returns

The return value is the next CS:IP value, if the function is successful. If the *htask* parameter is invalid, the return value is NULL.

Comments

TaskGetCSIP should not be called if *htask* identifies the current task.

See Also

DirectedYield, **TaskSetCSIP**, **TaskSwitch**

TaskNext (3.1)

#include toolhelp.h

BOOL TaskNext(*lpte***)**

TASKENTRY FAR* *lpte;* /* address of TASKENTRY structure */

The **TaskNext** function fills the specified structure with information about the next task on the task queue.

Parameter	Description
lpte	Points to a **TASKENTRY** structure to receive information about the next task.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **TaskNext** function can be used to continue a walk through the task queue. The walk must have been started by the **TaskFirst** or **TaskFindHandle** function.

See Also

TaskFindHandle, **TaskFirst**, **TASKENTRY**

TaskSetCSIP (3.1)

#include toolhelp.h

DWORD TaskSetCSIP(*htask, wCS, wIP***)**

```
HTASK htask;      /* handle of task        */
WORD wCS;         /* value in CS register  */
WORD wIP;         /* value in IP register  */
```

The **TaskSetCSIP** function sets the CS:IP value of a sleeping task. When the task is yielded to, it will begin execution at the specified address.

Parameter	Description
htask	Identifies the task to be assigned the new CS:IP value.
wCS	Contains the new value of the CS register.
wIP	Contains the new value of the IP register.

Returns

The return value is the previous CS:IP value for the task. The **TaskSwitch** function uses this value. The return value is NULL if the *htask* parameter is invalid.

Comments

TaskSetCSIP should not be called if *htask* identifies the current task.

See Also

DirectedYield, **TaskGetCSIP**, **TaskSwitch**

TaskSwitch (3.1)

#include toolhelp.h

BOOL TaskSwitch(*htask, dwNewCSIP***)**

HTASK *htask;* /* handle of task */
DWORD *dwNewCSIP;* /* execution address within task */

The **TaskSwitch** function switches to the given task. The task begins executing at the specified address.

Parameter	Description
htask	Identifies the new task.
dwNewCSIP	Identifies the address within the given task at which to begin execution. Be very careful that this address is not in a code segment owned by the given task.

Returns

The return value is nonzero if the task switch is successful. Otherwise, it is zero.

Comments

When the task identified by the *htask* parameter yields, **TaskSwitch** returns to the calling application.

TaskSwitch changes the CS:IP value of the task's stack frame to the value specified by the *dwNewCSIP* parameter and then calls the **DirectedYield** function.

See Also

DirectedYield, **TaskSetCSIP**, **TaskGetCSIP**

TerminateApp (3.1)

#include toolhelp.h

void TerminateApp(*htask, wFlags***)**

HTASK *htask;* /* handle of task */
WORD *wFlags;* /* termination flags */

The **TerminateApp** function ends the given application instance (task).

Parameter	Description
htask	Identifies the task to be ended. If this parameter is NULL, it identifies the current task.
wFlags	Indicates how to end the task. This parameter can be one of the following values:

Value	Meaning
UAE_BOX	Calls the Windows kernel to display the Application Error message box and then ends the task.
NO_UAE_BOX	Calls the Windows kernel to end the task but does not display the Application Error message box. The application's interrupt or notification callback function should have displayed an error message, a warning, or both.

Returns

This function returns only if *htask* is not NULL and does not identify the current task.

Comments

The **TerminateApp** function unregisters all callback functions registered with the Tool Help functions and then ends the application as if the given task had produced a general-protection (GP) fault or other error.

TerminateApp should be used only by debugging applications, because the function may not free not all objects owned by the ended application.

See Also

InterruptRegister, **InterruptUnRegister**, **NotifyRegister**, **NotifyUnRegister**

TimerCount (3.1)

#include toolhelp.h

BOOL TimerCount(*lpti***)**

TIMERINFO FAR* *lpti;* /* address of structure for execution times */

The **TimerCount** function fills the specified structure with the execution times of the current task and VM (virtual machine).

Parameter	Description
lpti	Points to the **TIMERINFO** structure that will receive the execution times.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **TimerCount** function provides a consistent source of timing information, accurate to the millisecond. In enhanced mode, **TimerCount** uses the VTD (virtual timer device) to obtain accurate execution times.

In standard mode, **TimerCount** calls the **GetTickCount** function, which returns information accurate to one clock tick (approximately 55 ms). **TimerCount** then reads the hardware timer to estimate how many milliseconds remain until the next clock tick. The resulting time is accurate to 1 ms.

Before calling **TimerCount**, an application must initialize the **TIMERINFO** structure and specify its size, in bytes, in the **dwSize** member.

See Also

GetTickCount, **TIMERINFO**

Toolhelp Functions (3.1)

ClassFirst	Retrieves information about first class in class list
ClassNext	Retrieves information about next class in class list
GlobalEntryHandle	Retrieves information about given global memory object
GlobalEntryModule	Retrieves information about specified module segment
GlobalFirst	Retrieves information about first global memory object
GlobalHandleToSel	Converts the given global handle to a selector
GlobalInfo function	Retrieves information about the global heap
GlobalNext	Retrieves information about next global memory object
InterruptRegister	Installs callback function to handle system interrupts
InterruptUnRegister	Removes function handling system interrupts
LocalFirst	Retrieves information about first local memory object
LocalInfo function	Fills structure with information about local heap
LocalNext	Retrieves information about next local memory object
MemManInfo function	Retrieves information about the memory manager
MemoryRead	Reads memory from an arbitrary global heap object
MemoryWrite	Writes memory to an arbitrary global heap object
ModuleFindHandle	Retrieves information about the given module
ModuleFindName	Retrieves information about module with specified name
ModuleFirst	Retrieves information about the first module
ModuleNext	Retrieves information about the next module
NotifyRegister	Installs a notification callback function
NotifyUnRegister	Removes a notification callback function
StackTraceCSIPFirst	Retrieves information about a stack frame
StackTraceFirst	Retrieves information about the first stack frame
StackTraceNext	Retrieves information about the next stack frame
SystemHeapInfo	Retrieves information about the USER and GDI heaps
TaskFindHandle	Retrieves information about a task
TaskFirst	Retrieves information about first task in task queue
TaskGetCSIP	Returns the next CS:IP value of a sleeping task
TaskNext	Retrieves information about next task on the task queue
TaskSetCSIP	Sets the CS:IP value of a sleeping task
TaskSwitch	Switches to a specific address within a new task
TerminateApp	Ends the given application instance (task)
TimerCount	Retrieves execution times of current task and VM

Windows SDK Tools (3.1)

Analyzing Performance: Profiler

Profiler analyzes applications running with Windows in 386 enhanced mode; however, it cannot analyze applications running with Windows in standard mode.

The following topics describe how to set up and use Profiler:

Overview of Profiler

Profiler contains the following:

- A sampling utility
- A reporting utility
- A set of functions your application can call

The sampling utility gathers information about the time spent between adjacent labels and records memory addresses of code. The utility is a special device driver, VPROD.386. To run Profiler, install VPROD.386 and then run Windows directly.

Profiler stores the information it gathers in a buffer. It writes the buffer to disk when Windows terminates, producing a CSIPS.DAT file and a SEGENTRY.DAT file in the directory that was your current directory when you started Windows. The CSIPS.DAT file contains statistical samplings of the code segment (CS) and instruction pointer (IP) registers. The SEGENTRY.DAT file contains information about the movement of code segments. Because code segments can be located at different physical addresses during the execution of the program, information from both the CSIPS.DAT and SEGENTRY.DAT files is required to prepare the profiling report.

After the sampling utility has finished gathering information, the SHOWHITS.EXE reporting utility organizes and displays the results.

With Profiler's functions, you start and stop examining code, manage the output of code samples, and get information about Profiler. All applications that Profiler examines must include the two functions that start and stop the sampling of code. Other Profiler functions are optional.

Preparing to Run Profiler

To profile an application running with Windows in 386 enhanced mode, you can use any system that is capable of running Windows in 386 enhanced mode.

In addition to ensuring that your system is compatible with Profiler, you must do the following:

1 Ensure that the Windows directory is defined in your PATH environment variable.

2 Include in your application at least the two mandatory Profiler functions **ProfStart** and **ProfStop**.

ProfStart indicates when you want Profiler to start sampling code; **ProfStop** indicates when you want Profiler to stop sampling. Other Profiler functions are optional.

3 Compile your application. Then link the compiled code with the standard Windows libraries, using the appropriate command-line option to prepare a symbol map (.MAP) file that includes **PUBLIC** symbols. The .MAP file is required by Microsoft Symbol File Generator (MAPSYM). For information about how to create the .MAP file during linking, see the documentation that accompanied your linker. For more information about MAPSYM, see Advanced Debugging in Protected Mode: WDEB386.

4 Use MAPSYM to convert the .MAP file to a symbol (.SYM) file.

Using Profiler Functions

In addition to the mandatory **ProfStart** and **ProfStop** functions, Profiler includes functions that determine whether Profiler is installed, specify a rate for sampling, and control the output buffer. Following are the available Profiler functions:

Function	Description
ProfClear	Discards all buffered Profiler samples.
ProfFinish	Stops profile sampling and flushes profile buffer.
ProfFlush	Flushes the Profiler sampling buffer to disk.
ProfInsChk	Determines whether Profiler is installed.
ProfSampRate	Sets the Profiler sampling rate.
ProfSetup	Sets Profiler buffer size and sample quantity.
ProfStart	Starts Profiler sampling.
ProfStop	Stops Profiler sampling.

PROFILER: Sampling Code

To use the Profiler functions, you must first install VPROD.386, a virtual device driver. Your application can call the **ProfSetup** function to set the size of the output buffer (up to 1064K).

Profiler sampling uses memory that is otherwise available to Windows. Therefore, using Profiler may decrease the performance of the application you are analyzing. By specifying a small output buffer for Profiler, you can reduce the amount of memory used. However, a small output buffer may cause sample loss.

Profiler can write samples to disk only when Windows indicates it is safe to do so. When the sampling buffer is full, Profiler ignores additional samples until the buffer is flushed to disk. To minimize sample loss, either increase the buffer size or periodically call the **ProfFlush** function.

To profile applications, do the following:

1 Install the VPROD.386 driver by adding the following setting to the [386enh] section of your SYSTEM.INI file:

```
device=vprod.386
```

2 Run Windows in 386 enhanced mode.

3 Run the application you want to profile.

4 When you have finished profiling your application, remove the SYSTEM.INI file setting you added in step 1.

Displaying Samples: SHOWHITS.EXE

To display the data Profiler gathers, run the SHOWHITS.EXE application from the MS-DOS command line. This reporting utility reads CSIPS.DAT, SEGENTRY.DAT, and .SYM files and then organizes and displays the data. The CSIPS.DAT and SEGENTRY.DAT files are located where the sampling utility placed them--that is, in the directory that was your current directory when you started Windows. To ensure that SHOWHITS.EXE can locate these files, either run SHOWHITS.EXE from the same directory or specify full paths for the CSIPS.DAT and SEGENTRY.DAT files. If the .SYM files are not in the current directory, use the ***/i****path* option on the **showhits** command line to specify the directory or directories containing them.

SHOWHITS.EXE reads .SYM files to match instruction pointer samples with global symbols in the application. When you run SHOWHITS.EXE, the utility searches for .SYM files that contain symbolic names identical to the names of modules that Profiler sampled. Each match is called a hit. If the sampled program is written in the C language, the symbolic names are typically function names. If the sampled program is written in assembly language, the symbolic names can be either procedure names or **PUBLIC** symbols within procedures.

SHOWHITS.EXE reports the number of times sampling occurred between adjacent symbols.

The syntax for the **showhits** command line is as follows:

showhits [***/i****path* [***/i****path* [...]]] [*cs_file*] [*seg_file*]

Following are the command-line options and parameters:

/i*path*	Specifies one or more directories to search for .SYM files. SHOWHITS.EXE loads all .SYM files from the specified directories, regardless of their relevance to the application you are profiling. The default value is the current directory.
cs_file	Specifies the full path of the CSIPS.DAT file. If no path is specified, SHOWHITS.EXE looks for the file in the current directory.
seg_file	Specifies the full path of the SEGENTRY.DAT file. If no path is specified, SHOWHITS.EXE looks for the file in the current directory.

SHOWHITS.EXE displays information about hits, which are instruction pointer samples, in the following four categories:

Category	Description
Unrecognized segments	A list of instruction pointer values that occur within segments for which there are no symbols of module names. Unrecognized segments are typically code for device drivers, terminate-and-stay-resident (TSR) programs, and other code that Windows does not use.
Known segments	The number of hits that occur within known modules. Hits on known segments typically include counts for the application and counts for such Windows modules as KERNEL, GDI, and DISPLAY. Profiler also counts hits in MS-DOS and the read-only memory (ROM) basic input-and-output system (BIOS). In addition to displaying hits, SHOWHITS.EXE lists the total number of hits and the segment's percentage of total hits.
Breakdown	A detailed breakdown of the hits between labels of the modules for which SHOWHITS.EXE finds .SYM files. SHOWHITS.EXE also displays the total number of hits and the percentage of the total number.
Summary	A list of the top hits.

The following example illustrates a profiling-report display:

```
Here are the Hits for Unrecognized Segments

Here are the Hits for Known Segments
```

```
 0.3%        3  Hits on SYSTEM!
 0.5%        5  Hits on HELLO!
76.5%      786  Hits on DISPLAY!
11.3%      116  Hits on GDI!
11.5%      118  Hits on KERNEL!

   1028  TOTAL HITS

HELLO!_TEXT

 0.4%        4  Hits between labels _HelloPaint and _HelloInit
 0.1%        1  Hits between labels __cintDIV and __fptrap

Profiler Summary (Top 10 Hits):

 0.4%        4  HELLO! _TEXT! _HelloPaint - _HelloInit
 0.1%        1  HELLO! _TEXT! __cintDIV - __fptrap
```

Advanced Debugging in Protected Mode: WDEB386

Microsoft Windows 80386 Debugger (WDEB386.EXE) is used to test and debug Windows applications and dynamic-link libraries (DLLs) running with the Microsoft Windows operating system in standard or 386 enhanced mode. With 80386 Debugger commands, you can inspect and manipulate test code and environment status, install breakpoints, and perform other debugging operations.

Although 80386 Debugger offers debugging features not available in CodeView for Windows (**CVW**), 80386 Debugger lacks the convenient window interface of CVW and does not provide source-level debugging.

To use 80386 Debugger, you must have a serial terminal connected to the computer on which you are running the debugger and test application.

The following topics describe how to set up and use WDEB386:

Preparing Symbol Files for the 80386 Debugger

Preparing Symbol Files for 80386 Debugger

To prepare application symbol files, perform the following steps:

1 Compile your C-language source files, using the appropriate command-line option to generate object files with line-number information for use by 80386 Debugger. For more information about compiler options, see the documentation that accompanied your compiler.

2 Link the compiled code with the standard Windows libraries, using the appropriate command-line option to prepare a symbol map (.MAP) file that includes **PUBLIC** symbols. The map file is required by Microsoft Symbol File Generator (MAPSYM).

You may also want to use the linker option for display of line-number information. For more information about linker options, see the documentation that accompanied your linker.

3 Run MAPSYM to create a symbol file for symbolic debugging. MAPSYM converts the contents of your application's symbol map (.MAP) file into a form suitable for loading with 80386 Debugger; then MAPSYM copies the result to a symbol (.SYM) file.

Following is the command-line syntax for MAPSYM:

mapsym [**/l**][**/n**] *mapfilename*

/l	Directs MAPSYM to display information on the screen about the conversion. The information includes the names of groups defined in the application, the application start address, the number of segments, and the number of symbols per segment.
/n	Directs MAPSYM to ignore line-number information in the map file. The resulting symbol file contains no line-number information.
mapfilename	Specifies the filename for a symbol map file that was created during linking. If you do not give a filename extension, .MAP is assumed. If you do not give a full path, the current directory and drive are assumed. MAPSYM creates a new symbol file having the same name as the map file but with the .SYM extension.

In the following example, MAPSYM uses the symbol information in FILE.MAP to create FILE.SYM in the current directory on the current drive:

```
mapsym /l file.map
```

Information about the conversion is sent to the screen.

Note: MAPSYM always places the new symbol file in the current directory on the current drive. MAPSYM can process up to 10,000 symbols for each segment in the application and up to 1024 segments.

Starting the Debugger

Starting 80386 Debugger

A three-wire null modem cable is the minimum cable requirement for the serial terminal. In a three-wire null modem cable, the TxD (transmit data) and RxD (receive data) lines are in opposite positions at the two ends of the cable, but the signal ground is connected straight through.

The command-line syntax is as follows:

wdeb386 [**/C:***comport*] [**/D:"***commands***"**] [**/F:***filename*] [**/N**] [**/T:***hhhh*] [**/S:***symfile*] [**/V**[**P**]] [**X**] *winfile* [*parameters*]

Following are the command-line options and parameters:

/C:*comport*	Specifies a COM port for debugger output. If this option is not specified, 80386 Debugger checks first for COM2. If COM2 is not found, the debugger then checks for COM1. If neither COM1 nor COM2 exists, the debugger checks for any other COM port in the read-only memory (ROM) data area (40:0). A three-wire null modem cable is all that is needed for terminal connection; no DTR (data-terminal-ready) and CTS (clear-to-send) handshaking is used.
/D:"*commands***"**	Carries out the 80386 Debugger command line specified by the string enclosed in quotation marks. Spaces, semicolons (;), and other punctuation can be included in the command string. To use a single quote (') on the command line, use double quotation marks (") before and after the single quotation mark. The commands specified in this option are carried out after symbols are loaded. This means you can set breakpoints in code even before the code has been loaded. Before a segment or module has been loaded or defined, breakpoints can be set on the logical address (a combination of map number and group number) until the segment or module is defined, at which point the breakpoint turns into a real breakpoint.
/F: *filename*	Specifies a file containing command-line options for 80386 Debugger. Maximum file size is 4K, and the input file cannot contain the **/F** option.
/N	Sets the following options: **dislwr** **codebytes** **symaddrs** **int3line** **newvec** **newreg** **newprompt**
/S: *symfile*	Specifies a symbol file to be loaded. This option can be repeated to load more than one symbol file. If the symbol files are not in your current directory, you must supply a full path, because 80386 Debugger does not use the PATH environment variable to locate any of the files supplied on the command line. When memory is low, you can use more symbol files by running 80386 Debugger in the Windows directory and specifying the full path of WIN386.EXE (such as \WINDOWS\SYSTEM\WIN386.EXE) instead of WIN.COM.
/T:*hhhh*	Sets the port number for the timing card. (The default number is 250h.)
/V	Enables verbose mode, which displays messages indicating which segments are being being loaded. This option displays the messages for both Windows in 386 enhanced mode and Windows applications.
/VP	Enables verbose mode, which displays messages indicating which segments are being loaded. This option displays the messages for applications only.
/X	Causes symbols to be loaded into Extended Memory Specification (XMS)

	memory. This option has no effect with Windows version 3.1.
winfile	Specifies the Windows application to run under 80386 Debugger control. You will usually specify WIN.COM.
parameters	Specifies any parameters to be passed to the application.

Note: The length of the command line cannot exceed 128 characters.

Following are two examples of valid commands:

```
wdeb386 /V /S:\windows\system\krnl286.sym /S:myapp.sym
\windows\win.com /s myapp

wdeb386 /C:1 /S:krnl386.sym /s:user.sym /S:\myapp\myapp.sym
\windows\win.com /3 myapp
```

You can start 80386 Debugger as a device driver by placing the following line in your CONFIG.SYS file:

```
device=c:\windev\wdeb386.exe
```

You must specify the full path to the WDEB386.EXE file. You can specify any command-line options on the line with device= (for example, you can load symbol files).

Entering the Debugger

Entering 80386 Debugger

To enter 80386 Debugger at any time interrupts are not disabled, press the CTRL+C key combination on the debugging terminal. A nonmaskable interrupt (NMI) can be used to enter the debugger even when interrupts are disabled.

An **int 3** instruction or a call to the Windows **DebugBreak** function passes control to the 80386 Debugger.

When a Windows application running in standard or 386 enhanced mode attempts to read or write memory with a bad selector, beyond a selector limit, or with a selector set to 0, a general protection (GP) fault occurs.

In such cases, Windows displays a dialog box notifying the user of a problem. When 80386 Debugger is loaded, the dialog box has a Cancel button. If the user chooses the Cancel button, Windows passes control to the debugger at the instruction that caused the fault with a display of the following form:

```
GENERAL PROTECTION VIOLATION
AX=00000000 BX=00002136 CX=06040079 DX=00001EF5 SI=000000C3 DI=00002283
IP=00000028 SP=80012126 BP=0000212C CR2=80501FFC CR3=0293 IOPL=0 F=-- --
CS=0915 SS=091D DS=091D ES=0000 FS=0000 GS=0000 -- NV UP EI PLZR NA PE NC
00AD:00000FA0  MOV BX, WORD PTR ES:[BX]
ES:65DF=INV:0003#
```

For more information about commands shown in the remaining examples in this section, see Command Parameters.

You can determine the cause of the GP fault by looking at the value and the limit of the selector. To dump the local descriptor table (LDT) entry, you can use a command of the following form:

dl *selector*

The ability to continue execution depends on the cause of the fault. If the fault was caused by reading or writing beyond the selector limit, it may be possible to skip the instruction by incrementing the IP register.

To determine how many bytes the instruction contains, you may need to display the actual code bytes when disassembling the instruction. To do this, use the following commands:

```
y codebytes
r
```

If the fault is caused by a critical logic error, such as trying to use a selector for a temporary variable, there probably is no way to continue execution of the application. You may need to restart the computer.

Debugger Command Format

Command Syntax

To enter 80386 Debugger commands, you use a debugging terminal rather than your computer's keyboard.

Commands and parameters are not case-sensitive.

If a syntax error occurs in a debugger command, 80386 Debugger redisplays the command line and indicates the error with a caret (^) and the word Error, as in the following example:

```
A100
 ^ Error
```

Command Keys

Following are the command keys:

Key	Action
CTRL+A	Repeats the previous command.
CTRL+C	Halts 80386 Debugger output, and returns to the debugger prompt.
CTRL+S	Freezes an 80386 Debugger display.
CTRL+Q	Restarts the display.

If the target system is executing code, CTRL+S and CTRL+Q are ignored.

Command Parameters

You can separate 80386 Debugger command parameters with delimiters (spaces or commas), but a delimiter is required only between two consecutive hexadecimal values. The following commands are equivalent:

```
dCS:100 110
d CS:100 110
d,CS:100,110
```

Following are the parameters you can use with 80386 Debugger commands:

addr Represents an address parameter in one of four forms. For more information about the operators shown in the following address forms, see Section 5.4.3, "Binary and Unary Operators."

Address	Mode
#1f:02C0	Protected-mode address (selector:offset)
%31020	Linear address
%%31020	Physical address
&0100:02FF	Real-mode address (segment:offset)

Any of these specified address forms overrides the current address type.

byte Specifies a two-digit hexadecimal value.

cmds Specifies an optional set of debugger commands to be executed with the **bp** (Set Breakpoint) or **j** (Conditionally Execute) command.

count Specifies a count. Valid values depend on the command with which this parameter is being used.

dword Represents an eight-digit (4-byte) hexadecimal value. The **DWORD** data type is most commonly used as a physical address.

expr Represents a combination of parameters and operators that evaluates to an 8-bit, 16-bit, or 32-bit value. An *expr* parameter can be used as a value in any command. An *expr*

parameter can combine any symbol, number, or address with any of the binary and unary operators.

flags Specifies one or more conditions. Valid conditions depend on the command with which this parameter is being used.

group-name Specifies the name of a group that contains the map symbols you want to display.

list Specifies a series of byte values or a string. The *list* parameter must be the last parameter on the command line. Following is an example of the **f** (Fill) command with a *list* parameter:

```
fCS:100 42 45 52 54 41
```

map-name Specifies the name of a symbol map file.

name-chars Specifies one or more characters.

number Specifies a numeric value. Valid values depend on the command with which this parameter is being used.

object Specifies a handle, a selector, or (in 386 enhanced mode) a heap address.

option Specifies an option. Valid options depend on the command with which this parameter is being used.

range Specifies the block of memory on which the command should operate. The *range* parameter can be two addresses (*addr addr*); or it can be one address and a length (*addr* **L** *word,* where *word* is the number of items on which the command should operate; 80h is the default value). Following are three valid examples:

```
CS:100 110
CS:100 L 10
CS:100
```

The limit for *range* is 10000h. To specify a word of 10000h using only four digits, use 0000h or 0h.

reg Specifies the name of a microprocessor register.

string Represents any number of characters enclosed in single quotation marks (') or double quotation marks ("). For quotation marks that must appear within *string,* you must use two sets of quotation marks. For example, the following strings are valid:

```
'This ''string'' is OK.'
\"This \"\"string\"\" is OK.\"
```

However, the following strings are not valid:

```
\"This \"string\" is not OK.\"
\"This 'string' is not OK.\"
```

The ASCII values of the characters in the string are used as a list of byte values.

word Specifies a four-digit (2-byte) hexadecimal value.

Stopping Execution

The BreakInDebugVxD entry in the [386Enh] section of SYSTEM.INI controls where WDEB386 stops execution when CTRL+ALT+SYSREQ is pressed. The default setting for this entry is FALSE, which causes WDEB386 to stop in application code. When the setting is TRUE, WDEB386 stops at the current instruction, which is frequently in WIN386.EXE or in a VxD.

Binary and Unary Operators

Following, in descending order of precedence, are the binary operators that can be used in 80386 Debugger commands:

Operator	Meaning

( )	Parentheses
:	Address binder
*	Multiplication
/	Integer division
MOD	Modulus (remainder)
+	Addition
-	Subtraction
>	Greater-than relational operator
<	Less-than relational operator
>=	Greater-than/equal-to relational operator
<=	Less-than/equal-to relational operator
==	Equal-to relational operator
!=	Not-equal-to relational operator
AND	Bitwise Boolean AND
XOR	Bitwise Boolean exclusive OR
OR	Bitwise Boolean OR
&&	Logical AND
||	Logical OR

Following, in descending order of precedence, are the unary operators that can be used in 80386 Debugger commands:

Operator	Meaning
&(*seg*)	Address of segment value
#(*sel*)	Address of selector value
%%(*phy*)	Address as a physical value
%(*lin*)	Address as a linear value
-	Two's complement
!	Logical NOT operator
NOT	One's complement
SEG	Segment address of operand
OFF	Address offset of operand
BY	Low-order byte from given address
WO	Low-order word from given address
DW	Doubleword from given address
POI	Pointer (4 bytes) from given address--this operator works only with 16:16 addresses
PORT	1 byte from given port
WPORT	Word from given port

Regular Expressions

The set of regular expressions that 80386 Debugger supports for matching symbols is similar to the set supported by UNIX grep. The 80386 Debugger set includes a few enhancements.

Following are the 80386 Debugger wildcards:

Wildcard	Description
.	Matches any single character.
[]	Defines a character class; matches a set or range of characters.
^	Negates a character class.

Following are the 80386 Debugger postfix operators:

Operator	Description
*	Causes the previous wildcard or single character to match zero or more characters.
#	Matches zero or one.
+	Plus sign, matches one or more.

Anywhere a symbol is accepted, a regular expression can be used. If there is more than one match, a list of matching symbols is displayed and you must select the proper symbol. The symbol match is not case-sensitive.

The asterisk (*), number sign (#), and plus sign (+) are already math expression operators. To be recognized as a regular expression operator, each of these characters must be immediately preceded by an escape character--the backslash (\). The period (.), opening bracket ([), and closing bracket (]) do not require escape characters. Anything inside the brackets of a character class does not have to be escaped. Following are valid character classes:

```
[a-z]
[;*+#]
```

Characters are escaped at two levels: in the expression evaluator and in the regular expression parser. A character special to the expression evaluator (*, #, +, or \) must be escaped to make it to the regular expression parser. If a character special to the regular expression parser must be escaped (for example, to match symbols with * or # in them), it must be escaped twice. If a backslash is needed in an expression, it must be double escaped.

Following are sample regular expressions:

Regular expression	Description
sym.*	Matches any symbols beginning with the string sym.
sym*	Matches sym alone and sym followed by any characters.
.*sym.*	Matches any symbols containing the string sym.
sym[0-9]	Matches sym0, sym1, sym2, and so on.
sym*	Matches sym*.
sym\\\\	Matches sym\.
sym\\\\.*	Matches any symbols beginning with the string sym\.

Common Command Directory

Common Commands

This section documents the commands available in all environments in which you can use 80386 Debugger. A command that begins with a period (.) is called a dot command.

Command	Description
?	Display expression, or display help menu.
.?	Display external commands.
.b	Set baud rate for COM port.
.df	Display global free list.
.dg	Display global heap.
.dh	Display local heap.
.dm	Display global module list.
.dq	Dump task queues.
.du	Display list of least recently used (LRU) global memory objects.
.reboot	Restart target system.
bc	Clear breakpoint.
bd	Disable breakpoint.
be	Enable breakpoint.
bl	List breakpoints.
bp	Set breakpoint.
br	Set breakpoint on debug register.
c	Compare memory locations.
d	Display memory.
db	Display bytes.
dd	Display doublewords.
dg	Display global descriptor table (GDT).
di	Display interrupt descriptor table (IDT).
dl	Display local descriptor table (LDT).
dp	Display page directory and page tables.
dt	Display task state segment (TSS).
dw	Display words.
e	Enter byte.
f	Fill memory.
g	Go.
h	Perform hexadecimal arithmetic.
i	Display 1 byte of input.
j	Conditionally execute command.
k	Display current stack frame.
ka	Set backtrace argument.
kt	Display stack frame of task.
la	List absolute symbols.
lg	List groups.
lm	List maps.
ln	List nearest symbol.

ls	List symbols.
m	Move memory.
o	Write output to a port.
p	Execute instruction, returning from any call or interrupt.
r	Display register.
s	Search for a byte.
t	Execute instruction.
u	Disassemble bytes.
v	Display debugger version.
vc	Clear interrupt vector.
vl	List debugger interrupt vectors.
vo	List debugger interrupt vectors in specified format.
vs	Add debugger interrupt vector (not at ring 0).
vt	Add debugger interrupt vector.
w	Change active map list.
wa	Add map to active list.
wr	Remove map from active list.
y	Change debugger configuration.
z	Zap embedded **int 1** or **int 3** instruction.
zd	Execute default command string.
zl	Display default command string.
zs	Change default command string.

? WDEB386 command

? [[*option***.**]*expr*]&**?** [**"***string***",** *expr***,** *expr***,** [...]]

The **?** command evaluates an expression and displays the result.

The **?** command with no arguments displays a list of commands and syntax recognized by the debugger.

Parameter	Description
option	Specifies the format in which to display the expression specified by *expr.* The *option* parameter can be one of the following characters:

Character	Format
h	Hexadecimal
d	Decimal
t	Decimal
o	Octal
q	Octal
y	Binary

If *option* is given, a period (.) must be used to separate *option* and *expr.* If *option* is not given, the command displays all formats, an ASCII character representation, and whether the expression is TRUE or FALSE.

expr — Specifies an expression consisting of one or more addresses, numbers, and operators. The operators in the expression can be any of the 80386 Debugger operators listed in Section 5.4.3, "Binary and Unary Operators." The addresses in the expression can be 32-bit physical addresses or protected-mode addresses (selector:offset). The number sign (#) operator overrides the current address type.

string — Specifies a **printf** formatting string. Supported **printf** format characters are as follows:

Format character	Meaning
%%	%
%c	Character
%[-][+][ ][0][*width*][.*precision*][p][n]d	Decimal
%[-][0][*width*][.*precision*][p][n]u	Unsigned decimal
%[-][#][0][*width*][.*precision*][p][n]x	Hexadecimal
%[-][#][0][*width*][.*precision*][p][n]X	Hexadecimal
%[-][0][*width*][.*precision*][p][n]o	Octal
%[-][0][*width*][.*precision*][p][n]b	Binary
%[-][*width*][.*precision*][a]s	String
%[-][*width*][.*precision*][a][p][n][L][H][N]S	Symbol
%[-][*width*][.*precision*][a][p][n][L][H][N]G	Group:symbol
%[-][*width*][.*precision*][a][p][n][L][H][N]M	Map:group:symbol
%[-][*width*][.*precision*][a][p][n][L][H][N]A	Address

Specifying an asterisk (*) for the *width* or *precision* parameter causes the field width or precision, respectively, to be picked up from the next parameter. Decimal values can also be specified for the *width* and *precision* parameters.

The following escape sequences are supported:

Escape sequence	Description
\a	Alert (bell) character
\b	Backspace

\n	New line
\r	Carriage return
\t	Horizontal tab

The following table describes the optional prefixes:

Prefix	Format character(s)	Meaning
a	s,S,G,M,A	Address argument size
H	S,G,M,A	16-bit offset
L	S,G,M,A	32-bit offset
N	S,G,M,A	Offset only
p	S,G,M	Get the previous symbol
n	S,G,M	Get the next symbol
p	A	Get the previous symbol address
n	A	Get the next symbol address
p	d,u,x,X,o,b	Get the previous symbol offset
n	d,u,x,X,o,b	Get the next symbol offset

Example

The following example looks up the physical address of selector 1Fh in the current local descriptor table (LDT) and adds 220h to it:

```
?%(#001F:0220)
```

The following example displays the value of the expression DS:SI + BX:

```
? ds:si+bx
```

The debugger returns a display similar to the following:

```
987A:000001B3 %00098953 %%00098953
```

The following example displays the value of the arithmetic expression 3*4:

```
? 3*4
```

The debugger returns the following display:

```
0Ch 12T 14Q 00001100Y '.' TRUE
```

.? WDEB386 command

.?

The **.?** command displays a list of external commands. These commands are part of 80386 Debugger, but they are specific to the environment in which the debugger is running.

.b WDEB386 command

.b *number* [*addr*]

The **.b** command sets the baud rate for the debugging port (COM2).

Parameter	Description
number	Specifies the baud rate. It can be one of the following values: 150, 300, 600, 1200, 2400, 4800, 9600, or 19200. Because the default radix for the debugger is 16, you must type **t** after the number to indicate a decimal value.
addr	Specifies 1 for COM1 or 2 for COM2; anything else is taken as a base port address. If there is no COM2, 80386 Debugger checks for COM1 and then for any other COM port address in the read-only memory (ROM) data area to use as the console.

Example

The following example sets the baud rate to 1200:

```
#.b 1200t
```

.df WDEB386 command

.df

The **.df** command displays a list of the free global memory objects in the global heap.

The list has the following form:

*address***:** *size owner* [*chain*]

address	Specifies the selector of the memory in standard mode. In 386 enhanced mode, the *address* field specifies physical and heap addresses.
size	Specifies the size, in paragraphs (multiples of 16 bytes), of the object in standard mode. In 386 enhanced mode, the *size* field specifies the size of the object, in bytes.
owner	Always specifies that the module is free.
chain	Specifies the previous and next addresses in the list of least recently used (LRU) objects. 80386 Debugger displays the addresses only if the segment is movable and discardable.

.dg WDEB386 command

.dg [*object*]

The **.dg** command displays a list of the global memory objects in the global heap.

Parameter	Description
object	Specifies the first object to be listed. The *object* parameter can be a handle, a selector, or (in 386 enhanced mode) a heap address.

The list has the following form:

*address***:** *size segment-type owner* [*handle flags chain*]

address Specifies the selector of the memory in standard mode. In 386 enhanced mode, the *address* field specifies physical and heap addresses.

size Specifies the size, in paragraphs (multiples of 16 bytes), of the object in standard mode. In 386 enhanced mode, the *size* field specifies the size of the object, in bytes.

segment-type Specifies the type of object. The type can be any one of the following:

Segment type	Meaning
CODE	Segment contains application code.
DATA	Segment contains application data and possible stack and local heap data.
FREE	Segment belongs to pool of free memory objects ready for allocation by an application.
PRIV	Segment contains private data.
SENTINAL	Segment marks the beginning or end of the global heap.

owner Specifies the module name of the application or library that allocated the memory object. The acronym PDB is used for memory objects that represent process descriptor blocks. These blocks contain execution information about applications.

handle Specifies the handle of the global memory object. If 80386 Debugger displays no handle, the segment is fixed.

flags Specifies either of the following:

Flag	Meaning
D	The segment is movable and discardable.
L	The segment is locked. If the segment is locked, the lock count appears to the right of the flag.

If 80386 Debugger displays a handle but no flag, the segment is movable but not discardable.

chain Specifies the previous and next addresses in the list of least recently used (LRU) objects. Addresses are displayed only if the segment is movable and discardable (specified by the D flag).

.dh WDEB386 command

.dh

The **.dh** command displays a list of the local memory objects in the local heap (if any) belonging to the current data segment. The command uses the current value of the DS register to locate the data segment and check for a local heap.

The list of memory objects has the following form:

*offset***:** *size* { **BUSY** | **FREE** }

offset Specifies the address offset from the beginning of the data segment to the local memory object.

size Specifies the size of the object, in bytes.

If **BUSY** is displayed, the object has been allocated and is currently in use. If **FREE** is displayed, the object is in the pool of free objects ready to be allocated by the application. A special memory object, **SENTINAL**, may also be displayed.

.dm WDEB386 command

.dm

The **.dm** command displays a list of the global modules in the global heap.

The list has the following form:

module-handle module-type module-name filename

module-handle	Specifies the handle of the module.
module-type	Specifies either a dynamic-link library (DLL) or the name of the application you are debugging.
module-name	Specifies the name of the module.
filename	Specifies the name of the file from which you loaded the application.

.dq WDEB386 command

.dq

The **.dq** command displays a list containing information about the various task queues supported by the system.

The list has the following form:

*task-descriptor-block stack-segment***:***stack-pointer number-of-events*
priority internal-messaging-information module

task-descriptor-block	Specifies the selector or segment address. The task descriptor block is identical to the process descriptor block (PDB).
*stack-segment***:***stack-pointer*	Specifies the stack segment and pointer.
number-of-events	Specifies the number of events waiting for the segment.
priority	Specifies the priority of the segment.
internal-messaging-information	Specifies information about internal messages.
module	Specifies the module name.

.du WDEB386 command

.du

The **.du** command displays a list of the least recently used (LRU) global memory objects in the global heap.

The list has the following form:

*address***:** *size segment-type owner* [*handle flags chain*]

address Specifies the selector of the memory in standard mode. In 386 enhanced mode, the *address* field specifies physical and heap addresses.

size Specifies the size, in paragraphs (multiples of 16 bytes), of the object in standard mode. In 386 enhanced mode, the *size* field specifies the size of the object, in bytes.

segment-type Specifies the type of object. The type can be any one of the following:

Segment type	Meaning
CODE	Segment contains application code.
DATA	Segment contains application data and possible stack and local heap data.
FREE	Segment belongs to pool of free memory objects ready for allocation by an application.
PRIV	Segment contains private data.
SENTINAL	Segment marks the beginning or end of the global heap.

owner Specifies the module name of the application or library that allocated the memory object. The acronym PDB is used for memory objects that represent process descriptor blocks. These blocks contain execution information about applications.

handle Specifies the handle of the global memory object.

flags Specifies D, which means the segment is movable and discardable.

chain Specifies the previous and next addresses in the LRU list.

.reboot WDEB386 command

.reboot

The **.reboot** command causes the target system to restart.

bc WDEB386 command

bc *list* | *****

The **bc** command removes one or more defined breakpoints.

Parameter	Description
list	Specifies any combination of integer values in the range 0 through 9. If you specify *list,* the debugger removes the specified breakpoints.
*****	Clears all breakpoints.

Example

The following example removes breakpoints 0, 4, and 8:

```
bc 0 4 8
```

The following example removes all breakpoints:

```
bc *
```

bd WDEB386 command

bd *list* | *****

The **bd** command temporarily disables one or more breakpoints. To restore breakpoints disabled by the **bd** command, use the **be** (Enable Breakpoints) command.

Parameter	Description
list	Specifies any combination of integer values in the range 0 through 9. If you specify *list,* the debugger disables the specified breakpoints.
*****	Disables all breakpoints.

Example

The following example disables breakpoints 0, 4, and 8:

```
bd 0 4 8
```

The following example disables all breakpoints:

```
bd *
```

be WDEB386 command

be *list* | *****

The **be** command restores (enables) one or more breakpoints that have been temporarily disabled by a **bd** (Disable Breakpoints) command.

Parameter	Description
list	Specifies any combination of integer values in the range 0 through 9. If you specify *list,* the debugger enables the specified breakpoints.
*****	Enables all breakpoints.

Example

The following example enables breakpoints 0, 4, and 8:

```
be 0 4 8
```

The following example enables all breakpoints:

```
be *
```

bl WDEB386 command

bl

The **bl** command lists current information about all breakpoints created by the **bp** (Set Breakpoints) command.

Example

If no breakpoints are currently defined, the debugger displays nothing. Otherwise, the breakpoint number, enabled status, breakpoint address, number of passes remaining, initial number of passes (in parentheses), and any optional debugger commands to be executed when the breakpoint is reached are displayed on the screen, as in the following example:

```
0 e 04BA:0100
4 d 04BA:0503 4 (10)
8 e 0D2D:0001 3 (3) "R;DB DS:SI"
9 e xxxx:0012
```

In this example, breakpoints 0 and 8 are enabled (e) and 4 is disabled (d). Breakpoint 4 had an initial pass count of 10h and has four remaining passes to be taken before the breakpoint. Breakpoint 8 had an initial pass count of 3 and must make all three passes before it halts execution and forces the debugger to execute the optional debugger commands enclosed in quotation marks. Breakpoint 0 shows no initial pass count, which means it was set to 1. Breakpoint 9 shows a virtual breakpoint (a breakpoint set in a segment that has not been loaded into memory).

bp WDEB386 command

bp[*number*]*addr* [*count*] [**"***cmds***"**]

The **bp** command creates a software breakpoint at an address. When the application is running, software breakpoints stop execution and force the debugger to execute the default or optional command string. Unlike breakpoints created by the **g** (Go) command, software breakpoints remain in memory until you remove them with the **bc** (Clear Breakpoints) command or temporarily disable them with the **bd** (Disable Breakpoints) command.

The debugger allows up to 10 software breakpoints (0 through 9). If you specify more than 10 breakpoints, the debugger returns the following message:

```
Too Many Breakpoints
```

The *addr* parameter is required for all new breakpoints.

Parameter	Description
number	Specifies which breakpoint is being created. No space is allowed between the **bp** and *number.* If *number* is omitted, the first available breakpoint number is used.
addr	Specifies any valid instruction address--the first byte of an operation code (opcode).
count	Specifies the number of times the breakpoint is to be ignored before being executed. It can be any 16-bit value.
cmds	Specifies an optional list of debugger commands to be executed in place of the default command when the breakpoint is reached. You must enclose optional commands in quotation marks and separate optional commands with semicolons (;).

Example

The following example creates a breakpoint at address CS:123:

```
bp 123
```

The following example creates breakpoint 8 at address 400:23 and executes a **db** (Display Bytes) command:

```
bp8 400:23 "db DS:SI"
```

The following example creates a breakpoint at address 100 in the current CS selector and displays the registers before comparing a block of memory. The breakpoint is ignored 16 (10h) times before being executed.

```
bp 100 10 "r;c100 L 100 300"
```

br WDEB386 command

br[*number*] *flags* [*count*] [**"***cmds***"**]

The **br** command sets an 80386 debug register breakpoint. Debug registers can be used to break on data reads and writes and instruction execution. Up to four debug registers can be set and enabled at one time.

Parameter	Description
number	Specifies which breakpoint is being created. No space is allowed between the **br** command and the *number* parameter. If *number* is omitted, the first available breakpoint number is used.
flags	Specifies the length and break conditions for the breakpoint. This parameter can be some combination of the following values:

Value	Meaning
1	Set 1-byte length (default value).
2	Set word length on word boundary.
4	Set doubleword length on doubleword boundary.
E	Break on instruction execution only (1-byte length only).
W	Break on writes only.
R	Break on reads and writes.

count	Specifies the number of times the breakpoint is to be ignored before being executed. It can be any 16-bit value.
cmds	Specifies an optional list of debugger commands to be executed in place of the default command when the breakpoint is reached. You must enclose the group of optional commands in quotation marks and separate optional commands with semicolons (;).

c WDEB386 command

c *range addr*

The **c** command compares one memory location with another memory location.

If the two memory areas are identical, the debugger displays nothing and returns the debugger prompt. Differences, when they exist, are displayed in the following form:

addr1 byte1 byte2 addr2

Parameter	Description
range	Specifies the block of memory that is to be compared with a block of memory starting at *addr.*
addr	Specifies the starting address of the second block of memory.

Example

This section shows two forms of the **c** command that have the same effect. Each compares the block of memory from 100h to 1FFh with the block of memory from 300h to 3FFh.

The first example specifies a *range* with a starting address of 100h and an ending address of 1FFh. This block of memory is compared with a block of memory of the same size starting at 300h.

```
c100 1FF 300
```

The second example compares the same block of memory but specifies the *range* by using the **L** (length) option.

```
c100 L 100 300
```

d WDEB386 command

d [*range*]

The **d** command displays the contents of memory at a given address or in a range of addresses. The **d** command displays one or more lines, depending on the *range* given. Each line displays the address of the first item displayed. The command always displays at least one value. The memory display is in the format defined by a previously executed **db** (Display Bytes), **dd** (Display Doublewords), or **dw** (Display Words) command. Each subsequent **d** (typed without parameters) displays the bytes immediately following those last displayed.

Parameter	Description
range	Specifies the block of memory to display. If you omit *range,* the **d** command displays the next byte of memory after the last one displayed. The **d** command must be separated by at least one space from any *range* value.

Example

The following example displays 20h bytes at CS:100:

```
d CS:100 L 20
```

The following example displays all the bytes in the range 100h to 115h in the CS selector:

```
d CS:100 115
```

db WDEB386 command

db [*range*]

The **db** command displays the values of the bytes at a given address or in a given range.

The display is in two portions: a hexadecimal display (each byte is shown in hexadecimal format) and an ASCII display (the bytes are shown as ASCII characters). A nonprinting character is denoted by a period (.) in the ASCII portion of the display. Each display line shows 16 bytes, with a hyphen between the eighth and ninth bytes. Each displayed line begins on a 16-byte boundary.

Parameter	Description
range	Specifies the block of memory to display. If you omit *range,* 128 bytes are displayed beginning at the first address after the address displayed by the previous **db** command.

Example

The following example displays 0Ah bytes of memory, beginning at the specified address:

```
db CS:100 0A
```

This example displays lines in a format similar to the following:

```
04BA:0100 54 4F 4D 20 53  . . . 45 52 TOM SAWYER
```

Each line of the display begins with an address, incremented by 10h from the address on the previous line.

dd WDEB386 command

dd [*range*]

The **dd** command displays the hexadecimal values of the doublewords at the address specified or in the specified range of addresses.

The **dd** command displays one or more lines, depending on the *range* given. Each line displays the address of the first doubleword in the line, followed by up to four hexadecimal doubleword values. The hexadecimal values are separated by spaces. The **dd** command displays values up to the end of the *range* or until the first 32 doublewords have been displayed.

Typing **dd** displays 32 doublewords at the current dump address. For example, if the last byte in the previous **dd** command was 04BA:0110, the display starts at 04BA:0111.

Parameter	Description
range	Specifies the block of memory to display. If you omit *range,* 32 doubleword values are displayed beginning at the first address after the address displayed by the previous **dd** command.

Example

The following example displays the doubleword values from CS:100 to CS:110:

```
dd CS:100 110
```

The resulting display is similar to the following:

```
04BA:0100 7473:2041 676E:6972 5405:0104 0A0D:7865
04BA:0110 0000:002E
```

No more than four values per line are displayed.

dg WDEB386 command

dg[**a**] [*range*]

The **dg** command displays the specified range of entries in the global descriptor table (GDT).

Parameter	Description
range	Specifies the range of entries in the GDT. If you omit *range,* the debugger displays the entire contents of the GDT.
a	Causes all entries in the table to be displayed, not just the valid entries. By default, only the valid GDT entries are displayed. If the command is passed a local descriptor table (LDT) selector, it displays the appropriate LDT entry.

Example

The following example displays only the valid entries from 0h to 40h in the GDT:

```
dg 0 40
```

The resulting display is similar to the following:

```
0008  Data Seg  Base=01D700 Limit=3677 DPL=0 Present ReadWriteAccessed
0010  TSS Desc  Base=007688 Limit=002B DPL=0 Present Busy
0018  Data Seg  Base=020D7A Limit=03FF DPL=0 Present ReadWrite
0020  Data Seg  Base=000000 Limit=03FF DPL=0 Present ReadWrite
0028  LDT Desc  Base=000000 Limit=0000 DPL=0 Present
0030  Data Seg  Base=000000 Limit=0000 DPL=0 Present ReadWrite
0040  Data Seg  Base=000400 Limit=03BF DPL=3 Present ReadWrite
```

di WDEB386 command

di[**a**] [*range*]

The **di** command displays the specified range of entries in the interrupt descriptor table (IDT).

Parameter	Description
a	Causes all entries in the table to be displayed, not just the valid ones. The default is to display just the valid IDT entries.
range	Specifies the range of entries to be displayed. If you omit *range,* the debugger displays all IDT entries.

Example

The following example displays the valid IDT entries in the range 0h through 10h:

```
di 0 10
```

The resulting display is similar to the following:

```
0000  Int Gate  Sel=1418    Offst=03D8 DPL=3 Present
0001  Int Gate  Sel=2D38    Offst=0049 DPL=3 Present
0002  Int Gate  Sel=1418    Offst=03E4 DPL=3 Present
0003  Int Gate  Sel=2D38    Offst=006F DPL=3 Present
0004  Int Gate  Sel=1418    Offst=0417 DPL=3 Present
0005  Int Gate  Sel=1418    Offst=041D DPL=3 Present
0006  Int Gate  Sel=1418    Offst=0423 DPL=3 Present
0007  Int Gate  Sel=2D38    Offst=00A3 DPL=3 Present
0008  Int Gate  Sel=1418    Offst=042F DPL=3 Present
0009  Int Gate  Sel=2D38    Offst=00CA DPL=3 Present
000A  Int Gate  Sel=2D38    Offst=00D3 DPL=3 Present
000B  Int Gate  Sel=2D38    Offst=0156 DPL=3 Present
000C  Int Gate  Sel=2D38    Offst=01A4 DPL=3 Present
000D  Int Gate  Sel=2D38    Offst=01C6 DPL=3 Present
```

dl WDEB386 command

dl[**a** | **p** | **s** | **h**] [*range*]

The **dl** command displays the specified range of entries in the local descriptor table (LDT).

Parameter	Description
a	Causes all entries in the table to be displayed, not just the valid ones. By default, only the valid LDT entries are displayed. If the command is passed a global descriptor table (GDT) selector, it displays the appropriate GDT entry.
p	Causes private segment selectors to be displayed.
s	Causes shared segment selectors to be displayed.
h	Causes huge segment selectors to be displayed. To display the huge segment selectors, give the shadow selector followed by the maximum number of selectors reserved for that segment plus 1.
range	Specifies the range of entries to be displayed. If you omit *range,* the entire table is displayed.

Example

The following example displays all the LDT entries:

```
dla 4 57
```

The command produces a display similar to the following:

```
0014  Call Gate Sel=1418    Offst=0417 DPL=0 NotPres WordCount=1D
001C  Code Seg  Base=051418 Limit=0423 DPL=0 NotPres ExecOnly
0027  Reserved  Base=87F000 Limit=FEA5 DPL=3 Present
0034  Code Seg  Base=05F000 Limit=1805 DPL=0 NotPres ExecOnly
003C  Code Seg  Base=05F000 Limit=EF57 DPL=0 NotPres ExecOnly
0047  Code Seg  Base=4DC000 Limit=0050 DPL=3 Present ExecOnly
004D  Reserved  Base=71F000 Limit=F841 DPL=1 NotPres
0057  Code Seg  Base=59F000 Limit=E739 DPL=3 Present ExecOnly
```

dp WDEB386 command

dp[**a**|**d**] [*range*]

The **dp** command displays the page directory and page tables. Page tables are always skipped if the corresponding page directory entry is not present. Page directory entries appear with an asterisk next to the page frame.

Parameter	Description
a	Displays all present page directory and page table entries; by default, page directory and page table entries that are zero are skipped.
d	Displays only page directory entries. If a count is given as part of the optional range, it will be interpreted as a page directory entry count.
range	Specifies the range of linear addresses for page tables.

Example

The following example displays the page directory and page table in the range 0 through 12h:

```
dp 0 l2
```

The resulting display is similar to the following:

```
%00000000 *frame=00FCE  state=3  res=0  c A  pb1=0  pb0=0  U W P
%00000000  frame=00000  state=3  res=0  c u  pb1=0  pb0=0  U W P
%00001000  frame=00001  state=3  res=0  c u  pb1=0  pb0=0  U W P
```

The display produced by the **dp** command can contain flags that have the following meanings:

Bit set	Bit clear	Meaning
D	c	Dirty/clean
A	u	Accessed/unaccessed
U	s	User/supervisor
W	r	Writable/read-only
P	n	Present/not-present

dt WDEB386 command

dt [*addr*]

The **dt** command displays the current task state segment (TSS) or the selected TSS if you specify the optional address.

Parameter	Description
addr	Specifies the address of the TSS to display. If no *addr* is given, **dt** displays the current TSS pointed to by the TR register.

Example

The following example displays the current TSS:

```
dt
```

The resulting display is similar to the following:

```
AX=0000 BX=0000 CX=0000 DX=0000 SP=0000 BP=0000 SI=0000 DI=0000
IP=0000 CS=0000 DS=0000 ES=0000 SS=0000 NV UP DI PL NZ NAPO NC
SS0=0038  SP0=08DE  SS1=0000  SP1=0000  SS2=0000  SP2=0000
IOPL=0    LDTR=0028 LINK=0000
```

dw WDEB386 command

dw [*range*]

The **dw** command displays the hexadecimal values of the words at a given address or in a given range of addresses.

The command displays one or more lines, depending on the *range* given. Each line displays the address of the first word in the line, followed by up to eight hexadecimal word values. The hexadecimal values are separated by spaces. The command displays values until the end of the *range* or until the first 64 words have been displayed.

Typing **dw** displays 64 words at the current dump address. For example, if the last word in the previous **dw** command was displayed at address 04BA:0110, the next display will start at 04BA:0112.

Parameter	Description
range	Specifies the range of addresses to display. If you omit *range,* 64 words are displayed beginning at the first address after the address displayed by the previous **dw** command.

Example

The following example displays the word values from CS:100 to CS:110:

```
dw CS:100 110
```

The resulting display is similar to the following:

```
04BA:0100 2041 7473 6972 676E 0104 5404 7865 0A0D
04BA:0110 002E
```

e WDEB386 command

e *addr* [*list*]

The **e** command enters byte values into memory at a specified address. You can specify the new values on the command line or let the debugger prompt you for values. If the debugger prompts you, it displays the address and its contents and then waits for you to perform one of the following actions:

- Replace a byte value with a value you type. Type the value after the current value. If the byte you type is an invalid hexadecimal value or contains more than two digits, the system does not echo the illegal or extra character.
- Press the SPACEBAR to advance to the next byte. To change the value, type the new value after the current value. If, when you press the SPACEBAR, you move beyond an 8-byte boundary, 80386 Debugger starts a new display line with the address displayed at the beginning.
- Type a hyphen (-) to return to the preceding byte. If you decide to change a byte before the current position, typing the hyphen returns the current position to the previous byte. When you type the hyphen, a new line is started with its address and byte value displayed.
- Press ENTER to terminate the **e** command. You can press ENTER at any byte position.

Parameter	Description
addr	Specifies the address of the first byte to be entered.
list	Specifies the byte values used for replacement. These values are inserted automatically. If an error occurs when you are using the list form of the command, no byte values are changed.

Example

The following example prompts you to change the value EB at CS:100:

```
eCS:100
04BA:0100 EB.
```

To step through the subsequent bytes without changing values, press the SPACEBAR. In the following example, the SPACEBAR is pressed three times:

```
04BA:0100 EB.41  10. 00. BC.
```

To return to a value at a previous address, type a hyphen, as shown in the following example:

```
04BA:0100  EB.41    10. 00. BC.-
04BA:0102  00.-
04BA:0101  10.
```

This example returns to the address CS:101.

f WDEB386 command

f *range list*

The **f** command fills the addresses in a specified range with the values in the specified list.

Parameter	Description
range	Specifies the block of memory to be filled. If *range* contains more bytes than the number of values in *list,* the debugger uses *list* repeatedly until all bytes in *range* are filled. If any of the memory in *range* is not valid (bad or nonexistent), an error occurs in all succeeding locations.
list	Specifies the list of values to fill the given *range.* If *list* contains more values than the number of bytes in *range,* the debugger ignores the extra values in *list.*

Example

The following example fills memory locations 04BA:100 through 04BA:1FF with the bytes specified, repeating the five values until it has filled all 100h bytes:

```
f04BA:100 L 100 42 45 52 54 41
```

g WDEB386 command

g[**s**|**h**|**t**|**z**] [**=***addr* [*addr*[...]]]

The **g** command executes the application currently in memory. If you type the **g** command by itself, the current application runs as if it had been run outside the debugger. If you specify **=***addr,* execution begins at the specified address.

Specifying an optional breakpoint address causes execution to halt at the first address encountered, regardless of the position of the address in the list of addresses that halts execution or application branching. When execution of the application reaches a breakpoint, the default command string is executed.

The stack (SS:SP) must be valid and have 6 bytes available for this command. The **g** command uses an **iret** instruction to cause a jump to the application being tested. The stack is set, and the user flags, CS register, and IP register are pushed on the user stack. (If the user stack is not valid or is too small, the operating system may crash.) An interrupt code (0CCh) is placed at the specified breakpoint addresses.

When the debugger encounters an instruction with the breakpoint code, it restores all breakpoint addresses listed with the **g** command to their original instructions. If you do not halt execution at one of the breakpoints, the interrupt codes are not replaced with the original instructions.

Parameter	Description
s	Shows the time, in microseconds, from when the system is started with **gs** until the next entry to the debugger. No attempt is made to calculate and remove debugger overhead from the measurement. Requires a timing card.
h	Displays the approximate debugger overhead in the **s** option. Requires a timing card.
t or **z**	Allows trapped exceptions to resume at the original trap handler address without having to unhook the exception. Use these options instead of the **vcp d; t; vsp d** command.
=*addr*	Specifies the address at which execution is to begin. The equal sign (=) is needed to distinguish the starting address from the breakpoint address.
addr	Specifies one or more breakpoint addresses where execution is to halt. You can specify up to 10 breakpoints, but only at addresses containing the first byte of an operation code (opcode). If you attempt to set more than 10 breakpoints, an error message is displayed.

Example

The following example executes the application currently in memory until address 7550 in the CS selector is executed. The debugger then executes the default command string, removes the **int 3** trap from this address, and restores the original instruction. When you resume execution, the original instruction is executed.

```
gCS:7550
```

h WDEB386 command

h *word word*

The **h** command performs hexadecimal arithmetic on the two specified parameters.

The debugger adds, subtracts, and multiplies the two parameters; divides the second parameter by the first; and then displays the results on one line. The debugger does 32-bit multiplication and displays the result as doublewords. The debugger displays the result of division as a 16-bit quotient and a 16-bit remainder.

Parameter	Description
word	Specifies a 16-bit word parameter.

Example

The following example performs the calculations on 300h and 100h:

```
h 300 100
```

The resulting display is the following:

```
+0400  -0200 *0000 0003 /0003 0000
```

i WDEB386 command

i *word*

The **i** command accepts and displays 1 byte from a specified port.

Parameter	Description
word	Specifies the 16-bit port address.

Example

The following example displays the byte at port address 2F8h:

```
i2F8
```

j WDEB386 command

j *expr* [**"***cmds***"**]

The **j** command executes the specified commands when the specified expression is TRUE. If *expr* is FALSE, the debugger continues to the next command line (excluding the commands in *cmds*).

The **j** command is useful in breakpoint commands to conditionally break execution when an expression becomes TRUE.

Parameter	Description
expr	Evaluates to a Boolean TRUE or FALSE.
cmds	Specifies a list of debugger commands to be executed when *expr* is TRUE. The list must be enclosed in single or double quotation marks. You must separate optional commands with semicolons (;). Single commands do not require quotation marks.

Example

The following example causes execution to break if AX does not equal zero when the breakpoint is reached:

```
bp 167:1454 "J AX == 0;G"
```

The following example displays the registers and continues execution when the byte pointed to by DS:SI +3 is equal to 40h; otherwise, it displays the descriptor table:

```
bp 167:1462 "J BY (DS:SI+3) == 40 'R;G';DG DS"
```

k WDEB386 command

k[**b**|**s**|**v**] [*addr*] [*addr*]

This command displays the current stack frame. Each line shows the name of a procedure, its arguments, and the address of the statement that called it. The command displays four 2-byte arguments by default. The **ka** command changes the number of arguments displayed by this command.

Using the **k** command at the beginning of a function (before the function prolog has been executed) gives incorrect results. The command uses the BP register to compute the current backtrace, and this register is not correctly set for a function until its prolog has been executed.

Parameter	Description
b	Indicates the stack frame is 32 bits wide.
s	Indicates the stack frame is 16 bits wide.
v	Displays the verbose version of stack information--that is, information about stack location and frame pointer values for each frame.
addr	Specifies an optional stack-frame address (SS:BP) or an optional code address (CS:IP).

ka WDEB386 command

ka *count*

The **ka** command sets the number of arguments displayed for all subsequent stack trace commands. The initial default value is 4.

Parameter	Description
count	Specifies the number of arguments to be displayed. The *count* parameter must be in the range 0 through 1Fh.

kt WDEB386 command

k[**b**|**s**|**v**]**t** [*addr*]

This command displays the stack frame of the current task or the task specified by the *addr* parameter. Each line shows the name of a procedure, its arguments, and the address of the statement that called it. The command displays four 2-byte arguments by default. The **ka** command changes the number of arguments displayed by this command.

Parameter	Description
b	Indicates the stack frame is 32 bits wide.
s	Indicates the stack frame is 16 bits wide.
v	Displays the verbose version of stack information--that is, information about stack location and frame pointer values for each frame.
addr	Specifies the segment address of the process descriptor block (PDB) for the task to be traced. To obtain the *addr* value, use the .**dq** (Dump Task Queue) command. If *addr* is not supplied, the **kt** command displays the stack frame of the current task.

la WDEB386 command

la

The **la** command lists the absolute symbols in the active map.

lg WDEB386 command

lg

The **lg** command lists the selector (or segment) and the name of each group in the active map.

Example
The **lg** command produces a display similar to the following:

```
#0090:0000 DOSCODE
#0828:0000 DOSGROUP
#1290:0000 DBGCODE
#16C0:0000 DBGDATA
#1A38:0000 TASKCODE
#1AD8:0000 DOSRING3CODE
#1AE0:0000 DOSINITCODE
#2018:0000 DOSINITRMCODE
#20A8:0000 DOSINITDATA
#23F8:0000 DOSMTE
#2420:0000 DOSHIGHDATA
#28D0:0000 DOSHIGHCODE
#3628:0000 DOSHIGH2CODE
#0090:0000 DOSCODE
```

lm WDEB386 command

lm

The **lm** command lists the symbol files currently loaded and indicates which one is active.

The last symbol file loaded is made active by default. Use the **w** (Change Map) command to change the active file.

Example

The **lm** command returns a display similar to the following:

```
COMSAM2D is active.
DISK01D.
```

ln WDEB386 command

ln [*addr*]

The **ln** command lists the symbol nearest the specified address. The command lists the nearest symbol before and after the specified *addr* parameter. This command also shows line-number information if it is available in the symbol file.

Parameter	Description
addr	Specifies any valid instruction address. The default value is the current disassembly address.

Example

The **ln** command without the *addr* parameter displays the nearest symbols before and after the current disassembly address. The output looks similar to the following:

```
6787 VerifyRamSemAddr + 10
67AA PutRamSemID - 13
```

ls WDEB386 command

ls *group-name* | *name-chars* | ***

The **ls** command lists the symbols in the specified group or lists names that match the search specification in all groups. The only valid wildcard is a single asterisk (*) as the last character on the command line; all other characters are ignored.

Parameter	Description
group-name	Names the group that contains the symbols you want to list.
name-chars	Specifies the beginning characters of the symbols you want to list.

Example

The following example displays all the symbols in the DOSRING3CODE group:

```
ls DOSRING3CODE
```

Symbols are displayed in a format similar to the following:

```
0000 Sigdispatch
001A LibInitDisp
```

The following example displays all the symbols that begin with the string vkd:

```
ls vkd*
```

Group names are displayed as they are searched, in a form similar to the following:

```
GROUP: [0028] CODE
        60003A74 VKD_Control_Debug
GROUP: [0030] DATA
        6001DFFC VKD_CB_Offset
GROUP: [0030} IDATA
```

The following example displays the address and group for the symbol VMM_base:

```
ls vmm_base
```

m WDEB386 command

m *range addr*

The **m** command moves a block of memory from one memory location to another.

Overlapping moves--those in which part of the block overlaps some of the current addresses--are always performed without loss of data. Addresses that could be overwritten are moved first. For moves from higher to lower addresses, the sequence of events is first to move the data at the block's lowest address and then to work toward the highest. For moves from lower to higher addresses, the sequence is first to move the data at the block's highest address and then to work toward the lowest.

Note that if the addresses in the block being moved will not have new data written to them, the data that was in the block before the move will remain. The **m** command copies the data from one area into another, in the sequence described, and writes over the new addresses--hence, the importance of the moving sequence.

To review the results of a memory move, use the **d** (Display Memory) command, specifying the same address you used with the **m** command.

Parameter	Description
range	Specifies the block of memory to be moved.
addr	Specifies the starting address at which the memory is to be relocated.

Example

The following example first moves the data at address CS:110 to CS:510 and then moves the data at CS:10F to CS:50F, and so on, until the data at CS:100 is moved to CS:500:

```
mCS:100 110 CS:500
```

o WDEB386 command

o *word byte*

The **o** command writes a byte to a 16-bit port address.

Parameter	Description
word	Specifies the 16-bit port address to be written to.
byte	Specifies the 8-bit value to be written to the port.

Example

The following example writes the byte value 4Fh to output port 2F8h:

```
o 2F8 4F
```

p WDEB386 command

p[**n**] [**=***addr*][*count*]

The **p** command executes the instruction at a specified address and displays the current values of all the registers and flags (whatever the **zd** command has been set to). It then executes the default command string, if any.

The **p** command is identical to the **t** (Trace Instructions) command, except that it automatically executes and returns from any calls or software interrupts it encounters. The **t** command always stops after executing into the call or interrupt, leaving execution control inside the called routine.

Parameter	Description
n	Suppresses the register display so just the assembly line is displayed. The suppression results only if the default command, **zd**, is set to a normal setting, **r**.
addr	Specifies the starting address at which to begin execution. If you omit the optional *addr* parameter, execution begins at the instruction pointed to by the CS and IP registers. Use the equal sign (=) only if you specify *addr.*
count	Specifies the number of instructions to execute before stopping and executing the default command string. The command executes the default command string for each instruction before executing the next.

Example

The following example executes the instruction pointed to by the current CS and IP register values before it executes the default command string:

```
p
```

The following example executes the instruction at address CS:120 before it executes the default command string:

```
p=120
```

r WDEB386 command

r *reg*=*word*

The **r** command displays the contents of one or more central processing unit (CPU) registers and allows the contents to be changed to new values. If you specify the *reg* parameter with the **r** command, the 16-bit value of that register is displayed in hexadecimal format followed by a colon (:) prompt on the next line. You can then enter a new *word* value for the specified register or press ENTER if you do not want to change the register value.

If you specify **f** for *reg,* the debugger displays the flags in a row at the beginning of a new line and displays a hyphen (-) after the last flag.

You can type new flag values in any order as alphabetic pairs. You do not have to leave spaces between these values. To terminate the **r** command, press ENTER. Any flags for which you did not specify new values remain unchanged.

If you type more than one value for a flag or enter an invalid flag name, the flags up to the error in the list are changed and those flags at and after the error are not changed. In addition, 80386 Debugger returns the following error message:

```
Bad Flag
```

Parameter	Description
reg	Specifies the register to be displayed. If you omit *reg,* the debugger displays the contents of all registers and flags along with the next executable instruction.
word	Specifies the new value for the register. For the Flags register, set or clear a flag by using one of the following names:

Flag code	Meaning
OV	Overflow set
NV	Overflow clear
DN	Direction decrement
UP	Direction increment
EI	Interrupt enabled
DI	Interrupt disabled
NG	Sign negative
PL	Sign positive
ZR	Zero set
NZ	Zero clear
AC	Auxiliary carry set
NA	Auxiliary carry clear
PE	Parity even
PO	Parity odd
CY	Carry set
NC	Carry clear
NT	Nested task switch (on and off)

For the machine status word (MSW) register, use the following names to set a flag:

Flag name	Action
TS	Sets the task switch bit.
EM	Sets the emulation processor extension bit.
MP	Sets the monitor processor extension bit.

PM Sets the protected-mode bit.

Comments

Setting the protected-mode bit from within the debugger does *not* set the target system to run in protected mode. The debugger simulates the setting. To configure the target system to run in protected mode, you would have to set the PM bit in the MSW register and reset the target system to restart in protected mode.

Example

The **r** command without parameters produces a display similar to the following:

```
AX=0698  BX=2008  CX=2C18  DX=18AB  SP=1B7A  BP=00FF  SI=0020  DI=10CD
IP=0450  CS=18B0  DS=1BE8  ES=0DA8  SS=0048  NV UP DI PL NZ NA PONC
GDTR=01BE80 3687  IDTR=01F508 03FF  TR=0010  LDTR=0028 IOPL=3 MSW=PM
18B0:0450 C3             RET
```

The following example displays each flag with a two-letter code. To change any flag, type the two-letter code that inverts the setting. The flags are either set or cleared.

```
rf
```

The example produces a display similar to the following:

```
NV UP DI NG NZ AC PE NC - _
```

To change the value of a flag's setting, type the two-letter code that inverts the setting for that flag. The following example changes the sign flag to positive, enables interrupts, and sets the carry flag:

```
NV UP DI NG NZ AC PE NC - PLEICY
```

The following command modifies the MSW bits:

```
rmsw
```

Then 80386 Debugger displays the status of the MSW register and prints a colon on the next line.

s WDEB386 command

s *range list* | **"***string***"**

The **s** command searches an address range for a specified list of bytes or an ASCII character string.

You can include one or more bytes in *list,* but multiple bytes must be separated by a space or comma. When you search for more than one byte, the command returns the address of only the first byte in the string. When *list* contains only one byte, the debugger displays the addresses of all occurrences of the byte in *range.*

Parameter	Description
range	Specifies the block of memory to be searched.
list	Specifies one or more byte values to search for.
string	Specifies an ASCII character string to be searched for. The string must be enclosed in quotation marks.

Example

The following example searches for byte 41h in the address range CS:100 to CS:110:

```
sCS:100 110 41
```

If it finds the value, this command produces a display similar to the following:

```
04BA:0104
04BA:010D
```

t WDEB386 command

t[**a**|**c**|**n**|**s**|**x**|**z**][**=***start_addr*][*count*][*addr*]

The **t** command executes one or more instructions along with the default command string and then displays the decoded instruction. If you include the *start_addr* parameter, tracing starts at the specified address. Otherwise, the command steps through the next machine instruction and then executes the default command string.

The **t** command uses the hardware trace mode of the Intel microprocessor. Consequently, you can also trace instructions stored in read-only memory (ROM).

Parameter	Description
a	Indicates that an ending address is specified for the trace. Instructions are traced until the address in *addr* is reached.
c	Suppresses all output and counts instructions traced. An ending address is required for this command. Instructions are traced until the address in *addr* is reached.
n	Suppresses the register display so just the assembly line is displayed. This works only if the default command, **zd**, is set to **r** (the normal setting).
s	Suppresses output; the instruction and count are displayed for each **call** and the return from that call.
x	Forces the debugger to trace regions of code known to be untraceable (_PGSwitchContext, for example).
z	Allows original trap handler address to be traced into without having to unhook the exception. Use this option instead of **vcp d; t; vsp d**.
start_addr	Specifies the instruction address at which to start tracing. The equal sign (=) is required.
count	Specifies the number of instructions to execute and trace.
addr	Specifies the instruction address at which to stop tracing.

Example

The following example traces the current position (04BA:011A) and uses the default command string (**r** command) to display registers:

```
t
```

The resulting output is similar to the following:

```
AX=0E00  BX=00FF  CX=0007  DX=01FF  SP=039D  BP=0000  SI=005C  DI=0000
IP=011A  CS=04BA  DS=04BA  ES=04BA  SS=04BA  NV UP DI NG NZ AC PENC
GDTR=01D700 3677  IDTR=020D7A 03FF  TR=0010  LDTR=0028 IOPL=3 MSW=PM
04BA:011A  CD21          PUSH   21
```

The following command causes the debugger to execute 16 (10h) instructions beginning at 011A in the current selector:

```
t=011A 10
```

The debugger executes and displays the results of the default command string for each instruction. The display is scrolled until the last instruction is executed. Press the CTRL+S key combination to stop the scrolling and CTRL+Q to resume.

u WDEB386 command

u [*range*]

The **u** command disassembles bytes and displays the source statements, with addresses and byte values, that correspond to them.

The display of disassembled code looks similar to a code listing for an assembled file. If you type the **u** command by itself, 20h bytes are disassembled at the first address after the one displayed by the previous **u** command.

Parameter	Description
range	Specifies the block of memory in which instructions are to be disassembled. If no *range* is given, the command disassembles the next 20h bytes.

Example

The following example disassembles and displays 20h bytes from the specified address:

```
uCS:046C
```

The resulting display is similar to the following:

```
1A60:046C C3              RET
1A60:046D 9A6B3E100D      CALL  0D10:3E6B
1A60:0472 33C0            XOR  AX,AX
1A60:0474 50              PUSH  AX
1A60:0475 9D              POPF
1A60:0476 9C              PUSHF
1A60:0477 58              POP  AX
1A60:0478 2500F0          AND  AX,F000
1A60:047B 3D00F0          CMP  AX,F000
1A60:047E 7508            JNZ  0488
1A60:0480 689C26          PUSH  269C
1A60:0483 9AF105100D      CALL  0D10:05F1
```

If the bytes at some addresses are altered, the disassembler alters the instruction statements. You can also use the **u** command for the changed locations, for the new instructions viewed, and for the disassembled code used to edit the source file.

v WDEB386 command

v

The **v** command displays the current 80386 Debugger version number and date.

vc WDEB386 command

vc[**n** | **p** | **r** | **v**] *number*[**,***number* [**,**...]]

The **vc** command clears the specified interrupt vector and reinstalls the previous interrupt vector.

Parameter	Description
n	Removes the beep from traps that beep when encountered; does not clear the traps.
p	Clears protected-mode vectors only.
r	Clears real-mode vectors only.
v	Clears virtual 8086 (V86) mode vectors only.
number	Specifies the interrupt vector to clear.

vl WDEB386 command

vl[**n** | **p** | **r** | **v**]

Lists the interrupt vectors that the debugger intercepts. Vectors that have been set with the **vt** command (as opposed to **vs**) are listed with an asterisk (*) following the vector number.

Parameter	Description
n	Lists the traps that beep when encountered.
p	Lists the protected-mode vectors only.
r	Lists the real-mode vectors only.
v	Lists the virtual 8086 (V86) mode vectors only.

vo WDEB386 command

vo[**n** | **p** | **r** | **v**]

The **vo** command lists interrupt vectors in the display format based on the **newvec** option. For details, see the **v** command.

Parameter	Description
n	Lists the traps that beep when encountered.
p	Lists the protected-mode vectors only.
r	Lists the real-mode vectors only.
v	Lists the virtual 8086 (V86) mode vectors only.

vs WDEB386 command

vs[**n** | **p** | **r** | **v**] *number*[**,***number*[**,**...]]

The **vs** command adds a new interrupt vector to the list of intercepted vectors. Vectors set by this command do not intercept interrupts that occur at ring 0.

Parameter	Description
n	Lists the traps that beep when encountered.
p	Lists the protected-mode vectors only.
r	Lists the real-mode vectors only.
v	Lists the virtual 8086 (V86) mode vectors only.
number	Specifies the interrupt vector to intercept.

vt WDEB386 command

vt[**n** | **p** | **r** | **v**] *number*[**,***number*[**,**...]]

The **vt** command adds a new interrupt vector to the list of intercepted vectors.

Parameter	Description
n	Lists the traps that beep when encountered.
p	Lists the protected-mode vectors only.
r	Lists the real-mode vectors only.
v	Lists the virtual 8086 (V86) mode vectors only.
number	Specifies the interrupt vector to intercept.

w WDEB386 command

w [*map-name*]

The **w** command changes the active map file.

Parameter	Description
map-name	Specifies the name of the map file you want to make active. Use the **lm** (List Map) command to display a list of available map files. If *map-name* is not specified, the loaded maps are displayed and the user is prompted to select a map by pressing its corresponding number.

Example

The **lm** command can be used to display the loaded map files in a form similar to the following:

```
COMSAM2D is active.
DISK01D.
```

Then the following command can be used to change the active map file to DISK01D:

```
w DISK01D
```

The following command displays the list of loaded maps:

```
w
```

The resulting display is similar to the following, prompting the user to type the number corresponding to the map to activate:

```
1. KERNEL
2. Win386 is active
activate which map?
```

In this case, pressing 1 activates the KERNEL map; pressing 2 leaves the Win386 map activated; and pressing the SPACEBAR leaves the current map activated. Any other key is ignored, and the debugger will continue to wait for input.

wa WDEB386 command

wa *map-name*

The **wa** command adds the specified map to the list of active maps.

Parameter	Description
map-name	Specifies the map to add to the list of active maps.

wr WDEB386 command

wr *map-name*

The **wr** command removes the specified map from the list of active maps.

Parameter	Description
map-name	Specifies the map to remove from the list of active maps.

y WDEB386 command

y[**?** | *option*]

The **y** command changes the debugger configuration. The following list describes the available configuration options. All settings are toggles.

Parameter	Description	
?	Displays a list of supported options.	
option	Following are the available configuration options:	
	/a	Controls automatic symbol loading. If this option is set, Windows will not load symbols automatically.
	/n	Sets the following options: **codebytes** **dislwr** **int3line** **newprompt** **newreg** **newvec** **symaddrs**
	/v	Controls segment load notification messages. If this option is set, all segment load notifications will be displayed.
	386env	Controls the size of addresses, registers, and so on when displayed. When this option is on, addresses, registers, and so on are shown in 32-bit format; otherwise, they are shown in 16-bit format.
	codebytes	Causes the disassembler to display the code bytes along with the disassembled instructions.
	disaddr	Causes the disassembler to display the disassembly address.
	disline	Causes the disassembler to display the filename and line number of each operation code (opcode).
	dislwr	Controls the disassembler's lowercase option. When the flag is on, disassembly is in lowercase.
	int3line	Causes the disassembler to display the filename and line number on **int 3** instructions.
	newprompt	Causes 80386 Debugger to produce a double prompt when paging is enabled and a nesting level if the debugger is reentered.
	newreg	Controls the format of the register display.
	newvec	Controls the display format for the intercepted interrupt vectors.
	regterse	Controls the number of registers displayed by the **r** (Register Dump) command. In the 80386 environment, when **regterse** is on, only the first three lines are displayed (instead of the normal six lines plus disassembly line). In the 80286 environment (**386env** off), only the first two lines are displayed (instead of the normal three lines plus disassembly line).
	scrncols	Sets the number of screen columns in the debug display. The default is 79 columns.
	scrnlines	Sets the number of screen lines in the debug display. The default is 24 lines.
	skipint3s	Causes the debugger to ignore inline **int 3** instructions.
	symaddrs	Causes the disassembler to display symbol values along with the symbols.

teftibase Sets the base port address for the timing card.

z WDEB386 command

z

Replaces the instruction bytes of the current **int 3** instruction or the previous **int 1** instruction with **nop** instructions. This allows the user to avoid **int 1** or **int 3** instructions that were assembled into the executable file by breaking into the debugger more than once.

zd WDEB386 command

zd

The **zd** command executes the default command string.

The default command string is initially set to the **r** (Display Registers) command by the debugger. The default command string is executed every time a breakpoint is encountered during execution of the application or whenever a **p** (Program Trace) or **t** (Trace Instructions) command is executed.

Use the **zl** command to display the default command string and the **zs** command to change the default command string.

zl WDEB386 command

zl

The **zl** command displays the default command string.

Example
The following example displays the default command string:

```
zl
```

The resulting output is similar to the following:

```
"R"
```

zs WDEB386 command

zs "*string***"**

The **zs** command makes it possible for you to change the default command string.

Parameter	Description
string	Specifies the new default command string. The string must be enclosed in single or double quotation marks. You must separate the debugger commands within the string with semicolons.

Example

The following example changes the current default command string to an **r** (Display Register) command followed by a **c** (Compare Memory) command:

```
zs "r;c100 L 100 300"
```

The following example begins execution whenever an **int 3** instruction is executed in your test application. This example executes a **g** (Go) command every time an **int 3** instruction is executed.

```
zs "j (by cs:ip) == cc 'g'"
```

You can use **zs** as follows to set up a watchpoint:

```
zs "j (wo 40:1234) == 0eeed;t"
```

This command traces until the word at 40:1234 is *not* equal to 0EEED. This does not work if you are tracing through the mode switching code in MS-DOS or other sections of code that cannot be traced.

CodeView for Windows

The Microsoft CodeView for Windows (**CVW**) debugger is a powerful, easy-to-use tool for the Microsoft Windows operating system. With CVW, you have the power to test the execution of your application and examine your data simultaneously. You can isolate problems quickly because you can display any combination of variables--global or local--while you interrupt or trace an application's execution.

CVW provides a variety of ways to analyze an application. You can use the debugger to examine source code, disassemble machine code, or examine a mixed display that shows you precisely which machine instructions correspond to each of your C-language statements. You can also monitor the occurrence of specific Windows messages.

CVW is similar to Microsoft CodeView (CV) version 3.0 for Microsoft® MS-DOS®. If you are familiar with CV for MS-DOS, see Differences Between CVW and CodeView for MS-DOS for a concise description of the unique features of CVW.

This topic serves as a complement to the **CVW** Help system. A significant portion of the CVW documentation is online. For information about using the CVW Help system, see Accessing Help.

Using CVW with a Single Monitor

CodeView for Windows version 3.07 allows you to debug Windows applications with a single monitor. See **Using Codeview with a Single Monitor** for more information.

The following topics describe how to set up and use CodeView for Windows:

Requirements for Using CVW
Comparing CVW with Other Microsoft Debuggers
Preparing to Run CVW
Starting a Debugging Session
Saving Session Information
Using Codeview with a Single Monitor
Working with the CVW Screen
Getting On-line Help in CVW
Displaying Program Data
Modifying Program Data
Controlling Program Execution
Handling Abnormal Termination of the Application
Ending a CVW Session
Advanced CVW Techniques
Customizing CVW with the TOOLS.INI File

Note: **CVW** supports the Microsoft Mouse or any fully compatible pointing device. This topic describes both mouse and keyboard procedures.

Requirements for Using CVW

Requirements for Using CodeView for Windows

Following are the system requirements for using **CVW**:

- Your system must have at least 384K of extended memory. For applications compiled with many symbols, 1 megabyte or more of extended memory is required.
- For 80386-based systems, the following required entry is automatically added to the [386enh] section of your SYSTEM.INI file when you install **CVW**:

```
device=windebug.386
```

- Your PATH environment variable must include the directory (or directories) containing CVW3.EXE, CVWIN.DLL, WINDEBUG.386, and CVW3.HLP.

Using CVW with a Single Monitor

Using CVW with a Single Monitor

It is possible to use **CVW** version 3.07 with a single monitor. For single-monitor debugging, you must have one of the following:

- A VGA display. **CVW** directly supports single-monitor debugging with a VGA display in both 386 enhanced and standard modes. No additional driver is needed.
- An EGA or other display with an 80386-based or 80486-based system running in 386 enhanced mode (you must use a VGA display in standard mode). With a non-VGA (or nonstandard VGA) display, you must install the VCV.386 driver. Place the driver in your Windows \SYSTEM directory and add the following entry to the [386enh] section of your Windows SYSTEM.INI file:

```
device=vcv.386
```

Using CVW with a Secondary Monitor

You may find it more convenient to use a dual-monitor configuration. With the secondary monitor connected to your system, you can view **CVW** output and Windows output simultaneously. (CVW version 3.07 does not support a serial terminal.)

If you are using a secondary monochrome monitor for your **CVW** display, you need a monochrome adapter card and monochrome display monitor.

To set up a secondary monitor for debugging, do the following:

1. Install a secondary monochrome adapter card in a free slot in your computer, and connect the monochrome monitor to the port in the back.
2. Set the switches for the secondary display adapter to the appropriate settings, according to the display adapter and computer manufacturers' recommendations.

To use the secondary monochrome monitor, you must specify the **/2** option on the command line when you start CVW.

If your system is an IBM Personal System/2, it must be configured with an IBM 8514/a display as the primary monitor and a VGA display as the secondary monitor. To use this configuration, specify the **/8** (8514/a) option on the **cvw** command line when you choose the Run command from the File menu in Program Manager. If your VGA display is monochrome, you must also use the **/b** (black-and-white) option. The 8514/a display serves as the Windows screen and the VGA display as the debugging screen.

Do not attempt to run non-Windows applications or MS-DOS Shell while running **CVW** with the **/8** option.

By default, the debugging screen operates in 50-line mode in this configuration. If you specify the **/8** option, you can optionally specify the **/25** or **/43** option for 25- or 43-line mode, respectively, on the VGA debugging screen.

For more information about the command-line display options for **CVW**, see Display Options.

Comparing CVW with Other Microsoft Debuggers

Comparing CodeView for Windows with Other Microsoft Debuggers

If you have programmed in the Windows environment, you may have used the Microsoft Symbolic Debugger (SYMDEB) to debug Windows applications. You may also be familiar with CodeView (CV) for MS-DOS. This section describes the features and functions of **CVW** that are different from the features and functions of these other Microsoft debugging tools.

Differences Between CVW and SYMDEB

CVW has all the capabilities of SYMDEB and a number of features that SYMDEB does not provide. Following is a summary of the differences between SYMDEB and CVW:

SYMDEB feature	CVW feature
Debugs applications in real mode.	Debugs applications in protected mode.
Examines only global (static) variables.	Examines both global and local variables.
Examines memory only when you specify simple memory addresses or symbol	.2Examines memory directly, but also uses the C-language expression evaluators to combine any variables with higher-level-language syntax. Provides only breakpoints to interrupt execution.
Does not set breakpoints or tracepoints on Windows messages.	Sets breakpoints and tracepoints on Windows messages.
Works through command line.	Works through command line or menus.

Differences Between CVW and CodeView for MS-DOS

With **CVW**, as with CV for MS-DOS, you can display and modify *any* variable, section of addressable memory, or processor register; monitor the path of execution; and precisely control where execution pauses. However, CV for MS-DOS and CVW differ in the following ways:

CV feature	CVW feature
Starts from the MS-DOS prompt.	Starts from within Windows.
Repeats a search when you press ALT+/.	Repeats a search when you press CTRL+R.
Returns to MS-DOS upon termination.	Returns to Windows under normal termination conditions. An abnormal termination of CVW may cause the Windows session to be terminated.

In addition to these differences, **CVW** includes the following unique features:

- The ability to track your application's segments and data as Windows moves their locations in memory. As items are moved, the debugger readjusts its symbol table accordingly.
- The **(lh)** and **(gh)** type casts, which you can use to dereference local and global handles of a memory object into near and far pointer addresses. For a more detailed description, see Dereferencing Memory Handles.
- Windows-specific commands. **CVW** has the following six new commands:

Command	Action
wdl (Windows Display Local Heap)	Displays a list of the memory objects in the local heap.
wdg (Windows Display Global Heap)	Displays a list of the memory objects in the global heap.
wdm (Windows Display Modules)	Displays a list of the application and library modules available to Windows.
wwm (Windows Watch Message)	Displays a Windows message or class of messages in the **CVW** Command window.

wbm (Windows Breakpoint Message)	Sets a breakpoint on a Windows message or class of messages.
wka (Windows Kill Application)	Terminates the task that is running. You should use this command with caution.

Preparing to Run CVW

Preparing Windows Applications for Debugging

If you want to use symbolic information and access source files with **CVW**, preparation depends on your compiler and linker.

Suppose, for example, that you were using Microsoft C Optimizing Compiler (CL), version 5.1 or later, and Microsoft Segmented Executable Linker (LINK). You would compile with the **/Zi** option to produce object files containing symbolic information and the **/Od** (disable optimization) option to ensure that code generated by the compiler would match the statements in the C-language source code. You would link with the **/co** option to produce an executable file containing symbolic information.

For further information about the settings you need to use, see the documentation that accompanied your compiler and linker.

Setting Up the Debugging Version of Windows

You can run **CVW** with either the debugging or retail version of Windows. The debugging version performs error checking that is not available with the retail version.

For example, the debugging version of Windows checks whether a window handle passed to a Windows function is valid. When the debugging version of Windows detects such an error, it reports a fatal exit. If this happens while you are running **CVW**, the fatal exit is reported in the CVW Command window. For details about this error handling, see "Handling Abnormal Termination of the Application."

When you use the debugging version of Windows with **CVW**, the Windows core dynamic-link libraries (DLLs) provide debugging support. These DLLs (KRNL286.EXE, KRNL386.EXE, GDI.EXE, and USER.EXE) contain symbol information that makes it easier to determine the cause of an error. For example, if your application were to cause a general protection (GP) fault while running with the debugging version, Windows would display symbol information for the Windows code that was running when the GP fault was detected. If, instead, your application were running with the retail version of Windows, Windows would be able to display only CS:IP address values of the code that was being executed when the fault occurred.

CVW does not automatically use these Windows core DLL symbols. To provide CVW access to these symbols, you must specify one or more of the core DLLs either by using the **/l** command-line option or in response to the DLL prompt within CVW. If you are running CVW with Windows in standard mode, specify KRNL286.EXE. In 386 enhanced mode, specify KRNL386.EXE. For an explanation of how to load symbols from a DLL, see "Starting a Debugging Session for Dynamic-Link Libraries."

To install the debugging version of Windows, run the batch program N2D.BAT from your Windows system directory. This batch program replaces the nondebugging Windows core files with the debugging versions. (It copies both symbol files and executable files.) When the batch program has finished running, you start the debugging version of Windows by typing the **win** command. No special command-line options are required. To restore the nondebugging version of Windows, follow the same procedure using the batch program D2N.BAT.

Starting a Debugging Session

As with Windows applications, you can start **CVW** in any of several ways. For a complete description of how to start Windows applications, see the *Microsoft Windows User's Guide.* To specify CVW options and parameters, you must choose the Run command from the File menu in Program Manager. For more information about CVW options, see "Command-Line Options."

You can run **CVW** to debug any of the following:

- A single application
- Multiple instances of an application
- Multiple applications
- DLLs

This section describes the methods you use to perform these tasks and summarizes the display options you can specify when you start **CVW** from the Run dialog box. This dialog box appears when you choose the Run command from the File menu in Program Manager.

Display Options

You must specify your display selection on the command line when you start CVW. The following list describes the display options:

Option	Display configuration
None	VGA; debugging on single monitor
/v (VCV.386 must be installed)	Non-VGA; debugging on single monitor
/2	Any; debugging on secondary monochrome monitor
/8	8514/a; debugging on secondary VGA monitor

Starting a Debugging Session for a Single Application

After you start **CVW** from Windows, CVW displays the Command Line dialog box. To start debugging a single application, do the following:

1 In the Command Line dialog box, type the name of the application. If you do not include an extension, **CVW** assumes the .EXE extension by default. You can also include any arguments that the application recognizes. Following is the syntax of the command to start debugging a single application:

app_name[**.exe**] [*app_arguments*]

2 Press ENTER, or choose the OK button.

CVW displays a dialog box with the following message:

```
Name any other DLL or executable with debug info.
```

3 Because you are debugging only one application and no DLLs, press ENTER or choose the OK button. **CVW** loads the application and displays on the debugging screen the source code for the application's **WinMain** function.

4 Set any breakpoints you want in the code.

5 To continue running the application, choose the <F5=Go> button on the status line or press the F5 key.

You can avoid startup dialog boxes and start **CVW** more quickly by specifying the application name as an argument on the command line, as follows:

1 From the Program Manager File menu, choose Run.

2 Type the application name and any application arguments on the command line. Following is the command syntax to start debugging a single application:

cvw [*cvw_options*] *app_name*[**.exe**] [*app_arguments*]

3 Press ENTER, or choose the OK button.

Starting a Debugging Session for Multiple Instances of an Application

Windows can run multiple instances of an application simultaneously, which can cause a problem for your application. For example, two instances of an application might interfere with each other, or one application might corrupt the data of the other.

To help you solve problems associated with running multiple instances of an application, **CVW** allows you to debug multiple instances of an application at the same time. You can determine which instance of an application you are looking at by examining the DS register at any breakpoint.

To debug multiple instances of an application, perform the following steps:

1 Start **CVW** as usual for your application.

2 Run one or more additional instances of your application by choosing Run from the Program Manager File menu.

Specifying your application name more than once when starting **CVW** does not have the effect of loading multiple instances of the application.

The breakpoints you set in your application apply to all instances of the application. To determine which instance of the application has the current focus in **CVW**, examine the DS register.

Starting a Debugging Session for Multiple Applications

You can debug two or more applications at the same time, such as a dynamic data exchange (DDE) client and server. However, when global symbols are shared by applications (such as the symbol name WINMAIN), **CVW** resolves symbol references to the first application named when you started CVW.

Perform the following steps to debug two applications at the same time:

1 Start **CVW** as usual for a single application.

2 Type the name of the second application when **CVW** displays a dialog box with the following message:

```
Name any other DLL or executable with debug info.
```

You *must* include the .EXE extension after the filename of the second application.

3 Set breakpoints in either or both applications, choosing Open Module from the **CVW** File menu to display the source code for the different modules.

4 Press F5 to continue running the first application.

5 From the Program Manager File menu, choose Run, type the application name and any application arguments, and press ENTER or choose the OK button to start execution of the second application.

An alternative way to load the symbols for a second application is to use the **/l** option on the command line when you start **CVW**, as follows:

```
cvw /l second.exe first.exe
```

The **/l** option and the name of the second application must precede the name of the first application on the command line in the Run dialog box. You can repeat the **/l** option for each application to be included in the debugging session. Once **CVW** starts, choose the Run command from the Program Manager File menu to start the second application.

Starting a Debugging Session for Dynamic-Link Libraries

You can debug one or more DLLs while you are debugging an application. However, no distinction is made between global symbols shared by the applications and any DLLs.

Perform the following steps to debug a DLL at the same time as an application:

1 Start **CVW** as usual for the application.

2 Type the name of the DLL when **CVW** displays a dialog box with the following message:

```
Name any other DLL or executable with debug info.
```

CVW assumes the .DLL extension if you do not supply an extension with the filename. If your DLL has another extension (such as .DRV), you must specify it explicitly.

3 From the File menu, choose Open Module to display the source code for the different modules. Set breakpoints in either the application or the DLL.

4 Press F5 to continue running the application.

Alternatively, you can use the **/l** option to specify the DLL on the command line in the Run dialog box, as follows:

```
cvw /l appdll appname.exe
```

The **/l** option and the name of the DLL must precede the name of the first application on the command line. You can repeat the **/l** option for each DLL to be included in the debugging session. The .DLL extension is the default extension for the **/l** option.

CVW allows you to debug the LibEntry initialization routine of a DLL. If your application implicitly loads the library, a special technique is required to debug the LibEntry routine. An application implicitly loads a DLL if the library routines are imported in the application's module-definition (.DEF) file or if your application imports library routines through an import library when you link the application. An application explicitly loads a DLL by calling the **LoadLibrary** function.

If you type in the Command Line dialog box the name of an application that implicitly loads a DLL, **CVW** automatically loads the DLL and executes the DLL's LibEntry routine when CVW loads the application. In this case, you have no opportunity to debug the LibEntry routine. To avoid this problem, perform the following steps:

1 Instead of typing the name of your application in the Command Line dialog box, type the name of a dummy application that does not implicitly load the library.

2 Type the name of your DLL, being sure to include the extension if it is not .DLL, when the following message is displayed:

```
Name any other DLL or executable with debug info.
```

3 From the File menu, choose Open Module to display the source code for the library module containing the LibEntry routine. Set breakpoints in the LibEntry routine.

4 From the File menu, choose Open Module to display the source code for other library or application modules. Set breakpoints.

5 Press F5 to start running the dummy application.

6 Run the application that implicitly loads the DLL by choosing Run from the Program Manager File menu. **CVW** will resume control when the breakpoint in the LibEntry routine is encountered.

Alternatively, you can use a command line of the following form to specify the dummy application, your application, and the DLL:

```
cvw /l appdll dummyapp
```

After this command starts **CVW**, you need to perform steps 5 and 6 of the preceding procedure.

Command-Line Options

Following is the command-line syntax to start **CVW** from the Run dialog box, which is displayed when you choose the Run command from the Program Manager File menu:

cvw [*cvw_options*] *app_name*[**.exe**] [*app_arguments*]

Parameters are not case-sensitive. Following are the command-line parameters:

cvw_options Specifies one or more options that modify how **CVW** runs. Options are not case-sensitive. Valid options are as follows:

Option	Purpose
/b	Specifies a monochrome VGA display used as the secondary display with an 8514/a display. This option is valid only in conjunction with the **/8** option.
/c *command*	Specifies one or more commands that **CVW** is to carry out when it loads the application specified by the *app_name* parameter. The group of commands must be enclosed in double quotation marks ("). Commands must be separated with semicolons (;).
/l *dll_or_exe*	Specifies the name of an application or DLL that has been compiled and linked with **CVW** symbols. CVW assumes the default filename extension .DLL if no extension is supplied. You can use the **/l** option more than once to specify multiple DLLs or executable files.
/m	Disables the use of the mouse on the debugging screen. You should use this option when you set breakpoints in code that is responsive to mouse movements on the Windows application screen.
/tsf	Inverts save-state-file status for the current session.
/v	Allows single-monitor debugging on a non-VGA display.
/2	Allows **CVW** to use a secondary monochrome monitor for debugger output while displaying Windows output on your primary monitor.
/8	Allows **CVW** to use an 8514/a display as the Windows display and a VGA display for debugger output.
/25	Specifies 25-line mode for the secondary VGA display. This option is valid only in conjunction with the **/8** option.
/43	Specifies 43-line mode for the secondary VGA display. This option is valid only in conjunction with the **/8** option.
/50	Specifies 50-line mode for the secondary VGA display. This option is valid only in conjunction with the **/8** option. The **/50** option is not required, because 50-line mode is the default for the dual-monitor configuration.

app_name[**.exe**] Specifies the location and name of the application for which **CVW** is to load symbols and issue an initial breakpoint. The .EXE extension is optional.

app_arguments Specifies one or more arguments recognized by the application that **CVW** loads.

Saving Session Information

After your session, **CVW** stores session information in a file called CURRENT.STS, which is located in the directory pointed to by the INIT environment variable or in the current directory. If this file does not already exist, CVW automatically creates it. Session information includes the following:

- **CVW** display windows that were opened
- Breakpoint locations

CVW saves this information, which becomes the default session information the next time you run a CVW session for that application.

By default, this feature is enabled. You can disable this feature by placing the following entry in your TOOLS.INI file:

```
[cvw]
StateFileRead: n
```

The **/tsf** option temporarily inverts this setting when you run CVW. That is, if TOOLS.INI disables this feature, running **CVW** with the **/tsf** option saves session information for that session only.

If your Windows session abnormally terminates while **CVW** is running, the CURRENT.STS file may be corrupted. This may cause CVW to fail when it first tries to execute the application you are debugging. If this happens, delete the CURRENT.STS file before attempting to run CVW again.

Note: Microsoft Programmer's WorkBench (PWB) version 2.0 modifies the CURRENT.STS file. Once PWB has modified this file, **CVW** cannot read the command settings.

Working with the CVW Screen

Working with the CodeView for Windows Screen

When you start **CVW**, the CVW menu bar and three display windows--the Local window, the Source window, and the Command window--appear.

Using CVW Display Windows

CVW divides the screen into logically separate sections called display windows, so that a large amount of information can be displayed in an organized and easy-to-read presentation. Each CVW display window is a distinct area on your monitor that operates independently of the other display windows. The name of each display window appears in the window's title bar. The following list describes the eight types of CVW display windows:

CVW display window	Purpose
Source window	Displays the source code. You can open a second source window to view a header file, another source file, or the same source file at a different location.
Command window	Accepts debugging commands.
Watch window	Displays the current values of selected variables.
Local window	Lists the values of all variables local to the current function or block.
Memory window	Shows the contents of memory. You can open a second Memory window to view a different section of memory.
Reg window	Displays the contents of the microprocessor's registers, including flags.
8087 window	Displays the registers of the coprocessor or its software emulator.
Help window	Displays the Help options or any Help information that you request.

Opening Display Windows

Following are the two ways to open **CVW** display windows:

- Choose a window from the View menu. (Note that you can open two Source windows and two Memory windows.)
- Perform an operation that automatically opens a window if it is not already open. For example, selecting a Watch variable automatically opens the Watch window.

CVW continually and automatically updates the contents of all its display windows.

Selecting Display Windows

To select a window, click anywhere in it. You can also press F6 or SHIFT+F6 to move the focus from one window to the next.

The selected window is called the active window and is marked in three ways:

- The window's name is displayed in reverse video.
- The cursor appears in the window.
- Vertical and horizontal scroll bars appear in the window.

Typing commands in the Source window causes **CVW** to temporarily shift its focus to the Command window. Whatever you type is appended to the last line in the Command window. If the Command window is closed, CVW beeps in response to your input and ignores the input.

Adjusting Display Windows

CVW display windows often contain more information than they can display on the screen. Although you cannot change the relative positions of the display windows, you can manipulate a selected window by using the mouse, as follows:

- To scroll through the information in the window, use the vertical or horizontal scroll bar.
- To maximize a window so that it fills the screen, click the Maximize arrow at the right end of the window's top border. To restore the window to its previous size and position, click the Maximize arrow

again.

- To change the size of a window:

1 Position the cursor anywhere on the border between two windows.

2 Press and hold down the left mouse button.

Two double-headed arrows appear on the line.

3 Drag the mouse to enlarge or reduce the window.

- To close a window, click the Close box at the left end of the top border.

The adjacent windows automatically expand to recover the empty space.

You can also use the following keyboard commands:

Keyboard command	Description
PAGE UP or PAGE DOWN	Scrolls through the text vertically.
CTRL+F10	Maximizes a selected display window.
CTRL+F8	Enables the arrow keys to resize the active window.
CTRL+F4	Removes a selected display window.

You can also choose the Maximize, Size, and Close commands from the View menu to manipulate a selected display window.

The different **CVW** display windows can help you to conduct a variety of debugging activities simultaneously. These activities are initiated and controlled with CVW debugging commands, which you can type on the command line when you start CVW or choose from CVW menus.

Using the Menu Bar

In addition to display windows, the **CVW** screen includes a menu bar, which contains the following menus. For a more detailed description of CVW menus and commands, see CVW Help.

Menu — **Contents**

File — This menu contains the following commands:

Command	Description
Open Source	Opens any text file, and reads it into the active Source window.
Open Module	Opens the source file of any module for which **CVW** information has been loaded, and reads it into the active Source window.
Exit	Ends your **CVW** session, and returns you to Windows.

Edit — This menu contains the following commands:

Command	Description
Undo	Retracts the most recent edit, and restores the current line to its previous condition.
Copy	Copies selected text to the paste buffer.
Paste	Inserts text from the paste buffer into the active window at the present cursor location, if that location is valid (for example, text cannot be pasted into the Source window).

View — This menu contains the following commands:

Command	Description
Source	Opens a new Source window.
Memory	Opens a new Memory window.
Register	Acts as a switch to open and close the Reg window.
8087	Acts as a switch to open and close the 8087 window.
Local	Acts as a switch to open and close the Local window.
Watch	Acts as a switch to open and close the Watch window.

	Command	Acts as a switch to open and close the Command window.
	Help	Acts as a switch to open and close the Help window.
	Maximize	Enlarges the active window so that it fills the screen.
	Size	Enables the arrow keys to resize the active window.
	Close	Closes the active window.

Search — This menu contains the following commands:

Command	Description
Find	Searches for the next occurrence of a text string or a regular expression that you supply in the Find dialog box.
Selected Text	Searches for the next occurrence of a string of selected text.
Repeat Last Find	Searches for the next occurrence of the string or regular expression specified in the previous Find dialog box.
Label/Function	Searches for a label definition or function in the active Source window; if one is found, moves the input focus to the found label definition or function in the active Source window.

Run — This menu contains the following command:

Command	Description
Animate	Continues running an application while displaying the execution path in the Source window. This type of display is called an animated trace display.

Watch — This menu contains the following commands:

Command	Description
Add Watch	Adds an expression to the Watch window.
Delete Watch	Deletes an expression from the Watch window.
Set Breakpoint	Specifies where to interrupt execution of an application. You can set breakpoints on lines of source code, variables, expressions, and Windows messages.
Edit Breakpoints	Performs editing functions on breakpoints; they can be added, removed, modified, enabled, or disabled.
Quick Watch	Selects one expression for the Quick Watch dialog box. For a description of the Quick Watch window, see Section 4.9.4, "Using the Quick Watch Command."

Options — This menu contains the following commands:

Command	Description
Source Window	Sets the display characteristics of the active Source window.
Memory Window	Sets the display characteristics of the active Memory window.
Trace Speed	Sets the speed of tracing and execution of an application.
Case Sensitivity	Turns case sensitivity on or off.
386 Instructions	Reads all 80386 instructions as 32-bit values when this command is checked; otherwise, reads all instructions as 16-bit values.

Calls — The contents and size of this menu change as your application runs. The Calls menu shows the currently executing routine and the trail of routines from which it was called. Your application must execute at least the beginning of the **WinMain** function before **CVW** will display the current routine. When you select one of the lines in the Calls menu, CVW displays the source code corresponding to the calling location in the active source window.

Help — This menu can be used to access Help.

Getting On-line Help in CVW

Accessing Help

CVW Help contains detailed information and examples not found in this topic. You can access Help by choosing a command from the Help menu described in the preceding section or by selecting an item on your screen and pressing F1. Help is available on such items as commands, menus, dialog boxes, and error messages.

Displaying Program Data

Displaying Application Data

CVW offers a variety of ways to display variables, processor registers, and memory. You can also modify the values of any of these items as the application runs. This section describes how to display the following:

- Variables in the Watch window
- Expressions in the Watch window
- Arrays and structures in the Watch window
- A single expression in the Quick Watch dialog box
- Windows messages in the Command window
- Memory in the Memory window
- Contents of registers in the Reg window

Displaying Variables

You can use the Watch window to monitor the value of a given variable throughout the execution of your application. For example, **do**, **for**, and **while** loops can cause problems when they don't terminate correctly. By displaying loop variables in the Watch window, you can determine whether a loop variable achieves its proper value.

To add a variable to the Watch window, perform the following steps:

1 In the Source window, use the mouse or the arrow keys to position the cursor on the name of the variable you want to watch.

2 From the Watch menu, choose Add Watch, or press CTRL+W.

An Add Watch dialog box appears with the selected variable's name displayed in the Expression field.

3 Choose the OK button or press ENTER to add the variable to the Watch window.

If you want to add a variable other than the one shown in the dialog box, type its name over the one displayed and press ENTER.

Adding a Watch variable opens the Watch window automatically if it is not already open. The Watch window appears at the top of the screen.

When you add a local variable, the following message may be displayed:

```
Watch Expression Not in Context
```

This message appears when execution has not yet reached the C-language function that defines the local variable. Global variables (those declared outside C-language functions) never cause **CVW** to display this message; you can watch them from anywhere in the application.

If any two or more applications or DLLs you are debugging contain global variables with the same name, **CVW** displays the variable of only the first application or DLL containing that variable name.

For example, if you are debugging App1 and App2, which both contain a global variable named hInst, **CVW** always displays the value of hInst in App1--even if CVW stopped at a breakpoint in App2.

The Watch window can display as many variables as you like; the quantity is limited only by available memory. You can scroll through information in the Watch window to view other variables. **CVW** automatically updates all watched variables as the application runs, including those not currently visible.

To remove a variable from the Watch window, do the following:

1 From the Watch menu, choose Delete Watch.

2 Scroll through information in the Delete Watch dialog box, and select the variable you want to remove.

Alternatively, you can position the cursor on any line in the Watch window and press CTRL+Y to delete the line.

Displaying Expressions

You may have noticed that the Add Watch dialog box prompts for an expression, not simply a variable name. You can add any valid combination of variables, constants, or operators as an expression for **CVW** to evaluate and display in the Watch window.

The advantage of evaluating expressions is that you can reduce several variables to a single value, which may be easier to interpret than the components that make it up. For example, imagine a **for** loop in which the ratio between two variables, var1 and var2, should remain constant. You suspect that one of these variables sometimes has the wrong value. To see when the quotient changes, without having to mentally divide two numbers, you can specify the following expression for display in the Watch window:

```
(var1 / var2)
```

You can also display Boolean expressions. For example, if the variable var is never supposed to be greater than 100 or less than 25, the following expression evaluates to 1 (TRUE) when var exceeds its limits:

```
(var < 25 || var > 100)
```

Displaying Arrays and Structures

An application variable is usually a scalar quantity (a single character, integer, or floating-point value). The variable appears in the Watch window with the variable name to the left, followed by an equal sign (**=**) and the current value.

The Watch window provides a different way to display aggregate data items, such as arrays and structures. Arrays and structures contain multiple values that can be arranged in one or more layers. You can control how these variables appear in the Watch window--whether all, part, or none of their internal structure is displayed.

For example, the array WordHolder initially appears in the Watch window in the following form:

```
+WordHolder[] = [...]
```

The brackets indicate that this variable contains more than one element. The plus sign (**+**) indicates that the variable has more elements than are displayed on the screen. You can expand the variable to display any or all of its components; this technique is called dereferencing.

To dereference (expand) the array, you can double-click anywhere on the displayed line or you can position the cursor on the line and press ENTER. For example, if WordHolder is a six-character array containing the word Basic, the Watch window display changes to the following:

```
-WordHolder[]
   [0]  =  66 'B'
   [1]  =  97 'a'
   [2]  =  115 's'
   [3]  =  105 'i'
   [4]  =  99 'c'
   [5]  =  0 ''
```

Note that both the individual character values and their ASCII decimal equivalents are listed. The minus sign (-) indicates that no further expansion is possible. To contract the array, you can double-click its line again or you can position the cursor on the line and press ENTER.

Displaying Character Arrays

If viewing a character array in this form is inconvenient, use either of the following methods to specify

the watchpoint:

- Type the variable name, a comma (**,**), and the letter **s**, as shown in the following example:

  ```
  WordHolder,s
  ```

  CVW displays the contents of the array, as follows:

  ```
  WordHolder,s[] = "Basic"
  ```

- Cast the variable's name to a character pointer, as shown in the following example:

  ```
  (char *)WordHolder
  ```

  CVW displays the address of the array and its contents, as follows:

  ```
  (char *)WordHolder = 0x8C7:0x0010 "Basic"
  ```

Displaying Multidimensional Arrays

You can display an array with more than one dimension. For example, imagine an integer array (5 by 5) named Matrix, whose diagonal elements are the numbers 1 through 5 and whose other elements are zero. Unexpanded, the array is displayed like this:

```
+Matrix[] = [...]
```

Double-click on the word Matrix (or position the cursor on that line and press ENTER) to change the display to the following:

```
-Matrix[]
  +[0][]  =  [...]
  +[1][]  =  [...]
  +[2][]  =  [...]
  +[3][]  =  [...]
  +[4][]  =  [...]
```

The actual values of the elements are not shown yet. You have to descend one more level to see them. For example, to view the elements of the third row of the array, position the cursor anywhere on its subscript line (the +[2] line) and press ENTER. The following example shows the third row of the array dereferenced:

```
-Matrix[]
  +[0][]  =  [...]
  +[1][]  =  [...]
  -[2][]
     [0]  = 0
     [1]  = 0
     [2]  = 3
     [3]  = 0
     [4]  = 0
  +[3][]  =  [...]
  +[4][]  =  [...]
```

Dereferencing the fifth row (+[4]) of the array produces this display:

```
-Matrix[]
  +[0][]  =  [...]
  +[1][]  =  [...]
  -[2][]
     [0]  = 0
     [1]  = 0
     [2]  = 3
```

```
    [3]  = 0
    [4]  = 0
+[3][]   =  [...]
-[4][]
    [0]  = 0
    [1]  = 0
    [2]  = 0
    [3]  = 0
    [4]  = 5
```

Any element of an array or structure can be independently expanded or contracted; you need not display every element of the variable. If you want to view only one or two elements of a large array, specify the particular array or structure elements in the Expression field of the Add Watch dialog box.

You can dereference a pointer in the same way as an array or structure. The Watch window displays the pointer address, followed by all the elements of the variable to which the pointer currently refers. You can display multiple levels of indirection (that is, pointers referencing other pointers) simultaneously.

Displaying Dynamic Array Elements

An array may have dynamic elements that change as some other variable changes. Just as you can display a particular element of an array by selecting its subscript, you can also display a dynamic array element by specifying its variable subscript. For example, suppose that the loop variable p is a subscript for the array variable Catalogprice. The Watch window expression Catalogprice[p] displays only the array element currently specified by the variable p, not the entire array.

You can mix constant and variable subscripts. For example, the expression BigArray[3][i] displays only the element in the third row of the array to which the index variable i points.

Using the Quick Watch Command

Using the Quick Watch command is a convenient way to take a quick look at a variable or expression. Because the Quick Watch dialog box can display only one variable at a time, it's best to use the Watch window to view most variables.

Selecting the Quick Watch command from the Watch menu (or pressing SHIFT+F9) displays the Quick Watch dialog box. If the cursor is in the Source, Local, or Watch window, the variable at the current cursor position appears in the Quick Watch dialog box.

The Quick Watch display automatically expands arrays and structures to their first level. For example, an array with three dimensions expands to the first dimension. You can expand or contract an element just as you would in the Watch window; position the cursor on the appropriate line and press ENTER. If the array has more lines than the Quick Watch dialog box can display, you can view the rest of the array either by using the scroll bar or by pressing the DOWN ARROW or PAGE DOWN key.

To add a Quick Watch item to the Watch window, choose the Add Watch button. Arrays and structures appear in the Watch window expanded as they were displayed in the Quick Watch dialog box.

You can also display a Quick Watch dialog box for a variable by typing two question marks and the variable name in the Command window. For example, the following command shows the contents of the Index variable:

```
?? Index
```

Tracing Windows Messages

You can trace occurrences of a Windows message or an entire class of Windows messages by using the **wwm** (Windows Watch Message) command. **CVW** displays the messages in the CVW Command window.

To trace a Windows message or message class, type the **wwm** command in the Command window. The syntax for the command is as follows:

wwm *winproc msgname* | *msgclasses*

The *winproc* parameter is the symbol name or address of an application's window procedure. The *msgname* parameter is the name of a Windows message, such as WM_PAINT. The *msgclasses* parameter is a string of characters that identify one or more classes of messages to be traced. If *msgclasses* is not specified, **CVW** traces all message classes. The class, if specified, is consistent with those defined in Microsoft Windows Spy (SPY.EXE); they are as follows:

Message class	Type of Windows message
c	Clipboard
d	DDE
i	Initialization
m	Mouse
n	Input
s	System
w	Window management
z	Nonclient

For example, the following command traces all mouse and input messages sent to the MainWndProc procedure:

```
wwm MainWndProc mn
```

The following example illustrates how the **CVW** Command window displays a Windows message:

```
HWND:1c00 wParm:0000 lParm:000000 msg:000F WM_PAINT
```

Displaying Memory

Selecting the Memory command from the View menu opens a Memory window. You can have two **CVW** Memory windows open at a time.

By default, memory is displayed as byte values in hexadecimal format, with 16 bytes per line. At the end of each line is a second display of the same memory in ASCII form. Values that correspond to printable ASCII characters (decimal values 32 through 127) are displayed in decimal format. Values outside that range are represented by periods (.).

Byte values are not always the most convenient way to view memory. If the area of memory you are examining contains character strings or floating-point values, you might prefer to view them in a directly readable form. The Memory Window command on the Options menu displays a dialog box with the display options in the following categories:

- ASCII characters
- Byte, word, or doubleword binary values
- Signed or unsigned integer decimal values
- Short (32-bit), long (64-bit), or 10-byte (80-bit) floating-point values

You can also cycle through these display formats directly by pressing SHIFT+F3.

If a section of memory cannot be displayed as a valid floating-point number, the value shown includes the characters NAN (not a number).

Displaying Local and Global Memory Objects

CVW is also useful for displaying global and local memory objects in their respective Windows heaps. You can use the **wdg** (Windows Display Global Heap) command to display the entire heap of global memory objects in the Command window, or you can use the **wdl** (Windows Display Local Heap) command to display the entire heap of local memory objects in the Command window.

For the **wdg** command, you can specify a global handle to display a partial list of the global heap. The Command window displays the first five memory objects in the global heap, starting at the handle

rather than at the beginning of the heap. The following example illustrates the **wdg** output format:

```
 (1)    (2)       (3)        (4)       (5)    (6)
047E  (0A7D)  00000020b   MYAPP    PRIV MOVEABLE DISCARDABLE

                                                (7)
0A6D          00000134b   MYAPP    DATA FIXED PGLOCKED=0001

                            (8)
0806  (0805)  00000600b   PDB (0465)

 (9)
FREE          000000A0b
```

The following table describes the indicated fields:

Field	Description
1	The value of the handle of a global memory object. Global memory objects are displayed in the order in which Windows manages them, which is typically not in ascending handle order.
2	A memory selector. This value is not displayed if the selector value is the same as the global handle, as is the case for **DATA** objects.
3	The length, in bytes, of the global memory object.
4	The name of the application or library module that allocated the object.
5	The type of global memory object, which can be the following:

Type	Meaning
PRIV	Application or DLL global data, or system object
CODE	Code segment
DATA	Data segment of application or DLL
FREE	Free memory object in the global heap

6	One of the following memory allocation attributes: **MOVEABLE** **MOVEABLE DISCARDABLE** **FIXED**
7	One of the following dispositions if the object is movable:

Disposition	Meaning
LOCKED=*number*	Number of times the object has been locked with any of the Windows functions that lock data
PGLOCKED=*number*	Number of times Windows has locked the object in its linear address space

8	The handle of the application or library module that allocated the process descriptor block (PDB).
9	A free memory object, followed by the size of the free object, in bytes.

The following example shows sample output of the **wdl** (Windows Display Local Heap) command:

```
 (1)    (2)    (3)     (4)
190A:  000A   BUSY   (16DA)
```

The following table describes the indicated fields:

Field	Description

1 The offset of the local memory object in the local data segment

2 The length of the object, in bytes

3 One of the following dispositions:

Disposition	Meaning
BUSY	A currently allocated object
FREE	A free object in the local heap

4 A local memory handle

Displaying Variables with a Live Expression

"Using the Quick Watch Command," explains how to display a specific array element by adding the appropriate expression to the Watch window. It is also possible to view a particular array element or structure element in the Memory window. This **CVW** display feature is called a live expression, because the displayed area of memory changes to reflect the value of a pointer or subscript. For example, if Buffer is an array and pBuf is a pointer to that array, then *pBuf points to the array element currently referenced. A live expression displays the section of memory beginning with this element.

CVW displays live expressions in a Memory window. To create a live expression:

1 From the Options menu, choose Memory Window.

2 Select the Live Expression check box, and type the name of the element you want to view.

For example, if pszMsg is a pointer to a null-terminated array of characters and you want to see what it currently points to, type the following:

```
*pszMsg
```

3 Choose the OK button, or press ENTER.

A new Memory window opens. The first memory location in the window is the first memory location of the live expression. The section of memory displayed changes to the section the pointer currently references.

You can use the Memory Window command on the Options menu to display the value of the live expression in a readable form. This is especially convenient when the live expression represents strings or floating-point values, which are difficult to interpret in hexadecimal form.

It is usually more convenient to view an item in the Watch window than as a live expression. However, you might find some items easier to view as live expressions. For example, you can examine what is currently at the top of the stack by specifying SS:SP as the live expression.

Dereferencing Memory Handles

In a Windows application, the **LocalLock** and **GlobalLock** functions are used to dereference memory handles into near or far pointers. In a debugging session, you may know the handle of the memory object, but might not know which near or far address it dereferences to, unless you are debugging in an area where the application has just completed a **LocalLock** or **GlobalLock** function call. To get the near and far pointer addresses for your local and global handles, use the **(lh)** and **(gh)** type casts. For example, you could use **(lh)** to dereference the array in the following code:

```
HANDLE hLocalMem;
PBYTE pbArray;

hLocalMem = LocalAlloc(LMEM_MOVEABLE, 100);
pbArray = (PBYTE)LocalLock(hLocalMem);

/* Use the array.     */

LocalUnlock(hLocalMem);
```

To properly display this array in **CVW**, you can use the following command:

```
dw (lh)hLocalMem
```

If you set a breakpoint immediately after the **LocalLock** function, you could find out where the local object was allocated in the application's data segment by looking at the value of the pbArray variable. To display the value of pbArray, use the following **CVW** command:

```
dw pbArray
```

Note that you cannot rely on the value of pbArray anywhere else in the application, because it may change or the memory object may move.

In the following example, the memory object lpszTest is a string:

```
HANDLE hGlobalMem;
LPSTR  lpszTest;

hGlobalMem = GlobalAlloc(GMEM_MOVEABLE, 10L)
lpszTest = GlobalLock(hGlobalMem);

lstrcpy(lpszTest, "ABCDEF");

GlobalUnlock(hGlobalMem);
```

To display the contents of the string, you could use double type casting, as follows:

```
? *(char far*) (gh)lpszTest,s
```

The **(gh)** type cast returns a pointer to the far address of the global memory object.

Displaying the Contents of Registers

Selecting the Register command from the View menu (or pressing F2) opens a Reg window on the right side of the screen. The current values of the microprocessor's registers appear in this window.

At the bottom of the window are a group of mnemonics representing the processor flags. When your application first starts running, all values are shown in normal-intensity video. Any subsequent changes are marked in high-intensity video. For example, suppose the overflow flag is not set when the application starts. The corresponding mnemonic is NV, and it appears in normal-intensity video. If the overflow flag is subsequently set, the mnemonic changes to OV and appears in high-intensity video.

Selecting the 386 Instructions command from the Options menu displays the contents of the registers as 32-bit values. This command is valid only if your computer uses an 80386 processor. Selecting this command a second time changes the registers back to 16-bit values.

You can also display the registers of an 8087/80287/80387 coprocessor in a separate window by choosing the 8087 command from the View menu. If your application uses a coprocessor emulator, the emulated registers are displayed instead.

Displaying Windows Modules

The **wdm** (Windows Display Modules) command displays a list of all the DLL and task modules that Windows has loaded. For each module, the list shows the module handle, the type of module (DLL or task), the name of the module, and the path of the module.

Modifying Program Data

Modifying Application Data

You can easily change the values of variables, memory locations, or registers displayed in the Watch, Memory, Reg, or 8087 window. Simply position the cursor at the value you want to change, and type the appropriate value. If you change your mind, press ALT+BACKSPACE to undo the last change you made.

The Memory window displays the starting address of each line in segment:offset form. Altering the address automatically shifts the display to the corresponding section of memory. If that section is not used by your application, memory locations are displayed as double question marks (??). You cannot change memory that is displayed as question marks.

You can also change the values of memory locations by modifying the right side of the memory display, which shows memory values in ASCII form. For example, you can change a byte from decimal value 75 (ASCII value for uppercase K) to decimal value 85 (ASCII value for uppercase U). To do so, place the cursor over the letter K, which corresponds to the position where the memory value is 75, and type **U**.

To change a processor flag, you can click its mnemonic or you can position the cursor on a mnemonic and press any key (except TAB or SPACEBAR). Repeat these operations to restore the flag to its previous setting.

Although you can alter most items from the Watch window, sometimes it is useful to modify a register or memory directly. For example, if a function returns a value in the AX register, you can modify the AX register to change a returned value without executing the function.

Warning: You should be especially cautious when altering machine-level values. The effect of changing a register, flag, or memory location may vary from having no effect at all to causing the operating system to crash.

Controlling Program Execution

Controlling Execution of Your Application

This section describes how you can use **CVW** to control the execution of your application.

Following are the three possible forms of execution in **CVW**:

Application execution	Description
Continuous	The application runs until either a previously specified breakpoint has been reached or the application terminates normally.
Single-step	The application pauses after each line of code has been executed.
Animated	The application pauses after each line of code has been executed, but execution continues after a short pause. The application continues to run until you press a key.

Continuous Execution

With continuous execution, you can quickly execute bug-free sections of code. To initiate continuous execution, either you can click the right mouse button on the line of code you want to debug or examine in more detail or you can position the cursor on this line and then press F7. Execution proceeds at full speed and pauses when it reaches the selected line.

You can also use a breakpoint to cause execution to pause at a specific line of code. **CVW** provides you with several types of breakpoints to control your application's execution. The sections that follow describe how to use breakpoints.

Selecting Breakpoint Lines

By specifying one or more lines as breakpoints, you can skip over the parts of the application that you don't want to examine. Execution of the application proceeds at full speed up to the first breakpoint, at which execution is interrupted; pressing F5 causes execution to continue up to the next breakpoint; and so on. You can set as many breakpoints as you want, provided that you have available memory.

Following are several ways to set breakpoints:

- Double-click anywhere on the desired breakpoint line. The selected line is highlighted to show that it is a breakpoint. To remove the breakpoint, double-click on the line a second time.
- Position the cursor anywhere on the line at which you want execution to pause. Press F9 to select the line as a breakpoint and to highlight it. Press F9 a second time to remove the breakpoint and highlighting.
- Display the Set Breakpoint dialog box by choosing the Set Breakpoint command from the Watch menu. Select one of the breakpoint options that permits you to specify a line (location). The line on which the cursor rests is the default breakpoint line in the Location field. If this line is not the location you want, replace it by typing another line number in the Location field. When you type a new line number, make sure that you precede it with a period.
- Your application can call the Windows **DebugBreak** function to interrupt execution and return control to CVW. When your application calls the **DebugBreak** function, execution may stop within the **DebugBreak** code rather than in your application. You may have to single-step out of the **DebugBreak** code and back into your application.

A breakpoint line must contain executable code. You cannot select a blank line, a comment line, or a declaration line (such as a variable declaration or a preprocessor statement) as a breakpoint.

To set a breakpoint on a multiline statement, you must position the cursor on the last line of the statement. If you try to set a breakpoint on any other line of the statement, **CVW** does not accept it.

If your compiler optimizes your code, some lines of code may be repositioned or reorganized for more efficient execution. These changes can prevent **CVW** from recognizing the corresponding lines of source code as breakpoints. Therefore, it is a good idea to disable optimization during development. You can restore optimization once debugging is completed.

A breakpoint can also be set at a function or an explicit address. To set a breakpoint at a function, simply enter the name of the function in the Set Breakpoint dialog box. To set a breakpoint at an address, enter the address in CS:IP form.

If any of the applications or DLLs you are debugging share names for certain window procedures (such as MainWndProc), you can refer by name only to the procedure that is defined in the first application or DLL.

You can remove a breakpoint by choosing the Edit Breakpoints command from the Watch menu or by selecting the breakpoint in the Source window and pressing F9. When your application pauses at a breakpoint, you can continue execution by pressing F5. You cannot remove a breakpoint set by an application calling the **DebugBreak** function.

Setting Breakpoint Values

Breakpoints are not limited to specific lines of code. **CVW** can also break execution when an expression changes value or reaches a particular value. Use one of the following methods to set a breakpoint value:

- To interrupt execution when an expression *changes* value, type the name of the expression in the Expression field of the Set Breakpoint dialog box.
- To interrupt execution when an expression *reaches* a particular value, use that value in the expression you type in the Expression field of the Set Breakpoint dialog box.

  For example, if you want the application to pause when a variable named looptest equals 17, type the following in the Expression field:

  ```
  looptest==17
  ```

  The application pauses when this statement becomes true.

You can also use the Set Breakpoint dialog box to combine value breakpoints with line breakpoints so that execution stops at a specified line only if an expression has simultaneously changed value or reached a specified value.

For large variables (such as arrays and character strings), you can specify the number of bytes you want checked (up to 32K) in the Length field.

Note: When a breakpoint is tied to a variable, **CVW** must check the variable's value after each machine instruction is executed. This computational overhead slows execution greatly. For maximum speed when debugging, either tie value breakpoints to specific lines or set value breakpoints only after you have reached the section of code that needs to be debugged.

Setting Breakpoints on Windows Messages

You can also set a breakpoint on a Windows message or an entire class of Windows messages. By using this feature, you can track your application's response to user input and window-management messages.

To set a breakpoint on a Windows message or message class, type the **wbm** (Windows Breakpoint Message) command in the Watch window. The syntax for the command is:

wbm *winproc msgname* | *msgclasses*

The *winproc* parameter is the symbol name or address of an application's window procedure. The *msgname* parameter is the name of a Windows message, such as WM_PAINT. The *msgclasses* parameter is a string of characters that identify one or more classes of messages. If *msgclasses* is not specified, **CVW** traces all message classes. If it is specified, the classes are consistent with those defined in Microsoft Windows Spy (SPY.EXE); they are as follows:

Message class	Type of Windows message
c	Clipboard
d	DDE
i	Initialization

m	Mouse
n	Input
s	System
w	Window management
z	Nonclient

For example, if your application is failing to refresh the client area of a window, you might set a breakpoint on the **WM_PAINT** message so that you can watch your application's behavior as it processes the message. The following command interrupts execution whenever the application's MainWndProc procedure receives a WM_PAINT message:

```
wbm MainWndProc WM_PAINT
```

Using Breakpoints

This section shows how breakpoints can help you find the cause of a problem.

One of the most common bugs is a **for** loop that executes too many or too few times. If you set a breakpoint that encloses the loop statements, the application pauses after each iteration. You can then monitor the loop variable or critical program variables in the Watch or Local window to find the error in loop processing.

You can specify that a breakpoint is to be ignored. To set the number of times a breakpoint is to be ignored before execution is interrupted, perform the following steps:

1 From the Watch menu, choose Set Breakpoint.

2 In the Pass Count field of the Set Breakpoint dialog box, type the decimal number.

For example, suppose your application repeatedly calls a function to create a binary tree. You suspect that something goes wrong approximately halfway through the process. You could mark the line that calls the function as the breakpoint, then specify how many times this line is to be executed before execution pauses. Running the application creates a representative (but unfinished) tree structure that can be examined from the Watch window. You can then continue your analysis by using single-step execution, which is described in the next section.

Another programming error is assignment of the wrong value to a variable. If you enter a variable in the Expression field of the Set Breakpoint dialog box, execution is interrupted every time the variable changes value.

Breakpoints make it possible for you to interrupt execution of an application so that you can assign new values to variables. For example, if a limit value is set by a variable, you can change the value to see if it affects the application's execution. Similarly, you can pass a variety of values to a **switch** statement to see if they are correctly processed. This ability to alter variables provides an especially convenient way to test new functions without having to write a stand-alone test application.

When your application reaches a breakpoint and you change a variable, you might want to watch each step be executed while you check the value of that variable. This technique is called single-stepping.

Single-Step Execution

When single-stepping, **CVW** pauses after each line of code is executed. If a line contains more than one executable statement, CVW executes all the statements on the line before pausing. The next line to be executed is displayed in reverse video. You can use either the Trace command or the Step command to single-step through an application.

To use Trace, press F8. Trace displays each step of every function for which **CVW** has symbolic information. Each line of the function is a separate step. If CVW does not have symbolic information for a function, the function runs in a single step.

To use Step, press F10. Step displays each step of the current function but does not step into function calls. Instead, the called function runs as a single step.

You can alternate between Trace and Step as you like. Which method you should use depends on whether you want to see what happens within a particular function.

Attempting to step or trace through Windows startup code while viewing assembly-language instructions causes unpredictable results. To step through your application while viewing assembly-language instructions, set a breakpoint at the **WinMain** function and begin stepping through the application only after the breakpoint has been reached.

Using the Trace command to step out of a window procedure causes **CVW** to step into Windows system code.

Animated Execution

To trace through the application continuously without having to press F8, choose the Animate command from the Run menu. The speed of execution is controlled by the Trace Speed command on the Options menu. You can interrupt animated execution at any time by pressing any key.

Jumping to a Particular Location

At times, you may wish to force the system to jump to a particular location in your application during execution. For example, you may want to avoid executing code that you know has bugs, or you may want to repeatedly execute a particularly troublesome portion of your application.

To jump to a specific location in your application, do the following:

1 From the Options menu, choose Source. Select the Mix Source and Assembly radio button and the Show Machine Code check box.

2 In the Source window, view the line of source code to which you want to jump.

3 Examine the code offset of the first machine instruction for the assembled statement.

4 To change the IP register to this code offset, type the **rip** (Register IP) command in the command window, supplying the value in hexadecimal format.

CVW highlights the line to which you have jumped.

Warning: Do not jump from one procedure to another. Jumping from one procedure to another disrupts the stack.

Assembled source code for a given statement may rely on memory values and registers set in previous instructions. If you cause execution to jump to a specific point in your application, values and registers may not be correctly set, particularly if optimization was not disabled during compiling.

Interrupting Your Application

There may be times when you want to interrupt your application immediately. You can force an immediate interruption of a **CVW** session by pressing CTRL+ALT+SYS RQ. You then have the opportunity to change debugging options; for example, you can add breakpoints and modify variables. To resume continuous execution, just press F5; to single-step, press F10.

You should take care when you interrupt the **CVW** session. For example, if you interrupt the session while Windows code or other system code is being executed, attempting to use the Step command or the Trace command could produce unpredictable results. When you interrupt the CVW session, it is usually safer to set breakpoints in your code and resume continuous execution than to use Step or Trace.

An infinite loop in your code presents a special problem. Again, because you should avoid using Step or Trace after interrupting your application, you should try to locate the loop by setting breakpoints in places you suspect are in the loop.

Whether or not you locate the infinite loop, you will have to terminate your application. The **wka** (Windows Kill Application) command terminates the task that is currently running. You should use the **wka** command only when your application is the one being executed.

If your application is currently executing a module that contains symbol information, the **CVW** Source window highlights the current instruction. However, if your application contains modules without symbolic information, it is more difficult to determine whether the assembly-language code displayed in the Source window belongs to your application or to another task.

In this case, use the **wdg** (Windows Display Global Heap) command, supplying the value in the CS register as the parameter. **CVW** displays a listing that indicates whether the code segment belongs to your application. If the code segment does belong to your application, you can use the **wka** command without affecting other tasks. The **wka** command does not perform all the cleanup tasks associated with the normal termination of a Windows application. For example, graphics device interface (GDI) objects created during the execution of the application but not destroyed before you terminated the application remain allocated in the systemwide global heap. This reduces the amount of memory available during your Windows session. Because of this, you should use the **wka** command to terminate the application only if you cannot terminate it normally.

The **wka** command simulates a fatal error in your application. Because of this, when you use the **wka** command, Windows displays an error message. After you close the message box, Windows may not release subsequent mouse input messages from the system queue until you press a key. If this happens, the cursor moves on the Windows screen, but Windows does not appear to respond to the mouse. After you press any key, Windows responds to all mouse events that occurred before you pressed the key.

Handling Abnormal Termination of the Application

Your application can terminate abnormally in one of two ways while you are debugging it with CVW. It can cause a fatal exit, or it can cause a GP fault. In both cases, **CVW** regains control, giving you the opportunity to examine the state of the system when your application terminated. In particular, you can often determine the location in your application's code where the error occurred or which call caused the error. CVW makes it possible for you to view registers, display the global heap, display memory, and examine the source code.

Once you have determined where the error occurred, type the **q** (Quit) command in the Command window to terminate CVW. In most cases, control returns to Windows.

Handling a Fatal Exit

If the abnormal termination was a fatal exit and the application was running with the retail version of Windows, **CVW** displays a fatal exit code and the CS:IP register contains an address in the Windows code itself. This small amount of information provides little to help you locate the last call that your application made before the error was detected.

If, however, your application was running with the debugging version of Windows, the **CVW** Command window displays a stack trace that is much more useful for finding the error in your source code.

After the stack trace appears in the **CVW** Command window, Windows prompts you with the following message:

```
Abort, Break, or Ignore?
```

To locate the cause of the error, press the B key. This allows **CVW** to regain control from Windows.

In most cases, the stack trace will have been scrolled past the top of the **CVW** Command window; but once CVW regains control, you can scroll the information in the window to examine the entire stack trace. The following information appears at the top of the stack trace:

- A fatal exit number. For more information about Windows debugging messages, see Appendix C, "Windows Debugging Version."
- The CS:IP address, the name of the Windows function where the error was detected, or the name of the last Windows function called before the error was detected.

Following this information, additional Windows functions may be listed in the stack trace. Somewhere near the top of the stack trace, a CS:IP address is listed without a Windows function name. In most cases, this is the location in the source code of your application at which the call to a Windows function occurred, triggering the fatal exit.

To examine this location in your source code, open or switch to a Source window and use the **v** (View) command followed by the CS:IP address; be sure to precede both the segment and the offset with the hexadecimal prefix **0x**. For example, if **CVW** indicates that the error occurred at 07DA:0543 in your application, type the following command:

```
v 0x07DA:0x0543
```

If the module at which the error occurred was compiled to produce object files containing symbolic information, the **CVW** Source window displays the location in your code at which the errant call to a Windows function occurred.

The first CS:IP address without a name in the stack trace may point to a location in your code without symbols. For example, the code may be in a DLL you didn't specify with the **/l** command-line option or when **CVW** prompted you for a DLL, or the address might be in a module that was not compiled to produce symbolic information. In such cases, CVW reports that no source code is available. If this happens, continue down the stack trace, using the **v** command to examine each unnamed CS:IP address. You are likely to find a location in a module that was compiled to produce symbolic information and to find this location made a call into one of your modules that was not compiled to produce symbolic information.

Handling a General Protection Fault

When a general protection (GP) fault occurs, **CVW** displays a message in the Command window to notify you of the event. If the GP fault occurred at an instruction in one of your modules, CVW displays the corresponding source code if the module was compiled to produce symbolic information. You can obtain information about the chain of calls leading up to the GP fault by using the CVW Call menu. This menu displays a backtrace of calls in the form of a series of segments and offsets, starting at the most recent call.

If your application was running with the debugging version of Windows, the backtrace shows function names next to some of the segment:offset pairs. By examining the function names, you may be able to determine where in your code the error occurred.

Ending a CVW Session

Ending a Session

To terminate a **CVW** session, you can choose the Exit command from the File menu or type the **q** (Quit) command in the Command window.

You can also terminate your application without terminating CVW. While Windows is terminating the application, it notifies CVW. **CVW** then displays the following message:

```
Program terminated normally (0)
```

The value in parentheses is the return value of the **WinMain** function. This value is usually the *wParam* parameter of the **WM_QUIT** message, which in turn is the value of the *nExitCode* parameter passed to the **PostQuitMessage** function.

If you were debugging more than one application or DLL, you can press F5 to continue the debugging session.

Advanced CVW Techniques

Advanced Techniques

Once you are comfortable displaying variables, changing variables, and controlling the execution of your application, you may want to experiment with the following advanced techniques:

- Using multiple Source windows
- Checking for undefined pointers
- Handling register variables
- Redirecting **CVW** input and output

Using Multiple Source Windows

You can have two Source windows open at the same time. The windows can display two different sections of source code for the same application. They can both track CS:IP addresses, or one can display a high-level listing and one can display an assembly-language listing. You can move freely between the Source windows, executing a single line of source code or a single assembly-language instruction at a time.

Checking for Undefined Pointers

Until a pointer has been explicitly assigned a value, its value is undefined. Its value can be completely random, or it can be some consistent value (such as 1) that does not point to a useful data address.

Accessing a value through an uninitialized pointer address can cause inexplicable or erratic application behavior, because the data is not being read from or written to the intended location. For example, suppose that var1 is mistakenly written to the address specified by an uninitialized pointer and that then var2 is written there. When var1 is read back, it does not have its original value, having been replaced by var2.

Handling Register Variables

A register variable is stored in one of the microprocessor's registers, rather than in random-access memory (RAM). This speeds up access to the variable.

A conventional variable can become a register variable in either of the following ways:

- The variable is declared as a register variable. If a register is free, the compiler stores the variable there.
- The compiler stores a frequently used variable (such as a loop variable) in a register during optimization to speed up execution.

Register variables can cause problems during debugging. As with local variables, they are visible only within the function where they are defined. In addition, a register variable may not always be displayed with its current value.

Usually, it is a good idea to turn off all optimization and to avoid declaring register variables until the application has been fully debugged. Any side effects produced by optimization or register variables can then be easily isolated.

Redirecting CodeView for Windows Input and Output

You can cause **CVW** to receive input from an input file and generate output to an output file. To redirect CVW input and output, you can use the **/c** option on a command line of the following form to start CVW:

cvw /c "<*infile***; t >***outfile***"**

When you redirect input in this way, **CVW** carries out any commands in *infile* during startup. When CVW exhausts all commands in the input file, focus automatically shifts to the Command window.

When you redirect output, it is sent to both *outfile* and the Command window. You can use the **t** parameter before the right angle bracket (**>**) on the command line to send output to the Command

window. You can also redirect output from the command line after **CVW** has started.

Redirection is a useful way to automate **CVW** startup. Although redirection makes it possible for you to keep a viewable record of command-line input and output, you cannot record mouse operations. Some applications--particularly interactive ones--may need modification to allow for redirection of input to the application itself.

Customizing CVW with the TOOLS.INI File

Modifying the TOOLS.INI File

To customize the behavior and user interface of **CVW**, modify the [cvw] section of your TOOLS.INI file. The TOOLS.INI file is an ASCII text file. You should place it in a directory pointed to by the INIT environment variable. (If you do not use the INIT environment variable, CVW looks for TOOLS.INI only in the CVW source directory.)

Most TOOLS.INI customizations control screen colors, but you can also specify startup commands or the name of the file that receives **CVW** output. The Help system contains complete information about all the TOOLS.INI entries for CVW.

Monitoring DDE Transactions: DDESPY

DDESpy is a typical DDE monitoring application. Because DDE is a cooperative activity, DDE monitoring applications must follow certain guidelines for your Windows system to operate properly while they are in use. In particular, DDE monitoring applications should not perform DDE server or client communications--problems may arise when the monitoring application intercepts its own communications.

The following topics describe how to set up and use DDESPY:

Output Options
Monitor Options
Tracking Options

DDESPY Output Options

The Output Menu

DDESpy can display DDE information in a window or on your debugging terminal or can save the displayed information in a file for later use.

You use the Output menu to select where DDESpy is to send output. If you choose the File command, you must specify the name of an output file. After you have chosen the File command once, DDESpy prompts you for an output filename every time you restart the application.

From the Output menu, you can choose the Clear Screen command to clear the display window. You can choose the Mark command to add text to the display as a marker--for example, before a DDE event to make it easier to find the event in the output file.

DDESPY Monitor Options

The Monitor Menu

You use the Monitor menu to specify one or more types of DDE information that DDESpy is to display. The following information can be displayed:

String Handle Data
Sent DDE Messages
Posted DDE Messages
Callbacks
Errors

The Dynamic Data Exchange Management Library (DDEML) passes information by using shared memory. The contents of the shared memory depend on the type of DDE transaction. Several structures have been defined to allow applications using DDE to access the information in the shared memory. DDESpy displays the contents of the appropriate structure for the DDE activity being monitored.

Monitoring String Handle Data

Monitoring String-Handle Data

The DDEML uses the **MONHSZSTRUCT** structure to pass string-handle data. DDESpy displays the following information from this structure:

- Task (application instance)
- Time, in milliseconds, since you started Windows
- Activity type (create, destroy, or increment)
- String handle
- String contents

The following example shows a typical DDESpy display of string-handle data:

```
Task:0x94f, Time:519700, String Handle Created: c4a4(this is a test)
Task:0x94f, Time:526126, String Handle Created: c4aa(another test)
```

Monitoring Sent and Posted DDE Messages

Monitoring Sent or Posted DDE Messages

The DDEML uses the **MONMSGSTRUCT** structure to send and post DDE messages. DDESPY displays the following information from this structure:

- Task
- Time
- Handle of receiving window
- Transaction type (sent or posted)
- Message type
- Handle of sending application
- Other message-specific information

The following example shows a typical DDESpy display of DDE message activity:

```
Task:0x8df Time:642402 hwndTo=0x38dc Message(Sent)=Initiate:
       hwndFrom=9224, App=0xc35d("Server")
       Topic=*
Task:0x94f Time:642457 hwndTo=0x2408 Message(Sent)=Ack:
       hwndFrom=9396, App=0xc35d("Server")status=c35d(fAck fBusy )
       Topic=Item=0xc361("System")
```

Monitoring Callbacks

Monitoring Callbacks

The DDEML uses the **MONCBSTRUCT** structure to pass information to application callback functions. DDESpy displays the following information from this structure:

- Task
- Time
- Transaction type
- Exchanged-data format, if any
- Conversation handle
- String handles and their referenced strings
- Transaction-specific data

The following example shows a typical DDESPY display of callback activity:

```
Task:0x8df Time:2882628 Callback:
       Type=Advstart, fmt=0x1("CF_TEXT"), hConv=0xc24b4,
       hsz1=0xc361("System") hsz2=0xc4df("xxcall"), hData=0x0,
       lData1=0x83f0000, lData2=0x0
       return=0x0
```

Monitoring Errors

Monitoring Errors

When an error occurs during a DDE transaction, the DDEML places the error value and associated information in a **MONERRSTRUCT** structure. DDESpy uses this structure to display the following information about the error:

- Task (the handle of the application that caused the error)
- Time
- Error value and name

Tracking Options

DDESPY can also display information about aspects of DDE communication in your Windows system:

- String handles
- Active conversations
- Active links
- Registered servers

You use the Track menu to specify which DDE activity DDESpy is to track. When you choose a command from the Track menu, DDESpy creates a separate window for the display of information in conjunction with the DDE functions. For each window created, DDESpy updates the displayed information as DDE activity occurs. Events that occurred prior to creation of the tracking window are not displayed in the tracking window.

DDESpy can sort the displayed information in the tracking window. If you select the heading for a particular column in the tracking window, DDESpy will sort the displayed information based on the column you selected. This can be useful if you are searching for a particular event or handle.

Tracking String Handles

Windows maintains a systemwide string table containing the string handles applications use in DDE transactions. To display the system string table so that the string, the string handle, and the string usage count are shown, choose the String Handles command from the Track menu.

Tracking Active Conversations

To see a display of all active DDE conversations in your Windows system, choose the Active Conversations command from the Track menu. The Active Conversations window shows the server name, the current topic, and the server and client handles for each active conversation.

Tracking Active Links

To see a display of all active DDE advise loops, choose the Active Links command from the Track menu. The Active Links window shows the server name, topic, item format, transaction type, client handle, and server handle for every active advise loop in your Windows system.

Tracking Registered Servers

Server applications use the **DdeNameService** function to register with the DDEML. When the DDEML receives the **DdeNameService** function call, it adds the server name and an instance-specific name to a list of registered servers. To see a list of registered servers, choose the Registered Servers command from the Track menu.

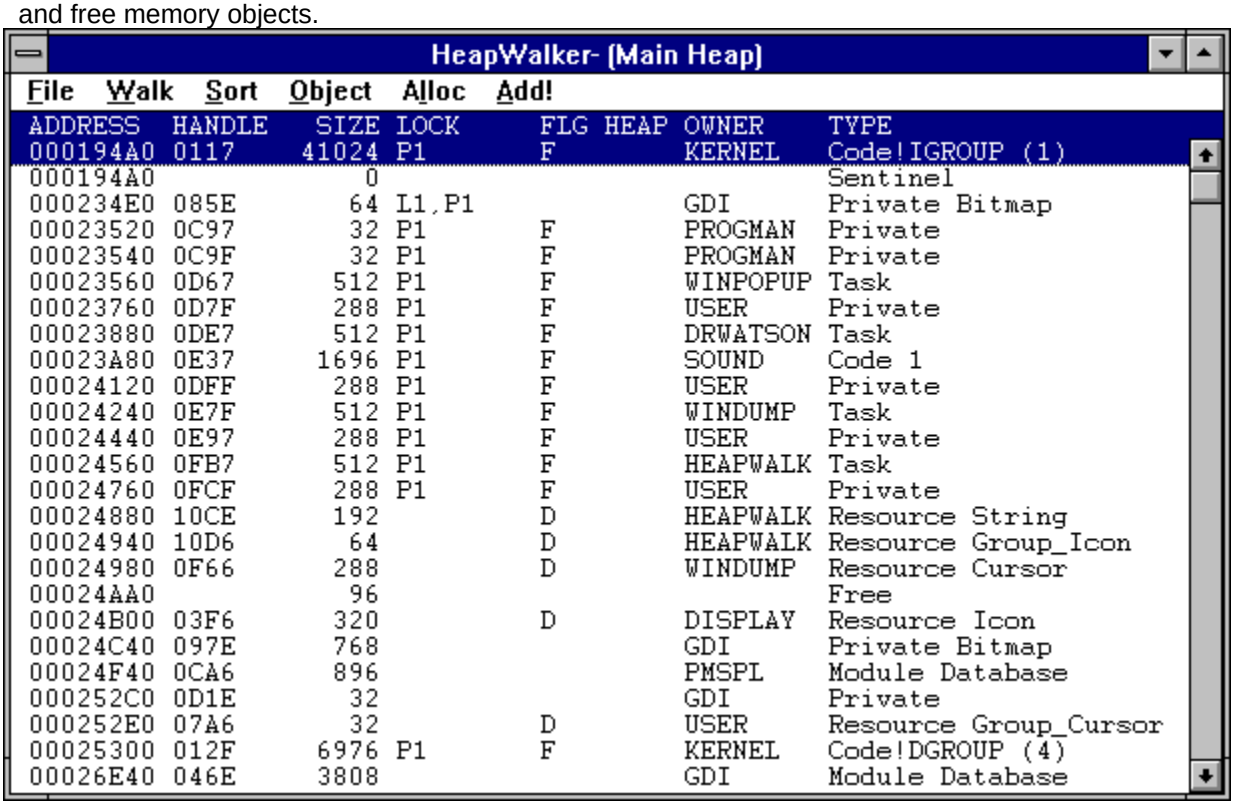
Viewing the Heap: HEAPWALK

The following topics describe how to use HEAPWALK:

The HEAPWALK Window

The Heap Walker Window

When you start Heap Walker, it scans the global heap and displays information about the allocated and free memory objects.



Heap Walker displays the following information about each object:

Column heading	Information displayed
ADDRESS	Address of the memory object (displayed in hexadecimal format).
HANDLE	Handle of the memory object (displayed in hexadecimal format).
SIZE	Size of the memory object, in bytes (displayed in decimal format).
LOCK	Lock count of the object. There are two types of lock counts: page-locked (P) and object-locked (L). Page-locked means that virtual memory will not be used to page the object (pieces of the object will not be written to the swap file); object-locked means the entire object will not be discarded.
FLG	D if the object is discardable; F if the object is fixed (not movable or discardable).
HEAP	Y if the object has a local heap.
OWNER	Owner of the object (name of the module that allocated the object).
TYPE	Type of object (code segment, data segment, resource, and so on). Heap Walker searches for symbol files and lists names for segments whenever corresponding symbol files are found.

Performing File Operations: The File Menu

The following commands are on the File menu:

Command	Action
Save	Saves in a file the current listing of objects in the heap. Heap Walker writes the first listing you save to the file HWG00.TXT and numbers subsequent files consecutively (HWG01.TXT, HWG02.TXT, and so on).
Exit	Closes Heap Walker.
About	Displays information about the current version of Heap Walker.

When you save a current heap listing to a file, Heap Walker includes all the information shown in the HeapWalker-[Main Heap] window, the number of free blocks in the heap, the size of the largest free block, the total free global heap space, and the following information about each module that has allocated memory from the global heap:

- Module name
- Number of discardable segments loaded in memory
- Number of bytes in discardable segments
- Number of bytes in nondiscardable segments
- Total number of bytes used by the module

Walking the Heap: The Walk Menu

The following commands are on the Walk menu:

Command	Action
Walk Heap	Displays all objects in the global heap.
Walk LRU List	Displays only discardable objects. Heap Walker lists objects from the least recently used to the most recently used. The object at the top of the list has been least recently used and, therefore, is most eligible for discarding.
Walk Free List	Displays only free blocks of memory.
GC(0) and Walk	Compacts the global heap, asking for 0 bytes, and then displays the heap.
GC(-1) and Walk	Attempts to discard all discardable objects and then displays the heap.
GC(-1) and Hit A:	Attempts to discard all discardable objects and then accesses drive A. This command is used to test critical error handling.
Set Swap Area	Resets the code fence. The code fence defines an area of memory reserved for discardable code.
Segmentation Test	Dumps the heap to a file called HWG*xx*.TXT and then compacts the heap.

Sorting Memory Objects: The Sort Menu

The Sort menu is useful for sorting memory objects in a variety of ways. The following commands are on the Sort menu:

Command	Action
Address	Sorts numerically by address.
Module	Sorts alphabetically by the owning module's name and sorts alphabetically by object type within each owner name.
Size	Sorts numerically by object size.
Type	Sorts alphabetically by object type and sorts alphabetically by owner name within each object type.
Refresh Seg Names	Searches for symbol files and lists segment names. This command can be used to list segment names for applications loaded after you start Heap Walker.

Displaying Memory Objects: The Object Menu

The Object menu is useful for viewing objects selectively. The following commands are on the Object menu:

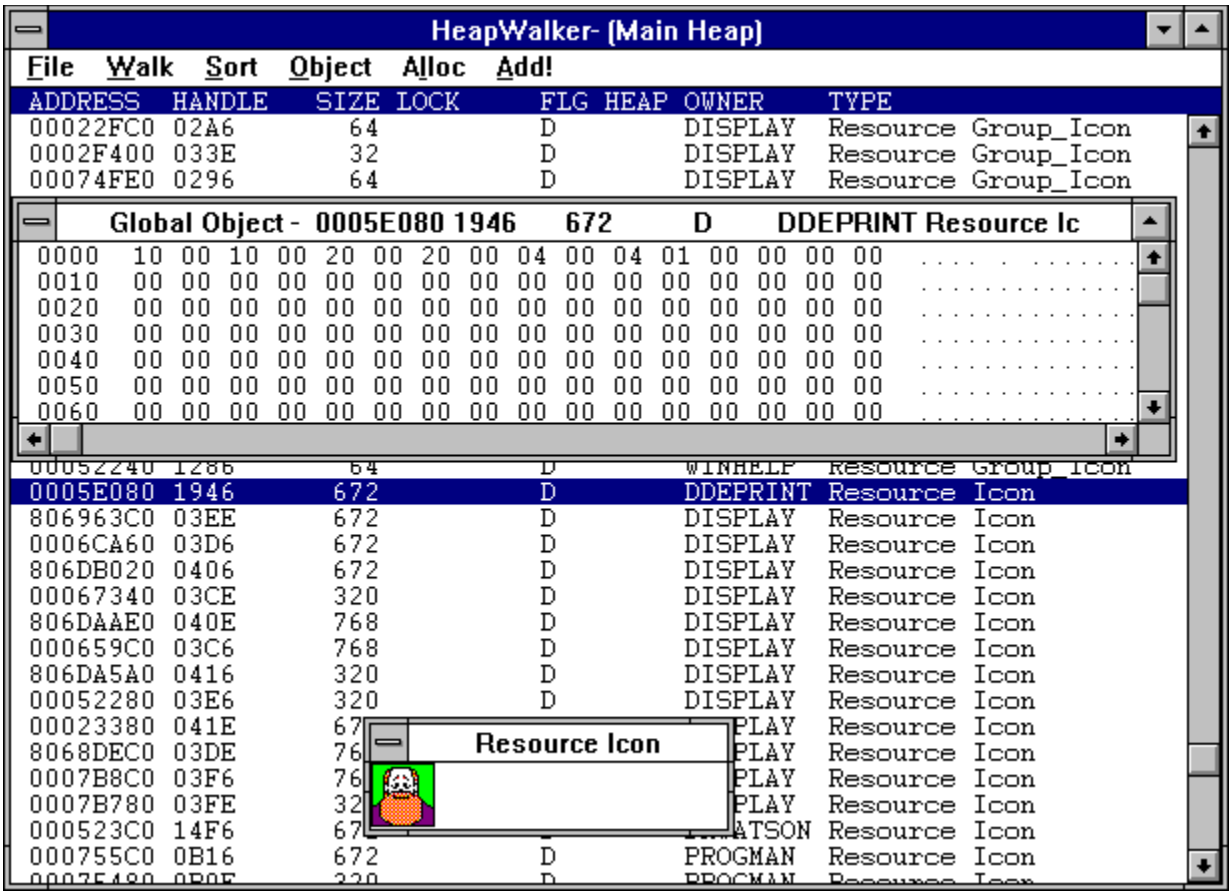
Command	Action
Show	Displays the contents of a selected object in hexadecimal format and ASCII format. When possible for resources, this command displays the resource (such as an icon, menu, or dialog box).
Discard	Discards a selected object.
Oldest	Marks a selected object as the next candidate for discarding.
Newest	Marks a selected object as the last candidate for discarding.
LocalWalk	Displays the local heap of the currently selected object, if it has one.
LC(-1) and LocalWalk	Compacts the selected local heap and then displays the heap.
GDI LocalWalk	Displays the GDI local heap and provides information about the objects in the heap.
User LocalWalk	Displays the USER local heap and provides information about the objects in the heap.

The Show Command

To display a hexadecimal dump of an object, select the object in the HeapWalker-[Main Heap] window and either double-click the left mouse button or choose the Show command from the Object menu. In addition to the hexadecimal dump, the Show command can display the following kinds of resources:

- Bitmaps
- Cursors
- Dialog boxes
- Icons
- Menus

For example, the following illustration shows how the Show command displays the memory and icon associated with the selected memory object.

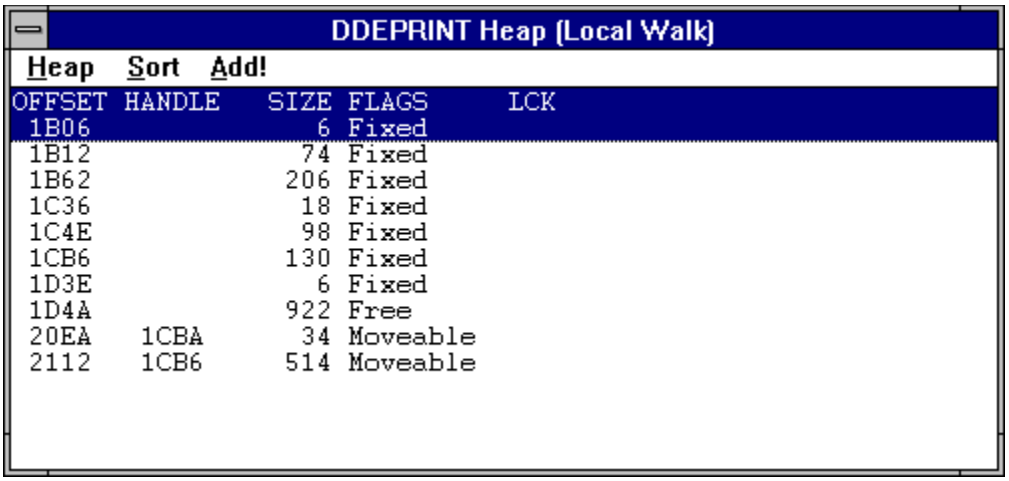


The LocalWalk Commands

You can choose the LocalWalk command from the Object menu to view the local heap for a selected object. You can also choose the GDI LocalWalk or User LocalWalk command to view the GDI or USER local heap, respectively, at any time. Local Walk windows show the following information:

Window heading	Information displayed
OFFSET	Offset of the object from the beginning of the heap. You can use this information to locate the contents of the object within the hexadecimal display of the heap.
HANDLE	Handle of the object.
SIZE	Size of the object, in bytes.
FLAGS	Whether the object is movable, fixed, or free.
LCK	Lock count for the object.
TYPE	Object type (shown only for GDI and USER heaps).

The following illustration shows a Local Walk window.



Windows allocates the first object in the local heap, so there are always at least two objects in a local heap.

Local Walk: The Heap Menu

Following are the commands on the Heap menu:

Command	Action
Info	Displays a message box showing the number of free, movable, and fixed objects; the number of bytes they use; the total number of allocated objects; and the number of bytes they use.
Save	Saves the Local Walk display to a file. The first file saved is named HWL00.TXT; subsequent files are numbered sequentially (HWL01.TXT, HWL02.TXT, and so on). The file contains all the information shown in the Local Walk window and a summary of local objects by type (free, movable, fixed, and total allocated).

Local Walk: The Sort Menu

Following are the commands on the Sort menu:

Command	Action
Address	Sorts the Local Walk display numerically by address.
Flags	Sorts the Local Walk display alphabetically by flags (fixed, free, or movable).
Size	Sorts the Local Walk display numerically by object size.

Local Walk: The Add! Menu

The Add! menu displays a message box showing the total number of bytes used by selected objects.

Allocating Memory: The Alloc Menu

The Alloc menu is useful for allocating memory for test purposes. You can allocate all free memory and then run your program to see how it behaves when no memory is available. You can free all or a specified part of the allocated memory.

The following commands are available from the Alloc menu:

Command	Action
Allocate All of Memory	Allocates all free memory. This command is useful for testing out-of-memory conditions in applications.
Free All	Frees memory allocated by the Allocate All of Memory command.
Free 1K	Frees 1K of the memory allocated by the Allocate All of Memory command.
Free 2K	Frees 2K of the memory allocated by the Allocate All of Memory command.
Free 5K	Frees 5K of the memory allocated by the Allocate All of Memory command.
Free 10K	Frees 10K of the memory allocated by the Allocate All of Memory command.
Free 25K	Frees 25K of the memory allocated by the Allocate All of Memory command.
Free 50K	Frees 50K of the memory allocated by the Allocate All of Memory command.
Free XK	Frees a specified number of kilobytes of the memory allocated by the Allocate All of Memory command. A dialog box is displayed, in which you can specify the number.

The last eight commands apply only to memory allocated when you chose the first command--it is not possible to free memory allocated by another program.

Determining Memory Size: The Add! Menu

The Add! menu on the Heap Walker menu bar adds the total number of bytes of selected memory objects. Opening this menu displays a dialog box that shows the number of selected segments and total segment sizes.

Suggestions for Using HEAPWALK

Suggestions for Using Heap Walker

One error that frequently occurs in applications is the failure to free memory objects when they are no longer needed. This can cause Windows to fail when one of its data segments grows beyond the 64K limit.

You can use Heap Walker to help determine if your application is not freeing memory objects. With Heap Walker, you can view changes in the sizes of all Windows data segments to observe the effect your application has on these segments.

To check how your application changes the sizes of the Windows data segments, follow these steps:

1 Make sure that your application does not generate fatal exits.

2 Start the debugging version of Windows.

3 Start Heap Walker, and note the sizes of the GDI and USER data segments. This establishes the reference for comparing the size of the data segments later.

4 From the Object menu, choose the GDI LocalWalk command to display the GDI Heap (Local Walk) window, which lists the different objects in the GDI data segment. Then choose the Save command from the Heap menu to copy this list to a file; the file will also contain a summary of GDI objects.

5 Run your application, and exercise it fully over a long period of time, noting the changes in the size of the GDI and USER data segments that Heap Walker displays as your application runs. While your application is running, repeat step 4 a number of times to take "snapshots" of the effect your application has on the GDI data segment.

6 Close your application, take a final snapshot of the GDI data segment, and note the total sizes of the GDI and USER data segments.

As you analyze the data that you've recorded, you should look for GDI objects that your application creates but does not delete when they are no longer needed.

Monitoring Messages: SPY

Microsoft Windows Spy (SPY.EXE) is a tool for the Microsoft Windows operating system. Spy makes it possible for you to monitor messages sent to one or more windows and to examine the values of message parameters.

Note: If you are using the Microsoft CodeView for Windows (**CVW**) debugger to debug your application, you can use **CVW** instead of Spy to trace messages.

The following topics describe how to use **SPY**:

Choosing Options
Choosing a Window: The Window Menu
Turning Spy On and Off: The Spy Menu

This topic describes how to use the Options!, Window, and Spy menus to specify how Spy is to operate.

Selecting Options: The Options! Menu

The Options! menu displays a dialog box in which you make selections about the following:

Monitored message types
Output device
Synchronous or asynchronous output

Selecting Message Types

Selecting Message Types

Under Messages, you can select any of the following message types you want Spy to monitor:

Message	Description
Mouse	Mouse messages, such as **WM_MOUSEMOVE** and **WM_SETCURSOR**
Input	Input messages, such as **WM_CHAR** and **WM_COMMAND**
System	Systemwide messages, such as **WM_ENDSESSION** and **WM_TIMECHANGE**
Window	Window manager messages, such as **WM_SIZE** and **WM_SHOWWINDOW**
Init	Initialization messages, such as **WM_INITMENU** and **WM_INITDIALOG**
Clipboard	Clipboard messages, such as **WM_RENDERFORMAT**
Other	Messages other than the types explicitly listed
DDE	Dynamic data exchange (DDE) messages, such as **WM_DDE_REQUEST**
Non Client	Windows nonclient messages, such as **WM_NCDESTROY** and **WM_NCHITTEST**

By default, Spy monitors all messages.

Selecting the Output Device

Selecting the Output Device

Under Output, you can select which of the following output devices you want Spy to send messages to:

Device	Description
Window	Spy displays messages in the Spy window. You can specify how many messages Spy stores in its buffer. By default, Spy stores up to 100 lines of messages, which you can view by scrolling through the Spy window. You can also change the maximum number of lines that can be stored in the buffer.
Com1	Spy sends messages to the COM1 port.
File	Spy sends messages to the specified file. The default output file is SPY.OUT.

Selecting Frequency of Output

Selecting Frequency of Output

Under Display, you can select which of the following frequency options you want Spy to use:

Option	Description
Synchronous	Spy displays messages as it receives them.
Asynchronous	Spy queues messages for display.

By default, Spy sends messages synchronously.

Selecting a Window: The Window Menu

Use the Window menu to select the window you want Spy to monitor. The Window menu contains the following commands:

Command	Description
Window	Specifies the window that Spy is to monitor. When you choose the Window command, Spy displays the Spy Window dialog box. This dialog box displays information about the window in which the cursor is located. As you move the cursor from window to window, the following information is updated:
All Windows	Specifies that Spy is to display messages received by all windows.
Clear Window	Clears the Spy window.

Item	Description
Window	Handle of the window.
Class	Window class.
Module	Program that created the window.
Parent	Handle of the parent window and the name of the program that created the parent window.
Rect	Upper-right and lower-left coordinates of the window and the window size in screen coordinates.
Style	Style bits of the window in which the cursor is located, the principal style of the window, and an identifier if the window is a child window. The principal style can be **WS_POPUP**, **WS_ICONIC**, **WS_OVERLAPPED**, or WS_CHILD.

Turning Spy On and Off: The Spy Menu

Starting and Stopping Spy: The Spy Menu

After using the Options! and Window menus to make your selections, start Spy by clicking the window you selected and choosing the OK button in the dialog box.

To stop monitoring messages, resume monitoring messages, or close Spy, use the Spy menu. The Spy menu contains the following commands:

Command	Description
Spy On/Off	Starts and stops message monitoring.
Exit	Closes Spy.
About Spy	Provides information about the version of Spy you are using.

Compressing Files: compress.exe

Compressing Files: Compress

Compress (COMPRESS.EXE) creates compressed versions of one or more files. The resulting files are typically 25 to 45 percent smaller than the original files.

Command-line syntax for Compress is as follows:

compress [***/?***][***/r***] *source destination*

Following are command-line options and parameters for Compress:

/?	Displays information about how to use Compress.
/r	Specifies that compressed files should be renamed.
source	Specifies the source filename. The name can include a drive letter, a directory path, or both; and it can contain wildcards.
destination	Specifies the destination. This parameter can consist of a directory (with optional drive letter), a filename, or any combination of the two. If the *source* parameter contains wildcards and the *destination* parameter does not specify only a directory, the ***/r*** option must be used. If the *destination* parameter does not contain a filename, Compress uses the filename or filenames specified by the *source* parameter when Compress copies the file or files to the location specified by the *destination* parameter.

The Microsoft File Expansion Utility (Expand) restores files previously compressed by the Compress utility.

Expanding Compressed Files: expand.exe

Decompressing Compressed Files: Expand

Expand (EXPAND.EXE) decompresses files previously compressed by Compress. Expand restores these files to their original sizes.

Command-line syntax for Expand is as follows:

expand [**/?**][**/r**] *source destination*

Following are command-line options and parameters for Expand:

/?	Displays information about how to use Expand.
/r	Specifies that compressed files should be renamed.
source	Specifies the source filename. The name can include a drive letter, a directory path, or both; and it can contain wildcards.
destination	Specifies the destination. This parameter can consist of a directory (with optional drive letter), a filename, or any combination of the two. If the *source* parameter contains wildcards and the *destination* parameter does not specify only a directory, the **/r** option must be used. If the *destination* parameter does not contain a filename, Expand uses the filename or filenames specified by the *source* parameter when Expand copies the file or files to the location specified by the *destination* parameter.

The following example shows how to create decompressed versions of all the files on drive A, writing them to a directory on drive C:

```
expand a:*.* c:\mydir
```

Dr. Watson

Microsoft Windows Dr. Watson is a diagnostic tool for the Microsoft Windows operating system. It detects system and application failures caused by Windows applications and can store information in a disk file. This file can help you find and fix problems in your applications.

Only a single instance of Dr. Watson can be run at a time. Dr. Watson uses the dynamic-link library TOOLHELP.DLL, so it runs only in standard or 386 enhanced mode. Dr. Watson cannot trap faults in a Windows MS-DOS session.

Configuring Dr. Watson from the WIN.INI File

You can configure Dr. Watson to meet your needs by including settings for any of the following entries in the [Dr. Watson] section of your WIN.INI file (note the space between Dr. and Watson):

DisLen
DisStack
GPContinue
LogFile
ShowInfo
SkipInfo
TrapZero

The SkipInfo Entry

The SkipInfo Entry

The SkipInfo entry controls which parts of the failure report are actually written to disk. Following are the values you can set to disable parts of the failure report:

Value	Meaning
32bitregs	Disable values of 32-bit registers and of the FS and GS registers on 80386/80486 processors.
clues	Disable the dialog box titled "Dr. Watson's Clues."
information	Disable system information, such as the Windows version number, processor type, and memory available.
registers	Disable 16-bit registers.
segments	Disable segment contents, base addresses, length, and flags.
stack	Disable stack backtrace.
summary	Disable four-line summary at beginning of error report.
tasks	Disable list of all active tasks (running applications).
time	Disable Dr. Watson start and stop times.

Each of the SkipInfo values can be abbreviated to its first three letters. The following example disables the Dr. Watson's Clues dialog box and the stack backtrace:

```
[Dr. Watson]

SkipInfo=clu sta
```

The ShowInfo Entry

The ShowInfo Entry

Some parts of the Dr. Watson failure report are disabled by default. They can be enabled with the ShowInfo entry. Following are the values you can set to enable parts of the failure report:

Value	Meaning
disassembly	Enable separate disassembly of the fault address. This does not affect disassembly of stack frames. (See Section 6.1.3, "The DisLen Entry.")
errorlog	Enable error logging.
locals	Enable stack dump of local variable and parameter values.
modules	Enable list of all loaded modules, including dynamic-link libraries (DLLs) and font files.
paramlog	Enable parameter-validation error logging.
sound	Enable audible warnings.

Each of the ShowInfo values can be abbreviated to its first three letters. The following example sets all six values for the ShowInfo entry, enabling those six parts of the failure report:

```
[Dr. Watson]

ShowInfo=dis err loc mod par sou
```

The DisLen Entry

The DisLen Entry

The DisLen entry controls how many instructions are disassembled in stack traces and the disassembly portion of the failure report. The default value is 8. The following example sets the value to 4:

```
[Dr. Watson]

DisLen=4
```

The TrapZero Entry

The TrapZero Entry

By default, Dr. Watson does not trap divide overflow exceptions, because many applications provide their own handling. The TrapZero entry can be used to enable trapping of divide overflow exceptions, as shown in the following example:

```
[Dr. Watson]

TrapZero=1
```

The GPContinue Entry

The GPContinue Entry

One of the most advanced features of Dr. Watson enables an application to continue even after a general protection (GP) fault occurs. Because a GP fault means that a bug has been encountered, continuing is dangerous. However, some application developers requested the ability to continue running an application even after a GP fault. If the GPContinue entry is used, Dr. Watson performs the following tests when a GP fault occurs. If each of the following four conditions is true, Dr. Watson allows the application to continue:

1 Bit 0 of GPContinue is set.

2 The faulting instruction is one that can be allowed to continue.

The following example, which happens to be beyond the end of a segment, would be allowed to continue:

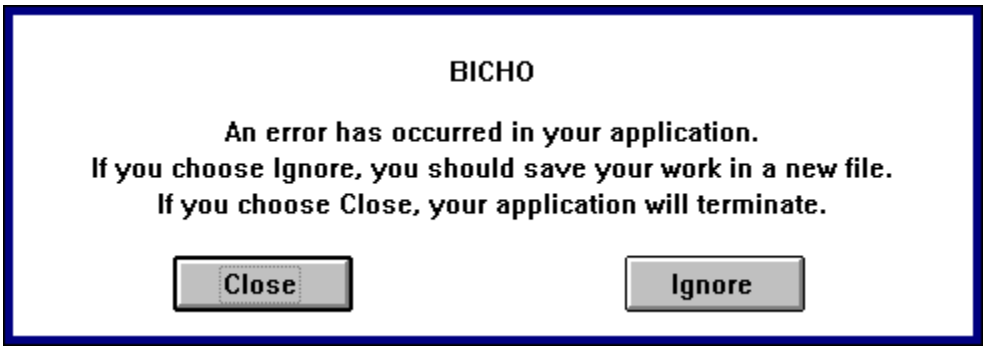
```
mov     ax,[ffff]
```

The following instruction, which involves an invalid address, would not be allowed to proceed:

```
jmp     seg:offs
```

3 The fault is *not* in KERNEL or USER. (Or the fault is in KERNEL or USER, and you have set the appropriate bit in the GPContinue value to continue in spite of the risk.)

4 The user wants to continue. Dr. Watson displays the following dialog box so that the user can decide.



If the user chooses the Close button, an error message box appears.

Although it is very risky, you can also allow continuation in KERNEL or USER by setting GPContinue as required. Following are the bits and values for the GPContinue entry:

Bit	Value	Meaning
0	1	Allow continuation. (This is the default setting.)
1	2	Write only three-line reports.
2	4	Continue even if the fault is in KERNEL.
3	8	Continue even if the fault is in USER.

You must combine these values. The following example permits continuation after a GP fault in USER:

```
set GPContinue=9
```

The DisStack Entry

The DisStack Entry

The DisStack entry controls how many levels back on the stack are to be disassembled. The default value is 2. The following example sets the value to 100:

```
[Dr. Watson]

DisStack=100
```

The LogFile Entry

The LogFile Entry

By default, the Dr. Watson log file is named DRWATSON.LOG and placed in the Windows directory. The filename can be changed to any valid filename, even the name of a printer or debugging terminal. For example, to write to a terminal on COM1, use the following setting:

```
[Dr. Watson]

LogFile=com1
```

Compiling Resources: Resource Compiler

Microsoft Windows Resource Compiler (RC) is a tool for the Microsoft Windows operating system.

This topic describes how to do the following:

Including Resources in an Application

To include resources in your Windows application, do the following:

1 Create individual resource files for cursors, icons, bitmaps, dialog boxes, and fonts. To do this, you can use Microsoft Image Editor and Dialog Editor (IMAGEDIT.EXE and DLGEDIT.EXE) and Microsoft Windows Font Editor (FONTEDIT.EXE).

2 Create a resource-definition file that describes all the resources used by the application.

3 Use RC to compile the resource-definition file.

4 Add the compiled resource files to the application's compiled executable file.

Creating a Resource-Definition File

After creating individual resource files for your application's icon, cursor, font bitmap, and dialog box resources, you create a resource-definition file. A resource-definition file is an ASCII text file with the file extension .RC.

The .RC file lists every resource in your application and describes some types of resources in great detail. For a resource that exists in a separate file, such as an icon or cursor, the .RC file simply names the resource and the file that contains it. For some resources, such as a menu, the entire definition of the resource exists within the .RC file.

An .RC file can contain either or both of the following types of information:

- Statements, which name and describe resources.
- Directives, which instruct RC to perform actions on the resource-definition file before compiling it. Directives can also assign values to names.

The following sections describe the statements and directives you can use in a resource-definition file.

Single-Line Statements

A single-line resource-definition statement can begin with any of the following keywords:

Keyword	Description
BITMAP	Defines a bitmap by naming it and specifying the name of the file that contains it. (To use a particular bitmap, the application requests it by name.)
CURSOR	Defines a cursor by naming it and specifying the name of the file that contains it. (To use a particular cursor, the application requests it by name.)
FONT	Specifies the name of a file that contains a font.
ICON	Defines an icon by naming it and specifying the name of the file that contains it. (To use a particular icon, the application requests it by name.)

Multiline Statements

A multiline resource-definition statement can begin with any of the following keywords:

Keyword	Description
ACCELERATORS	Defines menu accelerator keys.
DIALOG	Defines a template that an application can use to create dialog boxes.
MENU	Defines the appearance and function of an application menu.
RCDATA	Defines data resources. Data resources let you include binary data directly into the executable file.
STRINGTABLE	Defines string resources. String resources are null-terminated ASCII strings that can be loaded from the executable file.

Directives

The following directives can be used as needed in the resource-definition file to instruct RC to perform actions or to assign values to names:

Keyword	Description
#define	Defines a specified name by assigning it a given value.
#elif	Marks an optional clause of a conditional compilation block.
#else	Marks the last optional clause of a conditional compilation block.
#endif	Marks the end of a conditional compilation block.
#if	Carries out conditional compilation if a specified expression is true.
#ifdef	Carries out conditional compilation if a specified name is defined.
#ifndef	Carries out conditional compilation if a specified name is not defined.
#include	Copies the contents of a file into the resource-definition file before RC processes the latter.
#undef	Removes the current definition of the specified name.

Sample Resource-Definition File

The following example shows an .RC file that defines the resources for an application named Shapes:

```
#include "SHAPES.H"

ShapesCursor  CURSOR  SHAPES.CUR
ShapesIcon    ICON    SHAPES.ICO

ShapesMenu    MENU
    BEGIN
        POPUP "&Shape"
            BEGIN
                MENUITEM "&Clear", ID_CLEAR
                MENUITEM "&Rectangle", ID_RECT
                MENUITEM "&Triangle", ID_TRIANGLE
                MENUITEM "&Star", ID_STAR
                MENUITEM "&Ellipse", ID_ELLIPSE
            END
    END
```

The **CURSOR** statement names the application's cursor resource ShapesCursor and specifies the cursor file SHAPES.CUR, which contains the image for that cursor.

The **ICON** statement names the application's icon resource ShapesIcon and specifies the icon file SHAPES.ICO, which contains the image for that icon.

The **MENU** statement defines an application menu named ShapesMenu, a pop-up menu with five menu items.

The menu definition, enclosed by the **BEGIN** and **END** keywords, specifies each menu item and the menu identifier that is returned when the user selects that item. For example, the first item on the menu, Clear, returns the menu identifier ID_CLEAR when the user selects it. The menu identifiers are defined in the application header file, SHAPES.H.

For more information about resource-definition files, the syntax of resource statements, and how to define your own resources, see the *Microsoft Windows Programmer's Reference, Volume 4.*

Resource Compiler (RC) serves the following functions:

- It compiles the resource-definition file and the resource files (such as icon and cursor files) into a binary resource (.RES) file.
- It combines the .RES file with the executable (.EXE) file created by the linker; the result is an executable Windows application.
- It marks the Windows application as a Windows 3.0 or Windows 3.1 application.

Note: Each Windows application and dynamic-link library (DLL) must be identified with a Windows version number. For this reason, use RC on each Windows application or DLL you build, even if it uses no resources. For more information about Windows versions, see the discussions of the **/30** and **/31** options in Specifying Options.

Command-Line Syntax

To start RC, use the **rc** command. What you need to specify on the command line depends on whether you are compiling resources, adding compiled resources to an executable file, or both.

The following line shows **rc** command-line syntax:

rc [*options*] *definition-file* [*executable-file*]

Following are several ways you can use the **rc** command:

- To compile resources separately, use the **rc** command in the following form:

  rc /r [*options*] *definition-file*

  When you use this form, RC ignores any executable file you specify.
- To compile an .RC file and add the resulting .RES file to the executable file, use the **rc** command in the following form:

  rc [*options*] *definition-file* [*executable-file*]
- To compile an application or DLL that does not have a .RES file, use the **rc** command in the following form:

  rc [*options*] *dll-or-executable-file*

  When you use this form, the filename must explicitly have an .EXE, .DRV, or .DLL extension.
- To simply add a compiled resource (.RES) file to an executable file, use the **rc** command in the following form:

  rc [*options*] *res-file***.res** [*executable-file*]

Specifying Options

The **rc** command's *options* parameter can include one or more of the following options:

/30	Marks the executable file so it will run with Windows version 3.0 or Windows version 3.1. By default, RC marks the executable file to run only with Windows 3.1.
/31	Marks the executable file so it will run only with Windows 3.1. This is the default condition.
/?	Displays a list of **rc** command-line options.
/d	Defines a symbol for the preprocessor that you can test with the **#ifdef** directive.
/e	Changes the default location of global memory for a DLL from below the Expanded Memory Specification (EMS) bank line to above the EMS bank line. This option has no effect with Windows 3.1.
/fe *newname*	Uses *newname* for the name of the .EXE file.
/fo *newname*	Uses *newname* for the name of the .RES file.
/h	Displays a list of **rc** command-line options.
/i	Searches the specified directory before searching the directories specified by the INCLUDE environment variable.
/k	Disables the load-optimization feature of RC. If this option is not specified, the compiler arranges segments and resources in the executable file so that all preloaded information is contiguous. This feature allows Windows to load the application much more quickly. If you do not specify the **/k** option, all data segments, nondiscardable code segments, and the entry-point code segment will be preloaded, unless any segment and its relocation information exceed 64K. If the **PRELOAD** attribute is not assigned to these segments in the module-definition (.DEF) file when you link your application, RC will add the **PRELOAD** attribute and display a warning. Resources and segments will have the same segment alignment. This alignment should be as small as possible to limit the size of the final executable file. You can set the alignment by using the **link** command with the **/a** option.
/l[**im32**]	Specifies to Windows that the application uses expanded memory directly, according to

	the Lotus/Intel/Microsoft Expanded Memory Specification (LIM EMS), version 3.2. This option has no effect with Windows 3.1.
/m[**ultinst**]	Assigns each instance of the application task to a distinct EMS bank when Windows is running with the EMS 4.0 memory configuration. (By default, all instances of a task share the same EMS bank.) This option has no effect with Windows 3.1.
/p	Creates a private DLL that is called by only one application. This allows Windows to use memory more efficiently, because only one application (or multiple instances of the same application) calls the DLL. For example, in the large-frame EMS memory model, the DLL is loaded above the EMS bank line, freeing memory below the bank line. This option has no effect with Windows 3.1.
/r	Creates an .RES file from an .RC file. Use this option when you do not want to add the compiled .RES file to the .EXE file.
/t	Creates an application that runs with Windows only in protected (standard or 386 enhanced) mode. If the user attempts to run the application in real mode, Windows will display a message that the application cannot run in real mode. This option has no effect with Windows 3.1.
/v	Displays messages that report on the progress of the compiler.
/x	Prevents RC from checking the INCLUDE environment variable when searching for header files or resource files.
/z	Prevents RC from checking for **RCINCLUDE** statements. When you have not used **RCINCLUDE** statements, using this option can greatly improve the speed of RC.

Options are not case-sensitive, and a hyphen (**-**) can be used in place of a slash mark (**/**). You can combine single-letter options if they do not require any additional parameters. For example, the following two commands are equivalent:

```
RC /R /V SAMPLE.RC

rc -rv sample.rc
```

Specifying the Resource-Definition File

The **rc** command's *definition-file* parameter specifies the name of the resource-definition file that contains the names, types, filenames, and descriptions of the resources to be added to the .EXE file. It can also specify the name of a compiled .RES file, in which case RC adds the compiled resources to the executable file.

Specifying the Executable File

The **rc** command's *executable-file* parameter specifies the name of the executable file that the compiled resources should be added to. If you do not specify an executable file, RC uses the executable file with the same name as the resource-definition file (excluding the filename extension).

Renaming the Executable File

The **rc** command's **/fe** option makes it possible for you to specify the name of the final executable file. The following example combines MYEXE.EXE with MYRES.RES to produce the final executable file FINAL.EXE:

```
rc /fe final.exe myres.res myexe.exe
```

Compiling Resources Separately

By default, RC adds the compiled resources to the specified executable file. Sometimes you might want to first compile the resources and then add them to the executable file in separate steps. This can be useful because resource files typically change little after initial development. You can save time by compiling your application's resources separately and then adding the compiled .RES file to your executable file each time you recompile the .EXE file.

You can use the **/r** option to compile the resources separately without adding them to the executable file. When you use this option, RC compiles the .RC file and creates a compiled resource (.RES) file.

For example, the following command reads the resource-definition file SAMPLE.RC and creates the compiled resource file SAMPLE.RES:

```
rc -r sample.rc
```

In this case, RC does not add SAMPLE.RES to the executable file.

Defining Names for the Preprocessor

You can specify conditional branching in a resource-definition file, based on whether a term is defined on the **rc** command line with the **/d** option.

For example, suppose your application has a pop-up menu, the Debug menu, that should appear only during debugging. When you compile the application for normal use, the Debug menu is not included. The following example shows the statements that can be added to the resource-definition file to define the Debug menu:

```
MainMenu MENU
BEGIN
  .
  .
  .
#ifdef DEBUG
        POPUP "&Debug"
        BEGIN
                MENUITEM "&Memory usage", ID_MEMORY
                MENUITEM "&Walk data heap", ID_WALK_HEAP
        END
#endif
END
```

When compiling resources for a debugging version of the application, you could include the Debug menu by using the following **rc** command:

```
rc -r -d debug myapp.rc
```

To compile resources for a normal version of the application--one that does not include the Debug menu--you could use the following **rc** command:

```
rc -r myapp.rc
```

Renaming the Compiled Resource File

By default, when compiling resources, RC names the compiled resource (.RES) file with the same name as the .RC file (but not the same extension) and places it in the same directory as the .RC file. The following example compiles MYAPP.RC and creates a compiled resource file named MYAPP.RES in the same directory as MYAPP.RC:

```
rc -r myapp.rc
```

The **/fo** option lets you give the resulting .RES file a name that differs from the name of the corresponding .RC file. For example, to name the resulting .RES file NEWFILE.RES, you would type the following command:

```
rc -r -fo newfile.res myapp.rc
```

The **/fo** option can also place the .RES file in a different directory. For example, the following command places the compiled resource file MYAPP.RES in the directory C:\SOURCE\RESOURCE:

```
rc -r -fo c:\source\resource\myapp.res myapp.rc
```

Controlling Which Directories the Resource Compiler Searches

By default, RC searches for header files and resource files (such as icon and cursor files) first in the current directory and then in the directories specified by the INCLUDE environment variable. (The PATH environment variable has no effect on which directories RC searches.)

Adding a Directory to Search

You can use the **/i** option to add a directory to the list of directories RC searches. The compiler then searches the directories in the following order:

1 The current directory

2 The directory or directories you specify by using the **/i** option, in the order in which they appear on the **rc** command line

3 The list of directories specified by the INCLUDE environment variable, in the order in which the variable lists them, unless you specify the **/x** option

The following example compiles the resource-definition file MYAPP.RC and adds the compiled resources to MYAPP.EXE:

```
rc /i c:\source\stuff /i d:\resources myapp.rc
```

When compiling the resource-definition file MYAPP.RC, RC searches for header files and resource files first in the current directory, then in C:\SOURCE\STUFF and D:\RESOURCES, and then in the directories specified by the INCLUDE environment variable.

Suppressing the INCLUDE Environment Variable

You can prevent RC from using the INCLUDE environment variable when determining the directories to search. To do so, use the **/x** option. The compiler then searches for files only in the current directory and in any directories you specify by using the **/i** option.

The following example compiles the resource-definition file MYAPP.RC and adds the compiled resources to MYAPP.EXE:

```
rc /x /i c:\source\stuff myapp.rc
```

When compiling the resource-definition file MYAPP.RC, RC searches for header files and resource files first in the current directory and then in C:\SOURCE\STUFF. It does not search the directories specified by the INCLUDE environment variable.

Displaying Progress Messages

By default, RC does not display messages that report on its progress as it compiles. You can, however, specify that RC is to display these messages. To do so, use the **/v** option.

The following example causes RC to report on its progress as it compiles the resource-definition file SAMPLE.RC, creates the compiled resource file SAMPLE.RES, and adds the .RES file to the executable file SAMPLE.EXE:

```
rc /v sample.rc
```

Creating Help Files

Microsoft Windows Help provides online help for users working with a Windows application. Windows Help provides a practical way to present information about your application in a format users can access easily.

This topic introduces the tools you can use to develop Windows Help files and to incorporate Help in Windows applications.

About Windows Help Files

Windows Help files can display information by using the following elements:

- Text in multiple fonts, sizes, and colors
- Bitmaps and metafiles with up to 16 colors
- Segmented-graphics bitmaps with embedded hot spots
- Cross-reference jumps for links to additional information
- Pop-up windows to present text and graphics
- Secondary windows to present information without the full menus and buttons of Windows Help
- Keywords to help users find the information they need

You create help files by creating topic and graphics files and a Help project file. A topic file contains the text for the help topic and contains the Help statements and macros that define the format of the text and the position of graphics in each topic. The graphics files contain the bitmaps and metafiles you want to display in the topics. The project file contains a description of how to build the help file.

You use the Microsoft Help Compiler to build the final help file. Combining the topic, graphics, and project files, the compiler creates a single help file (with the filename extension .HLP) that you can open and view by using Windows Help.

For more information about creating help files, see the following topics:

Creating Topic Files
Using Graphics Files
Creating Help Project Files
Using Help in a Windows Application
Help Macros
HPJ Statements
RTF Tokens

Creating Topic Files

A topic file contains the text for the help file, as well as the statements and macros that define the format of the text and the position of the graphics. Every topic file consists of one or more topics. A topic is any distinct unit of information, such as a contents screen, a conceptual description, a set of instructions, a keyboard table, a glossary definition, a list of jumps, a picture, and so on.

Windows Help displays only one topic at a time, but a user can view any topic in a help file by using a link to the topic or searching for keywords associated with the topic.

You create topic files directly by using a text editor and inserting Help statements. You can create them indirectly by using a word processor that generates rich-text format (RTF) files. The Help statements are an extended subset of the RTF statements, which provide a wide variety of formatting capabilities.

Declaring Character Set, Fonts, and Colors

When you create a topic file, you must ensure that the entire contents of the file are enclosed in braces ({ }). The first statement in the file must be the **\rtf** statement; it immediately follows the first opening brace. You should follow the **\rtf** statement with a **\ansi** statement (or a similar statement) that specifies the character set used in the file. The following example shows the general form for a topic file:

```
{\rtf1\ansi
     .
     .
     .
}
```

You must declare the names of the fonts you use in the file by using a **\fonttbl** statement. The **\fonttbl** statement, enclosed in braces, contains a list of font and family names and specifies a unique number for each font. You use these numbers with **\f** statements later in the file to set specific fonts. The following **\fonttbl** statement assigns font numbers 0, 1, and 2 to the TrueType fonts Times New Roman®, Courier New®, and Arial®, respectively:

```
{\fonttbl
\f0\froman Times New Roman;
\f1\fdecor Courier New;
\f2\fswiss Arial;}
```

You should also use the **\deff** statement to set the default font for the file. Windows Help uses this default font if no other font is specified. The following example sets the default font number to zero, corresponding to the Times New Roman font specified in the previous **\fonttbl** statement:

```
\deff0
```

If you use specific text colors or choose not to rely on the default text colors set by Windows, you must define your colors by using a **\colortbl** statement. The **\colortbl** statement, enclosed in braces, defines each color by specifying the amount of each primary color (red, green, and blue) used in it. The statement implicitly numbers the colors consecutively starting from zero. You use these color numbers with **\cf** statements later in the file to set the color. The following example creates four colors (black, red, green, and blue):

```
{\colortbl
\red0\green0\blue0;
\red255\green0\blue0;
\red0\green128\blue0;
\red0\green0\blue255;}
```

Although it is not shown here, you can put a semicolon immediately after the **\colortbl** statement to define the default color as 0.

Defining Individual Topics

Each topic starts with one or more **\footnote** statements and ends with a **\page** statement. All text and graphics specified between these statements belong to the topic.

Every topic must have a context string. Windows Help uses the context string to locate the topic when the user requests to view it. You assign a context string to a topic by using the **\footnote** statement and the number sign (#) footnote character. Context strings can consist of letters, digits, and the underscore character (_). To prevent conflicts, each context string in a help file must be unique.

You can also assign a title to the topic by using the **\footnote** statement and the dollar sign ($) footnote character. Windows Help uses the title to identify the topic in the History and Search dialog boxes. You must provide a title if you assign keywords to the topic.

The following example defines a small topic having the context string "topic1" and the title My Topic:

```
#{\footnote topic1}
$(DOLLAR_BRACE)\footnote My Topic}
This is my first topic.
\par
\page
```

In general, you use the **\par** statement to mark the end of each paragraph. In this example, the **\par** statement marks the end of the only paragraph in the topic.

You can add a macro to a topic by using the **\footnote** statement and the exclamation point (!) as the footnote character. For example, the following **\footnote** statement adds the **CopyTopic** macro to the topic:

```
!{\footnote CopyTopic()}
```

Windows Help executes the macro each time it displays the topic.

The total size of text and graphics data stored in a paragraph must not exceed 64K. (Bitmaps included by using the **bmc**, **bml**, and **bmr** statements do not contribute to this total.)

Setting Font Size and Name

You can set the font name and size by using the **\f** and **\fs** statements. The name is set by using a font number specified in the **\fonttbl** statement. The size of the font is specified in half-points. The following example sets the text to 10-point Times New Roman (if the **\fonttbl** statement matches the example given earlier):

```
\f0\fs20
```

Once you set the font name and size, the settings apply to all subsequent text up to the next **\plain** statement or until you change the name or size by using the **\f** or **\fs** statement again. The **\plain** statement resets the name and font to the defaults. The default font name is as set by the **\deff** statement; the default font size is 12 points.

Setting Space Before and After Paragraphs

You can set the amount of space before and after each paragraph by using the **\sb** and **\sa** statements. These statements let you control the amount of space that appears between paragraphs. You specify the space in twips. (A twip is 1/1440 inch, or 1/20 of a printer's point). The following example sets the space before a paragraph to 360 twips:

```
\sa360
This paragraph has 360 twips space immediately before it.
\par
This paragraph also has 360 twips before it.
\par
```

Once you set the space before or after a paragraph, the spacing applies to all subsequent paragraphs up to the next **\pard** statement or until you change the spacing by using the **\sa** and **\sb** statements again. The **\pard** statement restores the default spacing.

Setting the Left and Right Indents

When Windows Help displays its window, it automatically creates left and right margins and wraps text to fit within these margins. The margins are positioned slightly within the left and right edges of the window to prevent text in the topic from being clipped by the window.

You can override these margins by setting the left and right indents for a paragraph. The **\li** and **\ri** statements set an indent to a position relative to the corresponding left and right margins. For example, the following paragraph is indented 1 inch (1440 twips) from the left margin:

```
\\li1440
This paragraph is indented 1 inch.
\par \pard
This paragraph is not indented.
```

Once indents are set, they apply to all subsequent paragraphs up to the next **\pard** statement. Note that the **\pard** statement must follow the **\par** statement that ends the paragraph to be indented.

You can set an indent for the first line in a paragraph by using the **\fi** statement. This allows you to create paragraphs with hanging indents. It is also useful for creating two-column lists.

Setting Tab Stops

You can set tab stops by using the **\tx** statement. You can use one or more **\tx** statements, each setting a specific position in twips relative to the left margin. Once you have set tab stops, you can use the **\tab** statement to align subsequent text with the next tab. The tab settings remain active until you use the **pard** statement. The following example creates a two-column list by using a tab stop and paragraph indenting:

```
\fi-1440\li1440\tx1440
left
\tab
right
\par
left
\tab
right
\par
\pard
```

Breaking Lines

Ordinarily, Windows Help wraps all lines in a paragraph, fitting as many words on a line as will fit between the current left and right indents. You can force Windows Help to break a line at a given place by using the **\line** statement. You can control wrapping by using the **\keep** and **\pard** statements.

The following example uses the **\keep** statement to turn off word wrapping for three short lines and uses the **\pard** statement to restore the default properties:

```
\keep
3 pairs black socks\line
5 pairs blue socks\line
2 pairs brown socks\line
\par
\pard
```

The following example uses the **\keep** and **\pard** statements to create three nonwrapping paragraphs:

```
\keep
3 pairs black socks
\par
5 pairs blue socks
\par
2 pairs brown socks
\par
\pard
```

Creating Links and Pop-up Topics

Windows Help displays only one topic at a time. To enable users to view other topics, you must create hot spots that link your topics to other topics. You create a hot spot by using the **\strike**, **\ul**, or **\uldb** statement and a corresponding **\v** statement. When you create a link, you provide the text for the hot spot and the context string for the topic that is to be jumped to or displayed. The following example creates a hot spot named Glossary and establishes a link from the hot spot to the topic having the context string "glo1":

```
You can find a list of terms used in this
help file in the {\uldb Glossary}{\v glo1}.
```

When Windows Help displays the topic with this hot spot, it places a line under the word *Glossary* and colors the word green. The context string is not shown, but if the user clicks on the hot spot, Windows Help jumps to and displays the corresponding topic.

The **\strike** and **\uldb** statements are used to create jumps to other topics. The **\ul** statement creates a link to a pop-up topic. Windows Help displays pop-up topics in a pop-up window and leaves the current topic in the main window.

You can also associate a Help macro with a hot spot in a topic. For example, the following **\uldb** and **\v** statements create a hot spot for the **ExecProgram** macro:

```
{\uldb Clock}{\v !ExecProgram("clock.exe", 1)}
```

Windows Help executes the macro whenever the user chooses the hot spot. Windows Help continues displaying the topic while it executes the macro, unless the macro causes a jump to another topic.

Creating a Keyword List

You can also enable users to find and view topics by assigning keywords to the topics. You assign a keyword by using the **\footnote** statement and the letter *K* as the footnote character. Windows Help collects all keywords in a help file and displays them in its Search dialog box. Using this dialog box, a user can select a keyword and view the help topics associated with it. The following example assigns the keyword "Sample Topics" to the current topic:

```
#{\footnote topic1}
$(DOLLAR_BRACE)\footnote My Topic}
K{\footnote Sample Topics}
This is my first topic.
\par
\page
```

If a keyword begins with the letter *K,* you must place an extra space before the word. Multiple keywords for a topic are separated by semicolons.

A keyword can be assigned to any number of topics. When the user selects the keyword in the Search dialog box, Windows Help displays all topics associated with the keyword. The user then picks the one to view.

You can also create alternative keywords for a help file for use with the **WinHelp** function.

Creating Browse Sequences

You can enable users to browse through a sequence of help topics by creating a browse sequence and adding browse buttons to your help file. A browse sequence typically consists of two or more related topics that are intended to be read sequentially. You create a browse sequence by using the **\footnote** statement and the plus-sign (+) footnote character to assign a sequence identifier. The following example assigns a sequence identifier to the topic titled A Topic:

```
#{\footnote topic5}
$(DOLLAR_BRACE)\footnote A Topic}
+{\footnote shorttopics}
This is one topic in a browse sequence.
\par
\page
```

Windows Help adds topics with sequence identifiers to the browse sequence and determines the order of topics in the sequence by sorting the identifiers alphabetically. If two topics have the same identifier, Windows Help assumes that the topic that was compiled first is to be displayed first.

Windows Help uses the sequence only if the browse buttons have been enabled. You can enable the buttons by placing the following statements in the Help project file:

```
[CONFIG]
BrowseButtons()
```

For more information about the project file, see Section 3.4, "Creating Help Project Files."

You can create more than one browse sequence in a help file by using sequence numbers with sequence identifiers. The sequence number consists of a colon (:) followed by an integer. Windows Help combines all topics having the same sequence identifier (but different sequence numbers) into a single browse sequence and determines the order of the topics by sorting them alphabetically. To ensure that numerals are sorted correctly, they should have the same number of digits. For example, the numerals 1 through 10 should be 01 through 10.

```
#{\footnote topic10}
$(DOLLAR_BRACE)\footnote Alpha Topic #3}
+{\footnote alpha:3}
This topic is part of the alpha browse sequence.
\par
\page
```

Using Graphics Files

You can add bitmaps and metafiles to your help files by using the **bml**, **bmc**, and **bmr** statements. These statements take the name of a graphics file and insert the corresponding bitmap or metafile into the help file at the specified position.

Windows Help requires graphics files to be in one of the following formats:

- Windows bitmap (.BMP)
- Placeable Windows metafile (.WMF)
- Multiple-resolution bitmap (.MRB)
- Segmented-graphics bitmap (.SHG)

Multiple-resolution bitmaps can be created by using the Microsoft Multiple-Resolution Bitmap Compiler (MRBC). Segmented-graphics bitmaps can be created by using Microsoft Windows Hotspot Editor. Only 16-color and monochrome bitmaps may be used. Windows Help does not support 256-color bitmaps.

Although the **\pict** statement can also be used to add bitmaps and metafiles to a help file, the bitmap or metafile data must be inserted into the topic file rather than specified as a separate file.

Inserting a Bitmap in Text

You can insert a bitmap into a paragraph as if it were a character by using the **bmc** statement. The statement aligns the bottom of the bitmap with the base line of the current line of text and places the left edge of the bitmap at the next character position.

Since the bitmap is treated as text, any paragraph properties assigned to the paragraph also apply to the bitmap. Windows Help places text following the bitmap on the same base line at the next available character position.

In general, bitmaps inserted as characters should be clipped to the smallest possible size. Any extra white space at the top or bottom of the bitmap image affects the alignment of the bitmap with the text and may affect the spacing between lines.

You must not specify negative line spacing for paragraphs that contain **bmc** statements. Doing so might cause the bitmap to appear on top of the paragraph.

Wrapping Text Around a Bitmap

You can place a bitmap at the left or right margin of the Help window and have subsequent text wrap around the bitmap by using the **bml** or **bmr** statement. The **bml** statement inserts a bitmap at the left margin; **bmr** inserts it at the right.

If you want text to wrap around a bitmap, you must place the **bml** or **bmr** statement at the beginning of a paragraph. Windows Help aligns the start of the paragraph with the top of the bitmap and wraps around the left or right edge of the bitmap.

If you place a **bml** or **bmr** statement at the end of a paragraph, Windows Help places the bitmap under the paragraph instead of wrapping the text around the bitmap. If you do not want text to wrap around a bitmap, place **\par** statements immediately before and after the **bml** or **bmr** statement.

Using a Bitmap as a Hot Spot

You can use bitmaps as hot spots. This enables you to create graphics, such as icons or buttons, and use them as "jumps" to particular topics or as hot spots for macros.

You can also divide a single bitmap into several hot spots and assign a different link or macro to each hot spot. Such bitmaps, called segmented-graphics bitmaps, are created by using Hotspot Editor. For example, if you have a bitmap of a dialog box, you can assign links to each of the control windows in the dialog box, enabling the user to click a control window and view information about it. Segmented-graphics bitmaps already contain the context strings needed for the links; only a **bml** or **bmr** statement is needed to insert the bitmap. The **\strike** and **\v** statements must not be used.

Using a Bitmap on Different Displays

A multiple-resolution bitmap is a single bitmap file that contains one or more bitmaps that have been marked for use with specific displays, such as the CGA, EGA, VGA, or 8514 displays. You use multiple-resolution bitmaps to avoid problems associated with displaying bitmaps designed for a single type of display. Single-resolution bitmaps can have the following problems:

- Appear too big or too small on displays having different resolutions
- Appear stretched or compressed on displays with different aspect ratios
- Lack colors or use unintended colors on displays with different color capabilities.

You create multiple-resolution bitmaps by using MRBC. The compiler, an MS-DOS program, has the following command-line syntax:

mrbc [**/s**] *filename* ...

The *filename* parameter specifies the name of a Windows bitmap file. Typically, you specify several filenames, one for each type of display. Wildcards can be used. The compiler uses the filename of the first bitmap file as the name of the output file but gives the output file the filename extension .MRB. The following example combines the bitmap files MYBUTTON.EGA, MYBUTTON.VGA, and MYBUTTON.854 into the multiple-resolution bitmap file MYBUTTON.MRB:

```
mrbc mybutton.ega mybutton.vga mybutton.854
```

In this example, the compiler checks the **biXPelsPerMeter** and **biYPelsPerMeter** members of the **BITMAPINFOHEADER** structure in each bitmap file to determine the display type for the bitmap. (For a description of the **BITMAPINFOHEADER** structure, see the *Microsoft Windows Programmer's Reference, Volume 3.*) If these members are set to zero, the compiler prompts for the display type with a message such as the following:

```
Please enter the monitor type for the bitmap mybutton.ega:
```

You must enter at least the first character of one of the following display-type names: CGA, EGA, VGA, or 8514. The compiler sets the display type you specify, but it does not check that the type is valid. For example, if you specify VGA for an EGA bitmap, the compiler marks it as a VGA bitmap. The result may be undesirable.

The **/s** option, specifying silent mode, speeds up compilation if the names of the bitmap files conform to the MRBC filename convention. If you use the **/s** option, the compiler uses the first character of the filename extension to determine the display type for the bitmap, as described in the following list:

Letter	Meaning
C	CGA bitmap
E	EGA bitmap
V	VGA bitmap
8	8514 bitmap

If the filename extension starts with any other character, MRBC assumes a VGA bitmap. The following example creates the multiple-resolution bitmap file MYBUTTON.MRB, containing bitmaps for EGA, VGA, and 8514 displays:

```
mrbc /s mybutton.ega mybutton.vga mybutton.854
```

The compiler never writes over existing multiple-resolution bitmap files. If the output file already exists, the compiler displays an error message.

You insert multiple-resolution bitmaps into your help file by using the same statements as for Windows bitmaps.

Before displaying a multiple-resolution bitmap, Windows Help checks the display type for the computer and then selects the bitmap that has the closest matching resolution, aspect ratio, and color capabilities. Windows Help never displays more than one bitmap from a multiple-resolution bitmap file.

Creating Help Project Files

This section describes the format and contents of the Help project file (.HPJ) used to build the help file. The project file contains all the information the Microsoft Help Compiler needs to combine topic files and other elements into a help file.

Project File Sections

Every project file consists of one or more sections. Each section has a section name, enclosed in brackets ([]), that defines the purpose and format of statements and options in the section. Following are the sections used in project files:

Section	Description
[OPTIONS]	Specifies options that control the build process. This section is optional. If this section is used, it should be the first section listed in the project file, so that the options will apply during the entire build process.
[FILES]	Specifies topic files to be included in the build. This section is required.
[BUILDTAGS]	Specifies valid build tags. This section is optional.
[CONFIG]	Specifies Help macros that define nonstandard menus, buttons, and macros used in the help file. This section is required if the help file uses any of these features. This section is new for Windows 3.1.
[BITMAPS]	Specifies bitmap files to be included in the build. This section is not required if the project file lists a path for bitmap files by using the **BMROOT** or **ROOT** option.
[MAP]	Associates context strings with context numbers. This section is optional.
[ALIAS]	Assigns one or more context strings to the same topic. This section is optional.
[WINDOWS]	Defines the characteristics of the primary Help window and the secondary-window types used in the help file. This section is required if the help file uses secondary windows. This section is new for Windows 3.1.
[BAGGAGE]	Lists files that are to be placed within the help file (which contains its own file system). This section is optional.

Every project file requires a **[FILES]** section. This section names the topic files. Most project files also have an **[OPTIONS]** section that specifies how to build the help file. A very useful option in the **[OPTIONS]** section is the **COMPRESS** option, which specifies whether the help file should be compressed or uncompressed. Compressing a help file reduces its size considerably and saves valuable disk space.

The following example creates a compressed help file from two topic files, MAIN.RTF and MENUS.RTF:

```
[OPTIONS]
COMPRESS=TRUE

[FILES]
MAIN.RTF
MENUS.RTF
```

Using Macros in Project Files

You can add macros to the **[CONFIG]** section of a project file. Since Windows Help executes the macros when it first opens the help file, macros that create menus, menu items, and buttons are typically placed in this section. If there is more than one macro listed in the **[CONFIG]** section, Windows Help executes them in the order in which they are listed.

You can create new menu items and buttons for Windows Help by using such macros as **CreateButton** and **InsertMenu**. These macros define other Help macros and associate them with the menu items and buttons. Windows Help executes these macros when the user chooses a corresponding menu item or button. Macros that create Help buttons, menus, or menu items remain in

effect until the user quits Windows Help or opens a new help file.

You can extend the capabilities of Windows Help by developing your own dynamic-link libraries (DLLs) and defining Help macros that call functions in the libraries. To define Help macros that call DLL functions, you must register each function and its corresponding library by using the **RegisterRoutine** macro in the **[CONFIG]** section of the project file.

Sample Project File

The following example is a sample project file for the Cardfile application. Comments, marked by a beginning semicolon (;), indicate the purpose of each section in the file:

```
; Options used to define the Help title bar and icon
[OPTIONS]
ROOT=C:\HELP
BMROOT=C:\HELP\ART
CONTENTS=cont_idx_card
TITLE=Cardfile Help
ICON=CARDHLP.ICO
COMPRESS=OFF
WARNING=3
REPORT=ON
ERRORLOG=CARD.BUG

; Files used to build Cardfile Help
[FILES]
RTFTXT\COMMANDS.RTF
RTFTXT\HOWTO.RTF
RTFTXT\KEYS.RTF
RTFTXT\GLOSSARY.RTF

; Button macros and Using Help file
[CONFIG]
CreateButton("btn_up", "&Up", "JumpContents(`HOME.HLP')")
BrowseButtons()
SetHelpOnFile("APPHELP.HLP")

; Secondary-window characteristics
[WINDOWS]
picture = "Samples", (123,123,256,256), 0, (0,255,255), (255,0,0)
```

Using Help in a Windows Application

Windows applications can offer help to their users by using the **WinHelp** function to start Windows Help and display topics in the application's help file. The **WinHelp** function gives a Windows application complete access to the help file, as well as to the menus and commands of Windows Help. Many applications use **WinHelp** to implement context-sensitive Help. Context-sensitive Help enables users to view topics about specific windows, menus, menu items, and control windows by selecting the item with the keyboard or the mouse. For example, a user can learn about the Open command on the File menu by selecting the command (using the direction keys) and pressing the F1 key.

Choosing Help from the Help Menu

Every application should provide a Help menu to allow the user to open the help file with either the keyboard or the mouse. The Help menu should contain at least one Contents menu item that, when chosen, displays the contents or the main topic in the help file. To support the Help menu, the application's main window procedure should check for the Contents menu item and call the **WinHelp** function, as in the following example:

```
case WM_COMMAND:
    switch (wParam) {
    case IDM_HELP_CONTENTS:
        WinHelp(hwnd, "myhelp.hlp", HELP_CONTENTS, 0L);
        return 0L;
        .
        .
        .

    }
    break;
```

You can add other menu items to the Help menu for topics containing general information about the application. For example, if your help file contains a topic that describes how to use the keyboard, you can place a Keyboard menu item on the Help menu. To support additional menu items, your application must specify either the context string or the context identifier for the corresponding topic when it calls the **WinHelp** function. The following example uses a Help macro to specify the context string IDM_HELP_KEYBOARD for the Keyboard topic:

```
case IDM_HELP_KEYBOARD:
    WinHelp(hwnd, "myhelp.hlp", HELP_COMMAND,
            (LPSTR)"JumpID(\"myhelp.hlp\",\"IDM_HELP_KEYBOARD\")");
    return 0L;
```

A better way to display a topic is to use a context identifier. To do this, the help file must assign a unique number to the corresponding context string, in the **[MAP]** section of the project file. For example, the following section assigns the number 101 to the context string IDM_HELP_KEYBOARD:

```
[MAP]
IDM_HELP_KEYBOARD   101
```

An application can display the Keyboard topic by specifying the context identifier in the call to the **WinHelp** function, as in the following example:

```
#define IDM_HELP_KEYBOARD 101

WinHelp(hwnd, "myhelp.hlp", HELP_CONTEXT, (DWORD)IDM_HELP_KEYBOARD);
```

To make maintenance of an application easier, most programmers place their defined constants (such as IDM_HELP_KEYBOARD in the previous example) in a single header file. As long as the names of the defined constants in the header file are identical to the context strings in the help file, you can

include the header file in the **[MAP]** section to assign context identifiers, as shown in the following example:

```
[MAP]
#include <myhelp.h>
```

If a help file contains two or more Contents topics, the application can assign one as the default by using the context identifier and the HELP_SETCONTENTS value in a call to the **WinHelp** function.

Choosing Help with the Keyboard

An application can enable the user to choose a help topic with the keyboard by intercepting the F1 key. Intercepting this key lets the user select a menu, menu item, dialog box, message box, or control window and view Help for it with a single keystroke.

To intercept the F1 key, the application must install a message-filter procedure by using the **SetWindowsHook** function. This allows the application to examine all keystrokes for the application, regardless of which window has the input focus. If the filter procedure detects the F1 key, it posts a WM_F1DOWN message (application-defined) to the application's main window procedure. The procedure then determines which help topic to display.

The filter procedure should have the following form:

```
int FAR PASCAL FilterFunc(nCode, wParam, lParam)
int nCode;
WORD wParam;
DWORD lParam;
{
    LPMSG lpmsg = (LPMSG)lParam;

    if ((nCode == MSGF_DIALOGBOX || nCode == MSGF_MENU) &&
            lpmsg->message == WM_KEYDOWN && lpmsg->wParam == VK_F1) {
        PostMessage(hWnd, WM_F1DOWN, nCode, 0L);
    }

    DefHookProc(nCode, wParam, lParam, &lpFilterFunc);

    return 0;
}
```

The application should install the filter procedure after creating the main window, as shown in the following example:

```
lpProcInstance = MakeProcInstance(FilterFunc, hInstance);
if (lpProcInstance == NULL)
    return FALSE;

lpFilterFunc = SetWindowsHook(WH_MSGFILTER, lpProcInstance);
```

Like all callback functions, the filter procedure must be exported by the application.

The filter procedure sends a WM_F1DOWN message only when the F1 key is pressed in a dialog box, message box, or menu. Many applications also display the Contents topic if no menu, dialog box, or message box is selected when the user presses the F1 key. In this case, the application should define the F1 key as an accelerator key that starts Help.

To create an accelerator key, the application's resource-definition file must define an accelerator table, as follows:

```
1 ACCELERATORS
```

```
BEGIN
    VK_F1, IDM_HELP_CONTENTS, VIRTKEY
END
```

To support the accelerator key, the application must load the accelerator table by using the **LoadAccelerators** function and translate the accelerator keys in the main message loop by using the **TranslateAccelerator** function.

In addition to installing the filter procedure, the application must keep track of which menu, menu item, dialog box, or message box is currently selected. In other words, when the user selects an item, the application must set a global variable indicating the current context. For dialog and message boxes, the application should set the global variable immediately before calling the **DialogBox** or **MessageBox** function. For menus and menu items, the application should set the variable whenever it receives a **WM_MENUSELECT** message. As long as identifiers for all menu items and controls in an application are unique, an application can use code similar to the following example to monitor menu selections:

```
case WM_MENUSELECT:
    /*
     * Set dwCurrentHelpId to the Help ID of the menu item that is
     * currently selected.
     */

    if (HIWORD(lParam) == 0)             /* no menu selected    */
        dwCurrentHelpId = ID_NONE;

    else if (lParam & MF_POPUP) {        /* pop-up selected     */
        if ((HMENU)wParam == hMenuFile)
            dwCurrentHelpId = ID_FILE;
        else if ((HMENU)wParam == hMenuEdit)
            dwCurrentHelpId = ID_EDIT;
        else if ((HMENU)wParam == hMenuHelp)
            dwCurrentHelpId = ID_HELP;
        else
            dwCurrentHelpId = ID_SYSTEM;
    }

    else                                 /* menu item selected */
        dwCurrentHelpId = wParam;

    break;
```

In this example, the *hMenuFile, hMenuEdit,* and *hMenuHelp* parameters must previously have been set to specify the corresponding menu handles. An application can use the **GetMenu** and **GetSubMenu** functions to retrieve these handles.

When the main window procedure finally receives a WM_F1DOWN message, it should use the current value of the global variable to display a help topic. The application can also provide Help for individual controls in a dialog box by determining which control has the focus at this point, as shown in the following example:

```
case WM_F1DOWN:
    /*
     * If there is a current Help context, display it.
     */

    if (dwCurrentHelpId != ID_NONE) {
        DWORD dwHelp = dwCurrentHelpId;
```

```
        /*
         * Check for context-sensitive Help for individual dialog
         * box controls.
         */

        if (wParam == MSGF_DIALOGBOX) {
            WORD wID = GetWindowWord(GetFocus(), GWW_ID);
            if (wID != IDOK && wID != IDCANCEL)
                dwHelp = (DWORD) wID;
        }

        WinHelp(hWnd, szHelpFileName, HELP_CONTEXT, dwHelp);

        /*
         * This call is used to remove the highlighting from the
         * System menu, if necessary.
         */

        DrawMenuBar(hWnd);
    }

    break;
```

When the application ends, it must remove the filter procedure by using the **UnhookWindowsHook** function and free the procedure instance for the function by using the **FreeProcInstance** function.

Choosing Help with the Mouse

An application can enable the user to choose a help topic with the mouse by intercepting mouse input messages and calling the **WinHelp** function. To distinguish requests to view Help from regular mouse input, the user must press the SHIFT+F1 key combination. In such cases, the application sets a global variable when the user presses the key combination and changes the cursor shape to a question-mark pointer to indicate that the mouse can be used to choose a help topic.

To detect the SHIFT+F1 key combination, an application checks for the VK_F1 virtual-key value in each **WM_KEYDOWN** message sent to its main window procedure. It also checks for the VK_ESCAPE virtual-key code. The user presses the ESC key to quit Help and restore the mouse to its regular function. The following example checks for these keys:

```
case WM_KEYDOWN:
    if (wParam == VK_F1) {

        /* If Shift-F1, turn Help mode on and set Help cursor. */

        if (GetKeyState(VK_SHIFT)) {
            bHelp = TRUE;
            SetCursor(hHelpCursor);
            return DefWindowProc(hwnd, message, wParam, lParam);
        }

        /* If F1 without shift, call Help main index topic. */

        else {
            WinHelp(hwnd,"myhelp.hlp",HELP_CONTENTS,0L);
        }
    }

    else if (wParam == VK_ESCAPE && bHelp) {
```

```
        /* Escape during Help mode: turn Help mode off. */

        bHelp = FALSE;
        SetCursor((HCURSOR) GetClassWord(hWnd, GCW_HCURSOR));
    }

    break;
```

Until the user clicks the mouse or presses the ESC key, the application responds to **WM_SETCURSOR** messages by resetting the cursor to the arrow and question-mark combination.

```
case WM_SETCURSOR:
    /*
     * In Help mode, it is necessary to reset the cursor in response
     * to every WM_SETCURSOR message. Otherwise, by default, Windows
     * will reset the cursor to that of the window class.
     */

    if (bHelp) {
        SetCursor(hHelpCursor);
        break;
    }

    return (DefWindowProc(hwnd, message, wParam, lParam));

case WM_INITMENU:
    if (bHelp) {
        SetCursor(hHelpCursor);
    }

    return (TRUE);
```

If the user clicks the mouse button in a nonclient area of the application window while in Help mode, the application receives a **WM_NCLBUTTONDOWN** message. By examining the *wParam* value of this message, the application can determine which context identifier to pass to **WinHelp**.

```
case WM_NCLBUTTONDOWN:
    /*
     * If in Help mode (Shift+F1), display context-sensitive
     * Help for nonclient area.
     */

    if (bHelp) {
        dwHelpContextId =
            (wParam == HTCAPTION) ?(DWORD) HELPID_TITLE_BAR:
            (wParam == HTSIZE) ? (DWORD) HELPID_SIZE_BOX:
            (wParam == HTREDUCE) ? (DWORD) HELPID_MINIMIZE_ICON:
            (wParam == HTZOOM) ? (DWORD) HELPID_MAXIMIZE_ICON:
            (wParam == HTSYSMENU) ?(DWORD) HELPID_SYSTEM_MENU:
            (wParam == HTBOTTOM) ? (DWORD) HELPID_SIZING_BORDER:
            (wParam == HTBOTTOMLEFT) ? (DWORD) HELPID_SIZING_BORDER:
            (wParam == HTBOTTOMRIGHT) ?(DWORD) HELPID_SIZING_BORDER:
            (wParam == HTTOP) ?(DWORD) HELPID_SIZING_BORDER:
            (wParam == HTLEFT) ?(DWORD) HELPID_SIZING_BORDER:
            (wParam == HTRIGHT) ?(DWORD) HELPID_SIZING_BORDER:
            (wParam == HTTOPLEFT) ?(DWORD) HELPID_SIZING_BORDER:
```

```
            (wParam == HTTOPRIGHT) ? (DWORD) HELPID_SIZING_BORDER:
            (DWORD) 0L;

        if (!((BOOL) dwHelpContextId))
            return DefWindowProc(hwnd, message, wParam, lParam);
        bHelp = FALSE;
        WinHelp(hWnd, szHelpFileName, HELP_CONTEXT, dwHelpContextId);
        break;
    }

    return (DefWindowProc(hWnd, message, wParam, lParam));
```

If the user clicks a menu item while in Help mode, the application intercepts the **WM_COMMAND** message and sends the Help request:

```
case WM_COMMAND:

    /* In Help mode (Shift-F1)? */

    if (bHelp) {
        bHelp = FALSE;
        WinHelp(hWnd,szHelpFileName,HELP_CONTEXT, (DWORD)wParam);
        return NULL;
    }
```

Searching for Help with Keywords

An application can enable the user to search for help topics based on full or partial keywords. This method is similar to employing the Search dialog box in Windows Help to find useful topics. The following example searches for the keyword "Keyboard" and displays the corresponding topic, if found:

```
WinHelp(hwnd, "myhelp.hlp", HELP_KEY, "Keyboard");
```

If the topic is not found, Windows Help displays an error message. If more than one topic has the same keyword, Windows Help displays only the first topic.

An application can give the user more options in a search by specifying partial keywords. When a partial keyword is given, Windows Help usually displays the Search dialog box to allow the user to continue the search or return to the application. However, if there is an exact match and no other topic exists with the given keyword, Windows Help displays the topic. The following example opens the Search dialog box and selects the first keyword in the list starting with the letters *Ke:*

```
WinHelp(hwnd, "myhelp.hlp", HELP_PARTIALKEY, "Ke");
```

When the HELP_KEY and HELP_PARTIALKEY values are specified in the **WinHelp** function, Windows Help searches the K keyword table. This table contains keywords generated by using the letter *K* with **\footnote** statements in the topic file. An application can search alternative keyword tables by specifying the HELP_MULTIKEY value in the **WinHelp** function. In this case, the application must specify the footnote character and the full keyword in a **MULTIKEYHELP** structure, as follows:

```
HGLOBAL hglblmkh;
MULTIKEYHELP FAR* mkh;
PSTR pszKeyword = "Frame";
UINT cb;

cb = sizeof(MULTIKEYHELP) + lstrlen(pszKeyword);

hglblmkh = GlobalAlloc(GHND, (DWORD) cb);
if (hglblmkh == NULL)
```

```
    break;
mkh = (MULTIKEYHELP FAR*) GlobalLock(hglblmkh);

mkh->mkSize    = cb;
mkh->mkKeylist = 'L';
lstrcpy(mkh->szKeyphrase, pszKeyword);

WinHelp(hwnd, "myhelp.hlp", HELP_MULTIKEY, (DWORD) mkh);

GlobalUnlock(hglblmkh);
GlobalFree(hglblmkh);
```

If the keyword is not found, Windows Help displays an error message. If more than one topic has the keyword, Windows Help displays only the first topic.

Applications cannot use alternative keyword tables unless the **MULTIKEY** option is specified in the **[OPTIONS]** section of the project file.

Displaying Help in a Secondary Window

An application can display help topics in secondary windows instead of in Windows Help's main window. Secondary windows are useful whenever the user does not need the full capabilities of Windows Help. The Windows Help menus and buttons are not available in secondary windows.

To display Help in a secondary window, the application specifies the name of the secondary window along with the name of the help file. The following example displays the help topic having the context identifier IDM_FILE_SAVE in the secondary window named wnd_menu:

```
WinHelp(hwnd, "myhelp.hlp>wnd_menu", HELP_CONTEXT, IDM_FILE_SAVE);
```

The name and characteristics of the secondary window must be defined in the **[WINDOWS]** section of the project file, as in the following example:

```
[WINDOWS]
wnd_menu = "Menus", (128, 128, 256, 256), 0
```

Windows Help displays the secondary window with the initial size and position specified in the **[WINDOWS]** section. However, an application can set a new size and position by specifying the HELP_SETWINPOS value in the **WinHelp** function. In this case, the application sets the members in a **HELPWININFO** structure to specify the window size and position. The following examples sets the secondary window wnd_menu to a new size and position:

```
HANDLE hhwi;
LPHELPWININFO lphwi;
WORD wSize;
char *szWndName = "wnd_menu";

wSize = sizeof(HELPWININFO) + lstrlen(szWndName);
hhwi = GlobalAlloc(GHND, wSize);
lphwi = (LPHELPWININFO)GlobalLock(hhwi);

lphwi->wStructSize = wSize;
lphwi->x           = 256;
lphwi->y           = 256;
lphwi->dx          = 767;
lphwi->dy          = 512;
lphwi->wMax        = 0;
lstrcpy(lphwi->rgchMember, szWndName);

WinHelp(hwnd, "myhelp.hlp", HELP_SETWINPOS, lphwi);
```

```
GlobalUnlock(hhwi);
GlobalFree(hhwi);
```

Canceling Help

Windows Help requires an application to explicitly cancel Help so that Windows Help can free any resources it used to keep track of the application and its help files. The application can do this at any time.

An application cancels Windows Help by calling the **WinHelp** function and specifying the HELP_QUIT value, as shown in the following example:

```
WinHelp(hwnd, "myhelp.hlp", HELP_QUIT, NULL);
```

If the application has made any calls to the **WinHelp** function, it must cancel Help before it closes its main window (for example, in response to the **WM_DESTROY** message in the main window procedure). An application needs to call **WinHelp** only once to cancel Help, no matter how many help files it has opened. Windows Help remains running until all applications or dynamic-link libraries that have called the **WinHelp** function have canceled Help.

CODE Module Definition Statement

CODE Module-Definition Statement

CODE *attributes* [[**FIXED**|**MOVEABLE**]] [[**DISCARDABLE**]] [[**PRELOAD**|**LOADONCALL**]]

The **CODE** statement specifies the attributes of code segments.

Parameters

This statement takes no parameters. However, options selected from the following list must be specified:

Option	Meaning
FIXED	Specifies that the segment remains at a fixed memory location.
MOVEABLE	Specifies that the segment can be moved, if necessary, in order to compact memory.
DISCARDABLE	Specifies that the segment can be discarded if it is no longer needed.
PRELOAD	Specifies that the segment is loaded when the module is first loaded.
LOADONCALL	Specifies that the segment is loaded when it is called. The Resource Compiler (RC) may override this option.

Comments

There are no default attributes for code segments. The .DEF file should always define code-segment attributes explicitly.

The **FIXED** and **MOVEABLE** options are mutually exclusive. The **PRELOAD** and **LOADONCALL** options are mutually exclusive: If options conflict with each other, **MOVEABLE** overrides **FIXED** and **PRELOAD** overrides **LOADONCALL**.

Example

The following example sets defaults for the module's code segments so that they are movable and are not loaded until accessed.

```
CODE MOVEABLE LOADONCALL
```

DATA Module Definition Statement

DATA Module-Definition Statement

DATA [[**NONE**|**SINGLE**|**MULTIPLE**]] [[**FIXED**|**MOVEABLE**]]

The **DATA** statement specifies the attributes of the standard data segment, which is all application segments belonging to the DGROUP group and the DATA class. In C applications, the standard data segment is created automatically. The data is always preloaded.

Parameters

This statement takes no parameters. However, options selected from the following list must be specified:

Option	Meaning
NONE	Specifies that there is no data segment. To be effective, this option should be the only attribute of the segment. This option is valid only for libraries.
SINGLE	Specifies that a single data segment is shared by all instances of the module. This option is valid only for libraries.
MULTIPLE	Specifies that one data segment exists for each instance. This option is valid only for applications.
PRELOAD	Specifies that the segment is loaded when the module is first loaded.
FIXED	Specifies that the segment remains at a fixed memory location.
MOVEABLE	Specifies that the segment can be moved, if necessary, in order to compact memory.

Comments

There are no default attributes for data segments. The .DEF file should always define data-segment attributes explicitly. Data segments are always preloaded.

The **NONE**, **SINGLE**, and **MULTIPLE** options are mutually exclusive.

The **FIXED** amd **MOVEABLE** options are mutually exclusive.

If options conflict with each other, **MULTIPLE** overrides **NONE**, **SINGLE** overrides **NONE**, and **MOVEABLE** overrides **FIXED**.

Example

The following example defines application's data segment so that it can be moved. It also specifies that a single data segment is shared by all instances of the module.

```
DATA MOVEABLE SINGLE
```

DESCRIPTION Module Definition Statement

DESCRIPTION Module-Definition Statement

DESCRIPTION `*text*'

The **DESCRIPTION** statement inserts text into the application module. It is useful for embedding version-control or copyright information.

Parameter	Description
text	Specifies a one-line string enclosed in single quotation marks.

Example

The following example embeds the text "Microsoft Windows Template Application" in the application module.

```
DESCRIPTION 'Microsoft Windows Template Application'
```

EXETYPE Module Definition Statement

EXETYPE Module-Definition Statement EXETYPE *headertype*

The **EXETYPE** statement specifies the default executable-file (.EXE) header type. The statement is required for every Windows application.

Parameter	Description
headertype	Specifies the header type. When linking an application intended for the Windows environment, set this parameter to the value "WINDOWS".

Example

The following example specifies Windows as the .EXE header type.

```
EXETYPE WINDOWS
```

EXPORTS Module Definition Statement

EXPORTS Module-Definition Statement

EXPORTS *exportname* [[*ordinal-option*]] [[*res-option*]] [[*data-option*]] [[*parameter-option*]]

The **EXPORTS** statement specifies the names and attributes of the functions to be exported to other applications. The **EXPORTS** keyword marks the beginning of the definitions. It can be followed by any number of export definitions, each on a separate line.

Parameter	Description
exportname	Specifies the name of the function to be exported. This name consists of one or more ASCII characters in the following format: *<entryname>*=[[*internalname*]] The *entryname* parameter specifies the name to be used by other applications to access the exported function, and *internalname,* an optional parameter specifies the actual name of the function if *entryname* is not its real name.
ordinal-option	Defines ordinal value of the function. This parameter is an integer and has the following format: *@ordinal* The ordinal value defines the location of the function's name in the application's string table.
res-option	Specifies the optional keyword **RESIDENTNAME**, which stipulates that the function's name must be resident at all times.
data-option	Specifies the optional keyword **NODATA**, which stipulates that the function is not bound to a specific data segment. When called, the function uses the current data segment.
parameter-option	Specifies an integer value for the number of words the function expects to be passed as parameters. This parameter is optional.

Comments

When exporting functions from libraries, use an ordinal value rather than a name; using an ordinal conserves space.

Functions using the C calling convention (declared with the **_cdecl** keyword) must be exported with a leading underscore. For example, the following statement exports the MyPrintf function:

```
EXPORTS
    _MyPrintf
```

In addition, applications calling this function must explicitly import the function by declaring it (with the leading underscore) in the **IMPORTS** section of the application's module-definition (.DEF) file.

Functions using the **_fastcall** calling convention must be explicitly exported and imported with a leading @ symbol.

Example

The following example exports the SampleRead, StringIn and CharTest functions so that other applications, or Windows itself, can call them.

```
EXPORTS
         SampleRead=read2bin @1 8
         StringIn=str1 @2 4
         CharTest NODATA
```

HEAPSIZE Module Definition Statement

HEAPSIZE Module-Definition Statement HEAPSIZE *bytes*

The **HEAPSIZE** statement specifies the number of bytes needed by the application for its local heap. An application uses the local heap whenever it allocates local memory. The size of the local heap must be at least large enough to hold the current environment for an application.

Parameter	Description
bytes	Specifies the heap size in bytes. The default heap size is zero; the minimum size is 256 bytes. The heap size must not exceed 65,536 bytes (the size of a single physical segment).

Example

This example sets the size of the application's local heap to 4,096 bytes.

```
HEAPSIZE 4096
```

IMPORTS Module Definition Statement

IMPORTS Module-Definition Statement

IMPORTS [[internal-option]] *modulename* [[*entry-option*]]

The **IMPORTS** statement specifies the names and attributes of the functions to be imported from dynamic-link libraries (DLLs). The **IMPORTS** keyword marks the beginning of the definitions. It can be followed by any number of import definitions, each on a separate line.

Parameter	Description
internal-option	Specifies the name of the function to be imported. This name consists of one or more ASCII characters in the following format: *internal-name***=** The *internal-name* parameter specifies the name to be used by the application to call the function. This name must be unique.
modulename	Specifies one or more ASCII characters that constitute the name of the executable module containing the function. The module name must match the name of the executable file. For example, an application with the executable file SAMPLE.DLL has the module name "SAMPLE". The executable file must be named with the .DLL extension.
entry-option	Specifies the function to be imported. This parameter can be either *.entryname* or *.entryordinal,* where *entryname* is the actual name of the function and *entryordinal* is the ordinal value of the function.

Comments

Instead of listing imported DLL functions in the **IMPORTS** statement, you can specify an "import library" for the DLL in the LINK command line for your application.

Functions using the _**cdecl** or _**fastcall** calling conventions, however, must be explicitly imported in the module-definition file for the application (using either a leading underscore or a leading @ symbol, respectively).

Example

```
IMPORTS
          Sample.SampleRead
          write2hex=Sample.SampleWrite
          Read.1
```

LIBRARY Module Definition Statement

LIBRARY Module-Definition Statement LIBRARY *libraryname*

The **LIBRARY** statement specifies the name of a library module. Library modules are resource modules that contain code, data, and other resources but are not executed as independent programs.

Parameter	Description
libraryname	Specifies one or more ASCII characters that constitute the name of the library module. A library's module name must match the name of the executable file. For example, the library USER.EXE has the module name "USER". The *libraryname* parameter is optional. If it is not included, LINK takes the library name from the filename (without extension) for the executable file.

Comments

The starting address of the library module is determined by the object files for the library; it is an internally defined function.

If the .DEF file includes neither a **NAME** nor a **LIBRARY** statement, LINK uses a **NAME** statement without a *modulename* parameter as the default.

Example

This example gives a library the module name "Utilities."

```
LIBRARY Utilities
```

NAME Module Definition Statement

NAME Module-Definition Statement NAME *modulename*

The **NAME** statement specifies the name of the executable module for the application. The module name identifies the module when exporting functions.

Parameter	Description
modulename	Specifies one or more uppercase ASCII characters that constitute the name of the executable module. The module name must match the name of the executable file. For example, an application with the executable file SAMPLE.EXE has the module name "SAMPLE". Do not use system library names; examples of these names are KERNEL, USER, GDI, SHELL, COMMDLG, and TOOLHELP.

The *modulename* parameter is optional. If it is not included, LINK takes the module name from the filename (without extension) of the executable file. For example, if you do not specify a module name and the executable file is named MYAPP.EXE, LINK assumes that the module name is "MYAPP".

Comments

If the .DEF file includes neither a **NAME** nor a **LIBRARY** statement, LINK uses a **NAME** statement without a *modulename* parameter as the default.

Example

This example gives an application the module name "Calendar".

```
NAME Calendar
```

SEGMENTS Module Definition Statement

SEGMENTS Module-Definition Statement

SEGMENTS *segmentname* [[**CLASS** '*class-name*']] [[minalloc]]\ [[**FIXED**|**MOVEABLE**]] [[**DISCARDABLE**]] [[**SHARED**|**NONSHARED**]] [[**PRELOAD**|**LOADONCALL**]]

The **SEGMENTS** statement specifies the segment attributes of additional code and data segments.

Parameters

This statement takes no parameters. However, options selected from the following list must be specified:

Option	Meaning
FIXED	Specifies that the segment remains at a fixed memory location.
MOVEABLE	Specifies that the segment can be moved if necessary, in order to compact memory.
DISCARDABLE	Specifies that the segment can be discarded if it is no longer needed.
PRELOAD	Specifies that the segment is loaded when the module is first loaded.
LOADONCALL	Specifies that the segment is loaded when it is accessed or called. The Resource Compiler (RC) may override this option. For more information, see *Microsoft Windows Tools.*

Parameter	Description
segmentname	Specifies one or more ASCII characters that constitute the name of the new segment. This parameter can be any name, including the standard segment names _TEXT and _DATA, which represent the standard code and data segments.
class-name	Specifies the class name of the segment. If no class name is specified, LINK uses the CODE class name by default.
minalloc	Specifies the minimum allocation size for the segment. This value must be an integer. The *minalloc* parameter is optional.

Comments

There are no default attributes for additional segments. The .DEF file should always define the attributes of additional segments explicitly.

The **FIXED** and **MOVEABLE** options are mutually exclusive. The **PRELOAD** and **LOADONCALL** options are mutually exclusive. If options conflict with each other, **MOVEABLE** overrides **FIXED** and **PRELOAD** overrides **LOADONCALL**.

Example

The following example defines the segment named _TEXT as **FIXED**. It specifies the _INIT segment as **PRELOAD** and **DISCARDABLE**. The _RES segment of the data class becomes **PRELOAD** and **DISCARDABLE**.

```
SEGMENTS
       _TEXT FIXED
       _INIT PRELOAD DISCARDABLE
       _RES  CLASS 'DATA' PRELOAD DISCARDABLE
```

STACKSIZE Module Definition Statement

STACKSIZE Module-Definition Statement STACKSIZE *bytes*

The **STACKSIZE** statement specifies the number of bytes needed by the application for its local stack. An application uses the local stack whenever it makes function calls.

Parameter	Description
bytes	Specifies the stack size, in bytes. If the application makes no function calls, the default stack size is zero. If your application does make function calls and you specify a stack size smaller than 5K, Windows automatically sets the size to 5K.

Comments

Do not use the **STACKSIZE** statement for dynamic-link libraries (DLLs).

Example

This example sets the size of an application's stack to 6,144 bytes.

```
STACKSIZE 6144
```

STUB Module Definition Statement

STUB Module-Definition Statement STUB `*filename*'

The **STUB** statement appends the old-style executable file specified by *filename* to the beginning of the module. The executable stub should display a warning message and stop execution if the user attempts to run the module without having loaded Windows. The default file WINSTUB.EXE can be used if no other actions are required.

Parameter	Description
filename	Specifies the name of the old-style executable file to be appended to the module. The name must have the DOS filename format.

Comments

If the file named by *filename* is not in the current directory, LINK searches for the file in the directories specified in PATH environment variable.

Example

This example specifies the executable file WINSTUB.EXE as the stub for the application. If a user tries to run this application in the DOS environment rather than with the Windows operating system, WINSTUB.EXE starts instead.

```
STUB 'WINSTUB.EXE'
```

Module Definition Statements

CODE Module Definition Statement	Defines attributes of standard code segment
DATA Module Definition Statement	defines attributes of standard data segment
DESCRIPTION Module Definition Statement	Inserts text into application module
EXETYPE Module Definition Statement	Specifies the default .EXE header type
EXPORTS Module Definition Statement	Specifies functions to export to other apps
HEAPSIZE Module Definition Statement	Specifies size of local heap
IMPORTS Module Definition Statement	Specifies functions to import from DLLs
LIBRARY Module Definition Statement	Specifies name of a library module
NAME Module Definition Statement	Specifies name of executable module
SEGMENTS Module Definition Statement	Specifies segment attributes
STACKSIZE Module Definition Statement	Specifies size of local stack
STUB Module Definition Statement	Appends stub to the beginning of the module

[ALIAS] Section

[ALIAS]
context_string = alias
.
.
.

The **[ALIAS]** section assigns one or more context strings to the same topic alias. This section is optional.

Parameter	Description
context_string	Specifies the context string that identifies a particular topic. This context string may be used in a hotspot or in the **[MAP] section** to refer to a particular topic.
alias	Specifies the alternative string or alias name. This string is used in the **\footnote** statement. An alias string has the same form and follows the same conventions as the topic context string. That is, it is not case-sensitive and may contain the alphabetic characters A through Z, the numeric characters 0 through 9, and the period and underscore characters.

Comments

Because context strings must be unique for each topic and cannot be used for any other topic in the Help project, the **[ALIAS]** section provides a way to delete or combine help topics without recoding your files. For example, if you create a topic that replaces information in three other topics, you could manually search through your files for invalid cross-references to the deleted topics. The easier approach, however, would be to use the **[ALIAS]** section to assign the name of the new topic to the deleted topics.

The **[ALIAS]** section can also be used when your application has multiple context identifiers for one help topic. This situation occurs in context-sensitive Help.

Alias names can be used in a **[MAP]** section, but only if the **[ALIAS]** section precedes the **[MAP]** section.

Example

The following example creates several aliases:

```
[ALIAS]
sm_key=key_shrtcuts
cc_key=key_shrtcuts
st_key=key_shrtcuts     ; combined into Keyboard Shortcuts topic
clskey=us_dlog_bxs
maakey=us_dlog_bxs      ; covered in Using Dialog Boxes topic.
chk_key=dlogprts
drp_key=dlogprts
lst_key=dlogprts
opt_key=dlogprts
tbx_key=dlogprts        ; combined into Parts of Dialog Box topic.
frmtxt=edittxt
wrptxt=edittxt
seltxt=edittxt          ; covered in Editing Text topic.
```

See Also

[MAP]

[BAGGAGE] Section

[BAGGAGE]
filename
.
.
.

The **[BAGGAGE]** section lists files (typically multimedia elements) that the Microsoft Help Compiler stores within the help file's internal file system. Windows Help can access data files stored in the help file more efficiently than it can access files in the normal MS-DOS file system, since it doesn't have to read the file allocation table from CD-ROM.

Parameter	Description
filename	Specifies the full path of a file. If a file cannot be found, the compiler reports an error.

Comments

A maximum of 1,000 files can be stored as baggage files.

If a file is listed in the **[BAGGAGE]** section, you must use or write a dynamic-link library that uses Windows Help to read these files from the help file.

See Also

ROOT

[BITMAPS] Section

[BITMAPS]
filename
.
.
.

The **[BITMAPS]** section specifies the names and locations of the bitmap files specified in the **bmc**, **bml**, and **bmr** statements.

Parameter	Description
filename	Specifies the full path of a bitmap file. If a file cannot be found, the compiler reports an error.

Comments

For Windows 3.1, the **[BITMAPS]** section is not required if the bitmaps are located in the Help project directory or if the path containing the bitmaps is listed in the **BMROOT** or **ROOT** option. If the project file does not include either of these options, each bitmap filename must be listed in the **[BITMAPS]** section of the project file.

Example

The following example specifies three bitmap files:

```
[BITMAPS]
BMP01.BMP
BMP02.BMP
BMP03.BMP
```

See Also

BMROOT, **ROOT**

Changes for Windows 3.1

For Windows 3.1, the **[BITMAPS]** section is not required if the bitmaps are located in the Help project directory or if the path containing the bitmaps is listed in the **BMROOT** or **ROOT** option. For Windows 3.0, all bitmaps used in the help file must be placed in the **[BITMAPS]** section.

BMROOT Option

BMROOT = *path*[**,** *path*]...

The **BMROOT** option specifies the directory containing the bitmap files specified in the **bmc**, **bml**, and **bmr** statements.

Parameter	Description
path	Specifies a drive and full path.

Comments

If the project file has a **BMROOT** option, you do not need to list the bitmap files in the **[BITMAPS]** section.

If the project file does not have a **BMROOT** option, the Help compiler looks for bitmaps in the directories specified by the **ROOT** option. If the project file does not have a **ROOT** option or if the **ROOT** option does not specify the directory containing the bitmap files, the filename for each bitmap must be specified in the **[BITMAPS]** section.

Example

The following example specifies that bitmaps are in the \HELP\BMP directory on drive C: and the \GRAPHICS\ART directory on drive D:

```
[OPTIONS]
BMROOT=C:\HELP\BMP, D:\GRAPHICS\ART
```

See Also

[BITMAPS], **[OPTIONS]**, **ROOT**

BUILD Option

BUILD = *expression*

The **BUILD** option specifies which topics containing build tags are included in a build. The **BUILD** option does not apply to topics that do not contain build tags.

A topic contains a build tag if it contains a build-tag **\footnote** statement. Topics without build tags are always compiled, regardless of the current build expression.

Parameter	Description
expression	Specifies the build expression. This parameter consists of a combination of build tags (specified in the **[BUILDTAGS]** section) and the following operators:

Operator	Description
~	Applies the NOT operator to a single tag. The Help compiler compiles a topic only if the tag is *not* present. This operator has the highest precedence; the compiler applies it before any other operator.
&	Combines two tags by using the AND operator. The Help compiler compiles a topic only if it contains both tags. The compiler applies this operator only after the ~ operator has been applied.
|	Combines two tags by using the OR operator. The Help compiler compiles a topic if it has at least one tag. This operator has the lowest precedence; the compiler applies it only after all other operators have been applied.

Parentheses may be used to override operator precedence. Expressions enclosed in parentheses are always evaluated first.

Comments

Only one **BUILD** option can be given per project file.

The Help compiler evaluates all build expressions from left to right, using the specified precedence rules.

Example

The following examples assume that the **[BUILDTAGS]** section in the project file defines the build tags DEMO, MASTER, and TEST_BUILD. Although the following examples show several **BUILD** options on consecutive lines, only one **BUILD** option per project file is allowed.

```
BUILD = DEMO             ; compile topics that have the DEMO tag
BUILD = DEMO & MASTER    ; compile topics with both DEMO and MASTER
BUILD = DEMO | MASTER    ; compile topics with either DEMO or MASTER
BUILD = ~DEMO            ; compile topics that do not have DEMO
BUILD = (DEMO | MASTER) & TEST_BUILD
                         ; compile topics that have TEST_BUILD and
                         ; either DEMO or MASTER
```

See Also

[BUILDTAGS], **[OPTIONS]**

[BUILDTAGS] Section

[BUILDTAGS]
tag
.
.
.

The **[BUILDTAGS]** section defines the build tags for the help file. The Help compiler uses these tags to determine which topics to include when building the help file.

This section is used in conjunction with the build-tag **\footnote** statements. These **\footnote** statements associate a build tag with a given topic. If the build tag is also defined in the **[BUILDTAGS]** section, the Help compiler compiles the topic; otherwise, it ignores the topic.

Parameter	Description
tag	Specifies a build tag consisting of any combination of characters except spaces. The Help compiler strips any space characters from the tag. Also, the compiler treats uppercase and lowercase characters as the same characters (that is, it is case-insensitive).

Comments
The **[BUILDTAGS]** section is optional. If given, it can contain up to 30 build tags.

Example
The following example shows the form of the **[BUILDTAGS]** section in a sample project file:

```
[BUILDTAGS]
DEMO            ; topics to include in demo build
MASTER          ; topics to include in master help file
DEBUGBUILD      ; topics to include in debugging build
TESTBUILD       ; topics to include in a mini-build for testing
```

See Also
BUILD

CITATION Option

CITATION = *citation*

The **CITATION** option places a custom citation in the About dialog box of Windows Help. Windows Help displays the citation immediately below the Microsoft copyright notice.

Parameter	Description
citation	Specifies the citation. The notice can be any combination of characters; its length must be in the range 35 through 75 characters.

See Also
COPYRIGHT, **[OPTIONS]**

COMPRESS Option

COMPRESS = *compression-level*

The **COMPRESS** option specifies the level of compression to be used when building the help file. Compression levels indicate either no compression, medium compression (approximately 40%), or high compression (approximately 50%).

Parameter	Description
compression-level	Specifies the level of compression. This parameter can be one of the following values:

Value	Meaning
0	No compression
1	High compression
FALSE	No compression
HIGH	High compression
MEDIUM	Medium compression
NO	No compression
TRUE	High compression
YES	High compression

Comments

Depending on the degree of compression requested, the build uses either block compression or a combination of block and key-phrase compression. Block compression compresses the topic data into predefined units known as blocks. Key-phrase compression combines repeated phrases found within the source file(s). The compiler creates a phrase-table file with the .PH extension if one does not already exist. If the compiler finds a file with the .PH extension, it uses that file for the current compilation. Because the .PH file speeds up the compression process when little text has changed since the last compilation, you might want to keep the phrase file if you compile the same Help file several times with compression. However, you will get maximum compression if you delete the .PH file before starting each build.

See Also

[OPTIONS] section

[CONFIG] Section

[CONFIG]
macro
.
.
.

The **[CONFIG]** section contains one or more macros that carry out actions, such as enabling browse buttons and registering dynamic-link library (DLL) functions. Windows Help executes the macros when it opens the help file.

Parameter	Description
macro	Specifies a Windows Help macro.

Comments

The **[CONFIG]** section may include any number of lines. Each line of the **[CONFIG]** section may be up to 254 characters long.

Example

The following example registers a DLL, creates a button, enables the browse buttons, and sets the name of the help file containing information about how to use Help:

```
[CONFIG]
RegisterRoutine("bmp","HDisplayBmp","USSS")
RegisterRoutine("bmp","CopyBmp", "v=USS")
CreateButton("btn_up", "&Up", "JumpContents(`HOME.HLP')")
BrowseButtons()
SetHelpOnFile("APPHELP.HLP")
```

CONTENTS Option

CONTENTS = *context-string*

The **CONTENTS** option identifies the context string of the highest-level or Contents topic. This topic is usually a table of contents or index within the help file. Windows Help displays the Contents topic whenever the user clicks the Contents button.

Parameter	Description
context-string	Specifies the context string of a topic in the help file. The string can be any combination of characters, except spaces, and must also be specified in a context-string **\footnote** statement in some topic in the help file.

Comments

If the **[OPTIONS]** section does not include a **CONTENTS** option, the compiler assumes that the Contents topic is the first topic encountered in the first listed topic file in the **[FILES]** section of the project file.

The **CONTENTS** option is equivalent to the **INDEX** option that was available in Windows version 3.0.

Example

The following example sets the topic containing the context string "main_contents" as the Contents topic:

```
CONTENTS=main_contents
```

See Also

[FILES], **[OPTIONS]**

COPYRIGHT Option

COPYRIGHT = *copyright-notice*

The **COPYRIGHT** option places a custom copyright notice in the About dialog box of Windows Help. Windows Help displays the notice immediately below the Microsoft copyright notice.

Parameter	Description
copyright-notice	Specifies the copyright notice. The notice can be any combination of characters; its length must be in the range 35 through 75 characters.

Comments

The copyright notice is also appended to topics that are copied to the clipboard, unless it is replaced by using the **CITATION** option.

See Also

CITATION, **[OPTIONS]**

ERRORLOG Option

ERRORLOG = *error-filename*

The **ERRORLOG** option directs the Help compiler to write all error messages to the specified file. The compiler also displays the error messages on the screen.

Parameter	Description
error-filename	Specifies the name of the file to receive the error messages. This parameter can be a full or partial path if the error file should be written to a directory other than the project root directory.

Example
The following example writes all errors during the build to the HLPBUGS.TXT file in the Help project root directory.

```
ERRORLOG=HLPBUGS.TXT
```

See Also
[OPTIONS]

[FILES] Section

[FILES]
filename
.
.
.

The **[FILES]** section lists all topic files used to build the help file. Every project file requires a **[FILES]** section.

Parameter	Description
filename	Specifies the full or partial path of a topic file. If a partial path is given, the Help compiler uses the directories specified by the **ROOT** option to construct a full path. If a file cannot be found, the compiler reports an error.

Comments

The **#include** directive can also be used in the **[FILES]** section to specify the topic files indirectly by designating a file that contains a list of the topic files.

Example

The following example specifies four topic files:

```
[FILES]
rtftxt\COMMANDS.RTF
rtftxt\HOWTO.RTF
rtftxt\KEYS.RTF
rtftxt\GLOSSARY.RTF
```

The following example uses the **#include** directive to specify the topic files indirectly. In this case, the file RTFFILES.H must be in the project file (the Help compiler does not use the INCLUDE environment variable to search for files).

```
[FILES]
#include <rtffiles.h>
```

See Also

ROOT

FORCEFONT Option

FORCEFONT = *fontname*

The **FORCEFONT** option forces the specified font to be substituted for all requested fonts. The option is used to create help files that can be viewed on systems that do not have all fonts available.

Parameter	Description
fontname	Specifies the name of an available font. Font names must be spelled the same as they are in the Fonts dialog box in Control Panel. Font names cannot exceed 20 characters. If an invalid font name is given, the Help compiler uses the MS Sans Serif font as the default.

See Also
[OPTIONS]

ICON Option

ICON = *icon-file*

The **ICON** option identifies the icon file to display when the user minimizes Windows Help.

Parameter	Description
icon-file	Specifies the name of the icon file. This file must have the standard Windows icon-file format.

See Also
[OPTIONS]

LANGUAGE Option

LANGUAGE = *language-name*

The **LANGUAGE** option sets the sorting order for keywords in the Search dialog box.

Parameter	Description
language-name	Specifies the language on which to base sorting. This parameter can be the following:

Value	Meaning
scandanavian	Sets the sorting order to the Scandavanian-language order.

Comments

The default sorting order is the English-language order.

Microsoft Windows Help version 3.1 supports only English and Scandanavian sorting.

See Also

[OPTIONS]

[MAP] Section

[MAP]
context-string context-number
.
.
.

The **[MAP]** section associates context strings (or aliases) with context numbers for context-sensitive Help. The context number corresponds to a value the parent application passes to Windows Help in order to display a particular topic. This section is optional.

Parameter	Description
context-string	Specifies the context string of a topic in the help file. The string can be any combination of characters, except spaces, and must also be specified in a context-string **\footnote** statement in some topic in the help file.
context-number	Specifies the context number to associate with the context string. The number can be in either decimal or standard C hexadecimal format. Only one context number may be assigned to a context string or alias. Assigning the same number to more than one context string generates a compiler error. At least one space must separate the context number from the context string.

Comments
You can define the context strings listed in the **[MAP]** section either in a help topic or in the **[ALIAS]** section. The compiler generates a warning message if a context string appearing in the **[MAP]** section is not defined in any of the topic files or in the **[ALIAS]** section.

If you use an alias name, the **[ALIAS]** section must precede the **[MAP]** section in the Help project file.

The **[MAP]** section supports two additional statements for specifying context strings and their associated context numbers. The first statement has the following form:

#define *context-string context-number*

The *context-string* and *context-number* parameters are as described in the Parameters section.

The second statement has the following form:

#include "*filename*"

The *filename* parameter, which can be enclosed in either double quotation marks or angle brackets(<>), specifies the name of a file containing one or more **#define** statements. The file may contain additional **#include** statements as well, but files may not be nested in this way more than five deep.

Example
The following example assigns hexadecimal context numbers to the context strings:

```
[MAP]
Edit_Window     0x0001
Control_Menu    0x0002
Maximize_Icon   0x0003
Minimize_Icon   0x0004
Split_Bar       0x0005
Scroll_Bar      0x0006
Title_Bar       0x0007
Window_Border   0x0008
```

See Also
[ALIAS]

MAPFONTSIZE Option

MAPFONTSIZE = *m:p*

The **MAPFONTSIZE** option maps font sizes specified in topic files to different sizes when they are displayed in the Help window. This option is especially useful if there is a significant size difference between the authoring display and the intended user display.

Parameter	Description
m	Specifies the size of the source font. This parameter is either a single point size or a range of point sizes. A range of point sizes consists of the low and high point sizes separated by a hyphen (-). If a range is specified, all fonts in the range are changed to the size specified by the *p* parameter.
p	Specifies the size of the desired font for the help file.

Comments

Although the **[OPTIONS]** section can contain up to five font ranges, only one font size or range is allowed with each **MAPFONTSIZE** statement. If more than one **MAPFONTSIZE** statement is included, the source font size or range specified in subsequent statements cannot overlap previous mappings.

Example

The following examples illustrate the use of the **MAPFONTSIZE** option:

```
MAPFONTSIZE=8:12      ; display all 8-pt. fonts as 12-pt.
MAPFONTSIZE=12-24:16  ; display fonts from 12 to 24 pts. as 16 pts.
```

See Also

[OPTIONS]

MULTIKEY Option

MULTIKEY = *footnote-character*

The **MULTIKEY** option specifies the footnote character to use for an alternative keyword table. This option is intended to be used in conjunction with topic files that contain **\footnote** statements for alternative keywords.

Parameter	Description
footnote-character	Specifies the case-sensitive letter to be used for the keyword footnote.

Comments

Since keyword footnotes are case-sensitive, you should limit your keyword-table footnotes to one case, usually uppercase. If an uppercase letter is specified, the compiler will not include footnotes with the lowercase form of the same letter in the keyword table.

You may use any alphanumeric character for a keyword table except *K* and *k,* which are reserved for Help's standard keyword table. There is an absolute limit of five keyword tables, including the standard table. However, depending upon system configuration and the structure of your Help system, a practical limit of only two or three tables may be more realistic. If the compiler cannot create an additional keyword table, the additional table is ignored in the build.

Example

The following example illustrates how to enable the letter *L* for a keyword-table footnote:

```
MULTIKEY=L
```

See Also

[OPTIONS]

OLDKEYPHRASE Option

OLDKEYPHRASE = *onoff*

The **OLDKEYPHRASE** option specifies whether an existing key-phrase file should be used to build the help file.

Parameter	Description
onoff	Specifies whether the existing file should be used. This parameter can be one of the following values:

Value	Meaning
0	Recreate the file
1	Use the existing file
FALSE	Recreate the file
NO	Recreate the file
OFF	Recreate the file
ON	Use the existing file
TRUE	Use the existing file
YES	Use the existing file

See Also
[OPTIONS]

OPTCDROM Option

OPTCDROM = *yesvalue*

The **OPTCDROM** option optimizes a help file for display on CD-ROM by aligning topic files on predefined block boundaries.

Parameter	Description
yesvalue	Specifies that the file should be optimized for CD-ROM. This parameter can be any of the following values: **YES** **TRUE** **1** **ON**

See Also
[OPTIONS]

[OPTIONS] Section

[OPTIONS]
option
.
.
.

The **[OPTIONS]** section includes options that control how a help file is built and what feedback the build process displays. If this section is included in the project file, it should be the first section listed, so that the options will apply during the entire build process.

Parameter	Description
option	Specifies one of the following project-file options:

Option	Description
BMROOT	Specifies the directory containing the bitmap files named in the **bmc**, **bml**, and **bmr** statements in topic files. This option is new for Windows 3.1.
BUILD	Specifies which topics to include in the build.
CITATION	Specifies a string that is appended to topics that are copied from Windows Help instead of the **COPYRIGHT** string. This option is new for Windows 3.1.
COMPRESS	Specifies the type of compression to use during the build.
CONTENTS	Specifies the context string of the Contents topic for a help file. This option is new for Windows 3.1.
COPYRIGHT	Adds a unique copyright message for the help file to the About dialog box. This option is new for Windows 3.1.
ERRORLOG	Puts compilation errors in a file during the build. This option is new for Windows 3.1.
FORCEFONT	Forces all authored fonts in the topic files to appear in a different font when displayed in the Help window.
ICON	Specifies the icon file to be displayed when the help file is minimized. This option is new for Windows 3.1.
LANGUAGE	Specifies a different sorting order for help files authored in a Scandanavian language.
MAPFONTSIZE	Maps a font size in the topic file to a different font size in the compiled help file.
MULTIKEY	Specifies an alternative keyword table to use for mapping topics.
OLDKEYPHRASE	Specifies whether the compiler should use the existing key-phrase table or create a new one during the build. This option is new for Windows 3.1.
OPTCDROM	Optimizes the help file for CD-ROM use. This option is new for Windows 3.1.
REPORT	Controls the display of messages during the build process.
ROOT	Specifies the directories containing the topic and data files listed in the project file.
TITLE	Specifies the text displayed in the title bar of the Help window when the file is open.
WARNING	Specifies the level of error-message reporting the compiler is to display during the build.

Comments

These options can appear in any order within the **[OPTIONS]** section. The **[OPTIONS]** section is not required.

REPORT Option

REPORT = ON

The **REPORT** option displays messages on the screen during the build. These messages indicate when the Help compiler is performing the different phases of the build, including compiling the file, resolving jumps, and verifying browse sequences.

See Also
[OPTIONS], **WARNING**

ROOT Option

ROOT = *pathname*[**,** *pathname*]...

The **ROOT** option specifies the directories where the Help compiler looks for files listed in the project file.

Parameter	Description
pathname	Specifies either a drive and full path or a relative path from the project directory. If the project file has a **ROOT** option, all relative paths in the project file refer to one of these paths. If the project file does not have a **ROOT** option, all paths are relative to the directory containing the project file.

Comments

If the project file does not have a **BMROOT** option, the compiler looks in the directories specified in the **ROOT** option to find bitmaps positioned by using the **bmc**, **bml**, and **bmr** statements. If none of these directories contains these bitmaps, the bitmap filenames must be listed in the **[BITMAPS]** section of the project file.

Example

The following example specifies that the project root directory is C:\WINHELP\HELPDIR and is found on drive C:

```
[OPTIONS]
ROOT=C:\WINHELP\HELPDIR
```

Given this root directory, if the **[FILES]** section contains the entry TOPICS\FILE.RTF, the full path for the topic file is C:\WINHELP\HELPDIR\TOPICS\FILE.RTF.

See Also

[BITMAPS], **BMROOT**, **[OPTIONS]**

TITLE Option

TITLE = *titlename*

The **TITLE** option sets the title for the help file. Windows Help displays the title in its title bar whenever it displays the help file.

Parameter	Description
titlename	Specifies the title displayed in the Windows Help title bar. The title must not exceed 50 characters.

Comments

If no title is specified by using the **TITLE** option, Windows Help displays the title Windows Help in the title bar.

Example

The following example sets the help-file title to **ABC** Help.

```
[OPTIONS]
TITLE=ABC Help
```

See Also

[OPTIONS]

WARNING Option

WARNING = *level*

The **WARNING** option specifies the amount of debugging information the Help compiler is to report.

Parameter	Description
level	Specifies the warning level. This parameter may be one of the following values:

Value	Meaning
1	Report only the most severe errors.
2	Report an intermediate number of errors.
3	Report all errors and warnings.

Example

The following example specifies an intermediate level of error reporting:

```
[OPTIONS]
WARNING=2
```

See Also

[OPTIONS], **REPORT**

[WINDOWS] Section

[WINDOWS]
type = **"***caption***"**, (*x, y, width, height*), *sizing,*
(*clientRGB*), (*nonscrollRGB*), (*fTop*)
.
.
.

The **[WINDOWS]** section defines the size, location, and colors for the primary Help window and any secondary-window types used in a help file.

The secondary windows defined in this section are intended to be used with Windows applications that specify secondary windows when calling the **WinHelp** function.

Parameter	Description
type	Specifies the type of window that uses the defined attributes. For the primary Help window, this parameter is **main**. For a secondary window, this parameter may be any unique name of up to 8 characters. Any jumps that display a topic in a secondary window give this type name as part of the jump.
caption	Specifies the title for a secondary window. Windows Help places the title in the title bar of the window. To set the title for the primary Help window, use the **TITLE** option in the **[OPTIONS]** section.
x	Specifies the x-coordinate, in help units, of the window's upper-left corner. Windows Help always assumes the screen is 1024 help units wide, regardless of resolution. For example, if the x-coordinate is 512, the left edge of the Help window is in the middle of the screen.
y	Specifies the y-coordinate, in help units, of the window's upper-left corner. Windows Help always assumes the screen is 1024 help units high, regardless of resolution. For example, if the x-coordinate is 512, the top edge of the Help window is in the middle of the screen.
width	Specifies the default width, in help units, for a secondary window.
height	Specifies the default height, in help units, for a secondary window.
sizing	Specifies the relative size of a secondary window when Windows Help first opens the window. This parameter can be one of the following values:

Value	Meaning
0	Set the window to the size specified by the *x, y, width,* and *height* parameters.
1	Maximize the window; ignore the *x, y, width,* and *height* parameters.

clientRGB	Specifies the background color of the window. This parameter is an **RGB** color value consisting of three 8-bit hexadecimal numbers enclosed in parentheses and separated by commas. If this parameter is not given, Windows Help uses the default window color specified by Control Panel.
nonscrollRGB	Specifies the background color of the non-scrolling region (if any) in the Help window. This parameter is an **RGB** color value consisting of three 8-bit hexadecimal numbers enclosed in parentheses and separated by commas. If this parameter is not given, Windows Help uses the default window color specified by Control Panel.
fTop	Specifies whether the secondary window is displayed on top of all other windows. When this parameter is 1, the window is diplayed over all windows that do not also use this attribute. Otherwise, it should be zero. This parameter is optional.

Example

The following example defines two windows, the main window and a secondary window named "picture". The main-window definition sets the background color of non-scrolling regions in the main Help

window to (128, 0, 128) but leaves several other values empty (for which Windows Help will supply its own default values). The secondary-window definition sets the caption to "Samples" and sets the width and height of the window to about one-quarter of the width and height of the screen. The background colors for the window and non-scrolling region are (0, 255, 255) and (255, 0, 0), respectively. The *sizing* parameter for both the main and secondary windows is zero.

```
[WINDOWS]
main=, (, , , ), 0, (, , ), (128, 0, 128)
picture = "Samples", (123,123,256,256), 0, (0,255,255), (255,0,0)
```

See Also
[Options], **TITLE**

HPJ Statements

[ALIAS] Section	Assigns context strings to a topic alias
[BAGGAGE] Section	Lists files to add to the Help file
[BITMAPS] Section	Specifies the names of bitmap files
BMROOT Option	Specifies the directory containing bitmaps
BUILD Option	Specifies which topics to build
[BUILDTAGS] Section	Specifies valid build tags
CITATION Option	Inserts a citation string in the About dialog box
COMPRESS Option	Sets the level of compression for the help file
[CONFIG] Section	Specifies the Help file configuration
CONTENTS Option	Specifies the context string of the contents topic
COPYRIGHT Option	Inserts a copyright string in the About dialog box
ERRORLOG Option	Specifies the file to receive error messages
[FILES] Section	Specifies the topic files
FORCEFONT Option	Sets the Help file font
ICON Option	Specifies the Windows Help icon
LANGUAGE Option	Sets the sort-ordering for the keyword list
[MAP] Section	Associates context strings with context numbers
MAPFONTSIZE Option	Maps font sizes for the Help file
MULTIKEY Option	Specifies the footnote for alternate keywords
OLDKEYPHRASE Option	Specifies whether to use old phrase files
OPTCDROM Option	Optimizes help file for display on CD-ROM
[OPTIONS] Section	Contains options that control the Help compiler
REPORT Option	Displays build message during compilation
ROOT Option	Specifies the directories containing topic and data files
TITLE Option	Specifies the Help file title
WARNING Option	Specifies the warning level for error messages
[WINDOWS] Section	Contains definitions for Help windows

About WinHelp macro

About()

The **About** macro displays Windows Help's About dialog box.

Parameters

This macro does not take any parameters.

Comments

Use of this macro in secondary windows is not recommended.

AddAccelerator WinHelp macro

AddAccelerator(*key, shift-state,* "*macro*")

The **AddAccelerator** macro assigns a Help macro to an accelerator key (or key combination) so that the macro is carried out when the user presses the accelerator key(s).

Parameter	Description
key	Specifies the Windows virtual-key value. See the **Virtual key codes** topic for a list of virtual-key codes that may be used for this parameter.
shift-state	Specifies the combination of ALT, SHIFT, and CTRL keys to be used with the accelerator. This parameter may be one of the following values:

Value	Meaning
0	None
1	SHIFT
2	CTRL
3	SHIFT+CTRL
4	ALT
5	ALT+SHIFT
6	ALT+CTRL
7	SHIFT+ALT+CTRL

macro	Specifies the Help macro or macro string executed when the user presses the accelerator key(s). The macro must appear in quotation marks. Multiple macros in a string must be separated by semicolons.

Comments

The **AddAccelerator** macro can be abbreviated as **AA**.

Example

The following macro executes the Windows Clock program when the user presses ALT+SHIFT+**CONTROL**+F4:

```
AddAccelerator(0x73, 7, "ExecProgram(`clock.exe', 1)")
```

See Also

RemoveAccelerator

Annotate WinHelp macro

Annotate()

The **Annotate** macro displays the Annotation dialog box from the Edit menu.

Parameters

This macro does not take any parameters.

Comments

Use of this macro in secondary windows is not recommended.

AppendItem WinHelp macro

AppendItem("*menu-id*", "*item-id*", "*item-name*", "*macro*")

The **AppendItem** macro appends a menu item to the end of a menu created with the **InsertMenu** macro.

Parameter	Description
menu-id	Specifies the name used in the **InsertMenu** macro used to create the menu. This name must appear in quotation marks. The new item is appended to this menu.
item-id	Specifies the name that Windows Help uses internally to identify the menu item. This name must appear in quotation marks. This name is used by the **DisableItem** or **DeleteItem** macros.
item-name	Specifies the name that Windows Help displays on the menu for the item. This name must appear in quotation marks. Within the quotation marks, place an ampersand (&) before the character used for the macro's accelerator key.
macro	Specifies one or more macros that are to be executed when the user chooses the menu item. The macro must appear in quotation marks. Multiple macros in a string must be separated by semicolons (;).

Comments

Windows Help ignores this macro if it is executed in a secondary window.

If the keyboard accelerator conflicts with other menu access keys, Windows Help displays the error message "Unable to add item" and ignores the macro.

Example

The following macro appends a menu item labeled "Tools" to a pop-up menu that has an identifier "IDM_TLS". Choosing the menu item causes a jump to a topic with the context string "tpc1" in the TLS.HLP file:

```
AppendItem("IDM_BKS", "IDM_TLS", "&Tools", "JI(`tls.hlp', `tpc1')")
```

See Also

DeleteItem, **DisableItem**, **InsertMenu**

Back WinHelp macro

Back()

The **Back** macro displays the previous topic in the history list. The history list is a list of the last 40 topics the user has displayed since starting Windows Help.

Parameters

This macro does not take any parameters.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

If the **Back** macro is executed when the Back list is empty, Windows Help takes no action.

BookmarkDefine WinHelp macro

BookmarkDefine()

The **BookmarkDefine** macro displays the Define dialog from the Bookmark menu.

Parameters

This macro does not take any parameters.

Comments

Use of this macro in secondary windows is not recommended.

If the **BookmarkDefine** macro is executed from a pop-up window, the bookmark is attached to the topic that invoked the pop-up window.

BookmarkMore WinHelp macro

BookmarkMore()

The **BookmarkMore** macro displays the More dialog from the Bookmark menu. The More command appears on the Bookmark menu if the menu lists more than nine bookmarks.

Parameters

This macro does not take any parameters.

Comments

Use of the macro in secondary windows is not recommended.

BrowseButtons WinHelp macro

BrowseButtons()

The **BrowseButtons** macro adds browse buttons to the button bar.

Parameters

This macro does not take any parameters.

Comments

Windows Help ignores this macro if it is executed from a secondary window.

If the **BrowseButtons** macro is used with one or more **CreateButton** macros in the **[CONFIG] section** of the project file, the order of the browse buttons on the Windows Help button bar is determined by the order of the **BrowseButtons** macro in relation to the other macros listed in the [CONFIG] section.

Example

The following macros in the project file cause the Clock button to appear immediately before the two browse buttons on the button bar:

```
[CONFIG]
CreateButton("&Clock", "ExecProgram(`clock', 0)")
BrowseButtons()
```

See Also

CreateButton

ChangeButtonBinding WinHelp macro

ChangeButtonBinding("*button-id*", "*button-macro*")

The **ChangeButtonBinding** macro assigns a Help macro to a Help button.

Parameter	Description
button-id	Specifies the identifier assigned to the button by the **CreateButton** macro or, for a standard Help button, one of the following predefined button identifiers:

ID	Description
BTN_CONTENTS	Contents
BTN_SEARCH	Search
BTN_BACK	Back
BTN_HISTORY	History
BTN_PREVIOUS	Browse previous
BTN_NEXT	Browse next

The button identifier must be enclosed in quotation marks.

button-macro	Specifies the Help macro executed when the user selects the button. The macro must be enclosed in quotation marks.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

The **ChangeButtonBinding** macro can be abbreviated as **CBB**.

Example

In the following macro, "conts" is the context string for the table of contents in the DICT.HLP file:

```
ChangeButtonBinding("btn_contents", "JumpId(`dict.hlp', `conts')")
```

ChangeItemBinding WinHelp macro

ChangeItemBinding("*item-id*", "*item-macro*")

The **ChangeItemBinding** macro assigns a Help macro to an item previously added to a Windows Help menu using the **AppendItem** macro.

Parameter	Description
item-id	Identifies the menu item appended by the **AppendItem** macro. The item identifier must be enclosed in quotation marks.
item-macro	Specifies the Help macro to execute when the user selects the item. The macro must be enclosed in quotation marks.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

The **ChangeItemBinding** macro can be abbreviated as **CIB**.

Example

The following macro changes the menu item identified by "time_item" so that it displays the Windows clock:

```
ChangeItemBinding("time_item", "ExecProgram(`clock', 0)")
```

CheckItem WinHelp macro

CheckItem("*item-id*")

The **CheckItem** macro places a check-mark beside a menu item.

Parameter	Description
item-id	Identifies the menu item to check. The item identifier must be enclosed in quotation marks.

Comments

The **CheckItem** macro can be abbreviated as **CI**.

See Also

UncheckItem

CloseWindow WinHelp macro

CloseWindow("*window-name*")

The **CloseWindow** macro closes either a secondary window or the main Help window.

Parameter	Description
window-name	Specifies the name of the window to close. The name "main" is reserved for the main Help window. For secondary windows, the window name is defined in the **[WINDOWS]** section of the project file. This name must be enclosed in quotation marks.

Example

The following macro closes the secondary window named "keys":

```
CloseWindow("keys")
```

Contents WinHelp macro

Contents()

The **Contents** macro displays the Contents topic in the current Help file. The Contents topic is defined by the **CONTENTS** option in the **[OPTIONS]** section of the project file. If the project file does not have a **CONTENTS** option, the Contents topic is the first topic of the first topic file specified in the project file.

CopyDialog WinHelp macro

CopyDialog()

The **CopyDialog** macro displays the Copy dialog from the Edit menu.

Comments

Use of this macro in secondary windows is not recommended.

CopyTopic WinHelp macro

CopyTopic()

The **CopyTopic** macro copies all the text in the currently displayed topic to the Clipboard.

Comments

Use of the macro in secondary windows is not recommended.

CreateButton WinHelp macro

CreateButton("*button-id*", "*name*", "*macro*")

The **CreateButton** macro adds a new button to the button bar.

Parameter	Description
button-id	Specifies the name that WinHelp uses internally to identify the button. This name must appear in quotation marks. Use this name in the **DisableButton** or **DestroyButton** macro if you want to remove or disable the button or in the **ChangeButtonBinding** if you want to change the Help macro that the button executes in certain topics.
name	Specifies the text that appears on the button. To make a letter in this text the mnemonic for the button, place an ampersand (&) before that letter. The button name is case-sensitive and can have up to 29 characters in it -- any additional characters are ignored.
macro	Specifies the Help macro or macro string executed when the user clicks on the button. Multiple macros in a macro string must be separated by semicolons.

Comments

Windows Help allows a maximum of 16 custom buttons. It allows a total of 22 buttons, including the standard Browse buttons, on the button bar.

If the **BrowseButtons** macro is used with one or more **CreateButton** macros in the project file, the buttons appear in the same order on the button bar as the macros appear in the project file.

Windows Help ignores this macro if it is executed in a secondary window.

The **CreateButton** macro can be abbreviated as **CB**.

Example

The following macro creates a new button labeled "Ideas" that jumps to the topic with the context string "dir" in the IDEAS.HLP file when clicked:

```
CreateButton("btn_ideas", "&Ideas", "JumpId(`ideas.hlp', `dir')")
```

See Also

DisableButton, **DestroyButton**, **ChangeButtonBinding**, **JumpId**

DeleteItem WinHelp macro

DeleteItem("*item-id*")

The **DeleteItem** macro removes a menu item that was added by using the **AppendItem** macro.

Parameter	Description
item-id	Specifies the item identifier used in the **AppendItem** macro. The item identifier must be enclosed in quotation marks.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

Example

The following macro removes the menu item "Tools" appended in the example for the **AppendItem** macro:

```
DeleteItem("IDM_TOOLS")
```

See Also

AppendItem

DeleteMark WinHelp macro

DeleteMark("*marker-text***")**

The **DeleteMark** macro removes a text marker added with the **SaveMark** macro.

Parameter	Description
marker-text	Specifies the text marker previously added by the **SaveMark** macro. The marker text must be enclosed in quotation marks.

Comments

If the marker does not exist when the **DeleteMark** macro is executed, Windows Help displays a "Topic not found" error message.

Example

The following macro removes the marker "Managing Memory" from a Help file:

```
DeleteMark("Managing Memory")
```

See Also

SaveMark

DestroyButton WinHelp macro

DestroyButton("*button-id*")

The **DestroyButton** macro removes a button added with the **CreateButton** macro.

Parameter	Description
button-id	Identifies a button previously created by the **CreateButton** macro. The button identifier must be enclosed in quotation marks.

Comments

The button identifier cannot be an identifier for one of the standard Help buttons. For a list of those identifiers, see the **ChangeButtonBinding** macro.

Windows Help ignores this macro if it is executed in a secondary window.

See Also

CreateButton, **ChangeButtonBinding**

DisableButton WinHelp macro

DisableButton("*button-id*")

The **DisableButton** macro grays out a button added with the **CreateButton** macro. This button cannot be used in the topic until an **EnableButton** macro is executed.

Parameter	Description
button-id	Specifies the identifier assigned to the button by the **CreateButton** macro. The button identifier must be enclosed in quotation marks.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

The **DisableButton** macro can be abbreviated as **DB**.

See Also

CreateButton, **EnableButton**

DisableItem WinHelp macro

DisableItem("*item-id*")

The **DisableItem** macro grays out a menu item added with the **AppendItem** macro. The menu item cannot be used in the topic until an **EnableItem** macro is executed.

Parameter	Description
item-id	Identifies a menu item previously appended with the **AppendItem** macro. The item identifier must be enclosed in quotation marks.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

The **DisableItem** macro can be abbreviated as **DI**.

See Also

AppendItem

EnableButton WinHelp macro

EnableButton("*button-id*")

The **EnableButton** macro re-enables a button disabled with the **DisableButton** macro.

Parameter	Description
button-id	Specifies the identifier assigned to the button by the **CreateButton** macro. The button identifier must be enclosed in quotation marks.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

The **EnableButton** macro can be abbreviated as **EB**.

See Also

CreateButton, **DisableButton**

EnableItem WinHelp macro

EnableItem("*item-id*")

The **EnableItem** macro re-enables a menu item disabled with the **DisableItem** macro.

Parameter	Description
item-id	Specifies the identifier assigned to the menu item by the **AppendItem** macro. The item identifier must be enclosed in quotation marks.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

The **EnableItem** macro can be abbreviated as **EI**.

See Also

AppendItem, **DisableItem**

ExecProgram WinHelp macro

ExecProgram("*command-line*", *display-state*)

The **ExecProgram** macro executes a Windows application.

Parameter	Description
command-line	Specifies the command line for the application to be executed. The command line must be enclosed in quotation marks. Windows Help searches for this application in the current directory, followed by the Windows directory, the user's path, and the directory of the currently viewed Help file.
display-state	Specifies a value indicating how the application is shown when executed. It may be one of the following values:

Value	Meaning
0	Normal
1	Minimized
2	Maximized

Comments

The **ExecProgram** macro can be abbreviated as **EP**.

The backslash character should not be used to escape double quotation-mark characters in macros. Instead, you can enclose the command line in single quotation marks and omit the backslash for the double quotation marks, as shown in the following:

```
`command "string as parameter"'
```

Note that the first single quotation mark must be an open quote and the last single quotation mark must be a close quote.

Example

The following example executes the Clock application. The application is minimized when it starts:

```
ExecProgram(`clock.exe', 1)
```

Exit WinHelp macro

Exit()

The **Exit** macro exits the Windows Help application. It has the same effect as selecting Exit from the File menu.

Parameters

This macro does not take any parameters.

FileOpen WinHelp macro

FileOpen()

The **FileOpen** macro displays the Open dialog box from the File menu.

Parameters

This macro does not take any parameters.

Comments

Use of the macro in secondary windows is not recommended.

FocusWindow WinHelp macro

FocusWindow("*window-name*")

The **FocusWindow** macro changes the focus to the specified window, either the main Help window or a secondary window.

Parameter	Description
window-name	Specifies the name of the window to receive the focus. The name "main" is reserved for the main Help window. For secondary windows, the window name is defined in the **[WINDOWS] section** of the project file. This name must be enclosed in quotation marks.

Comments

This macro is ignored if the specified window does not exist.

Example

The following macro changes the focus to the secondary window "keys":

```
FocusWindow("keys")
```

GoToMark WinHelp macro

GoToMark("*marker-text*")

The **GoToMark** macro jumps to a marker set with the **SaveMark** macro.

Parameter	Description
marker-text	Specifies a text marker previously defined by using the **SaveMark** macro.

Example
The following macros jumps to the marker "Managing Memory".

```
GoToMark("Managing Memory")
```

See Also
SaveMark

HelpOn WinHelp macro

HelpOn()

The **HelpOn** macro displays the Help file for the Windows Help application. The macro carries out the same action as choosing the How to Use Help command on the Help menu.

Parameters

This macro does not take any parameters.

HelpOnTop WinHelp macro

HelpOnTop()

The **HelpOnTop** macro toggles the on-top state of Windows Help. It is equivalent to checking or unchecking the Always On Top command in the Help menu.

Parameters

This macro does not take any parameters.

Comments

Windows Help does not provide a macro to check the current state of the Always On Top command. It is up to the user to determine whether the macro should be used to change the state of the command.

History WinHelp macro

History()

The **History** macro displays the history list, which shows the last 40 topics the user has viewed since opening a Help file in Windows Help. It has the same effect as choosing the History button.

Parameters

This macro does not take any parameters.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

IfThen WinHelp macro

IfThen(**IsMark**("*marker-text*"), "*macro*")

The **IfThen** macro executes a Help macro if a given marker exists. It uses the **IsMark** macro to make the test.

Parameter	Description
marker-text	Specifies a text marker previously created by using the **SaveMark** macro. The marker must be enclosed in quotation marks.
macro	Specifies a Help macro or macro string to be executed if the marker exists. Multiple macros in a macro string must be separated by semicolons.

Example

The following macro jumps to the topic with context string "man_mem" if a marker named "Managing Memory" has been set by the **SaveMark** macro:

```
IfThen(IsMark("Managing Memory"), "JI(`trb.hlp', `man_mem')")
```

See Also

IsMark, **SaveMark**

IfThenElse WinHelp macro

IfThenElse(**IsMark**("*marker-text*"), "*macro1*", "*macro2*")

The **IfThenElse** macro executes one of two Help macros depending on whether or not a marker exists. It uses the **IsMark** macro to make the test.

Parameter	Description
marker-text	Specifies a text marker previously created by using the **IsMark** macro. The marker must be enclosed in quotation marks.
macro1	Specifies a Help macro or macro string to be executed if the marker exits. Multiple macros in either macro string must be separated by semicolons.
macro2	Specifies a Help macro or macro string to be executed if the marker does not exit. Multiple macros in either macro string must be separated by semicolons.

Example

The following macro jumps to the topic with context string "mem" if a marker named "Memory" has been set by the **SaveMark** macro. If the marker does not exist, it jumps to the next topic in the browse sequence.

```
IfThenElse(IsMark("Memory"), "JI(`trb.hlp', `mem')", "Next()")
```

See Also

IfThen, **IsMark**, **SaveMark**

InsertItem WinHelp macro

InsertItem("*menu-id*", "*item-id*", "*item-name*", "*macro*", *position*)

The **InsertItem** macro inserts a menu item at a given position on an existing menu. The menu can be either one you create with the **InsertMenu** macro or one of the standard Windows Help menus.

Parameter	Description
menu-id	Identifies either a standard Windows Help menu or a menu previously created by using the **InsertMenu** macro. For a standard menu, this parameter can be one of the following:

Name	Menu
MNU_FILE	File
MNU_EDIT	Edit
MNU_BOOKMARK	Bookmark menu
MNU_HELPON	Help

For other menus, this parameter must be the name used with the **InsertMenu** macro. In all cases, the menu identifier must be enclosed in quotation marks. The new item is inserted into this menu.

item-id	Specifies the name that Windows Help uses internally to identify the menu item. The item identifier must be enclosed in quotation marks.
item-name	Specifies the name Windows Help displays in the menu for the item. This name is case-sensitive and must be enclosed in quotation marks. An ampersand (&) before a character in the name identifies it as the item's keyboard access key.
macro	Specifies a Help macro or macro string to be executed when the user chooses the menu item. The macro must be enclosed in quotation marks. Multiple macros in a string must be separated by semicolons (;).
position	Specifies the position of the menu item in the menu. It must be an integer value. Position 0 is the first or topmost position in the menu.

Comments

The *item-id* parameter can be used in a subsequent **DisableItem** or **DeleteItem** macro to remove or disable the item or to change the operations that the item performs in certain topics.

Windows Help ignores this macro if it is executed in a secondary window.

The specified keyboard access keys must be unique. If a key conflicts with other menu access keys, Windows Help displays the error message "Unable to add item" and ignores the macro.

Example

The following macro inserts a menu item labeled "Tools" as the third item on a menu that has an identifier "MNU_BKS". Selecting the menu item causes a jump to a topic with the context string "tls1" in the TLS.HLP file:

```
InsertItem("mnu_bks", "m_tls", "&Tools", "JI(`tls.hlp', `tls1')", 3)
```

See Also

InsertMenu

InsertMenu WinHelp macro

InsertMenu("*menu-id*", "*menu-name*", *menu-position*)

The **InsertMenu** inserts a new menu in the Windows Help menu bar.

Parameter	Description
menu-id	Specifies the name that Windows Help uses internally to identify the menu. The menu identifier must be enclosed in quotation marks. This identifier can be used in the **AppendItem** macro to add macros to the menu.
menu-name	Specifies the name that Windows Help displays on the menu bar. This name must be enclosed in quotation marks. An ampersand (&) before a character in the name identifies it as the menu's keyboard access key.
menu-position	Specifies the position on the menu bar of the new menu name. This parameter must be an integer number. Positions are numbered from left to right, with position 0 the left-most menu.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

Example

The following macro adds a menu named "Utilities" to the Windows Help application. The label "Utilities" appears as the fourth item on the Windows Help menu bar. The user presses U with the ALT key to open the menu.

```
InsertMenu("IDM_UTIL", "&Utilities", 3)
```

See Also

AppendItem, **InsertItem**

IsMark WinHelp macro

IsMark("*marker-text*")

The **IsMark** macro tests whether or not a marker set by the **SaveMark** macro exists. It is used as a parameter to the conditional macros **IfThen** and **IfThenElse**. The **IsMark** macro returns nonzero if the mark exists or zero if it does not.

Parameter	Description
marker-text	Specifies a text marker previous created using the **SaveMark** macro.

Comments

The **Not** macro can be used to reverse the results of the **IsMark** macro.

Example

The following macro jumps to the topic with the context string "man_mem" if a marker named "Managing Memory" has been set by the **SaveMark** macro:

```
IfThen(IsMark("Managing Memory"), "JI(`trb.hlp', `man_mem')")
```

See Also

IfThen, **IfThenElse**, **Not**

JumpContents WinHelp macro

JumpContents("*filename*")

The **JumpContents** macro jumps to the Contents topic of a specified file in the Help file. The Contents topic is indicated by the CONTENTS option entry in the **[OPTIONS] section** of project file. If the CONTENTS option is not specified, Windows Help jumps to the first topic in the Help file.

Parameter	Description
filename	Specifies the name of the destination file for the jump. The filename must be enclosed in quotation marks. If Windows Help cannot find this file, it displays an error message and does not perform the jump.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

Example

The following macro jumps to the Contents topic of the PROGMAN.HLP file:

```
JumpContents("PROGMAN.HLP")
```

See Also

JumpContext

JumpContext WinHelp macro

JumpContext("*filename*", *context-number*)

Parameter	Description
filename	Specifies the name of the destination file for the jump. The filename must be enclosed in quotation marks. If Windows Help cannot find this file, it displays an error message and does not perform the jump.
context-number	Specifies the context number of the topic in the destination file. The context number must be defined in the [MAP] section of the project file. If the context number is not valid, Windows Help jumps to the Contents topic or to the first topic in the file instead and displays an error message.

Comments

The **JumpContext** macro can be abbreviated as **JC**.

Example

The following macro jumps to the topic mapped to the context number 801 in the PROGMAN.HLP file:

```
JumpContext("PROGMAN.HLP", 801)
```

See Also

JumpContents

JumpHelpOn WinHelp macro

JumpHelpOn()

The **JumpHelpOn** macro jumps to the Contents topic of the How to Use Help file. The How To Use Help file is either the default WINHELP.HLP file shipped with Windows 3.1 or the Help file designated by the **SetHelpOnFile** macro in the **[CONFIG] section** of the project file.

Parameters

This macro does not take any parameters.

Comments

If Windows Help cannot find the specified Help file, it displays an error message and does not perform the jump.

Example

The following macro jumps to the Contents topic of the designated How to Use Help file:

```
JumpHelpOn()
```

JumpId WinHelp macro

JumpId("*filename*", "*context-string*")

The **JumpId** macro jumps to the topic with the specified context string in the Help file.

Parameter	Description
filename	Specifies the name of the Help file containing the context string. The filename must be enclosed in quotation marks. If Windows Help does not find this file, it displays an error message and does not perform the jump.
context-string	Context string of the topic in the destination file. The context string must be enclosed in quotation marks. If the context string does not exist, Windows Help jumps to the Contents topic for that file instead.

Comments

The **JumpId** macro may be abbreviated as **JI**.

Example

The following macro jumps to a topic with "second_topic" as its context string in the SECOND.HLP file:

```
JI("second.hlp", "second_topic")
```

JumpKeyword WinHelp macro

JumpKeyword("*filename*", "*keyword*")

The **JumpKeyword** macro loads the indicated Help file, searches through the K keyword table, and displays the first topic containing the index keyword specified in the macro.

Parameter	Description
filename	Specifies the name of the Help file containing the desired keyword table. The filename must be enclosed in quotation marks. If this file does not exist, Windows Help displays an error message and does not perform the jump.
keyword	Specifies the keyword that the macro searches for. The keyword must be enclosed in quotation marks. If Windows Help finds more than one match, it displays the first matched topic. If it does not find any matches, it displays a "Not a keyword" message and displays the Contents topic of the destination file instead.

Comments

The **JumpKeyword** macro can be abbreviated as **JK**.

Example

The following macro displays the first topic that has "hands" as an index keyword in the CLOCK.HLP file:

```
JumpKeyword("clock.hlp", "hands")
```

Next WinHelp macro

Next()

The **Next** macro displays the next topic in the browse sequence for the Help file.

Parameters

This macro does not take any parameters.

Comments

If the currently displayed topic is the last topic of a browse sequence, this macro does nothing.

Windows Help ignores this macro if it is executed in a secondary window.

Not WinHelp macro

Not(**IsMark**("*marker-text*"))

The **Not** macro reverses the result (nonzero or zero) returned by the **IsMark** macro. It is used along with the **IsMark** macro as a parameter to the conditional macros **IfThen** and **IfThenElse**.

Parameter	Description
marker-text	Specifies a text marker previously created by using the **SaveMark** macro. The marker text must be enclosed in quotation marks.

Example

The following macro jumps to the topic with the context string "mem1" if a marker named "Memory" has not been set by the **SaveMark** macro:

```
IfThen(Not(IsMark("Memory")), "JI(`trb.hlp', `mem1')")
```

See Also

IfThen, **IfThenElse**, **IsMark**

PopupContext WinHelp macro

PopupContext("*filename*", *context-number*)

The **PopupContext** macro displays in a pop-up window the topic identified by a specific context number.

Parameter	Description
filename	Specifies the name of the file that contains the topic to be displayed. The filename must be enclosed in quotation marks. If Windows Help cannot find this file, it displays an error message.
context number	Specifies the context number of the topic to be displayed. The context number must be specified in the [MAP] section of the project file. If the context number is not valid, Windows Help displays the Contents topic or the first topic in the file instead.

Comments

The **PopupContext** macro can be abbreviated as **PC**.

Example

The following macro displays in a pop-up window the topic mapped to the context number 801 in the PROGMAN.HLP file:

```
PopupContext("progman.hlp", 801)
```

See Also

PopupId

PopupId WinHelp macro

PopupId("*filename*", "*context-string*")

The **PopupId** macro displays a topic from a specified file in a pop-up window.

Parameter	Description
filename	Specifies the name of the file containing the pop-up window topic. The filename must be enclosed in quotation marks. If this file does not exist, Windows Help displays a warning.
context-string	Specifies the context string of the topic in the destination file. If the requested context string does not exist, Windows Help displays the Contents topic or the first topic in the file.

Comments

The **PopupId** macro can be abbreviated as **PI**.

Example

The following macro displays a pop-up window with context string "second_topic" from the SECOND.HLP file:

```
PopupId("second.hlp", "second_topic")
```

See Also

PopupContext

PositionWindow WinHelp macro

PositionWindow(*x, y, width, height, state,* "*name*")

The **PositionWindow** macro sets the size and position of a window.

Parameter	Description
x	Specifies the x-coordinate, in help units, of the upper-left corner of the window. Windows Help always assumes the screen (regardless of resolution) is 1024 help units wide. For example, if the x-coordinate is 512, the left edge of the Help window is in the middle of the screen.
y	Specifies the y-coordinate, in help units, of the upper-left corner of the window. Windows Help always assumes the screen (regardless of resolution) is 1024 help units high. For example, if the y-coordinate is 512, the top edge of the Help window is in the middle of the screen.
width	Specifies the default width, in help units, of the window.
height	Specifies the default height, in help units, of the window.
state	Specifies how the window is sized. This parameter can be one of the following values:

Value	Meaning
0	Normal size
1	Maximized

If the parameter is 1, Windows Help ignores the *x, y, width,* and *height* parameters.

name	Specifies the name of the window to position. The name "main" is reserved for the main Help window. For secondary windows, the window name must be defined in the [WINDOWS] section of the project file. This name must be enclosed in quotation marks.

Comments

If the window to be positioned does not exist, Windows Help ignores the macro.

The **PositionWindow** macro can be abbreviated as **PW**.

Example

The following macro positions the secondary window "Samples" in the upper-left corner (100, 100) with a width and height of 500 (in help units):

```
PositionWindow(100, 100, 500, 500, 0, "Samples")
```

Prev WinHelp macro

Prev()

The **Prev** macro displays the previous topic in the browse sequence for the Help file. If the currently displayed topic is the first topic of a browse sequence, this macro does nothing.

Parameters

This macro does not take any parameters.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

Print WinHelp macro

Print()

The **Print** macro sends the currently displayed topic to the printer. It should be used only to print topics in windows other than the main Help window (for example, topics in a secondary window).

Parameters

This macro does not take any parameters.

See Also
PrinterSetup

PrinterSetup WinHelp macro

PrinterSetup()

The **PrinterSetup** macro displays the Printer Setup dialog box from the File menu.

Parameters

This macro does not take any parameters.

Comments

Use of the macro in secondary windows is not recommended.

See Also

Print

RegisterRoutine WinHelp macro

RegisterRoutine("*DLL-name*", "*function-name*", "*format-spec*")

The **RegisterRoutine** macro registers a function within a dynamic-link library (DLL). Registered functions can be used in macro footnotes in topic files or in the **[CONFIG]** section of the project file, the same as standard Help macros.

Parameter	Description
DLL-name	Specifies the filename of the DLL. The filename must be enclosed in quotation marks. If Windows Help cannot find the library, it displays an error message.
function-name	Specifies the name of the function to execute in the designated DLL.
format-spec	Specifies a string indicating the formats of parameters passed to the function. The format string must be enclosed in quotation marks. Characters in the string represent C parameter types:

Character	Description
u	**unsigned short** (**WORD**)
U	**unsigned long** (**DWORD**)
i	**short int**
I	**int**
s	**near char *** (PSTR)
S	**far char *** (**LPSTR**)
v	**void**

If the function is used as a Help macro, Windows Help makes sure the macro parameters match the parameter types given in this macro.

Comments

The **RegisterRoutine** macro can be abbreviated as **RR**.

Example

The following call registers a routine named PlayAudio in a DLL, MMLIB.DLL. PlayAudio takes arguments of the **far char ***, **int**, and **unsigned long** types:

```
RegisterRoutine("MMLIB", "PlayAudio", "SIU")
```

RemoveAccelerator WinHelp macro

RemoveAccelerator(*key, shift-state*)

The **RemoveAccelerator** macro removes the assignment of a Help macro to an accelerator key (or key combination). These assignments are made by using the **AddAccelerator** macro.

Parameter	Description
key	Specifies the Windows virtual-key value. See the **Virtual key codes** topic for a list of virtual-key codes that may be used for this parameter.
shift-state	Specifies the combination of ALT, SHIFT, and CTRL keys that were used with the accelerator. This parameter may be one of the following values:

Value	Meaning
0	None
1	SHIFT
2	CTRL
3	SHIFT+CTRL
4	ALT
5	ALT+SHIFT
6	ALT+CTRL
7	SHIFT+ALT+CTRL

Comments

The **RemoveAccelerator** macro can be abbreviated as **RA**. No error occurs when this macro is used with an accelerator for which a macro was not defined.

Example

The following macro disassociates a macro from the ALT+SHIFT+**CONTROL**+F4 key combination:

```
RemoveAccelerator(0x73, 7)
```

See Also

AddAccelerator

SaveMark WinHelp macro

SaveMark("*marker-text*")

The **SaveMark** macro saves the location of the currently displayed topic and file and associates a text marker with that location. The **GotoMark** macro can then be used to jump to this location.

Parameter	Description
marker-text	Specifies the text marker to be used to identify the topic location. This text must be enclosed in quotation marks, and it must be unique. If the same text is used for more than one marker, the most recently entered marker is used.

Comments

A text marker can be used with the **GotoMark**, **DeleteMark**, **IfThen**, and **IfThenElse** macros.

If the user exits Windows Help, all text markers are deleted.

Example

The following macro saves the marker "Managing Memory" in the current topic:

```
SaveMark("Managing Memory")
```

See Also

DeleteMark, **GotoMark**, **IfThen**, **IfThenElse**, **IsMark**, **Not**

Search WinHelp macro

Search()

The **Search** macro displays the dialog for the Search button, which allows users to search for topics using keywords defined by the K footnote character.

Parameters

This macro does not take any parameters.

Comments

Windows Help ignores this macro if it is executed in a secondary window.

SetContents WinHelp macro

SetContents("*filename*", *context-number*)

The **SetContents** macro designates a specific topic as the Contents topic in the specified Help file.

Parameter	Description
filename	Specifies the name of the Help file that contains the Contents topic. The filename must be enclosed in quotation marks. If Windows Help cannot find this file, it displays an error message and does not perform the jump.
context number	Specifies the context number of the topic in the specified file. The context number must be defined in the [MAP] section of the project file. If the context number is not valid, Windows Help displays an error message.

Example

The following example sets the topic mapped to the context number 801 in the PROGMAN.HLP file as the Contents topic. After executing this macro, clicking the Contents button will cause a jump to the topic specified by the *context-number* parameter:

```
SetContents("PROGMAN.HLP", 801)
```

SetHelpOnFile WinHelp macro

SetHelpOnFile("*filename*")

Parameter	Description
filename	Specifies the name of the replacement How to Use Help file. The filename must be enclosed in quotation marks. If Windows Help cannot find this file, it displays an error message.

Comments

If this macro appears in a topic in the Help file, the replacement file is set after execution of the macro. If this macro appears in the **[CONFIG] section** of the project file, the replacement file is set when the help file is opened.

Example

The following macro sets the Using Help file to MYHELP.HLP:

```
SetHelpOnFile("myhelp.hlp")
```

UncheckItem WinHelp macro

UncheckItem("*item-id*")

The **UncheckItem** macro removes the check mark from a menu item.

Parameter	Description
item-id	Identifies the menu item to uncheck. The item identifier must be enclosed in quotation marks.

Comments

The **UncheckItem** macro can be abbreviated **UI**.

See Also

CheckItem

Help Macros

About WinHelp macro	Displays the About dialog box
AddAccelerator WinHelp macro	Assigns a macro to an accelerator key
Annotate WinHelp macro	Displays Annotation dialog box
AppendItem WinHelp macro	Appends a menu item
Back WinHelp macro	Displays previous topic in the history list
BookmarkDefine WinHelp macro	Displays the Define dialog box
BookmarkMore WinHelp macro	Displays the More dialog box
BrowseButtons WinHelp macro	Adds browse buttons
ChangeButtonBinding WinHelp macro	Assigns a macro to a button
ChangeItemBinding WinHelp macro	Assigns a macro to a menu item
CheckItem WinHelp macro	Checks a menu item
CloseWindow WinHelp macro	Closes a window
Contents WinHelp macro	Displays the Contents topic
CopyDialog WinHelp macro	Displays the Copy dialog box
CopyTopic WinHelp macro	Copies current topic to the clipboard
CreateButton WinHelp macro	Adds a new button to the button bar
DeleteItem WinHelp macro	Removes a menu item
DeleteMark WinHelp macro	Deletes a text marker
DestroyButton WinHelp macro	Removes a button from the button bar
DisableButton WinHelp macro	Disables a button
DisableItem WinHelp macro	Disables a menu item
EnableButton WinHelp macro	Enables a button
EnableItem WinHelp macro	Enables a menu item
ExecProgram WinHelp macro	Executes a program
Exit WinHelp macro	Exits WinHelp
FileOpen WinHelp macro	Displays the Open dialog box
FocusWindow WinHelp macro	Changes the focus window
GoToMark WinHelp macro	Jumps to a marker
HelpOn WinHelp macro	Displays the Help on Using topic
HelpOnTop WinHelp macro	Toggles on-top state of help
History WinHelp macro	Displays the history list
IfThen WinHelp macro	Executes macro if marker exists
IfThenElse WinHelp macro	Executes one of two macros if marker exists
InsertItem WinHelp macro	Inserts a menu item
InsertMenu WinHelp macro	Inserts a new menu
IsMark WinHelp macro	Tests if a marker is set
JumpContents WinHelp macro	Jumps to the Contents topic
JumpContext WinHelp macro	Jumps to the specified context
JumpHelpOn WinHelp macro	Jumps to Using Help file
JumpId WinHelp macro	Jumps to the specified topic
JumpKeyword WinHelp macro	Jumps to the topic containing the keyword
Next WinHelp macro	Displays the next topic in the browse sequence
Not WinHelp macro	Reverses the IsMark macro
PopupContext WinHelp macro	Displays a topic in a popup window
PopupId WinHelp macro	Displays topic in a popup window
PositionWindow WinHelp macro	Sets the size and position of a window
Prev WinHelp macro	Displays previous topic in browse sequence
Print WinHelp macro	Prints the current topic
PrinterSetup WinHelp macro	Displays the Printer Setup dialog box
RegisterRoutine WinHelp macro	Registers a DLL function
RemoveAccelerator WinHelp macro	Assigns a macro to an accelerator key
SaveMark WinHelp macro	Saves a marker
Search WinHelp macro	Displays the Search dialog box
SetContents WinHelp macro	Sets the Contents topic
SetHelpOnFile WinHelp macro	Sets the Using Help help file

UncheckItem WinHelp macro Unchecks a menu item

RTF Tokens

\ansi	Specifies the ANSI character set
\b	Starts bold text
\bin	Specifies binary picture data
bmc	Displays a bitmap or metafile in text
bml	Displays a bitmap or metafile at the left margin
bmr	Displays a bitmap or metafile at the right margin
\box	Draws a box
\brdrb	Draws a bottom border
\brdrbar	Draws a vertical bar
\brdrdb	Sets double-lined borders
\brdrdot	Sets dotted border
\brdrl	Draws a left border
\brdrr	Draws a right border
\brdrs	Sets standard borders
\brdrt	Draws a top border
\brdrth	Sets thick borders
\cell	Marks end of table cell
\cellx	Sets the position of a cell's right edge
\cf	Sets the foreground color
\colortbl	Creates the color table
\deff	Sets default font
emc	Allows DLL to paint window in text
eml	Allows DLL to paint window at left margin
emr	Allows DLL to paint window at right margin
\f	Sets the font
\fi	Sets the first-line indent
\fldrslt	Result of a field
\fonttbl	Creates the font table
\footnote	Defines topic-specific information
\fs	Sets the font size
\'	Inserts a character by value
\i	Starts italic text
\intbl	Marks paragraph as in table
\keep	Makes text non-wrapping
\keepn	Creates a non-scrolling region
\li	Sets the left indent
\line	Breaks the current line
\mac	Sets the Apple MacIntosh character set
\page	Ends current topic
\par	Marks the end of a paragraph
\pard	Restores default paragraph properties
\pc	Sets the PC character set
\pich	Specifies the picture height
\pichgoal	Specifies the desired picture height

\picscalex	Specifies the horizontal scaling value
\picscaley	Specifies the vertical scaling value
\pict	Creates a picture
\picw	Specifies the picture width
\picwgoal	Specifies the desired picture width
\plain	Restores default character properties
\qc	Centers text
\ql	Aligns text left
\qr	Aligns text right
\ri	Sets the right indent
\row	Marks end of a table row
\rtf	Specifies the RTF version
\sa	Sets the spacing after a paragraph
\sb	Sets space before
\scaps	Starts small capitals
\sect	Marks the end of a section and paragraph
\sl	Sets the spacing between lines
\strike	Creates a hotspot
\tab	Inserts a tab character
\tqc	Tabs and centers text
\tqr	Tabs and aligns text right
\trgaph	Sets space between text columns in a table
\trleft	Sets left margin for the first cell
\trowd	Sets table defaults
\trqc	Sets relative column widths
\trql	Left-aligns table row
\tx	Sets a tab stop
\ul	Creates a link to a pop-up topic
\uldb	Creates a hot spot
\v	Creates a link to a topic
\wbitmap	Specifies a Windows bitmap
\wbmbitspixel	Specifies the number of bits per pixel
\wbmplanes	Specifies the number of planes
\wbmwidthbytes	Specifies the bitmap width in bytes
\wmetafile	Specifies a Windows metafile

\ansi RTF statement

\ansi

The **\ansi** statement sets the American National Standards Institute (ANSI) character set. The Windows character set is essentially equivalent to the ANSI character set.

See Also
\mac, **\pc**

\b RTF statement

\b

The **\b** statement starts bold text. The statement applies to all subsequent text up to the next **\plain** or **\b0** statement.

Comments

No **\plain** or **\b0** statement is required if the **\b** statement and subsequent text are enclosed in braces. Braces limit the scope of a character property statement to just the enclosed text.

The **\b0** statement was first supported in the Microsoft Help Compiler version 3.1.

Example

The following example sets "Note" to bold:

```
{\b Note}  Setting the Auto option frees novice users from
determining their system configurations.
```

See Also

\i, **\plain**, **\scaps**

\bin RTF statement

\bin*n*

The **\bin** statement indicates the start of binary picture data. The Help compiler interprets subsequent bytes in the file as binary data. This statement is used in conjunction with the **\pict** statement.

Parameter	Description
n	Specifies the number of bytes of binary data following the statement.

Comments

A single space character must separate the **\bin** statement from subsequent bytes. The Microsoft Help Compiler assumes that all subsequent bytes, including linefeed and carriage return characters, are binary data. These bytes can have any value in the range 0 through 255. For this reason, the **\bin** statement is typically used in program-generated files only.

If the **\bin** statement is not given with a **\pict** statement, the default picture data format is hexadecimal.

See Also

\pict

bmc RTF statement

\{**bmc** *filename*\}

The **bmc** statement displays a specified bitmap or metafile in the current line of text. The statement positions the bitmap or metafile as if it were the next character in the line, aligning it on the base line and applying the current paragraph properties.

Parameter	Description
filename	Specifies the name of a file containing either a Windows bitmap, a placeable Windows metafile, a multiresolution bitmap, or a segmented-graphics bitmap.

Comments

Since the **bmc** statement is not a standard RTF statement, the Microsoft Help Compiler relies on the opening and closing braces, including the backslashes (\), to distinguish the statement from regular text.

If a file containing a metafile is specified, the file must contain a placeable Windows metafile; the Microsoft Help Compiler will not accept standard Windows metafiles. Furthermore, Windows Help sets the MM_ANISOTROPIC mode prior to displaying the metafile, so the placeable Windows metafile must either set the window origin and extents or set some other mapping mode.

See Also

bmr, **bml**, **\wbitmap**

bml RTF statement

\{**bml** *filename*\}

The **bml** statement displays a specified bitmap or metafile at the left margin of the Help window. The first line of subsequent text aligns with the upper-right corner of the image and subsequent lines wrap along the right edge of the image.

Parameter	Description
filename	Specifies the name of a file containing either a Windows bitmap, a placeable Windows metafile, a multiresolution bitmap, or a segmented-graphics bitmap.

Comments

Since the **bml** statement is not a standard RTF statement, the Microsoft Help Compiler relies on the opening and closing braces, including the backslashes (\), to distinguish the statement from regular text.

If a file containing a metafile is specified, the file must contain a placeable Windows metafile; the Microsoft Help Compiler will not accept standard Windows metafiles. Furthermore, Windows Help sets the MM_ANISOTROPIC mode prior to displaying the metafile, so the placeable Windows metafile must either set the window origin and extents or set some other mapping mode.

See Also

bmc, **bmr**, **\wbitmap**

bmr RTF statement

\{**bmr** *filename*\}

The **bmr** statement displays a specified bitmap or metafile at the right margin of the Help window. The first line of subsequent text aligns with the upper-left corner of the image and subsequent lines wrap along the left edge of the image.

Parameter	Description
filename	Specifies the name of a file containing either a Windows bitmap, a placeable Windows metafile, a multiresolution bitmap, or a segmented-graphics bitmap.

Comments

Since the **bmr** statement is not a standard RTF statement, the Microsoft Help Compiler relies on the opening and closing braces, including the backslashes (\), to distinguish the statement from regular text.

If a file containing a metafile is specified, the file must contain a placeable Windows metafile; the Help compiler will not accept standard Windows metafiles. Furthermore, Windows Help sets the MM_ANISOTROPIC mode prior to displaying the metafile, so the placeable Windows metafile must either set the window origin and extents or set some other mapping mode.

See Also

bmc, **bml**, **\wbitmap**

\box RTF statement

\box

The **\box** statement draws a box around the current paragraph or picture. The statement applies to all subsequent paragraphs or pictures up to the next **\pard** statement.

Comments

For paragraphs, Windows Help uses the height of the paragraph, excluding space before or after the paragraph, as the height of the box. For pictures (as defined by **\pict** statements), Windows Help uses the specified height of the picture as the height of the box. For both paragraphs and pictures, the width of the box is equal to the space between the left and right indents.

Windows Help draws the box using the current border style.

Example

The following example draws a box around the paragraph:

```
\par \box
{\b Note}  Setting the Auto option frees novice users from
determining their system configurations.
\par \pard
```

See Also

\brdrb, **\brdrl**, **\brdrr**, **\brdrt**, **\pard**

\brdrb RTF statement

\brdrb

The **\brdrb** statement draws a border below the current paragraph or picture. The statement applies to all subsequent paragraphs or pictures up to the next **\pard** statement.

Comments

Windows Help draws the border using the current border style.

See Also

\box, **\brdrbar**, **\brdrl**, **\brdrr**, **\brdrt**, **\pard**

\brdrbar RTF statement

\brdrbar

The **\brdrbar** statement draws a vertical bar to the left of the current paragraph or picture. The statement applies to all subsequent paragraphs or pictures up to the next **\pard** statement.

Comments

Windows Help draws the border using the current border style.

In a print-based document, the **\brdrbar** statement draws the bar on the right side of paragraphs on odd-numbered pages, but on the left side of paragraphs on even-numbered pages.

See Also

\box, **\brdrl**, **\brdrb**, **\brdrr**, **\brdrt**, **\pard**

\brdrdb RTF statement

\brdrdb

The **\brdrdb** statement selects a double line for drawing borders. The selection applies to all subsequent paragraphs or pictures up to the next **\pard** statement.

See Also

\brdrdot, **\brdrs**, **\brdrth**, **\pard**

\brdrdot RTF statement

\brdrdot

The Help compiler ignores this statement.

See Also

\brdrs, **\brdrth**, **\brdrdb**, **\pard**

\brdrl RTF statement

\brdrl

The **\brdrl** statement draws a border to the left of the current paragraph or picture. The statement applies to all subsequent paragraphs or pictures up to the next **\pard** statement.

Comments

Windows Help draws the border using the current border style.

See Also

\box, **\brdrb**, **\brdrbar**, **\brdrr**, **\brdrt**, **\pard**

\brdrr RTF statement

\brdrr

The **\brdrr** statement draws a border to the right of the current paragraph or picture. The statement applies to all subsequent paragraphs or pictures up to the next **\pard** statement.

Comments

Windows Help draws the border using the current border style.

See Also

\box, **\brdrb**, **\brdrbar**, **\brdrl**, **\brdrt**, **\pard**

\brdrs RTF statement

\brdrs

The **\brdrs** statement selects a standard-width line for drawing borders. The selection applies to all subsequent paragraphs or pictures up to the next **\pard** statement.

See Also

\brdrdb, **\brdrdot**, **\brdrth**, **\pard**

\brdrt RTF statement

\brdrt

The **\brdrt** statement draws a border above the current paragraph or picture. The statement applies to all subsequent paragraphs or pictures up to the next **\pard** statement.

Comments

Windows Help draws the border using the current border style.

See Also

\box, **\brdrb**, **\brdrbar**, **\brdrl**, **\brdrr**, **\pard**

\brdrth RTF statement

\brdrth

The **\brdrth** statement selects a thick line for drawing borders. The selection applies to all subsequent paragraphs or pictures up to the next **\pard** statement.

See Also

\brdrdb, **\brdrdot**, **\brdrs**, **\pard**

\cell RTF statement (3.1)

\cell

The **\cell** statement marks the end of a cell in a table. A cell consists of all paragraphs from a preceding **\intbl** or **\cell** statement to the ending **\cell** statement. Windows Help formats and displays these paragraphs using the left and right margins of the cell and any current paragraph properties.

Comments

This statement was first supported in the Microsoft Help Compiler version 3.1.

Example

The following example creates a two-column table. The second column contains three separate paragraphs, each having different paragraph properties:

```
\cellx2880\cellx5760
\intbl
Alignment\cell
\ql
Left-aligned
\par
\qc
Centered
\par
\qr
Right-aligned\cell
\row \pard
```

See Also

\cellx, **\intbl**, **\row**, **\trgaph**, **\trleft**, **\trowd**

\cellx RTF statement (3.1)

\cellx*n*

The **\cellx** statement sets the absolute position of the right edge of a table cell. One **\cellx** statement must be given for each cell in the table. The first **\cellx** statement applies to the left-most cell, the last to the right-most cell. For each **\cellx** statement, the specified position applies to the corresponding cell in each subsequent row of the table up to the next **\trowd** statement.

Parameter	Description
n	Specifies the position of the cell's right edge, in twips. The position is relative to the left edge of the Help window. It is not affected by the current indents.

Comments

A table consists of a grid of cells in columns and rows. Each cell has an explicitly defined right edge; the position of a cell's left edge is the same as the position of the right edge of the adjacent cell. For the left-most cell in a row, the left edge position is equal to the Help window's left margin position. Each cell has a left and right margin between which Windows Help aligns and wraps text. By default, the margin positions are equal to the left and right edges. The **\trgaph** and **\trleft** statements can be used to set different margins for all cells in a row.

This statement was first supported in the Microsoft Help Compiler version 3.1.

Example

The following example creates a three-column table having two rows. The positions of the right edges of the three cells are 2, 4, and 6 inches, respectively:

```
\cellx2880\cellx5760\cellx8640
\intbl
Row 1 Cell 1\cell
Row 1 Cell 2\cell
Row 1 Cell 3\cell
\row
\intbl
Row 2 Cell 1\cell
Row 2 Cell 2\cell
Row 2 Cell 3\cell
\row \pard
```

See Also

\cell, **\intbl**, **\row**, **\trgaph**, **\trleft**, **\trowd**

\cf RTF statement

\cf*n*

The **\cf** statement sets the foreground color. The new color applies to all subsequent text up to the next **\plain** or **\cf** statement.

Parameter	Description
n	Specifies the color number to set as foreground. The number must be an integer number in the range 1 to the maximum number of colors specified in the color table for the Help file. If an invalid color number is specified, Windows Help uses the default foreground color.

Comments

No **\plain** or **\cf** statement is required if the **\cf** statement and subsequent text are enclosed in braces. Braces limit the scope of a character property statement to the enclosed text only.

If the **\cf** statement is not given, the default foreground color is the text color set by Control Panel.

Example

The following example displays green text:

```
{\colortbl;\red0\green255\blue0;}
{\cf1 This text is green.}
```

See Also

\colortbl

\colortbl RTF statement

{**\colortbl**
\red*r***\green***g***\blue***b;*
.
.
.
}

The **\colortbl** statement creates a color table for the Help file. The color table consists of one or more color definitions. Each color definition consists of one **\red**, **\green**, and **\blue** statement specifying the amount of primary color to use to generate the final color. Each color definition must end with a semicolon (;).

Parameter	Description
r	Specifies the intensity of red in the color. It must be an integer in the range 0 through 255.
g	Specifies the intensity of green in the color. It must be an integer in the range 0 through 255.
b	Specifies the intensity of blue in the color. It must be an integer in the range 0 through 255.

Comments

Color definitions are implicitly numbered starting at zero. A color definition's implicit number can be used in the **\cf** statement to set the foreground color.

The default colors are the window-text and window-background colors set by Control Panel. To override the default colors, both a **\colortbl** statement and a **\cf** statement must be given.

Example

The following example creates a color table containing two color definitions. The first color definition is empty (only the semicolon is given), so color number 0 always represents the default color. The second definition specifies green; color number 1 can be used to display green text:

```
{\colortbl;\red0\green255\blue0;}
```

See Also

\cf

\deff RTF statement

\deff*n*

The **\deff** statement sets the default font number. Windows Help uses the number to set the default font whenever a **\plain** statement is given or an invalid font number is given in a **\f** statement.

Parameter	Description
n	Specifies the number of the font to be used as the default font. This parameter must be a valid font number as specified by the **\fonttbl** statement for the Help file.

Comments

If the **\deff** statement is not given, the default font number is zero.

See Also

\f, **\fonttbl**, **\plain**

emc RTF statement

\{**emc** *module, class, data* [, *dx, dy*]\}

The **emc** statement allows an external dynamic-link library to paint a window that is embedded in a Help topic. This statement displays the window in the current line of text. The statement positions the window as if it were the next character in the line, aligning it on the base line and applying the current paragraph properties.

Parameter	Description
module	Specifies the name of the dynamic-link library that paints the embedded window.
class	Specifies the name of the registered window class for the embedded window.
data	Specifies a string that is passed to the embedded window in its **WM_CREATE** message.
dx	Specifies the suggested width of the embedded window. This parameter is optional.
dy	Specifies the suggested height of the embedded window. This parameter is optional.

Comments

Since the **emc** statement is not a standard RTF statement, the Microsoft Help Compiler relies on the opening and closing braces, including the backslashes (\), to distinguish the statement from regular text.

See Also

bmr, **bml**, **bmc**, **eml**, **emr**, **\wbitmap**

eml RTF statement

\{**eml** *module, class, data* [, *dx, dy*]\}

The **eml** statement allows an external dynamic-link library to paint a window that is embedded at the left margin in a Help topic. The first line of subsequent text aligns with the upper-right corner of the window and subsequent lines wrap along the right edge of the window.

Parameter	Description
module	Specifies the name of the dynamic-link library that paints the embedded window.
class	Specifies the name of the registered window class for the embedded window.
data	Specifies a string that is passed to the embedded window in its **WM_CREATE** message.
dx	Specifies the suggested width of the embedded window. This parameter is optional.
dy	Specifies the suggested height of the embedded window. This parameter is optional.

Comments

Since the **eml** statement is not a standard RTF statement, the Microsoft Help Compiler relies on the opening and closing braces, including the backslashes (\), to distinguish the statement from regular text.

See Also

bmr, **bml**, **bmc**, **emc**, **emr**, **\wbitmap**

emr RTF statement

\{**emr** *module, class, data* [, *dx, dy*]\}

The **emr** statement allows an external dynamic-link library to paint a window that is embedded at the right margin in a Help topic. The first line of subsequent text aligns with the upper-left corner of the window and subsequent lines wrap along the left edge of the window.

Parameter	Description
module	Specifies the name of the dynamic-link library that paints the embedded window.
class	Specifies the name of the registered window class for the embedded window.
data	Specifies a string that is passed to the embedded window in its **WM_CREATE** message.
dx	Specifies the suggested width of the embedded window. This parameter is optional.
dy	Specifies the suggested height of the embedded window. This parameter is optional.

Comments

Since the **emr** statement is not a standard RTF statement, the Microsoft Help Compiler relies on the opening and closing braces, including the backslashes (\), to distinguish the statement from regular text.

See Also

bmr, **bml**, **bmc**, **emc**, **eml**, **\wbitmap**

\f RTF statement

\f*n*

The **\f** statement sets the font. The new font applies to all subsequent text up to the next **\plain** or **\f** statement.

Parameter	Description
n	Specifies the font number. This parameter must be one of the integer font numbers defined in the font table for the Help file.

Comments

The **\f** statement does not set the point size of the font; use the **\fs** statement instead.

No **\plain** or **\f** statement is required if the **\f** statement and subsequent text are enclosed in braces. Braces limit the scope of a character property statement to just the enclosed text.

If the **\f** statement is not given, the default font is defined by the **\deff** statement (or is zero if no **\deff** statement is given).

Example

The following example uses the Arial font to display text:

```
{\fonttbl {\f0\fswiss Arial;}}
{\f0
This text illustrates the Arial font.}
\par
```

See Also

\deff, **\fonttbl**, **\fs**, **\plain**

\fi RTF statement

\fi*n*

The **\fi** statement sets the first-line indent for the paragraph. The new indent applies to the first line of each subsequent paragraph up to the next **\pard** statement or **\fi** statement. The first-line indent is always relative to the current left indent.

Parameter	Description
n	Specifies the indent, in twips. This parameter can be either a positive or negative number.

Comments

If the **\fi** statement is not given, the first-line indent is zero by default.

Example

The following example uses the first-line indent and a tab stop to make a numbered list:

```
\tx360\li360\fi-360
1
\tab
Insert the disk in drive A.
\par
2
\tab
Type a:setup and press the ENTER key.
\par
3
\tab
Follow the instructions on the screen.
\par \pard
```

See Also

\li, **\pard**

\fldrslt RTF statement

\fldrslt

The **\fldrslt** statement specifies the most recently calculated result of a field. The Microsoft Help Compiler interprets the result as text and formats it using the current character and paragraph properties.

Comments

The Help compiler ignores all field statements except the **\fldrslt** statement. Any text associated with other field statements is ignored.

\fonttbl RTF statement

{**\fonttbl**
    {**\f***n**family font-name;*}
        .
        .
        .
}

The **\fonttbl** statement creates a font table for the Help file. The font table consists of one or more font definitions. Each definition consists of a font number, a font family, and a font name.

Parameter	Description
n	Specifies the font number. This parameter must be an integer. This number can be used in subsequent **\f** statements to set the current font to the specified font. In the font table, font numbers should start at zero and increase by one for each new font definition.
family	Specifies the font family. This parameter must be one of the following:

Value	Meaning
fnil	Unknown or default fonts (default)
froman	Roman, proportionally spaced serif fonts (for example, MS Serif and Palatino)
fswiss	Swiss, proportionally spaced sans serif fonts (for example, Swiss)
fmodern	Fixed-pitch serif and sans serif fonts (for example, Courier, Elite, and Pica)
fscript	Script fonts (for example, Cursive)
fdecor	Decorative fonts (for example, Old English and ITC Zapf Chancery)
ftech	Technical, symbol, and mathematical fonts (for example, Symbol)

font-name	Specifies the name of the font. This parameter should specify an available Windows font.

Comments

If a font with the specified name is not available, Windows Help chooses a font from the specified family. If no font from the given family exists, Windows Help chooses a font having the same character set as specified for the Help file.

The **\deff** statement sets the default font number for the Help file. The default font is set whenever the **\pard** statement is given.

See Also

\deff, **\f**, **\fs**, **\pard**

\footnote RTF statement

{*n*}{\footnote {*n*} *text*}

The **\footnote** statement defines topic-specific information, such as the topic's build tags, context string, title, browse number, keywords, and execution macros. Every topic must have a context string, at least, to give the user access to the topic through links.

Parameter	Description
n	Specifies the footnote character. It can be one of the following:

Value	Meaning
*	Specifies a build tag. The Microsoft Help Compiler uses build tags to determine whether it should include the topic in the Help file. The *text* parameter can be any combination of characters but must not contain spaces. Uppercase and lowercase characters are treated as equivalent characters (case-insensitive). If a topic has build-tag statements, they must be the first statements in the topic. The Microsoft Help Compiler checks a topic for build tags if the project file specifies a build expression using the **BUILD** option.
#	Specifies a context string. The *text* parameter can be any combination of letters and digits but must not contain spaces. Uppercase and lowercase characters are treated as equivalent characters (case-insensitive). The context string can be used with the **\v** statement in other topics to create links to this topic.
$	Specifies a topic title. Windows Help uses the topic title to identify the topic in the Search and History dialog boxes. The *text* parameter can be any combination of characters including spaces.
+	Specifies the browse-sequence identifier. Windows Help adds topics having an identifier to the browse sequence and allows users to view the topics by using the browse buttons. The *text* parameter can be a combination of letters and digits. Windows Help determines the order of topics in the browse sequence by sorting the identifier alphabetically. If two topics have the same identifier, Windows Help assumes that the topic that was compiled first is to be displayed first. Windows Help uses the browse sequence identifier only if the browse buttons have been enabled by using the **BrowseButtons** macro.
K	Specifies a keyword. Windows Help displays all keywords in the Help file in the Search dialog box and allows a user to choose a topic to view by choosing a keyword. The *text* parameter can be any combination of characters including spaces. If the first character is the letter *K,* it must be preceded with an extra space or a semicolon. More than one keyword can be given by separating the keywords with semicolons (;). A topic cannot contain keywords unless it also has a topic title.
!	Specifies a Help macro. Windows Help executes the macro when the topic is displayed. The *text* parameter can be any Help macro.

If *n* is any letter (other than *K*), the footnote specifies an alternative keyword. Windows applications can search for topics having alternative keywords by using the HELP_MULTIKEY command with the **WinHelp** function.

text	Specifies the build tag, context string, topic title, browse-sequence number, keyword, or macro associated with the footnote. This parameter depends on the footnote type as specified by the *n* parameter.

Comments

Repetition of the footnote character, *n,* in the syntax is deliberate.

A topic can have more than one build-tag, context-string, keyword, and help-macro statement, but must

not have more than one topic-title or browse-sequence-number statement.

In print-based documents, the **\footnote** statement creates a footnote. The footnote is anchored to the character immediately preceding the **\footnote** statement.

The characters in a context string must be alphanumeric and can include underscore characters (_) and periods (.).

The browse sequence string consists of a major sequence string and a minor sequence string, delimited by a colon:

{+}{\footnote {+} *major:minor*}

This syntax specifies disjoint sets of ordered browse sequences. The major sequence string determines which browse sequence a topic belongs to, while the minor sequence string determines its position. Minor sequence strings are sorted alphabetically, not numerically; to use numbers, they should be preceded with zeros so that they are all the same length. All topics with browse sequence strings that omit the major sequence string are placed on the same browse sequence.

A topic cannot have more than one build tag footnote. If a topic has a build tag footnote, it must be the first thing in that topic. The title, browse sequence, and macro must be in the first paragraph. Context strings and keywords may appear anywhere; if placed in the middle of a topic, jumps to that context string or keyword will bring you to the middle of that topic.

Example

The following example defines a topic titled "Short Topic". The context string "topic1" can be used to create links to this topic. The keywords "example topic" and "short topic" appear in the Search dialog box and can be used to choose the topic for viewing:

```
${\footnote Short Topic}
#{\footnote topic1}
K{\footnote example topic;short topic}
This topic has a title, context string, and two keywords.
\par
\page
```

See Also

\v

\fs RTF statement

\fs*n*

The **\fs** statement sets the size of the font. The new font size applies to all subsequent text up to the next **\plain** or **\fs** statement.

Parameter	Description
n	Specifies the size of the font, in half points.

Comments

The **\fs** statement does not set the font face; use the **\f** statement instead.

No **\plain** or **\fs** statement is required if the **\fs** statement and subsequent text are enclosed in braces. Braces limit the scope of a character property statement to just the enclosed text.

If the **\fs** statement is not given, the default font size is 24.

Example

The following example sets the size of the font to 10 points:

```
{\fs20 This line is in 10 point type.}
\par
```

See Also

\plain, **\f**

\' RTF statement

\'*hh*

The **\'** statement converts the specified hexadecimal number into a character value and inserts the value into the Help file. The appearance of the character when displayed depends on the character set specified for the Help file.

Parameter	Description
hh	Specifies a two-digit hexadecimal value.

Comments

Since the Microsoft Help Compiler does not accept character values greater than 127, the **\'** statement is the only way to insert such character values into the Help file.

Example

The following example inserts a trademark in a Help file that uses the **\ansi** statement to set the character set:

```
ABC\'99 is a trademark of the ABC Product Corporation.
```

See Also

\ansi, **\mac**, **\pc**

\i RTF statement

\i

The **\i** statement starts italic text. The statement applies to all subsequent text up to the next **\plain** or **\i0** statement.

Comments

No **\plain** or **\i0** statement is required if the **\i** statement and subsequent text are enclosed in braces. Braces limit the scope of a character property statement to just the enclosed text.

Example

The following example sets "not" to italic:

```
You must {\i not} save the file without first setting the
Auto option.
```

See Also

\b, **\plain**, **\scaps**

\intbl RTF statement (3.1)

\intbl

The **\intbl** statement marks subsequent paragraphs as part of a table. The statement applies to all subsequent paragraphs up to the next **\row** statement.

Comments
This statement was first supported in Microsoft Help Compiler version 3.1.

Example
The following example creates a three-column table having two rows:

```
\cellx1440\cellx2880\cellx4320
\intbl
Row 1 Column 1\cell
Row 1 Column 2\cell
Row 1 Column 3\cell \row
\intbl
Row 2 Column 1\cell
Row 2 Column 2\cell
Row 2 Column 3\cell \row \pard
```

See Also
\cell, **\cellx**, **\row**, **\trgaph**, **\trleft**, **\trowd**

\keep RTF statement

\keep

The **\keep** statement prevents Windows Help from wrapping text to fit the Help window. The statement applies to all subsequent paragraphs up to the next **\pard** statement.

Comments

If the text in a paragraph exceeds the width of the Help window, Help displays a horizontal scroll bar.

In print-based documents, the **\keep** statement keeps paragraphs intact.

See Also

\keepn, **\line**

\keepn RTF statement

\keepn

The **\keepn** statement creates a non-scrolling region at the top of the Help window for the given topic. The **\keepn** statement applies to all subsequent paragraphs up to the next **\pard** statement. All paragraphs with this paragraph property are placed in the non-scrolling region.

Comments

If a **\keepn** statement is used in a topic, it must be applied to the first paragraph in the topic (and subsequent paragraphs as needed). The Help compiler displays an error message and does not create a non-scrolling region if paragraphs are given before the **\keepn** statement. Only one non-scrolling region per topic is allowed.

Windows Help formats, aligns, and wraps text in the non-scrolling region just as it does in the rest of the topic. It separates the non-scrolling region from the rest of the Help window with a horizontal bar. Windows Help sets the height of the non-scrolling region so that all all paragraphs in the region can be viewed if the help window is large enough. If the window is smaller than the non-scrolling region, the user will be unable to view the rest of the topic. For this reason, the non-scrolling region is typically reserved for a single line of text specifying the name or title of the topic.

In print-based documents, the **\keepn** statement keeps the subsequent paragraph with the paragraph that follows it.

See Also

\keep, **\page**

\li RTF statement

\li*n*

The **\li** statement sets the left indent for the paragraph. The indent applies to all subsequent paragraphs up to the next **\pard** or **\li** statement.

Parameter	Description
n	Specifies the indent, in twips. The value can be either positive or negative.

Comments

If the **\li** statement is not given, the left indent is zero by default. Windows Help automatically provides a small left margin so that if no indent is specified the text does not start immediately at the left edge of the Help window.

Specifying a negative left indent moves the starting point for a line of text to the left of the default left margin. If the negative indent is large enough, the start of the text may be clipped by the left edge of the help window.

Example

The following example uses the left indent and a tab stop to make a bulleted list. In this example, font number 0 is assumed to be the Symbol font:

```
Use the Auto command to:
\par
\tx360\li360\fi-360
{\f0\'B7}
\tab
Save files automatically
\par
{\f0\'B7}
\tab
Prevent overwriting existing files
\par
{\f0\'B7}
\tab
Create automatic backup files
\par \pard
```

See Also

\fi, **\pard**, **\ri**

\line RTF statement

\line

The **\line** statement breaks the current line without ending the paragraph. Subsequent text starts on the next line and is aligned and indented according to the current paragraph properties.

See Also

\par

\mac RTF statement

\mac

The **\mac** statement sets the Apple Macintosh character set.

See Also
\ansi, **\pc**

\page RTF statement

\page

The **\page** statement marks the end of a topic.

Comments
In a print-based document, the **\page** statement creates a page break.

Example
The following example shows a complete topic:

```
${\footnote Short Topic}
#{\footnote short_topic}
Most topics in a topic file consist of topic-title and
context-string statements followed by the topic text. Every
topic ends with a {\b \\page} statement.
\par
\page
```

See Also

\par

\par RTF statement

\par

The **\par** statement marks the end of a paragraph. The statement ends the current line of text and moves the current position to the left margin and down by the current line-spacing and space-after-paragraph values.

Comments

The first line of text after a **\par**, **\page**, or **\sect** statement marks the start of a paragraph. When a paragraph starts, the current position is moved down by the current space-before-paragraph value. Subsequent text is formatted using the current text alignment, line spacing, and left, right, and first-line indents.

Example

The following example has three paragraphs:

```
\ql
This paragraph is left-aligned.
\par \pard
\qc
This paragraph is centered.
\par \pard
\qr
This paragraph is right-aligned.
\par
```

See Also

\line, **\pard**, **\sect**

\pard RTF statement

\pard

The **\pard** statement restores all paragraph properties to default values.

Comments

If the **\pard** statement appears anywhere before the end of a paragraph (that is, before the **\par** statement), the default properties apply to the entire paragraph.

The default paragraph properties are as follows:

Property	Default
Alignment	Left-aligned
First-line indent	0
Left indent	0
Right indent	0
Space before	0
Space after	0
Line spacing	Tallest character
Tab stops	None
Borders	None
Border style	Single-width

See Also

\par

\pc RTF statement

\pc

The **\pc** statement sets the OEM character set (also known as code page 437).

See Also
\ansi, **\mac**

\pich RTF statement

\pich*n*

The **\pich** statement specifies the height of the picture. This statement must be used in conjunction with a **\pict** statement.

Parameter	Description
n	Specifies the height of the picture, in twips or pixels, depending on the picture type. If the picture is a metafile, the width is in twips; otherwise, the width is, in pixels.

See Also
\pict, **\picw**

\pichgoal RTF statement

\pichgoal*n*

The **\pichgoal** statement specifies the desired height of a picture. If necessary, Windows Help stretches or compresses the picture to match the requested height. This statement must be used in conjunction with a **\pict** statement.

Parameter	Description
n	Specifies the desired height, in twips.

Comments

The **\pichgoal** statement is not supported for metafiles. Applications should use the **\pich** statement, instead.

See Also

\pich, **\pict**, **\picwgoal**

\picscalex RTF statement

\picscalex*n*

The **\picscalex** statement specifies the horizontal scaling value. This statement must be used in conjunction with a **\pict** statement.

Parameter	Description
n	Specifies the scaling value as a percentage. If this value is greater than 100, the bitmap or metafile is enlarged.

Comments

If the **\picscalex** statement is not given, the default scaling value is 100.

See Also

\pict, **\picscaley**

\picscaley RTF statement

\picscaley*n*

The **\picscaley** statement specifies the vertical scaling value. This statement must be used in conjunction with a **\pict** statement.

Parameter	Description
n	Specifies the scaling value as a percentage. If this value is greater than 100, the bitmap or metafile is enlarged.

Comments

If the **\picscaley** statement is not given, the default scaling value is 100.

See Also

\pict, **\picscalex**

\pict RTF statement

\pict*picture-statementspicture-data*

The **\pict** statement creates a picture. A picture consists of hexadecimal or binary data representing a bitmap or metafile.

Parameter	Description
picture-statements	Specifies one or more statements defining the type of picture, the dimensions of the picture, and the format of the picture data. It can be a combination of the following statements:
picture-data	Specifies hexadecimal or binary data representing the picture. The picture data follows the last picture statement.

Statement	Descripton
\wbitmap	Specifies a Windows bitmap.
\wmetafile	Specifies a Windows metafile.
\picw	Specifies the picture width.
\pich	Specifies the picture height.
\picwgoal	Specifies the desired picture width.
\pichgoal	Specifies the desired picture height.
\picscalex	Specifies the horizontal scaling value.
\picscaley	Specifies the vertical scaling value.
\wbmbitspixel	Specifies the number of bits per pixel.
\wbmplanes	Specifies the number of planes.
\wbmwidthbytes	Specifies the bitmap width, in bytes.
\bin	Specifies binary picture data.

Comments

If a data format is not specified, the default format is hexadecimal.

See Also

\bin, **\pich**, **\pichgoal**, **\picscalex**, **\picscaley**, **\picw**, **\picwgoal**, **\wbitmap**, **\wbmbitspixel**, **\wbmplanes**, **\wbmwidthbytes**, **\wmetafile**

\picw RTF statement

\picw*n*

The **\picw** statement specifies the width of the picture. This statement must be used in conjunction with a **\pict** statement.

Parameter	Description
n	Specifies the width of the picture, in twips or pixels, depending on the picture type. If the picture is a metafile, the width is in twips; otherwise, the width is in pixels.

See Also
\pict, **\pich**

\picwgoal RTF statement

\picwgoal*n*

The **\picwgoal** statement specifies the desired width of the picture, in twips. If necessary, Windows Help stretches or compresses the picture to match the requested height. This statement must be used in conjunction with a **\pict** statement.

Parameter	Description
n	Specifies the desired width, in twips.

Comments

The **\picwgoal** statement is not supported for metafiles. Applications should use the **\picw** statement, instead.

See Also

\pict, **\picw**, **\pichgoal**

\plain RTF statement

\plain

The **\plain** statement restores the character properties to default values.

Comments

The default character properties are as follows:

Property	Default
Bold	Off
Italic	Off
Small caps	Off
Font	0
Font size	24

See Also

\b, **\i**, **\scaps**, **\f**, **\fs**

\qc RTF statement

\qc

The **\qc** statement centers text between the current left and right indents. The statement applies to subsequent paragraphs up to the next **\pard** statement or text-alignment statement.

Comments

If a **\ql**, **\qr**, or **\qc** statement is not given, the text is left-aligned by default.

See Also

\pard, **\ql**, **\qr**

\ql RTF statement

\ql

The **\ql** statement aligns text along the left indent. The statement applies to subsequent paragraphs up to the next **\pard** statement or text-alignment statement.

Comments

If a **\ql**, **\qr**, or **\qc** statement is not given, the text is left-aligned by default.

See Also

\pard, **\qc**, **\qr**

\qr RTF statement

\qr

The **\qr** statement aligns text along the right indent. The statement applies to subsequent paragraphs up to the next **\pard** statement or text-alignment statement.

Comments

If a **\ql**, **\qr**, or **\qc** statement is not given, the text is left-aligned by default.

See Also

\pard, **\qc**, **\ql**

\ri RTF statement

\ri*n*

The **\ri** statement sets the right indent for the paragraph. The indent applies to all subsequent paragraphs up to the next **\pard** or **\ri** statement.

Parameter	Description
n	Specifies the right indent, in twips. It can be a positive or negative value.

Comments

If the **\ri** statement is not given, the right indent is zero by default. Windows Help automatically provides a small right margin so that when no right indent is specified, the text does not end abruptly at the right edge of the Help window.

Windows Help never displays less than one word for each line in a paragraph even if the right indent is greater than the width of the window.

Example

In the following example, the right and left indents are set to one inch and the subsequent text is centered between the indents:

```
\li1440\ri1440\qc
Microsoft Windows Help\line
Sample File\line
```

See Also

\li, **\pard**

\row RTF statement

\row

The **\row** statement marks the end of a table row. The statement ends the current row and begins a new row by moving down pass the end of the longest cell in the row. The next **\cell** statement specifies the text of the leftmost cell in the next row.

Comments
This statement was first supported in the Microsoft Help Compiler version 3.1.

Example
The following example creates a table having four rows and two columns:

```
\cellx2880\cellx5760
\intbl
Row 1, Column 1\cell
Row 1, Column 2\cell \row
\intbl
Row 2, Column 1\cell
Row 2, Column 2\cell \row
\intbl
Row 3, Column 1\cell
Row 3, Column 2\cell \row
\intbl
Row 4, Column 1\cell
Row 4, Column 2\cell \row
\par \pard
```

See Also
\cell, **\cellx**, **\intbl**

\rtf RTF statement

\rtf*n*

The **\rtf** statement identifies the file as a rich-text format (RTF) file and specifies the version of the RTF standard used.

Parameter	Description
n	Specifies the version of the RTF standard used. For the Microsoft Help Compiler version 3.1, this parameter must be 1.

Comments

The **\rtf** statement must follow the first open brace in the Help file. A statement specifying the character set for the file must also follow the **\rtf** statement.

See Also

\ansi

\sa RTF statement

\sa*n*

The **\sa** statement sets the amount of vertical spacing after a paragraph. The vertical space applies to all subsequent paragraphs up to the next **\pard** or **\sa** statement.

Parameter	Description
n	Specifies the amount of vertical spacing, in twips.

Comments

If the **\sa** statement is not given, the vertical spacing after a paragraph is zero by default.

See Also

\sb, **\pard**

\sb RTF statement

\sb*n*

The **\sb** statement sets the amount of vertical spacing before the paragraph. The vertical space applies to all subsequent paragraphs up to the next **\pard** statement or **\sb** statement.

Parameter	Description
n	Specifies the amount of vertical spacing, in twips.

Comments

If the **\sb** statement is not given, the vertical spacing before the paragraph is zero by default.

See Also

\sa, **\pard**

\scaps RTF statement

\scaps

The **\scaps** statement starts small-capital text. The statement converts all subsequent lowercase letters to uppercase before displaying the text. This statement applies to all subsequent text up to the next **\plain** or **\scaps0** statement.

Comments

The **\scaps** statement does not affect uppercase letters.

No **\plain** or **\scaps0** statement is required if the **\scaps** statement and subsequent text are enclosed in braces. Braces limit the scope of a character property statement to just the enclosed text.

The **\scaps** statement does not reduce the point size of the text. To reduce point size, the **\fs** statement must be used.

Example

The following example displays the key name ENTER in small capitals:

```
Press the {\scaps enter} key to complete the action.
```

See Also

\fs, **\plain**

\sect RTF statement

\sect

The **\sect** statement marks the end of a section and paragraph.

See Also

\par

\sl RTF statement

\sl*n*

The **\sl** statement sets the amount of vertical space between lines in a paragraph. The vertical space applies to all subsequent paragraphs up to the next **\pard** or **\sl** statement.

Parameter	Description
n	Specifies the amount of vertical spacing, in twips. If this parameter is a positive value, Windows Help uses this value if it is greater than the tallest character. Otherwise, Windows Help uses the height of the tallest character as the line spacing. If this parameter is a negative value, Windows Help uses the absolute value of the number even if the tallest character is taller.

Comments

If the **\sl** statement is not given, Windows Help automatically sets the line spacing by using the tallest character in the line.

See Also

\pard

\strike RTF statement

\strike

The **\strike** statement creates a hot spot. The statement is used in conjunction with a **\v** statement to create a link to another topic. When the user chooses a hot spot, Windows Help displays the associated topic in the Help window.

The **\strike** statement applies to all subsequent text up to the next **\plain** or **\strike0** statement.

Comments
No **\plain** or **\strike0** statement is required if the **\strike** statement and subsequent text are enclosed in braces. Braces limit the scope of a character property statement to just the enclosed text.

The **\strike** statement creates the same type of hot spot as the **\uldb** statement.

In print-based documents, or whenever it is not followed by **\v**, the **\strike** statement creates strikeout text.

Example
The following example creates a hot spot for a topic. When displayed, the hot-spot text, "Hot Spot," is green and has a solid line under it:

```
{\strike Hot Spot}{\v Topic}
```

See Also
\ul, **\uldb**, **\v**

\tab RTF statement

\tab

The **\tab** statement inserts a tab character (ASCII character code 9).

Comments
The tab character (ASCII character code 9) has the same effect as the **\tab** statement.

See Also
\tqc, **\tqr**, **\tx**

\tqc RTF statement

\tqc

The **\tqc** statement is used with the **\tx** statement to create a tab stop where text is centered. For example, the following statement creates a centered tab stop at 2880 twips:

```
\tqc\tx2880
```

See Also
\tab, **\tqr**, **\tx**

\tqr RTF statement

\tqr

The **\tqr** statement is used with the **\tx** statement to create a tab stop where text right-justified. For example, the following statement creates a right-justified tab stop at 2880 twips:

```
\tqr\tx2880
```

See Also
\tab, **\tqc**, **\tx**

\trgaph RTF statement (3.1)

\trgaph*n*

The **\trgaph** statement specifies the amount of space between text in adjacent cells in a table. For each cell in the table, Windows Help uses the space to calculate the cell's left and right margins. It then uses the margins to align and wrap the text in the cell. Windows Help applies the same margin widths to each cell ensuring that paragraphs in adjacent cells have the specified space between them.

The **\trgaph** statement applies to cells in all subsequent rows of a table up to the next **\trowd** statement.

Parameter	Description
n	Specifies the space, in twips, between text in adjacent cells. If this parameter exceeds the actual width of the cell, the left and right margins are assumed to be at the same position in the cell.

Comments

The width of the left margin in the first cell is always equal to the space specified by this statement. The **\trleft** statement is typically used to move the left margin to a position similar to the left margins in all other cells.

This statement was first supported in the Microsoft Help Compiler version 3.1.

Example

The following example creates a three-column table with one-quarter inch space between the text in the columns:

```
\trgaph360 \cellx1440\cellx2880\cellx4320
\intbl
Row 1 Column 1\cell
Row 1 Column 2\cell
Row 1 Column 3\cell \row
\intbl
Row 2 Column 1\cell
Row 2 Column 2\cell
Row 2 Column 3\cell \row \pard
```

See Also

\cell, **\cellx**, **\intbl**, **\row**, **\trleft**, **\trowd**

\trleft RTF statement

\trleft*n*

The **\trleft** statement sets the position of the left margin for the first (leftmost) cell in a row of a table. This statement applies to the first cell in all subsequent rows of the table up to the next **\trowd** statement.

Parameter	Description
n	Specifies the relative position, in twips, of the left margin. This parameter can be a positive or negative number. The final position of the left margin is the sum of the current position and this value.

Comments

This statement was first supported in the Microsoft Help Compiler version 3.1.

Example

The following example creates a three-column table with one-quarter inch space between the text in the columns. The left margin in the first cell is flush with the left margin of the Help window:

```
\trgaph360\trleft-360 \cellx1440\cellx2880\cellx4320
\intbl
Row 1 Column 1\cell
Row 1 Column 2\cell
Row 1 Column 3\cell \row
\intbl
Row 2 Column 1\cell
Row 2 Column 2\cell
Row 2 Column 3\cell \row \pard
```

See Also

\cell, **\cellx**, **\intbl**, **\row**, **\trgaph**, **\trowd**

\trowd RTF statement

\trowd

The **\trowd** statement sets default margins and cell positions for subsequent rows in a table.

Comments
This statement was first supported in the Microsoft Help Compiler version 3.1.

See Also
\cell, **\cellx**, **\intbl**, **\row**, **\trgaph**, **\trleft**

\trqc RTF statement

\trqc

The **\trqc** statement directs Windows Help to dynamically adjust the width of table columns to fit in the current window.

Comments
In a print-based document, the **\trqc** statement centers a table row with respect to its containing column.

Windows Help will not resize a table to smaller than the widths specified in the **\trqc** statement. Therefore, the table should be created in the smallest size in which it would ever be displayed. All columns in the table are sized proportionally.

This statement was first supported in the Microsoft Help Compiler version 3.1.

See Also
\trowd, **\trql**

\trql RTF statement

\trql

The **\trql** statement aligns the text in each cell of a table row to the left.

Comments
This statement was first supported in the Microsoft Help Compiler version 3.1.

See Also
\trowd, **\trqc**

\tx RTF statement

\tx*n*

The **\tx** statement sets the position of a tab stop. The position is relative to the left margin of the Help window. A tab stop applies to all subsequent paragraphs up the next **\pard** statement.

Parameter	Description
n	Specifies the tab stop position, in twips.

Comments

If the **\tx** statement is not given, tab stops are set at every one-half inch by default.

See Also

\tab, **\tqc**, **\tqr**

\ul RTF statement

\ul

The **\ul** statement creates a link to a pop-up topic. The statement is used in conjunction with a **\v** statement to create a link to another topic. When the user chooses the link, Windows Help displays the associated topic in a pop-up window.

The **\ul** statement applies to all subsequent text up to the next **\plain** or **\ul0** statement.

Comments
No **\plain** or **\ul0** statement is required if the **\ul** statement and subsequent text are enclosed in braces. Braces limit the scope of a character property statement to just the enclosed text.

In print-base documents, or whenever it is not followed by **\v**, the **\ul** statement creates a continuous underline.

Example
The following example creates a pop-up link for a topic. When displayed, the link text, "Popup Link," is green and has a dotted line under it:

```
{\ul Popup Link}{\v PopupTopic}
```

See Also
\strike, **\uldb**, **\v**

\uldb RTF statement

\uldb

The **\uldb** statement creates a hot spot. This statement is used in conjunction with a **\v** statement to create a link to another topic. When the user chooses a hot spot, Windows Help displays the associated topic in the Help window.

The **\uldb** statement applies to all subsequent text up to the next **\plain** or **\uldb0** statement.

Comments
No **\plain** or **\uldb0** statement is required if the **\uldb** statement and subsequent text are enclosed in braces. Braces limit the scope of a character property statement to just the enclosed text.

The **\uldb** statement creates the same type of hot spot as the **\strike** statement.

Example
The following example creates a hot spot for a topic. When displayed, the hot-spot text, "Hot Spot," is green and has a solid line under it:

```
{\uldb Hot Spot}{\v Topic}
```

See Also
\strike, **\ul**, **\v**

\v RTF statement

{**\v** *context-string*}

The **\v** statement creates a link to the topic having the specified context string. The **\v** statement is used in conjunction with the **\strike**, **\ul**, and **\uldb** statements to create hot spots and links to topics.

Parameter	Description
context-string	Specifies the context string of a topic in the Help file. The string can be any combination of characters, except spaces, and must also be specified in a context-string **\footnote** statement in some topic in the Help file.

Comments

If the context string is preceded by a percent sign (%), Windows Help displays the associated hot spot or link without applying the standard underline and color. If the context string is preceded by an asterisk (*), Windows Help displays the associated hot spot or link with an underline but without applying the standard color.

In print-based documents, the **\v** statement creates hidden text.

For links or hot spots, the syntax of the **\v** statement is as follows:

[**%**|*****] *context* [**>***secondary-window*] [*@filename*]

In this syntax, *secondary-window* is the name of the secondary window to jump to. When the secondary window is not specified, the jump is to the same window as the current help topic is using. To jump to the main window, specify "main" for this parameter. This parameter may not be used with pop-up windows.

The *filename* parameter specifies a jump to a topic in a different help file.

For a macro hotspot, the syntax of the **\v** statement is as follows:

[**%**|*****] **!** *macro* [**;***macro*][**;**...]

Example

The following example creates a hot spot for the topic having the context string "Topic". Windows Help applies an underline and the color green the text "Hot Spot" when it displays the topic:

```
{\uldb Hot Spot}{\v Topic}
```

See Also

\footnote, **\strike**, **\ul**, **\uldb**

\wbitmap RTF statement

\wbitmap*n*

The **\wbitmap** statement sets the picture type to Windows bitmap. This statement must be used in conjunction with a **\pict** statement.

Parameter	Description
n	Specifies the bitmap type. This parameter is zero for a logical bitmap.

Comments

The **\wbitmap** statement is optional; if a **\wmetafile** statement is not specified, the picture is assumed to be a Windows bitmap.

Example

The following example creates a 32-by-8 pixel monochrome bitmap:

```
{
\pict \wbitmap0\wbmbitspixel1\wbmplanes1\wbmwidthbytes4\picw32\pich8
3FFFFFFC
F3FFFFCF
FF3FFCFF
FFF3CFFF
FFFC3FFF
FFCFF3FF
FCFFFF3F
CFFFFFF3
}
```

See Also

bmc, **bml**, **bmr**, **\pict**, **\wmetafile**

\wbmbitspixel RTF statement

\wbmbitspixel*n*

The **\wbmbitspixel** statement specifies the number of consecutive bits in the bitmap data that represent a single pixel. This statement must be used in conjunction with the **\pict** statement.

Parameter	Description
n	Specifies the number of bits per pixel.

Comments

If the **\wbmbitspixel** statement is not given, the default bits per pixel value is 1.

See Also

\pict, **\wbitmap**, **\wbmplanes**

\wbmplanes RTF statement

\wbmplanes*n*

The **\wbmplanes** statement specifies the number of color planes in the bitmap data. This statement must be used in conjunction with a **\pict** statement.

Parameter	Description
n	Specifies the number of bitmap planes.

Comments

If the **\wbmplanes** statement is not given, the default number of planes is 1.

See Also

\pict, **\wbitmap**, **\wbmbitspixel**

\wbmwidthbytes RTF statement

\wbmwidthbytes*n*

The **\wbmwidthbytes** statement specifies the number of bytes in each scan line of the bitmap data. This statement must be used in conjunction with the **\pict** statement.

Parameter	Description
n	Specifies the width of the bitmap, in bytes.

See Also
\pict, **\wbitmap**

\wmetafile RTF statement

\wmetafile*n*

The **\wmetafile** statement sets the picture type to a Windows metafile. This statement must be used in conjunction with the **\pict** statement.

Parameter	Description
n	Specifies the metafile type. This parameter must be 8.

Comments

Windows Help expects the hexadecimal data associated with the picture to represent a valid Windows metafile. By default, Windows Help sets the MM_ANISOTROPIC mapping mode prior to displaying the metafile. To ensure that the picture is displayed correctly, the metafile data must either set the window origin and extents by using the **SetWindowOrg** and **SetWindowExt** records or set another mapping mode by using the **SetMapMode** record.

Example

The following example creates a picture using a metafile:

```
{{\pict\wmetafile8\picw2880\pich2880
0100090000034f0000000200090000000000
050000000b0200000000050000000c026400
6400090000001d066200ff00640064000000
000008000000fa020000020000000000000000
040000002d0100000500000014020000000
0500000013026400640005000000014020000
64000500000013026400000008000000fa02
000000000000000000000040000002d010100
04000000f00100000300000000004e0dff00
870020000050000020000000000000000000}
\par }
```

See Also

bmc, **bml**, **bmr**, **\pict**, **\wbitmap**

AdjustWindowRect (2.x)

void AdjustWindowRect(*lprc, dwStyle, fMenu***)**

```
RECT FAR* lprc;      /* address of client-rectangle structure */
DWORD dwStyle;       /* window styles                         */
BOOL fMenu;          /* menu-present flag                     */
```

The **AdjustWindowRect** function computes the required size of the window rectangle based on the desired client-rectangle size. The window rectangle can then be passed to the **CreateWindow** function to create a window whose client area is the desired size.

Parameter	Description
lprc	Points to a **RECT** structure that contains the coordinates of the client rectangle.
dwStyle	Specifies the window styles of the window whose client rectangle is to be converted.
fMenu	Specifies whether the window has a menu.

Returns

This function does not return a value.

Comments

A client rectangle is the smallest rectangle that completely encloses a client area. A window rectangle is the smallest rectangle that completely encloses the window.

AdjustWindowRect does not take titles and borders into account when computing the size of the client area. For window styles that include titles and borders, applications must add the title and border sizes after calling **AdjustWindowRect**. This function also does not take the extra rows into account when a menu bar wraps to two or more rows.

See Also

AdjustWindowRectEx, **CreateWindowEx**

AdjustWindowRectEx (3.0)

void AdjustWindowRectEx(*lprc, dwStyle, fMenu, dwExStyle***)**

```
RECT FAR* lprc;      /* address of client-rectangle structure */
DWORD dwStyle;       /* window styles                         */
BOOL fMenu;          /* menu-present flag                     */
DWORD dwExStyle;     /* extended style                        */
```

The **AdjustWindowRectEx** function computes the required size of the rectangle of a window with extended style based on the desired client-rectangle size. The window rectangle can then be passed to the **CreateWindowEx** function to create a window whose client area is the desired size.

Parameter	Description
lprc	Points to a **RECT** structure that contains the coordinates of the client rectangle.
dwStyle	Specifies the window styles of the window whose client rectangle is to be converted.
fMenu	Specifies whether the window has a menu.
dwExStyle	Specifies the extended style of the window being created.

Returns

This function does not return a value.

Comments

A client rectangle is the smallest rectangle that completely encloses a client area. A window rectangle is the smallest rectangle that completely encloses the window.

AdjustWindowRectEx does not take titles and borders into account when computing the size of the client area. For window styles that include titles and borders, applications must add the title and border sizes after calling **AdjustWindowRectEx**. This function also does not take the extra rows into account when a menu bar wraps to two or more rows.

See Also

AdjustWindowRect, **CreateWindowEx**

AnsiLower (2.x)

LPSTR AnsiLower(*lpsz***)**

LPSTR *lpsz;* /* address of string, or specific character */

The **AnsiLower** function converts a character string to lowercase.

Parameter	Description
lpsz	Points to a null-terminated string or specifies a single character. If the high-order word of this parameter is zero, the low-order byte of the low-order word must contain a single character to be converted.

Returns

The return value points to a converted character string if the function is successful. Otherwise, the return value is a 32-bit value that contains the converted character in the low-order byte of the low-order word.

Comments

The conversion is made by the language driver for the current language (the one selected by the user at setup or by using Control Panel). If no language driver has been selected, Windows uses an internal function.

Example

The following example uses the **AnsiLower** function to convert two strings to lowercase for a non–case-sensitive comparison:

```
/*
 * Convert the target string to lowercase, and then
 * convert the subject string one character at a time.
 */

AnsiLower(pszTarget);
while (*pszTarget != '\0') {
    if (*pszTarget != (char) (DWORD) AnsiLower(
            MAKELP(0, *pszSubject)))
        return FALSE;
    pszTarget = AnsiNext(pszTarget);
    pszSubject = AnsiNext(pszSubject);
}
```

See Also

AnsiLowerBuff, **AnsiNext**, **AnsiUpper**

AnsiLowerBuff (3.0)

UINT AnsiLowerBuff(*lpszString, cbString***)**

LPSTR *lpszString;* /* address of string to convert */
UINT *cbString;* /* length of string */

The **AnsiLowerBuff** function converts a character string in a buffer to lowercase.

Parameter	Description
lpszString	Points to a buffer containing one or more characters.
cbString	Specifies the number of bytes in the buffer identified by the *lpszString* parameter. If *cbString* is zero, the length is 64K (65,536).

Returns
The return value specifies the length of the converted string if the function is successful. Otherwise, it is zero.

Comments
The language driver makes the conversion for the current language (the one selected by the user at setup or by using Control Panel). If no language driver has been selected, Windows uses an internal function.

Example
The following example uses the **AnsiLowerBuff** function to convert two strings to lowercase for a non–case-sensitive comparison:

```
AnsiLowerBuff(pszSubject, (UINT) lstrlen(pszSubject));
AnsiLowerBuff(pszTarget, (UINT) lstrlen(pszTarget));

while (*pszTarget != '\0') {
    if (*pszTarget != *pszSubject)
        return FALSE;
    pszTarget = AnsiNext(pszTarget);
    pszSubject = AnsiNext(pszSubject);
}
```

See Also
AnsiLower, **AnsiUpper**

AnsiNext (2.x)

LPSTR AnsiNext(*lpchCurrentChar***)**

LPCSTR *lpchCurrentChar;* /* address of current character */

The **AnsiNext** function moves to the next character in a string.

Parameter	Description
lpchCurrentChar	Points to a character in a null-terminated string.

Returns

The return value points to the next character in the string or to the null character at the end of the string, if the function is successful.

Comments

The **AnsiNext** function can be used to move through strings where each character is a single byte, or through strings where each character is two or more bytes (such as strings that contain characters from a Japanese character set).

Example

The following example uses the **AnsiNext** function to step through the characters in a filename:

```
/* Find the last backslash. */

for (lpszFile = lpszTemp; *lpszTemp != '\0';
        lpszTemp = AnsiNext(lpszTemp)) {

    if (*lpszTemp == '\\')
        lpszFile = AnsiNext(lpszTemp);
}
```

See Also

AnsiPrev

AnsiPrev (2.x)

LPSTR AnsiPrev(*lpchStart, lpchCurrentChar***)**

LPCSTR *lpchStart;* /* address of first character */
LPCSTR *lpchCurrentChar;* /* address of current character */

The **AnsiPrev** function moves to the previous character in a string.

Parameter	Description
lpchStart	Points to the beginning of the string.
lpchCurrentChar	Points to a character in a null-terminated string.

Returns

The return value points to the previous character in the string, or to the first character in the string if the *lpchCurrentChar* parameter is equal to the *lpchStart* parameter.

Comments

The **AnsiPrev** function can be used to move through strings where each character is a single byte, or through strings where each character is two or more bytes (such as strings that contain characters from a Japanese character set).

This function can be very slow, because the string must be scanned from the beginning to determine the previous character. Wherever possible, the **AnsiNext** function should be used instead of this function.

Example

The following example uses the **AnsiNext** and **AnsiPrev** functions to change every occurrence of the characters '\&' in a string to a single newline character:

```
/* Find ampersands. */

for (lpsz = lpszTest; *lpsz != '\0'; lpsz = AnsiNext(lpsz)) {

    /* Check the previous character. */

    if (*lpsz == '&' &&
            *(lpsz2 = AnsiPrev(lpszTest, lpsz)) == '\\') {
        lstrcpy(lpsz2, lpsz);
        *lpsz2 = '\n';
    }
}
```

See Also

AnsiNext

AnsiUpper (2.x)

LPSTR AnsiUpper(*lpszString***)**

LPSTR *lpszString;* /* address of string, or specific character */

The **AnsiUpper** function converts the given character string to uppercase.

Parameter	Description
lpszString	Points to a null-terminated string or specifies a single character. If the high-order word of this parameter is zero, the low-order byte of the low-order word must contain a single character to be converted.

Returns

The return value points to a converted character string if the function parameter is a character string. Otherwise, the return value is a 32-bit value that contains the converted character in the low-order byte of the low-order word.

Comments

The language driver makes the conversion for the current language (the one selected by the user at setup or by using Control Panel). If no language driver is selected, Windows uses an internal function.

Example

The following example uses the **AnsiUpper** function to convert two strings to uppercase for a non–case-sensitive comparison:

```
/*
 * Convert the target string to uppercase, and then
 * convert the subject string one character at a time.
 */

AnsiUpper(pszTarget);
while (*pszTarget != '\0') {
    if (*pszTarget != (char) (DWORD) AnsiUpper(
            MAKELP(0, *pszSubject)))
        return FALSE;
    pszTarget = AnsiNext(pszTarget);
    pszSubject = AnsiNext(pszSubject);
}
```

See Also

AnsiLower, **AnsiUpperBuff**

AnsiUpperBuff (3.0)

UINT AnsiUpperBuff(*lpszString, cbString***)**

LPSTR *lpszString;* /* address of string to convert */
UINT *cbString;* /* length of string */

The **AnsiUpperBuff** function converts a character string in a buffer to uppercase.

Parameter	Description
lpszString	Points to a buffer containing one or more characters.
cbString	Specifies the number of bytes in the buffer identified by the *lpszString* parameter. If *cbString* is zero, the length is 64K (65,536).

Returns
The return value specifies the length of the converted string if the function is successful.

Comments
The language driver makes the conversion for the current language (the one selected by the user at setup or by using Control Panel). If no language driver is selected, Windows uses an internal function.

Example
The following example uses the **AnsiUpperBuff** function to convert two strings to lowercase for a non–case-sensitive comparison:

```
/*
 * Convert both the subject and target strings to uppercase before
 * comparing.
 */

AnsiUpperBuff(pszSubject, (UINT) lstrlen(pszSubject));
AnsiUpperBuff(pszTarget, (UINT) lstrlen(pszTarget));

while (*pszTarget != '\0') {
    if (*pszTarget != *pszSubject)
        return FALSE;
    pszTarget = AnsiNext(pszTarget);
    pszSubject = AnsiNext(pszSubject);
}
```

See Also
AnsiLower, **AnsiUpper**

AnyPopup (2.x)

BOOL AnyPopup(void)

The **AnyPopup** function indicates whether an unowned, visible, top-level pop-up, or overlapped window exists on the screen. The function searches the entire Windows screen, not just the caller's client area.

Returns
The return value is nonzero if a pop-up window exists, even if the pop-up window is completely covered by other windows. The return value is zero if no pop-up window exists.

Comments
AnyPopup is a Windows 1.*x* function and remains for compatibility reasons. It is generally not useful.

This function does not detect unowned pop-up windows or windows that do not have the **WS_VISIBLE** style bit set.

See Also
GetLastActivePopup, **ShowOwnedPopups**

AppendMenu (3.0)

BOOL AppendMenu(*hmenu, fuFlags, idNewItem, lpNewItem***)**

```
HMENU hmenu;        /* handle of menu              */
UINT fuFlags;       /* menu-item flags             */
UINT idNewItem;     /* menu-item identifier        */
LPCSTR lpNewItem;   /* specifies menu-item content */
```

The **AppendMenu** function appends a new item to the end of a menu. The application can specify the state of the menu item by setting values in the *fuFlags* parameter.

Parameter	Description
hmenu	Identifies the menu to be changed.
fuFlags	Specifies information about the state of the new menu item when it is added to the menu. This parameter consists of one or more of the values listed in the following Comments section.
idNewItem	Specifies either the command identifier of the new menu item or, if the *fuFlags* parameter is set to **MF_POPUP**, the menu handle of the pop-up menu.
lpNewItem	Specifies the content of the new menu item. The interpretation of the *lpNewItem* parameter depends on the value of the *fuFlags* parameter.

Value	Menu-item content
MF_STRING	Contains a long pointer to a null-terminated string.
MF_BITMAP	Contains a bitmap handle in its low-order word.
MF_OWNERDRAW	Contains an application-supplied 32-bit value that the application can use to maintain additional data associated with the menu item. An application can find this value in the **itemData** member of the structure pointed to by the *lParam* parameter of the **WM_MEASUREITEM** and **WM_DRAWITEM** messages that are sent when the menu item is changed or initially displayed.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

Whenever a menu changes (whether or not the menu is in a window that is displayed), the application should call the **DrawMenuBar** function.

Each of the following groups lists flags that are mutually exclusive and cannot be used together:

- **MF_DISABLED**, **MF_ENABLED**, and **MF_GRAYED**
- **MF_BITMAP**, **MF_STRING**, and **MF_OWNERDRAW**
- **MF_MENUBARBREAK** and **MF_MENUBREAK**
- **MF_CHECKED** and **MF_UNCHECKED**

Following are the flags that can be set in the *fuFlags* parameter:

Value	Meaning
MF_BITMAP	Uses a bitmap as the item. The low-order word of the *lpNewItem* parameter contains the handle of the bitmap.
MF_CHECKED	Places a check mark next to the item. If the application has supplied check mark bitmaps (see the **SetMenuItemBitmaps** function), setting this flag displays the "check mark on" bitmap next to the menu item.
MF_DISABLED	Disables the menu item so that it cannot be selected, but does not gray it.
MF_ENABLED	Enables the menu item so that it can be selected, and restores it from its grayed state.

MF_GRAYED	Disables the menu item so that it cannot be selected, and grays it.
MF_MENUBARBREAK	Same as **MF_MENUBREAK** except that, for pop-up menus, separates the new column from the old column with a vertical line.
MF_MENUBREAK	Places the item on a new line for static menu-bar items. For pop-up menus, places the item in a new column, with no dividing line between the columns.
MF_OWNERDRAW	Specifies that the item is an owner-drawn item. The window that owns the menu receives a **WM_MEASUREITEM** message when the menu is displayed for the first time to retrieve the height and width of the menu item. The **WM_DRAWITEM** message is then sent whenever the owner window must update the visual appearance of the menu item. This option is not valid for a top-level menu item.
MF_POPUP	Specifies that the menu item has a pop-up menu associated with it. The *idNewItem* parameter specifies a handle to a pop-up menu to be associated with the item. This is used for adding either a top-level pop-up menu or adding a hierarchical pop-up menu to a pop-up menu item.
MF_SEPARATOR	Draws a horizontal dividing line. Can be used only in a pop-up menu. This line cannot be grayed, disabled, or highlighted. The *lpNewItem* and *idNewItem* parameters are ignored.
MF_STRING	Specifies that the menu item is a character string; the *lpNewItem* parameter points to the string for the menu item.
MF_UNCHECKED	Does not place a check mark next to the item (default). If the application has supplied check mark bitmaps (see **SetMenuItemBitmaps**), setting this flag displays the "check mark off" bitmap next to the menu item.

Example

The following example uses the **AppendMenu** function to append three items to a floating pop-up menu:

```
POINT ptCurrent;
HMENU hmenu;

ptCurrent = MAKEPOINT(lParam);
hmenu = CreatePopupMenu();
AppendMenu(hmenu, MF_ENABLED, IDM_ELLIPSE, "Ellipse");
AppendMenu(hmenu, MF_ENABLED, IDM_SQUARE, "Square");
AppendMenu(hmenu, MF_ENABLED, IDM_TRIANGLE, "Triangle");
ClientToScreen(hwnd, &ptCurrent);
TrackPopupMenu(hmenu, TPM_LEFTALIGN, ptCurrent.x,
    ptCurrent.y, 0, hwnd, NULL);
```

See Also

CreateMenu, **DeleteMenu**, **DrawMenuBar**, **InsertMenu**, **RemoveMenu**, **SetMenuItemBitmaps**

MF_BITMAP 0x0004

Uses a bitmap as the item. The low-order word of the *lpNewItem* parameter contains the handle of the bitmap.

MF_BITMAP 0x0004

MF_CHECKED 0x0008

Places a check mark next to the item. If the application has supplied check mark bitmaps (see the **SetMenuItemBitmaps** function), setting this flag displays the "check mark on" bitmap next to the menu item.

MF_CHECKED 0x0008

MF_DISABLED 0x0002

Disables the menu item so that it cannot be selected, but does not gray it.

MF_DISABLED 0x0002

MF_ENABLED 0x0000

Enables the menu item so that it can be selected, and restores it from its grayed state.

MF_ENABLED 0x0000

MF_GRAYED 0x0001

Disables the menu item so that it cannot be selected, and grays it.

MF_GRAYED 0x0001

MF_MENUBARBREAK 0x0020

Same as **MF_MENUBREAK** except that, for pop-up menus, separates the new column from the old column with a vertical line.

MF_MENUBARBREAK 0x0020

MF_MENUBREAK 0x0040

Places the item on a new line for static menu-bar items. For pop-up menus, places the item in a new column, with no dividing line between the columns.

MF_MENUBREAK 0x0040

MF_OWNERDRAW 0x0100

Specifies that the item is an owner-drawn item. The window that owns the menu receives a **WM_MEASUREITEM** message when the menu is displayed for the first time to retrieve the height and width of the menu item. The **WM_DRAWITEM** message is then sent whenever the owner window must update the visual appearance of the menu item. This option is not valid for a top-level menu item.

MF_OWNERDRAW 0x0100

MF_POPUP 0x0010

Specifies that the menu item has a pop-up menu associated with it. The *idNewItem* parameter specifies a handle to a pop-up menu to be associated with the item. This is used for adding either a top-level pop-up menu or adding a hierarchical pop-up menu to a pop-up menu item.

MF_POPUP 0x0010

MF_SEPARATOR 0x0800

Draws a horizontal dividing line. Can be used only in a pop-up menu. This line cannot be grayed, disabled, or highlighted. The *lpNewItem* and *idNewItem* parameters are ignored.

MF_SEPARATOR 0x0800

MF_STRING 0x0000

Specifies that the menu item is a character string; the *lpNewItem* parameter points to the string for the menu item.

MF_STRING 0x0000

MF_UNCHECKED 0x0000

Does not place a check mark next to the item (default). If the application has supplied check mark bitmaps (see **SetMenuItemBitmaps**), setting this flag displays the "check mark off" bitmap next to the menu item.

MF_UNCHECKED 0x0000

ArrangeIconicWindows (3.0)

UINT ArrangeIconicWindows(*hwnd***)**

HWND *hwnd;* /* handle of parent window */

The **ArrangeIconicWindows** function arranges all the minimized (iconic) child windows of a parent window.

Parameter	Description
hwnd	Identifies the parent window.

Returns
The return value is the height of one row of icons if the function is successful. Otherwise, it is zero.

Comments
An application that maintains its own minimized child windows can call **ArrangeIconicWindows** to arrange icons in a client window. This function also arranges icons on the desktop window, which covers the entire screen. The **GetDesktopWindow** function retrieves the window handle of the desktop window.

An application sends the **WM_MDIICONARRANGE** message to the MDI client window to prompt the client window to arrange its minimized MDI child windows.

See Also
GetDesktopWindow

BeginDeferWindowPos (3.0)

HDWP BeginDeferWindowPos(*cWindows***)**

int *cWindows;* /* number of windows */

The **BeginDeferWindowPos** function returns a handle of an internal structure. The **DeferWindowPos** function fills this structure with information about the target position for a window that is about to be moved. The **EndDeferWindowPos** function accepts a handle of this structure and instantaneously repositions the windows by using the information stored in the structure.

Parameter	Description
cWindows	Specifies the initial number of windows for which to store position information in the structure. The **DeferWindowPos** function increases the size of the structure if necessary.

Returns

The return value identifies the internal structure if the function is successful. Otherwise, it is NULL.

Comments

If Windows must increase the size of the internal structure beyond the initial size specified by the *cWindows* parameter but cannot allocate enough memory to do so, Windows fails the entire begin/defer/end window-positioning sequence. By specifying the maximum size needed, an application can detect and handle failure early in the process.

See Also

DeferWindowPos, **EndDeferWindowPos**

BeginPaint (2.x)

HDC BeginPaint(*hwnd, lpps***)**

HWND *hwnd;* /* handle of window to paint */
PAINTSTRUCT FAR* *lpps;* /* address of structure with paint information */

The **BeginPaint** function prepares the specified window for painting and fills a **PAINTSTRUCT** structure with information about the painting.

Parameter	Description
hwnd	Identifies the window to be repainted.
lpps	Points to the **PAINTSTRUCT** structure that will receive the painting information.

Returns
The return value is the handle of the device context for the given window if the function is successful.

Comments
The **BeginPaint** function automatically sets the clipping region of the device context to exclude any area outside the update region. The update region is set by the **InvalidateRect** or **InvalidateRgn** function and by the system after sizing, moving, creating, scrolling, or any other operation that affects the client area. If the update region is marked for erasing, **BeginPaint** sends a **WM_ERASEBKGND** message to the window.

An application should not call **BeginPaint** except in response to a **WM_PAINT** message. Each call to the **BeginPaint** function must have a corresponding call to the **EndPaint** function.

If the caret is in the area to be painted, **BeginPaint** automatically hides the caret to prevent it from being erased.

If the window's class has a background brush, **BeginPaint** will use that brush to erase the background of the update region before returning.

Example
The following example calls an application-defined function to paint a bar graph in a window's client area during the **WM_PAINT** message:

```
PAINTSTRUCT ps;

case WM_PAINT:
    BeginPaint(hwnd, &ps);
        .
        .
        .
    EndPaint(hwnd, &ps);
    break;
```

See Also
EndPaint, **InvalidateRect**, **InvalidateRgn**, **ValidateRect**, **ValidateRgn**, **PAINTSTRUCT**, **RECT**, **WM_PAINT**, **WM_ERASEBKGND**

BringWindowToTop (2.x)

BOOL BringWindowToTop(*hwnd***)**

HWND *hwnd;* /* handle of window */

The **BringWindowToTop** function brings the given pop-up or child window (including an MDI child window) to the top of a stack of overlapping windows. In addition, it activates pop-up, top-level, and MDI child windows. The **BringWindowToTop** function should be used to uncover any window that is partially or completely obscured by any overlapping windows.

Parameter	Description
hwnd	Identifies the pop-up or child window to bring to the top.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

Calling this function is similar to calling the **SetWindowPos** function to change a window's position in the Z-order. The **BringWindowToTop** function does not make a window a top-level window.

See Also

SetWindowPos

BuildCommDCB (2.x)

int BuildCommDCB(*lpszDef, lpdcb***)**

LPCSTR *lpszDef;* /* address of device-control string */
DCB FAR* *lpdcb;* /* address of device-control block */

The **BuildCommDCB** function translates a device-definition string into appropriate serial device control block (**DCB**) codes.

Parameter	Description
lpszDef	Points to a null-terminated string that specifies device-control information. The string must have the same form as the parameters used in the MS-DOS **mode** command.
lpdcb	Points to a **DCB** structure that will receive the translated string. The structure defines the control settings for the serial-communications device.

Returns
The return value is zero if the function is successful. Otherwise, it is -1.

Example
The following example uses the **BuildCommDCB** and **SetCommState** functions to set up COM1 to operate at 9600 baud, with no parity, 8 data bits, and 1 stop bit:

```
idComDev = OpenComm("COM1", 1024, 128);
if (idComDev < 0) {
    ShowError(idComDev, "OpenComm");
    return 0;
}

err = BuildCommDCB("COM1:9600,n,8,1", &dcb);
if (err < 0) {
    ShowError(err, "BuildCommDCB");
    return 0;
}

err = SetCommState(&dcb);
if (err < 0) {
    ShowError(err, "SetCommState");
    return 0;
}
```

Comments
The **BuildCommDCB** function only fills the buffer. To apply the settings to a port, an application should use the **SetCommState** function.

By default, **BuildCommDCB** specifies XON/XOFF and hardware flow control as disabled. To enable flow control, an application should set the appropriate members in the **DCB** structure.

See Also
SetCommState, **DCB**

CallMsgFilter (2.x)

BOOL CallMsgFilter(*lpmsg, nCode***)**

```
MSG FAR* lpmsg;     /* address of structure with message data */
int nCode;          /* processing code                        */
```

The **CallMsgFilter** function passes the given message and code to the current message-filter function. The message-filter function is an application-specified function that examines and modifies all messages. An application specifies the function by using the **SetWindowsHook** function.

Parameter	Description
lpmsg	Points to an **MSG** structure that contains the message to be filtered.
nCode	Specifies a code used by the filter function to determine how to process the message.

Returns

The return value specifies the state of message processing. It is zero if the message should be processed or nonzero if the message should not be processed further.

Comments

The **CallMsgFilter** function is usually called by Windows to let applications examine and control the flow of messages during internal processing in menus and scroll bars or when moving or sizing a window.

Values given for the *nCode* parameter must not conflict with any of the MSGF_ and HC_ values passed by Windows to the message-filter function.

See Also

SetWindowsHook, **MSG**

CallNextHookEx (3.1)

LRESULT CallNextHookEx(*hHook, nCode, wParam, lParam***)**

```
HHOOK hHook;        /* handle of hook function      */
int nCode;          /* hook code                    */
WPARAM wParam;      /* first message parameter      */
LPARAM lParam;      /* second message parameter     */
```

The **CallNextHookEx** function passes the hook information to the next hook function in the hook chain.

Parameter	Description
hHook	Identifies the current hook function.
nCode	Specifies the hook code to pass to the next hook function. A hook function uses this code to determine how to process the message sent to the hook.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value specifies the result of the message processing and depends on the value of the *nCode* parameter.

Comments

Calling the **CallNextHookEx** function is optional. An application can call this function either before or after completing any processing in its own hook function. If an application does not call **CallNextHookEx**, Windows will not call the hook functions that were installed before the application's hook function was installed.

See Also

SetWindowsHookEx, **UnhookWindowsHookEx**

CallWindowProc (2.x)

LRESULT CallWindowProc(*wndprcPrev, hwnd, uMsg, wParam, lParam***)**

```
WNDPROC wndprcPrev;     /* instance address of previous procedure  */
HWND hwnd;              /* handle of window                        */
UINT uMsg;              /* message                                 */
WPARAM wParam;          /* first message parameter                 */
LPARAM lParam;          /* second message parameter                */
```

The **CallWindowProc** function passes message information to the specified window procedure.

Parameter	Description
wndprcPrev	Specifies the procedure-instance address of the previous window procedure.
hwnd	Identifies the window that will receive the message.
uMsg	Specifies the message.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value specifies the result of the message processing and depends on the message sent.

Comments

The **CallWindowProc** function is used for window subclassing. Normally, all windows with the same class share the same window procedure. A subclass is a window or set of windows belonging to the same window class whose messages are intercepted and processed by another window procedure (or procedures) before being passed to the window procedure of that class.

The **SetWindowLong** function creates the subclass by changing the window procedure associated with a particular window, causing Windows to call the new window procedure instead of the previous one. Any messages not processed by the new window procedure must be passed to the previous window procedure by calling **CallWindowProc**. This allows you to create a chain of window procedures.

See Also

SetWindowLong

ChangeClipboardChain (2.x)

BOOL ChangeClipboardChain(*hwnd, hwndNext***)**

HWND *hwnd;* /* handle of window to remove */
HWND *hwndNext;* /* handle of next window */

The **ChangeClipboardChain** function removes the window identified by the **hwnd** parameter from the chain of clipboard viewers and makes the window identified by the *hwndNext* parameter the descendant of the *hwnd* parameter's ancestor in the chain.

Parameter	Description
hwnd	Identifies the window that is to be removed from the chain. The handle must have been passed to the **SetClipboardViewer** function.
hwndNext	Identifies the window that follows *hwnd* in the clipboard-viewer chain (this is the handle returned by the **SetClipboardViewer** function, unless the sequence was changed in response to a **WM_CHANGECBCHAIN** message).

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also
SetClipboardViewer, **WM_CHANGECBCHAIN**

ChangeMenu (2.x)

The Microsoft Windows 3.1 Software Development Kit (SDK) has replaced this function with five specialized functions, listed as follows:

Function	Description
AppendMenu	Appends a menu item to the end of a menu.
DeleteMenu	Deletes a menu item from a menu, destroying the menu item.
InsertMenu	Inserts a menu item into a menu.
ModifyMenu	Modifies a menu item in a menu.
RemoveMenu	Removes a menu item from a menu but does not destroy the menu item.

Applications written for Windows versions earlier than 3.0 may continue to call **ChangeMenu** as previously documented. Applications written for Windows 3.0 and 3.1 should call the new functions.

Example

The following example shows a call to **ChangeMenu** and how it would be rewritten to call **AppendMenu**:

```
ChangeMenu(hMenu,                  /* handle of menu              */
    0,                             /* position parameter not used */
    "&White",                      /* menu-item string            */
    IDM_PATTERN1,                  /* menu-item identifier        */
    MF_APPEND | MF_STRING | MF_CHECKED); /* flags                 */

AppendMenu(hMenu,                          /* handle of menu       */
    MF_STRING | MF_CHECKED,                /* flags                */
    IDM_PATTERN1,                          /* menu-item identifier */
    "&White");                             /* menu-item string     */
```

See Also

AppendMenu, **DeleteMenu**, **InsertMenu**, **ModifyMenu**, **RemoveMenu**

CheckDlgButton (2.x)

void CheckDlgButton(*hwndDlg, idButton, uCheck***)**

```
HWND hwndDlg;     /* handle of dialog box     */
int idButton;     /* button-control identifier*/
UINT uCheck;      /* check state              */
```

The **CheckDlgButton** function selects (places a check mark next to) or clears (removes a check mark from) a button control, or it changes the state of a three-state button.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the button.
idButton	Identifies the button to be modified.
uCheck	Specifies the check state of the button. If this parameter is nonzero, **CheckDlgButton** selects the button; if the parameter is zero, the function clears the button. For a three-state check box, if *uCheck* is 2, the button is grayed; if *uCheck* is 1, it is selected; if *uCheck* is 0, it is cleared.

Returns

This function does not return a value.

Comments

The **CheckDlgButton** function sends a **BM_SETCHECK** message to the specified button control in the given dialog box.

See Also

CheckRadioButton, **IsDlgButtonChecked**, **BM_GETCHECK**, **BM_SETCHECK**

CheckMenuItem (2.x)

BOOL CheckMenuItem(*hmenu, idCheckItem, uCheck***)**

```
HMENU hmenu;        /* handle of menu          */
UINT idCheckItem;   /* menu-item identifier    */
UINT uCheck;        /* check state and position */
```

The **CheckMenuItem** function selects (places a check mark next to) or clears (removes a check mark from) a specified menu item in the given pop-up menu.

Parameter	Description
hmenu	Identifies the menu.
idCheckItem	Identifies the menu item to be selected or cleared.
uCheck	Specifies how to determine the position of the menu item (**MF_BYCOMMAND** or **MF_BYPOSITION**) and whether the item should be selected or cleared (**MF_CHECKED** or **MF_UNCHECKED**). This parameter can be a combination of these values, which can be combined by using the bitwise OR operator. The values are described as follows:

Value	Meaning
MF_BYCOMMAND	Specifies that the *idCheckItem* parameter gives the menu-item identifier (**MF_BYCOMMAND** is the default).
MF_BYPOSITION	Specifies that the *idCheckItem* parameter gives the position of the menu item (the first item is at position zero).
MF_CHECKED	Selects the item (adds check mark).
MF_UNCHECKED	Clears the item (removes check mark).

Returns

The return value specifies the previous state of the item--MF_CHECKED or MF_UNCHECKED--if the function is successful. The return value is -1 if the menu item does not exist.

Comments

The *idCheckItem* parameter may identify a pop-up menu item as well as a menu item. No special steps are required to select a pop-up menu item.

Top-level menu items cannot have a check.

A pop-up menu item should be selected by position since it does not have a menu-item identifier associated with it.

See Also

GetMenuState, **SetMenuItemBitmaps**

CheckRadioButton (2.x)

void CheckRadioButton(*hwndDlg, idFirstButton, idLastButton, idCheckButton***)**

```
HWND hwndDlg;       /* handle of dialog box                  */
int idFirstButton;  /* identifier of first radio button in group*/
int idLastButton;   /* identifier of last radio button in group*/
int idCheckButton;  /* identifier of radio button to select  */
```

The **CheckRadioButton** function selects (adds a check mark to) a given radio button in a group and clears (removes a check mark from) all other radio buttons in the group.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the radio button.
idFirstButton	Specifies the identifier of the first radio button in the group.
idLastButton	Specifies the identifier of the last radio button in the group.
idCheckButton	Specifies the identifier of the radio button to select.

Returns

This function does not return a value.

Comments

The **CheckRadioButton** function sends a **BM_SETCHECK** message to the specified radio button control in the given dialog box.

See Also

CheckDlgButton, **IsDlgButtonChecked**, **BM_GETCHECK**, **BM_SETCHECK**

ChildWindowFromPoint (2.x)

HWND ChildWindowFromPoint(*hwndParent, pt***)**

```
HWND hwndParent;    /* handle of parent window          */
POINT pt;           /* structure with point coordinates */
```

The **ChildWindowFromPoint** function determines which, if any, of the child windows belonging to the given parent window contains the specified point.

Parameter	Description
hwndParent	Identifies the parent window.
pt	Specifies a **POINT** structure that defines the client coordinates of the point to be checked.

Returns

The return value is the handle of the child window (hidden, disabled, or transparent) that contains the point, if the function is successful. If the given point lies outside the parent window, the return value is NULL. If the point is within the parent window but is not contained within any child window, the return value is the handle of the parent window.

Comments

More than one window may contain the given point, but Windows returns the handle only of the first window encountered that contains the point.

See Also

WindowFromPoint

ClearCommBreak (2.x)

int ClearCommBreak(*idComDev***)**

int *idComDev;* /* device to be restored */

The **ClearCommBreak** function restores character transmission and places the communications device in a nonbreak state.

Parameter	Description
idComDev	Identifies the communications device to be restored. The **OpenComm** function returns this value.

Returns

The return value is zero if the function is successful, or -1 if the *idComDev* parameter does not identify a valid device.

Comments

This function clears the communications-device break state set by the **SetCommBreak** function.

See Also

OpenComm, **SetCommBreak**

ClientToScreen (2.x)

void ClientToScreen(*hwnd, lppt***)**

HWND *hwnd;* /* window handle for source coordinates */
POINT FAR* *lppt;* /* address of structure with coordinates */

The **ClientToScreen** function converts the client coordinates of a given point on the screen to screen coordinates.

Parameter	Description
hwnd	Identifies the window whose client area is used for the conversion.
lppt	Points to a **POINT** structure that contains the client coordinates to be converted.

Returns
This function does not return a value.

Comments
The **ClientToScreen** function replaces the coordinates in the **POINT** structure with the screen coordinates. The screen coordinates are relative to the upper-left corner of the screen.

Example
The following example uses the **LOWORD** and **HIWORD** macros and the **ClientToScreen** function to convert the mouse position to screen coordinates:

```
POINT pt;

pt.x = LOWORD(lParam);
pt.y = HIWORD(lParam);
ClientToScreen(hwnd, &pt);
```

See Also
MapWindowPoints, **ScreenToClient**

ClipCursor (2.x)

void ClipCursor(*lprc***)**

const RECT FAR* *lprc;* /* address of structure with rectangle */

The **ClipCursor** function confines the cursor to a rectangle on the screen. If a subsequent cursor position (set by the **SetCursorPos** function or by the mouse) lies outside the rectangle, Windows automatically adjusts the position to keep the cursor inside.

Parameter	Description
lprc	Points to a **RECT** structure that contains the screen coordinates of the upper-left and lower-right corners of the confining rectangle. If this parameter is NULL, the cursor is free to move anywhere on the screen.

Returns

This function does not return a value.

Comments

The cursor is a shared resource. An application that has confined the cursor to a given rectangle must free it before relinquishing control to another application.

See Also

GetClipCursor, **GetCursorPos**, **SetCursorPos**, **RECT**

CloseClipboard (2.x)

BOOL CloseClipboard(void)

The **CloseClipboard** function closes the clipboard.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The **CloseClipboard** function should be called when a window has finished examining or changing the clipboard. This lets other applications access the clipboard.

See Also
GetOpenClipboardWindow, **OpenClipboard**

CloseComm (2.x)

int CloseComm(*idComDev***)**

int *idComDev;* /* device to close */

The **CloseComm** function closes the specified communications device and frees any memory allocated for the device's transmission and receiving queues. All characters in the output queue are sent before the communications device is closed.

Parameter	Description
idComDev	Specifies the device to be closed. The **OpenComm** function returns this value.

Returns

The return value is zero if the function is successful. Otherwise, it is less than zero.

See Also

OpenComm

CloseWindow (2.x)

void CloseWindow(*hwnd***)**

HWND *hwnd;* /* handle of window to minimize */

The **CloseWindow** function minimizes (but does not destroy) the given window. To destroy a window, an application must use the **DestroyWindow** function.

Parameter	Description
hwnd	Identifies the window to be minimized.

Returns
This function does not return a value.

Comments
This function has no effect if the *hwnd* parameter identifies a pop-up or child window.

See Also
DestroyWindow, **IsIconic**, **OpenIcon**

CloseDriver (3.1)

LRESULT CloseDriver(*hdrvr, lParam1, lParam2***)**

```
HDRVR hdrvr;          /* handle of installable driver */
LPARAM lParam1;       /* driver-specific data         */
LPARAM lParam2;       /* driver-specific data         */
```

The **CloseDriver** function closes an installable driver.

Parameter	Description
hdrvr	Identifies the installable driver to be closed. This parameter must have been obtained by a previous call to the **OpenDriver** function.
lParam1	Specifies driver-specific data.
lParam2	Specifies driver-specific data.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

When an application calls **CloseDriver** and the driver identified by *hdrvr* is the last instance of the driver, Windows calls the **DriverProc** function three times. On the first call, Windows sets the third **DriverProc** parameter, *wMessage,* to **DRV_CLOSE**; on the second call, Windows sets *wMessage* to **DRV_DISABLE**; and on the third call, Windows sets *wMessage* to DRV_FREE. When the driver identified by *hdrvr* is not the last instance of the driver, only DRV_CLOSE is sent. The values specified in the *lParam1* and *lParam2* parameters are passed to the *lParam1* and *lParam2* parameters of the **DriverProc** function.

See Also

DriverProc, **OpenDriver**

CopyCursor (3.1)

HCURSOR CopyCursor(*hinst, hcur***)**

```
HINSTANCE hinst;        /* handle of application instance  */
HCURSOR hcur;           /* handle of cursor to copy        */
```

The **CopyCursor** function copies a cursor.

Parameter	Description
hinst	Identifies the instance of the module that will copy the cursor.
hcur	Identifies the cursor to be copied.

Returns

The return value is the handle of the duplicate cursor if the function is successful. Otherwise, it is NULL.

Comments

When it no longer requires a cursor, an application must destroy the cursor, using the **DestroyCursor** function.

The **CopyCursor** function allows an application or dynamic-link library to accept a cursor from another module. Because all resources are owned by the module in which they originate, a resource cannot be shared after the module is freed. **CopyCursor** allows an application to create a copy that the application then owns.

See Also

CopyIcon, **DestroyCursor**, **GetCursor**, **SetCursor**, **ShowCursor**

CopyIcon (3.1)

HICON CopyIcon(*hinst, hicon***)**

HINSTANCE *hinst;* /* handle of application instance */
HICON *hicon;* /* handle of icon to copy */

The **CopyIcon** function copies an icon.

Parameter	Description
hinst	Identifies the instance of the module that will copy the icon.
hicon	Identifies the icon to be copied.

Returns
The return value is the handle of the duplicate icon if the function is successful. Otherwise, it is NULL.

Comments
When it no longer requires an icon, an application should destroy the icon, using the **DestroyIcon** function.

The **CopyIcon** function allows an application or dynamic-link library to accept an icon from another module. Because all resources are owned by the module in which they originate, a resource cannot be shared after the module is freed. **CopyIcon** allows an application to create a copy that the application then owns.

See Also
CopyCursor, **DestroyIcon**, **DrawIcon**

CopyRect (2.x)

void CopyRect(*lprcDst, lprcSrc***)**

```
RECT FAR* lprcDst;          /* address of struct. for destination rect. */
const RECT FAR* lprcSrc;    /* address of struct. with source rect.     */
```

The **CopyRect** function copies the dimensions of one rectangle to another.

Parameter	Description
lprcDst	Points to the **RECT** structure that will receive the dimensions of the source rectangle.
lprcSrc	Points to the **RECT** structure whose dimensions are to be copied.

Returns

This function does not return a value.

See Also

SetRect, **RECT**

CountClipboardFormats (2.x)

int CountClipboardFormats(void)

The **CountClipboardFormats** function retrieves the number of different data formats currently in the clipboard.

Returns
The return value specifies the number of different data formats in the clipboard, if the function is successful.

See Also
EnumClipboardFormats

CreateCaret (2.x)

void CreateCaret(*hwnd, hbmp, nWidth, nHeight***)**

```
HWND hwnd;          /* handle of owner window          */
HBITMAP hbmp;       /* handle of bitmap for caret shape */
int nWidth;         /* caret width                     */
int nHeight;        /* caret height                    */
```

The **CreateCaret** function creates a new shape for the system caret and assigns ownership of the caret to the given window. The caret shape can be a line, block, or bitmap.

Parameter	Description
hwnd	Identifies the window that owns the new caret.
hbmp	Identifies the bitmap that defines the caret shape. If this parameter is NULL, the caret is solid; if the parameter is 1, the caret is gray.
nWidth	Specifies the width of the caret in logical units. If this parameter is NULL, the width is set to the system-defined window-border width.
nHeight	Specifies the height of the caret, in logical units. If this parameter is NULL, the height is set to the system-defined window-border height.

Returns

This function does not return a value.

Comments

If the *hbmp* parameter contains a bitmap handle, the *nWidth* and *nHeight* parameters are ignored; the bitmap defines its own width and height. (The bitmap handle must have been created by using the **CreateBitmap**, **CreateDIBitmap**, or **LoadBitmap** function.) If *hbmp* is NULL or 1, *nWidth* and *nHeight* give the caret's width and height, in logical units; the exact width and height (in pixels) depend on the window's mapping mode.

The **CreateCaret** function automatically destroys the previous caret shape, if any, regardless of which window owns the caret. Once created, the caret is initially hidden. To show the caret, use the **ShowCaret** function.

The system caret is a shared resource. A window should create a caret only when it has the input focus or is active. It should destroy the caret before losing the input focus or becoming inactive.

The system's window-border width or height can be retrieved by using the **GetSystemMetrics** function, specifying the **SM_CXBORDER** and **SM_CYBORDER** indices. Using the window-border width or height guarantees that the caret will be visible on a high-resolution screen.

Example

The following example creates a caret, sets its initial position, and then displays the caret:

```
case WM_SETFOCUS:
    CreateCaret(hwndParent, NULL, CARET_WIDTH, CARET_HEIGHT);
    SetCaretPos(CARET_XPOS, CARET_YPOS);
    ShowCaret(hwndParent);
    break;
```

See Also

CreateBitmap, **CreateDIBitmap**, **DestroyCaret**, **GetSystemMetrics**, **LoadBitmap**, **ShowCaret**

CreateCursor (3.0)

HCURSOR CreateCursor(*hinst, xHotSpot, yHotSpot, nWidth, nHeight, lpvANDplane, lpvXORplane***)**

```
HINSTANCE hinst;                /* handle of application instance */
int xHotSpot;                   /* horizontal position of hot spot */
int yHotSpot;                   /* vertical position of hot spot   */
int nWidth;                     /* cursor width                    */
int nHeight;                    /* cursor height                   */
const void FAR* lpvANDplane;    /* address of AND mask array       */
const void FAR* lpvXORplane;    /* address of XOR mask array       */
```

The **CreateCursor** function creates a cursor that has the specified width, height, and bit patterns.

Parameter	Description
hinst	Identifies the instance of the module that will create the cursor.
xHotSpot	Specifies the horizontal position of the cursor hot spot.
yHotSpot	Specifies the vertical position of the cursor hot spot.
nWidth	Specifies the width, in pixels, of the cursor.
nHeight	Specifies the height, in pixels, of the cursor.
lpvANDplane	Points to an array of bytes that contains the bit values for the AND mask of the cursor. These can be the bits of a device-dependent monochrome bitmap.
lpvXORplane	Points to an array of bytes that contains the bit values for the XOR mask of the cursor. These can be the bits of a device-dependent monochrome bitmap.

Returns

The return value is the handle of the cursor if the function is successful. Otherwise, it is NULL.

Comments

The *nWidth* and *nHeight* parameters must specify a width and height supported by the current display driver, since the system cannot create cursors of other sizes. An application can determine the width and height supported by the display driver by calling the **GetSystemMetrics** function and specifying the **SM_CXCURSOR** or **SM_CYCURSOR** value.

Before terminating, an application must call the **DestroyCursor** function to free any system resources associated with the cursor.

See Also

CreateIcon, **DestroyCursor**, **GetSystemMetrics**, **SetCursor**

CreateDialog (2.x)

HWND CreateDialog(*hinst, lpszDlgTemp, hwndOwner, dlgprc***)**

```
HINSTANCE hinst;        /* handle of application instance          */
LPCSTR lpszDlgTemp;     /* address of dialog box template name     */
HWND hwndOwner;         /* handle of owner window                  */
DLGPROC dlgprc;         /* instance address of dialog box procedure */
```

The **CreateDialog** function creates a modeless dialog box from a dialog box template resource.

Parameter	Description
hinst	Identifies an instance of the module whose executable file contains the dialog box template.
lpszDlgTemp	Points to a null-terminated string that names the dialog box template.
hwndOwner	Identifies the window that owns the dialog box.
dlgprc	Specifies the procedure-instance address of the dialog box procedure. The address must be created by using the **MakeProcInstance** function, except when the function and dialog box procedure are used in a DLL. For more information about the dialog box procedure, see the description of the **DialogProc** callback function.

Returns

The return value is the handle of the dialog box that was created, if the function is successful. Otherwise, it is NULL.

Comments

The **CreateWindowEx** function is called to create the dialog box. The dialog box procedure then receives a **WM_SETFONT** message (if the DS_SETFONT style was specified) and a **WM_INITDIALOG** message, and then the dialog box is displayed.

The **CreateDialog** function returns immediately after creating the dialog box.

To make the dialog box appear in the owner window upon being created, use the **WS_VISIBLE** style in the dialog box template.

Use the **DestroyWindow** function to destroy a dialog box created by the **CreateDialog** function.

A dialog box can contain up to 255 controls.

Example

The following example creates a modeless dialog box:

```
HWND hwndDlgFindBox;
DLGPROC dlgprc = (DLGPROC) MakeProcInstance(FindDlgProc, hinst);

hwndDlgFindBox = CreateDialog(hinst, "dlgFindBox", hwndParent, dlgprc);
```

See Also

CreateDialogIndirect, **CreateDialogIndirectParam**, **CreateDialogParam**, **DestroyWindow**, **MakeProcInstance**, **WM_INITDIALOG**

CreateDialogIndirect (2.x)

HWND CreateDialogIndirect(*hinst, lpvDlgTmp, hwndOwner, dlgprc***)**

```
HINSTANCE hinst;          /* handle of application instance          */
const void FAR* lpvDlgTmp; /* address of dialog box template          */
HWND hwndOwner;           /* handle of owner window                  */
DLGPROC dlgprc;           /* instance address of dialog box procedure */
```

The **CreateDialogIndirect** function creates a modeless dialog box from a dialog box template in memory.

Parameter	Description
hinst	Identifies the instance of the module that will create the dialog box.
lpvDlgTmp	Points to a global memory object that contains a dialog box template used to create the dialog box. This template is in the form of a **DialogBoxHeader** structure. For more information about this structure, see the **Dialog Box Resource** topic.
hwndOwner	Identifies the window that owns the dialog box.
dlgprc	Specifies the procedure-instance address of the dialog box procedure. The address must be created by using the **MakeProcInstance** function, except when the function and dialog box procedure are used in a DLL. For more information, see the description of the **DialogProc** callback function.

Returns

The return value is the window handle of the dialog box if the function is successful. Otherwise, it is NULL.

Comments

The **CreateWindowEx** function is called to create the dialog box. The dialog box procedure then receives a **WM_SETFONT** message (if the DS_SETFONT style was specified) and a **WM_INITDIALOG** message, and then the dialog box is displayed.

The **CreateDialogIndirect** function returns immediately after creating the dialog box.

To make the dialog box appear in the owner window upon being created, use the **WS_VISIBLE** style in the dialog box template.

Use the **DestroyWindow** function to destroy a dialog box created by the **CreateDialogIndirect** function.

A dialog box can contain up to 255 controls.

Example

The following example uses the **CreateDialogIndirect** function to create a dialog box from a dialog box template in memory:

```
DLGPROC dlgprc = (DLGPROC) MakeProcInstance(DialogProc, hinst);
HWND hdlg;
BYTE FAR* lpbDlgTemp;

.
. /* Allocate global memory and build a dialog box template. */
.

hdlg = CreateDialogIndirect(hinst, lpbDlgTemp, hwndParent, dlgprc);
```

See Also

CreateDialog, **CreateDialogIndirectParam**, **CreateDialogParam**, **DestroyWindow**, **MakeProcInstance**, **WM_INITDIALOG**, **WM_SETFONT**

CreateDialogIndirectParam (3.0)

HWND CreateDialogIndirectParam(*hinst, lpvDlgTmp, hwndOwner, dlgprc, lParamInit***)**

HINSTANCE *hinst;*	/* handle of application instance	*/
const void FAR* *lpvDlgTmp;*	/* address of dialog box template	*/
HWND *hwndOwner;*	/* handle of owner window	*/
DLGPROC *dlgprc;*	/* instance address of dialog box procedure	*/
LPARAM *lParamInit;*	/* initialization value	*/

The **CreateDialogIndirectParam** function creates a modeless dialog box from a dialog box template in memory. Before displaying the dialog box, the function passes an application-defined value to the dialog box procedure as the *lParam* parameter of the **WM_INITDIALOG** message. An application can use this value to initialize dialog box controls.

Parameter	Description
hinst	Identifies the instance of the module that will create the dialog box.
lpvDlgTmp	Points to a global memory object that contains a dialog box template used to create the dialog box. This template is in the form of a **DialogBoxHeader** structure. For more information about this structure, see the **Dialog Box Resource** topic.
hwndOwner	Identifies the window that owns the dialog box.
dlgprc	Specifies the procedure-instance address of the dialog box procedure. The address must be created by using the **MakeProcInstance** function, except when the function and dialog box procedure are used in a DLL. For more information, see the description of the **DialogProc** callback function.
lParamInit	Specifies the value to pass to the dialog box when processing the **WM_INITDIALOG** message.

Returns

The return value is the window handle of the dialog box if the function is successful. Otherwise, it is NULL.

Comments

The **CreateWindowEx** function is called to create the dialog box. The dialog box procedure then receives a **WM_SETFONT** message (if the DS_SETFONT style was specified) and a **WM_INITDIALOG** message, and then the dialog box is displayed.

The **CreateDialogIndirectParam** function returns immediately after creating the dialog box.

To make the dialog box appear in the owner window upon being created, use the **WS_VISIBLE** style in the dialog box template.

Use the **DestroyWindow** function to destroy a dialog box created by the **CreateDialogIndirectParam** function.

A dialog box can contain up to 255 controls.

Example

The following example calls the **CreateDialogIndirectParam** function to create a modeless dialog box from a dialog box template in memory. The example uses the *lParamInit* parameter to send two initialization parameters, wInitParm1 and wInitParm2, to the dialog box procedure when the **WM_INITDIALOG** message is being processed.

```
#define MEM_LENGTH  100
HGLOBAL hglbDlgTemp;
BYTE FAR* lpbDlgTemp;
DLGPROC dlgprc = (DLGPROC) MakeProcInstance(DialogProc, hinst);
HWND hwndDlg;
```

```
/* Allocate a global memory object for the dialog box template. */

hglbDlgTemp = GlobalAlloc(GHND, MEM_LENGTH);
    .
    . /* Build a DLGTEMPLATE structure in the memory object. */
    .
lpbDlgTemp = GlobalLock(hglbDlgTemp);
hwndDlg = CreateDialogIndirectParam(hinst, lpbDlgTemp,
    hwndParent, dlgprc, 0);
```

See Also

CreateDialog, **CreateDialogIndirect**, **CreateDialogParam**, **DestroyWindow**, **MakeProcInstance**, **WM_INITDIALOG**, **WM_SETFONT**

CreateDialogParam (3.0)

HWND CreateDialogParam(*hinst, lpszDlgTemp, hwndOwner, dlgprc, lParamInit***)**

```
HINSTANCE hinst;          /* handle of application instance          */
LPCSTR lpszDlgTemp;       /* address of name of dialog box template  */
HWND hwndOwner;           /* handle of owner window                  */
DLGPROC dlgprc;           /* instance address of dialog box procedure */
LPARAM lParamInit;        /* initialization value                    */
```

The **CreateDialogParam** function creates a modeless dialog box from a dialog box template resource. Before displaying the dialog box, the function passes an application-defined value to the dialog box procedure as the *lParam* parameter of the **WM_INITDIALOG** message. An application can use this value to initialize dialog box controls.

Parameter	Description
hinst	Identifies an instance of the module whose executable file contains the dialog box template.
lpszDlgTemp	Points to a null-terminated string that names the dialog box template.
hwndOwner	Identifies the window that owns the dialog box.
dlgprc	Specifies the procedure-instance address of the dialog box procedure. The address must be created by using the **MakeProcInstance** function, except when the function and dialog box procedure are used in a DLL. For more information about the dialog box procedure, see the description of the **DialogProc** callback function.
lParamInit	Specifies the value to pass to the dialog box when processing the **WM_INITDIALOG** message.

Returns

The return value is the handle of the dialog box that was created, if the function is successful. Otherwise, it is NULL.

Comments

The **CreateWindowEx** function is called to create the dialog box. The dialog box procedure then receives a **WM_SETFONT** message (if the DS_SETFONT style was specified) and a **WM_INITDIALOG** message, and then the dialog box is displayed.

The **CreateDialogParam** function returns immediately after creating the dialog box.

To make the dialog box appear in the owner window upon being created, use the **WS_VISIBLE** style in the dialog box template.

A dialog box can contain up to 255 controls.

Example

The following example uses the **CreateDialogParam** function to create a modeless dialog box. The function passes the application-defined flags MIXEDCASE and WHOLEWORD, which will be received by the dialog box as the *lParam* parameter of the **WM_INITDIALOG** message.

```
HWND hwndChangeBox;
DLGPROC dlgprc = (DLGPROC) MakeProcInstance(ChangeDlgProc, hinst);

hwndChangeBox = CreateDialogParam(hinst, "dlgFindBox",
    hwndParent, dlgprc, MIXEDCASE | WHOLEWORD);
```

See Also

CreateDialog, **CreateDialogIndirect**, **CreateDialogIndirectParam**, **DestroyWindow**, **WM_INITDIALOG**

CreateIcon (3.0)

HICON CreateIcon(*hinst, nWidth, nHeight, bPlanes, bBitsPixel, lpvANDbits, lpvXORbits***)**

```
HINSTANCE hinst;              /* handle of application instance        */
int nWidth;                   /* icon width                            */
int nHeight;                  /* icon height                           */
BYTE bPlanes;                 /* number of planes in XOR mask          */
BYTE bBitsPixel;              /* number of bits per pixel in XOR mask  */
const void FAR* lpvANDbits;   /* address of AND mask array             */
const void FAR* lpvXORbits;   /* address of XOR mask array             */
```

The **CreateIcon** function creates an icon that has the specified width, height, colors, and bit patterns.

Parameter	Description
hinst	Identifies an instance of the module that will create the icon.
nWidth	Specifies the width, in pixels, of the icon.
nHeight	Specifies the height, in pixels, of the icon.
bPlanes	Specifies the number of planes in the XOR mask of the icon.
bBitsPixel	Specifies the number of bits per pixel in the XOR mask of the icon.
lpvANDbits	Points to an array of bytes that contains the bit values for the AND mask of the icon. This array must specify a monochrome mask.
lpvXORbits	Points to an array of bytes that contains the bit values for the XOR mask of the icon. These bits can be the bits of a monochrome or device-dependent color bitmap.

Returns

The return value is the handle of the icon if the function is successful. Otherwise, it is NULL.

Comments

The *nWidth* and *nHeight* parameters must specify a width and height supported by the current display driver, since the system cannot create icons of other sizes. An application can determine the width and height supported by the display driver by calling the **GetSystemMetrics** function, specifying the **SM_CXICON** or **SM_CYICON** constant.

Before terminating, an application must call the **DestroyIcon** function to free system resources associated with the icon.

See Also

DestroyIcon, **GetSystemMetrics**

CreateMenu (2.x)

HMENU CreateMenu(void)

The **CreateMenu** function creates a menu. The menu is initially empty but can be filled with menu items by using the **AppendMenu** or **InsertMenu** function.

Returns

The return value is the handle of the newly created menu if the function is successful. Otherwise, it is NULL.

Comments

If the menu is not assigned to a window, an application must free system resources associated with the menu before exiting. An application frees menu resources by calling the **DestroyMenu** function. Windows automatically frees resources associated with a menu that is assigned to a window.

Example

The following example creates a main menu and a pop-up menu and associates the pop-up menu with an item in the main menu:

```
HMENU hmenu;
HMENU hmenuPopup;

/* Create the main and pop-up menu handles. */

hmenu = CreateMenu();
hmenuPopup = CreatePopupMenu();

/* Create the pop-up menu items. *./

AppendMenu(hmenuPopup, MF_ENABLED | MF_STRING, IDM_NEW,
     "&New");
AppendMenu(hmenuPopup, MF_ENABLED | MF_STRING, IDM_SAVE,
     "&Save");
AppendMenu(hmenuPopup, MF_ENABLED | MF_STRING, IDM_SAVE_AS,
     "&Save As");

/* Add the pop-up menu to the main menu. */

AppendMenu(hmenu, MF_ENABLED | MF_POPUP, (UINT) hmenuPopup,
     "&File");
```

See Also

AppendMenu, **DestroyMenu**, **InsertMenu**, **SetMenu**

CreatePopupMenu (3.0)

HMENU CreatePopupMenu(void)

The **CreatePopupMenu** function creates an empty pop-up menu.

Returns
The return value is the handle of the newly created menu if the function is successful. Otherwise, it is NULL.

Comments
An application adds items to the pop-up menu by calling the **InsertMenu** and **AppendMenu** functions. The application can add the pop-up menu to an existing menu or pop-up menu, or it can display and track selections on the pop-up menu by calling the **TrackPopupMenu** function.

Before exiting, an application must free system resources associated with a pop-up menu if the menu is not assigned to a window. An application frees a menu by calling the **DestroyMenu** function.

Example
The following example creates a main menu and a pop-up menu, and associates the pop-up menu with an item in the main menu:

```
HMENU hmenu;
HMENU hmenuPopup;

/* Create the main and pop-up menu handles. */

hmenu = CreateMenu();
hmenuPopup = CreatePopupMenu();

/* Create the pop-up menu items. */

AppendMenu(hmenuPopup, MF_ENABLED | MF_STRING, IDM_NEW,
    "&New");
AppendMenu(hmenuPopup, MF_ENABLED | MF_STRING, IDM_SAVE,
    "&Save");
AppendMenu(hmenuPopup, MF_ENABLED | MF_STRING, IDM_SAVE_AS,
    "&Save As");

/* Add the pop-up menu to the main menu. */

AppendMenu(hmenu, MF_ENABLED | MF_POPUP, (UINT) hmenuPopup,
    "&File");
```

See Also
AppendMenu, **CreateMenu**, **InsertMenu**, **SetMenu**, **TrackPopupMenu**

CreateWindow (2.x)

HWND CreateWindow(*lpszClassName, lpszWindowName, dwStyle, x, y, nWidth, nHeight, hwndParent, hmenu, hinst, lpvParam***)**

```
LPCSTR lpszClassName;       /* address of registered class name          */
LPCSTR lpszWindowName;      /* address of window text                    */
DWORD dwStyle;              /* window style                              */
int x;                      /* horizontal position of window             */
int y;                      /* vertical position of window               */
int nWidth;                 /* window width                              */
int nHeight;                /* window height                             */
HWND hwndParent;            /* handle of parent window                   */
HMENU hmenu;                /* handle of menu or child-window identifier */
HINSTANCE hinst;            /* handle of application instance            */
void FAR* lpvParam;         /* address of window-creation data           */
```

The **CreateWindow** function creates an overlapped, pop-up, or child window. The **CreateWindow** function specifies the window class, window title, window style, and (optionally) the initial position and size of the window. The **CreateWindow** function also specifies the window's parent (if any) and menu.

Parameter	Description
lpszClassName	Points to a null-terminated string specifying the window class. The class name can be any name registered with the **RegisterClass** function or any of the predefined control-class names. (See **Control classes**).
lpszWindowName	Points to a null-terminated string that represents the window name.
dwStyle	Specifies the style of window being created. This parameter can be a combination of the window styles and control styles given in the following Comments section.
x	Specifies the initial x-position of the window. For an overlapped or pop-up window, the *x* parameter is the initial x-coordinate of the window's upper-left corner, in screen coordinates. For a child window, *x* is the x-coordinate of the upper-left corner of the window in the client area of its parent window. If this value is CW_USEDEFAULT, Windows selects the default position for the window's upper-left corner and ignores the *y* parameter. CW_USEDEFAULT is valid only for overlapped windows. If CW_USEDEFAULT is specified for a non-overlapped window, the *x* and *y* parameters are set to 0.
y	Specifies the initial y-position of the window. For an overlapped window, the *y* parameter is the initial y-coordinate of the window's upper-left corner. For a pop-up window, *y* is the y-coordinate, in screen coordinates, of the upper-left corner of the pop-up window. For list-box controls, *y* is the y-coordinate of the upper-left corner of the control's client area. For a child window, *y* is the y-coordinate of the upper-left corner of the child window. All of these coordinates are for the window, not the window's client area. If an overlapped window is created with the **WS_VISIBLE** style and the *x* parameter set to CW_USEDEFAULT, Windows ignores the *y* parameter.
nWidth	Specifies the width, in device units, of the window. For overlapped windows, the *nWidth* parameter is either the window's width (in screen coordinates) or CW_USEDEFAULT. If *nWidth* is CW_USEDEFAULT, Windows selects a default width and height for the window (the default width extends from the initial x-position to the right edge of the screen, and the default height extends from the initial y-position to the top of the icon area). CW_USEDEFAULT is valid only for overlapped windows. If CW_USEDEFAULT is specified in *nWidth* for a non-overlapped window, *nWidth* and *nHeight* are set to 0.

nHeight	Specifies the height, in device units, of the window. For overlapped windows, the *nHeight* parameter is the window's height in screen coordinates. If the *nWidth* parameter is CW_USEDEFAULT, Windows ignores *nHeight.*
hwndParent	Identifies the parent or owner window of the window being created. A valid window handle must be supplied when creating a child window or an owned window. An owned window is an overlapped window that is destroyed when its owner window is destroyed, hidden when its owner is minimized, and that is always displayed on top of its owner window. For pop-up windows, a handle can be supplied but is not required. If the window does not have a parent window or is not owned by another window, the *hwndParent* parameter must be set to HWND_DESKTOP.
hmenu	Identifies a menu or a child window. This parameter's meaning depends on the window style. For overlapped or pop-up windows, the *hmenu* parameter identifies the menu to be used with the window. It can be NULL, if the class menu is to be used. For child windows, *hmenu* identifies the child window and is an integer value that is used by a dialog box control to notify its parent of events (such as the **EN_HSCROLL** message). The child window identifier is determined by the application and should be unique for all child windows with the same parent window.
hinst	Identifies the instance of the module to be associated with the window.
lpvParam	Points to a value that is passed to the window through the **CREATESTRUCT** structure referenced by the *lParam* parameter of the **WM_CREATE** message. If an application is calling **CreateWindow** to create a multiple document interface (MDI) client window, *lpvParam* must point to a **CLIENTCREATESTRUCT** structure.

Returns

The return value is the handle of the new window if the function is successful. Otherwise, it is NULL.

Comments

For overlapped, pop-up, and child windows, the **CreateWindow** function sends **WM_CREATE**, **WM_GETMINMAXINFO**, and **WM_NCCREATE** messages to the window. If the **WS_VISIBLE** style is specified, **CreateWindow** sends the window all the messages required to activate and show the window.

If the window style specifies a title bar, the window title pointed to by the *lpszWindowName* parameter is displayed in the title bar. When using **CreateWindow** to create controls such as buttons, check boxes, and edit controls, use the *lpszWindowName* parameter to specify the text of the control.

Before returning, the **CreateWindow** function sends a **WM_CREATE** message to the window procedure.

Following are the predefined control classes an application can specify in the *lpszClassName* parameter:

Class	Meaning
BUTTON	Designates a small rectangular child window that represents a button the user can turn on or off by clicking. Button controls can be used alone or in groups, and can either be labeled or appear without text. Button controls typically change appearance when the user clicks them.
COMBOBOX	Designates a control consisting of a list box and a selection field similar to an edit control. The list box may be displayed at all times or may be dropped down when the user selects a pop-up list box next to the selection field. Depending on the style of the combo box, the user can or cannot edit the contents of the selection field. If the list box is visible, typing characters into the selection box will cause the first list box entry that matches the characters typed to be highlighted. Conversely, selecting an item in the list box displays the selected text in the selection field.

EDIT	Designates a rectangular child window in which the user can type text from the keyboard. The user selects the control, and gives it the input focus by clicking it or moving to it by pressing the TAB key. The user can type text when the control displays a flashing caret. The mouse can be used to move the cursor and select characters to be replaced, or to position the cursor for inserting characters. The BACKSPACE key can be used to delete characters. Edit controls use the variable-pitch System font and display characters from the Windows character set. Applications compiled to run with earlier versions of Windows display text with a fixed-pitch System font unless they have been marked by the Windows 3.0 MARK utility (with the **MEMORY FONT** option specified). An application can also send the **WM_SETFONT** message to the edit control to change the default font. Edit controls expand tab characters into as many space characters as are required to move the cursor to the next tab stop. Tab stops are assumed to be at every eighth character position.
LISTBOX	Designates a list of character strings. This control is used whenever an application must present a list of names, such as filenames, from which the user can choose. The user can select a string by pointing to it and clicking. When a string is selected, it is highlighted and a notification message is passed to the parent window. A vertical or horizontal scroll bar can be used with a list box control to scroll lists that are too long for the control window. The list box automatically hides or shows the scroll bar as needed.
MDICLIENT	Designates an MDI client window. The MDI client window receives messages that control the MDI application's child windows. The recommended style bits are **WS_CLIPCHILDREN** and WS_CHILD. To create a scrollable MDI client window that allows the user to scroll MDI child windows into view, an application can also use the **WS_HSCROLL** and **WS_VSCROLL** styles.
SCROLLBAR	Designates a rectangle that contains a scroll box (also called a "thumb") and has direction arrows at both ends. The scroll bar sends a notification message to its parent window whenever the user clicks the control. The parent window is responsible for updating the position, if necessary. Scroll bar controls have the same appearance and function as scroll bars used in ordinary windows. Unlike scroll bars, however, scroll bar controls can be positioned anywhere in a window and used whenever needed to provide scrolling input for a window. The scroll bar class also includes size box controls (Maximize and Minimize buttons). These controls are small rectangles that the user can click to change the size of the window.
STATIC	Designates a simple text field, box, or rectangle that can be used to label, box, or separate other controls. Static controls take no input and provide no output.

Following are the window styles an application can specify in the *dwStyle* parameter.

Style	Meaning
MDIS_ALLCHILDSTYLES	Creates an MDI client window that can have any combination of window styles. When this style is not specified, an MDI child window has the **WS_MINIMIZE**, **WS_MAXIMIZE**, **WS_HSCROLL**, and **WS_VSCROLL** styles as default settings.
WS_BORDER	Creates a window that has a border.
WS_CAPTION	Creates a window that has a title bar (implies the **WS_BORDER** style). This style cannot be used with the **WS_DLGFRAME** style.
WS_CHILD	Creates a child window. Cannot be used with the **WS_POPUP** style.
WS_CHILDWINDOW	Same as the **WS_CHILD** style.
WS_CLIPCHILDREN	Excludes the area occupied by child windows when drawing within the parent window. Used when creating the parent window.

WS_CLIPSIBLINGS	Clips child windows relative to each other; that is, when a particular child window receives a paint message, the **WS_CLIPSIBLINGS** style clips all other overlapped child windows out of the region of the child window to be updated. (If WS_CLIPSIBLINGS is not specified and child windows overlap, it is possible, when drawing within the client area of a child window, to draw within the client area of a neighboring child window.) For use with the **WS_CHILD** style only.
WS_DISABLED	Creates a window that is initially disabled.
WS_DLGFRAME	Creates a window with a double border but no title.
WS_GROUP	Specifies the first control of a group of controls in which the user can move from one control to the next by using the arrow keys. All controls defined with the **WS_GROUP** style after the first control belong to the same group. The next control with the WS_GROUP style ends the style group and starts the next group (that is, one group ends where the next begins). Only dialog boxes use this style.
WS_HSCROLL	Creates a window that has a horizontal scroll bar.
WS_MAXIMIZE	Creates a window of maximum size.
WS_MAXIMIZEBOX	Creates a window that has a Maximize button.
WS_MINIMIZE	Creates a window that is initially minimized. For use with the **WS_OVERLAPPED** style only.
WS_MINIMIZEBOX	Creates a window that has a Minimize button.
WS_OVERLAPPED	Creates an overlapped window. An overlapped window has a title and a border.
WS_OVERLAPPEDWINDOW	Creates an overlapped window having the **WS_OVERLAPPED**, **WS_CAPTION**, **WS_SYSMENU**, **WS_THICKFRAME**, **WS_MINIMIZEBOX**, and **WS_MAXIMIZEBOX** styles.
WS_POPUP	Creates a pop-up window. Cannot be used with the **WS_CHILD** style.
WS_POPUPWINDOW	Creates a pop-up window that has the **WS_BORDER**, **WS_POPUP**, and **WS_SYSMENU** styles. The **WS_CAPTION** style must be combined with the **WS_POPUPWINDOW** style to make the System menu visible.
WS_SYSMENU	Creates a window that has a System-menu box in its title bar. Used only for windows with title bars.
WS_TABSTOP	Specifies one of any number of controls through which the user can move by using the TAB key. The TAB key moves the user to the next control specified by the **WS_TABSTOP** style. Only dialog boxes use this style.
WS_THICKFRAME	Creates a window with a thick frame that can be used to size the window.
WS_VISIBLE	Creates a window that is initially visible. This applies to overlapped, child, and pop-up windows. For overlapped windows, the *y* parameter is used as a **ShowWindow** function parameter.
WS_VSCROLL	Creates a window that has a vertical scroll bar.

The following styles may also be specified in the *dwStyle* parameter when a predfined control is being created:

Button styles
Combination box styles
Edit control styles
List box styles

Scroll bar styles
Static control styles

Following are the dialog box styles an application can specify in the *dwStyle* parameter:

Style	Meaning
DS_LOCALEDIT	Specifies that edit controls in the dialog box will use memory in the application's data segment. By default, all edit controls in dialog boxes use memory outside the application's data segment. This feature may be suppressed by adding the **DS_LOCALEDIT** flag to the Style command for the dialog box. If this flag is not used, **EM_GETHANDLE** and **EM_SETHANDLE** messages must not be used, because the storage for the control is not in the application's data segment. This feature does not affect edit controls created outside of dialog boxes.
DS_MODALFRAME	Creates a dialog box with a modal dialog box frame that can be combined with a title bar and System menu by specifying the **WS_CAPTION** and **WS_SYSMENU** styles.
DS_NOIDLEMSG	Suppresses **WM_ENTERIDLE** messages that Windows would otherwise send to the owner of the dialog box while the dialog box is displayed.
DS_SYSMODAL	Creates a system-modal dialog box.

See Also
AnsiToOem, **GetDialogBaseUnits**, **ShowWindow**, **CREATESTRUCT**, **CLIENTCREATESTRUCT**

Windows 3.1 changes

The following control styles have been added:

Value	Meaning
ES_READONLY	Prevents the user from entering or editing text in the edit control.
ES_WANTRETURN	Specifies that a carriage return be inserted when the user presses the ENTER key while entering text into mulitple-line edit control in a dialog box. Without this style, pressing the ENTER key has the same effect as pressing the dialog box's default pushbutton. This style has no effect on a single-line edit control.
CBS_DISABLENOSCROLL	The list box shows a disabled vertical scroll bar when the list box does not contain enough items to scroll. Without this style, the scroll bar is hidden when the list box does not contain enough items.
LBS_DISABLENOSCROLL	The list box shows a disabled vertical scroll bar when the list box does not contain enough items to scroll. Without this style, the scroll bar is hidden when the list box does not contain enough items.

The SS_USERITEM style has been removed.

CreateWindowEx (3.0)

HWND CreateWindowEx(*dwExStyle, lpszClassName, lpszWindowName, dwStyle, x, y, nWidth, nHeight, hwndParent, hmenu, hinst, lpvCreateParams***)**

```
DWORD dwExStyle;          /* extended window style                    */
LPCSTR lpszClassName;     /* address of registered class name         */
LPCSTR lpszWindowName;    /* address of window text                   */
DWORD dwStyle;            /* window style                             */
int x;                    /* horizontal position of the window        */
int y;                    /* vertical position of the window          */
int nWidth;               /* window width                             */
int nHeight;              /* window height                            */
HWND hwndParent;          /* handle of parent window                  */
HMENU hmenu;              /* handle of menu or child-window identifier*/
HINSTANCE hinst;          /* handle of application instance           */
void FAR* lpvCreateParams; /* address of window-creation data         */
```

The **CreateWindowEx** function creates an overlapped, pop-up, or child window with an extended style; otherwise, this function is identical to the **CreateWindow** function.

Parameter	Description
dwExStyle	Specifies the extended style of the window. This parameter can be one of the following values:

Style	Meaning
WS_EX_ACCEPTFILES	Specifies that a window created with this style accepts drag-drop files.
WS_EX_DLGMODALFRAME	Designates a window with a double border that may (optionally) be created with a title bar by specifying the **WS_CAPTION** style flag in the *dwStyle* parameter.
WS_EX_NOPARENTNOTIFY	Specifies that a child window created by using this style will not send the **WM_PARENTNOTIFY** message to its parent window when the child window is created or destroyed.
WS_EX_TOPMOST	Specifies that a window created with this style should be placed above all non-topmost windows and stay above them even when the window is deactivated. An application can use the **SetWindowPos** function to add or remove this attribute.
WS_EX_TRANSPARENT	Specifies that a window created with this style is to be transparent. That is, any windows that are beneath the window are not obscured by the window. A window created with this style receives **WM_PAINT** messages only after all sibling windows beneath it have been updated.

lpszClassName	Points to a null-terminated string containing the name of the window class.
lpszWindowName	Points to a null-terminated string containing the name of the window.
dwStyle	Specifies the style of the window. For a list of the window styles that can be specified in this parameter, see the preceding description of the **CreateWindow**

	function.
x	Specifies the initial left-side position of the window.
y	Specifies the initial top position of the window.
nWidth	Specifies the width, in device units, of the window.
nHeight	Specifies the height, in device units, of the window.
hwndParent	Identifies the parent or owner window of the window to be created.
hmenu	Identifies a menu or a child window. The meaning depends on the window style.
hinst	Identifies the instance of the module to be associated with the window.
lpvCreateParams	Contains any application-specific creation parameters. The window being created may access this data when the **CREATESTRUCT** structure is passed to the window by the **WM_NCCREATE** and **WM_CREATE** messages.

Returns
The return value identifies the new window if the function is successful. Otherwise, it is NULL.

Comments
The **CreateWindowEx** function sends the following messages to the window being created:

WM_NCCREATE
WM_NCCALCSIZE
WM_CREATE

Example
The following example creates a main window that has the **WS_EX_TOPMOST** extended style, makes the window visible, and updates the window's client area:

```
char szClassName[] = "MyClass";

/* Create the main window. */

hwnd = CreateWindowEx(WS_EX_TOPMOST, szClassName, "Grouper",
    WS_OVERLAPPEDWINDOW, CW_USEDEFAULT, CW_USEDEFAULT,
    CW_USEDEFAULT, CW_USEDEFAULT, NULL, NULL,
    hinst, NULL);

/* Make the window visible and update its client area. */

ShowWindow(hwnd, SW_SHOW);   /* always show the window */
UpdateWindow(hwnd);
```

See Also
CreateWindow, **SetWindowPos**, **CREATESTRUCT**

Windows 3.1 changes

The following styles may be used for the *dwExStyle* parameter:

Style	Meaning
WS_EX_ACCEPTFILES	Specifies that a window created with this style accepts drag-drop files.
WS_EX_TOPMOST	Specifies that a window created with this style should be placed above all non-topmost windows and stay above them even when the window is deactivated. An application can use the **SetWindowPos** function to add or remove this attribute.
WS_EX_TRANSPARENT	Specifies that a window created with this style is to be transparent. That is, any windows that are beneath the window are not obscured by the window. A window created with this style receives **WM_PAINT** messages only after all sibling windows beneath it have been updated.

WS_EX_ACCEPTFILES 0x00000010L

Specifies that a window created with this style accepts drag-drop files.

WS_EX_ACCEPTFILES 0x00000010L

WS_EX_DLGMODALFRAME 0x00000001L

Designates a window with a double border that may (optionally) be created with a title bar by specifying the **WS_CAPTION** style flag in the *dwStyle* parameter.

WS_EX_DLGMODALFRAME 0x00000001L

WS_EX_NOPARENTNOTIFY 0x00000004L

Specifies that a child window created by using this style will not send the **WM_PARENTNOTIFY** message to its parent window when the child window is created or destroyed.

WS_EX_NOPARENTNOTIFY 0x00000004L

WS_EX_TOPMOST 0x00000008L

Specifies that a window created with this style should be placed above all non-topmost windows and stay above them even when the window is deactivated. An application can use the **SetWindowPos** function to add or remove this attribute.

WS_EX_TOPMOST 0x00000008L

WS_EX_TRANSPARENT 0x00000020L

Specifies that a window created with this style is to be transparent. That is, any windows that are beneath the window are not obscured by the window. A window created with this style receives **WM_PAINT** messages only after all sibling windows beneath it have been updated.

WS_EX_TRANSPARENT 0x00000020L

DefDlgProc (3.0)

LRESULT DefDlgProc(*hwndDlg, uMsg, wParam, lParam***)**

```
HWND hwndDlg;       /* handle of dialog box          */
UINT uMsg;          /* message                       */
WPARAM wParam;      /* first message parameter       */
LPARAM lParam;      /* second message parameter      */
```

The **DefDlgProc** function provides default processing for any Windows messages that a dialog box with a private window class does not process.

Parameter	Description
hwndDlg	Identifies the dialog box.
uMsg	Specifies the message to be processed.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value specifies the result of the message processing and depends on the message sent.

Comments

The **DefDlgProc** function is the window procedure for the **DIALOG** window class. An application that creates new window classes that inherit dialog box functionality should use this function. **DefDlgProc** is not intended to be called as the default handler for messages within a dialog box procedure, since doing so will result in recursive execution.

An application creates a dialog box by calling one of the following functions:

Function	Description
CreateDialog	Creates a modeless dialog box.
CreateDialogIndirect	Creates a modeless dialog box.
CreateDialogIndirectParam	Creates a modeless dialog box and passes data to it when it is created.
CreateDialogParam	Creates a modeless dialog box and passes data to it when it is created.
DialogBox	Creates a modal dialog box.
DialogBoxIndirect	Creates a modal dialog box.
DialogBoxIndirectParam	Creates a modal dialog box and passes data to it when it is created.
DialogBoxParam	Creates a modal dialog box and passes data to it when it is created.

See Also

DefWindowProc

DefDriverProc (3.1)

LRESULT DefDriverProc(*dwDriverIdentifier, hdrvr, uMsg, lParam1, lParam2***)**

```
DWORD dwDriverIdentifier;     /* installable-driver identifier    */
HDRVR hdrvr;                  /* handle of installable driver     */
UINT uMsg;                    /* message number                   */
LPARAM lParam1;               /* first message parameter          */
LPARAM lParam2;               /* second message parameter         */
```

The **DefDriverProc** function provides default processing for any messages not processed by an installable driver.

Parameter	Description
dwDriverIdentifier	Identifies an installable driver. This parameter must have been obtained by a previous call to the **OpenDriver** function.
hdrvr	Identifies the installable driver.
uMsg	Specifies the message to be processed.
lParam1	Specifies 32 bits of additional message-dependent information.
lParam2	Specifies 32 bits of additional message-dependent information.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The **DefDriverProc** function processes messages that are not handled by the **DriverProc** function.

See Also
OpenDriver, **SendDriverMessage**

DeferWindowPos (3.0)

HDWP DeferWindowPos(*hdwp, hwnd, hwndInsertAfter, x, y, cx, cy, flags***)**

```
HDWP hdwp;              /* handle of internal structure   */
HWND hwnd;              /* handle of window to position */
HWND hwndInsertAfter;   /* placement-order handle         */
int x;                  /* horizontal position            */
int y;                  /* vertical position              */
int cx;                 /* width                          */
int cy;                 /* height                         */
UINT flags;             /* window-positioning flags       */
```

The **DeferWindowPos** function updates the given internal structure for the given window. The function then returns the handle of the updated structure. The **EndDeferWindowPos** function uses the information in this structure to change the position and size of a number of windows simultaneously.

Parameter	Description
hdwp	Identifies an internal structure that contains size and position information for one or more windows. This structure is returned by the **BeginDeferWindowPos** function or by the most recent call to the **DeferWindowPos** function.
hwnd	Identifies the window for which update information is to be stored in the structure.
hwndInsertAfter	Identifies a window that will precede the positioned window in the Z-order. This parameter must be a window handle, or one of the following values:

Value	Meaning
HWND_BOTTOM	Places the window at the bottom of the Z-order. If *hwnd* identifies a topmost window, the window loses its topmost status; the system places the window at the bottom of all other windows.
HWND_TOP	Places the window at the top of the Z-order.
HWND_TOPMOST	Places the window above all non-topmost windows. The window maintains its topmost position even when it is deactivated.
HWND_NOTOPMOST	Repositions the window to the top of all non-topmost windows (that is, behind all topmost windows). This flag has no effect if the window is already a non-topmost window.

This parameter is ignored if the **SWP_NOZORDER** flag is set in the *flags* parameter.

x	Specifies the x-coordinate of the window's upper-left corner.
y	Specifies the y-coordinate of the window's upper-left corner.
cx	Specifies the window's new width.
cy	Specifies the window's new height.
flags	Specifies one of eight possible 16-bit values that affect the size and position of the window. This parameter can be a combination of the following values:

Value	Meaning
SWP_DRAWFRAME	Draws a frame (defined in the window's class description) around the window.
SWP_HIDEWINDOW	Hides the window.
SWP_NOACTIVATE	Does not activate the window.

SWP_NOMOVE	Retains current position (ignores the *x* and *y* parameters).
SWP_NOREDRAW	Does not redraw changes. If this flag is set, no repainting of any kind occurs. This applies to the client area, the non-client area (including the title and scroll bars), and any part of the parent window uncovered as a result of the moved window. When this flag is set, the application must explicitly invalidate or redraw any parts of the window and parent window that must be redrawn.
SWP_NOSIZE	Retains current size (ignores the *cx* and *cy* parameters).
SWP_NOZORDER	Retains current ordering (ignores the *hwndInsertAfter* parameter).
SWP_SHOWWINDOW	Displays the window.

Returns

The return value is a handle of the updated structure if the function is successful. This handle may differ from the one passed to the function as the *hdwp* parameter and should be passed to the next call to **DeferWindowPos** or to the **EndDeferWindowPos** function.

The return value is NULL if insufficient system resources are available for the function to complete successfully and the repositioning process is terminated.

Comments

If a call to **DeferWindowPos** fails, the application should abandon the window-positioning operation without calling the **EndDeferWindowPos** function.

If the **SWP_NOZORDER** flag is not specified, Windows places the window identified by the *hwnd* parameter in the position following the window identified by the *hwndInsertAfter* parameter. If *hwndInsertAfter* is NULL, Windows places the window identified by *hwnd* at the top of the list. If *hwndInsertAfter* is **HWND_BOTTOM**, Windows places the window identified by *hwnd* at the bottom of the list.

All coordinates for child windows are relative to the upper-left corner of the parent window's client area.

A window can be made a topmost window either by setting the *hwndInsertAfter* parameter to **HWND_TOPMOST** and ensuring that the **SWP_NOZORDER** flag is not set, or by setting a window's Z-order so that it is above any existing topmost windows. When a non-topmost window is made topmost, its owned windows are also made topmost. Its owners are not changed.

If neither **SWP_NOACTIVATE** nor **SWP_NOZORDER** is specified (that is, when the application requests that a window be simultaneously activated and placed in the specified Z-order), the value specified in *hwndInsertAfter* is used only in the following circumstances:

- Neither **HWND_TOPMOST** or **HWND_NOTOPMOST** is specified in the *hwndInsertAfter* parameter.
- The window specified in the *hwnd* parameter is not the active window.

An application cannot activate an inactive window without also bringing it to the top of the Z-order. Applications can change the Z-order of an activated window without restrictions or activate a window and then move it to the top of the topmost or non-topmost windows.

A topmost window is no longer topmost if it is repositioned to the bottom (**HWND_BOTTOM**) of the Z-order or after any non-topmost window. When a topmost window is made non-topmost, the window and all of its owners, and its owned windows, are also made non-topmost.

A non-topmost window may own a topmost window, but not vice versa. Any window (for example, a dialog box) owned by a topmost window is itself made topmost to ensure that all owned windows stay above their owner.

See Also
BeginDeferWindowPos, **EndDeferWindowPos**

Windows 3.1 changes

If the *hwndInsertAfter* parameter is **HWND_TOPMOST**, the system places the window identified by the *hwnd* parameter above all non-topmost windows. The window maintains its topmost position even when the window is deactivated. If the *hwndInsertAfter* parameter is **HWND_BOTTOM** and *hwnd* identifies a topmost window, the window loses its topmost status--the system places the window at the bottom of all other windows.

The following window-positioning flags are new for Windows version 3.1:

Value	Meaning
HWND_BOTTOM	Places the window at the bottom of the Z order. If *hwnd* identifies a topmost window, the window loses its topmost status--the system places the window at the bottom of all other windows.
HWND_TOP	Places the window at the top of the Z order.
HWND_TOPMOST	Places the window above all non-topmost windows. The window maintains its topmost position even when the window is deactivated.
HWND_NOTOPMOST	Repositions the window to the top of all non-topmost windows (that is, behind all topmost window).

SWP_DRAWFRAME SWP_FRAMECHANGED

Draws a frame (defined in the window's class description) around the window.

SWP_DRAWFRAME SWP_FRAMECHANGED

SWP_HIDEWINDOW 0x0080

Hides the window.

SWP_HIDEWINDOW 0x0080

SWP_NOACTIVATE 0x0010

Does not activate the window.

SWP_NOACTIVATE 0x0010

SWP_NOMOVE 0x0002

Retains current position (ignores the *x* and *y* parameters).

SWP_NOMOVE 0x0002

SWP_NOREDRAW 0x0008

Does not redraw changes. If this flag is set, no repainting of any kind occurs. This applies to the client area, the non-client area (including the title and scroll bars), and any part of the parent window uncovered as a result of the moved window. When this flag is set, the application must explicitly invalidate or redraw any parts of the window and parent window that must be redrawn.

SWP_NOREDRAW 0x0008

SWP_NOSIZE 0x0001

Retains current size (ignores the *cx* and *cy* parameters).

SWP_NOSIZE 0x0001

SWP_NOZORDER 0x0004

Retains current ordering (ignores the *hwndInsertAfter* parameter).

SWP_NOZORDER 0x0004

SWP_SHOWWINDOW 0x0040

Displays the window.

SWP_SHOWWINDOW 0x0040

DefFrameProc (3.0)

LRESULT DefFrameProc(*hwnd, hwndMDIClient, uMsg, wParam, lParam***)**

```
HWND hwnd;          /* handle of frame window      */
HWND hwndMDIClient; /* handle of client window     */
UINT uMsg;          /* message                     */
WPARAM wParam;      /* first message parameter     */
LPARAM lParam;      /* second message parameter    */
```

The **DefFrameProc** function provides default processing for any Windows messages that the window procedure of a multiple document interface (MDI) frame window does not process. All window messages that are not explicitly processed by the window procedure must be passed to the **DefFrameProc** function, not the **DefWindowProc** function.

Parameter	Description
hwnd	Identifies the MDI frame window.
hwndMDIClient	Identifies the MDI client window.
uMsg	Specifies the message to be processed.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value specifies the result of the message processing and depends on the message sent. If the *hwndMDIClient* parameter is NULL, the return value is the same as for the **DefWindowProc** function.

Comments

Typically, when an application's window procedure does not handle a message, it passes the message to the **DefWindowProc** function, which processes the message. MDI applications use the **DefFrameProc** and **DefMDIChildProc** functions instead of **DefWindowProc** to provide default message processing. All messages that an application would usually pass to **DefWindowProc** (such as nonclient messages and **WM_SETTEXT**) should be passed to **DefFrameProc** instead. In addition to handling these messages, **DefFrameProc** also handles the following messages:

Message	Response
WM_COMMAND	The frame window of an MDI application receives the **WM_COMMAND** message to activate a particular MDI child window. The window identifier accompanying this message will identify the MDI child window assigned by Windows, starting with the first identifier specified by the application when it created the MDI client window. This value of the first identifier must not conflict with menu-item identifiers.
WM_MENUCHAR	When the user presses the ALT+- key combination, the System menu (often called Control menu) of the active MDI child window will be selected.
WM_SETFOCUS	**DefFrameProc** passes focus on to the MDI client, which in turn passes the focus on to the active MDI child window.
WM_SIZE	If the frame window procedure passes this message to **DefFrameProc**, the MDI client window will be resized to fit in the new client area. If the frame window procedure sizes the MDI client to a different size, it should not pass the message to **DefWindowProc**.

See Also

DefMDIChildProc, **DefWindowProc**

DefHookProc (2.x)

DWORD DefHookProc(*nCode, uParam, dwParam, lphhook***)**

```
int nCode;          /* process code                          */
UINT uParam;        /* first message parameter               */
DWORD dwParam;      /* second message parameter              */
HHOOK FAR* lphhook; /* points to address of next hook function */
```

This function is obsolete but has been retained for backward compatibility with Windows versions 3.0 and earlier. Applications written for Windows version 3.1 should use the **CallNextHookEx** function.

The **DefHookProc** function calls the next function in a chain of hook functions. A hook function is a function that processes events before they are sent to an application's message-processing loop in the **WinMain** function. When an application defines more than one hook function by using the **SetWindowsHook** function, Windows forms a linked list or hook chain. Windows places functions of the same type in a chain.

Parameter	Description
nCode	Specifies a code used by the Windows hook function (also called the message-filter function) to determine how to process the message.
uParam	Specifies 16 bits of additional message-dependent information.
dwParam	Specifies 32 bits of additional message-dependent information.
lphhook	Points to the variable that contains the procedure-instance address of the previously installed hook function returned by the **SetWindowsHook** function.

Returns

The return value specifies the result of the event processing and depends on the event.

Comments

Windows changes the value at the location pointed to by the *lphhook* parameter after an application calls the **UnhookWindowsHook** function. For more information, see the description of the **UnhookWindowsHook** function.

See Also

CallNextHookEx, **SetWindowsHook**, **UnhookWindowsHook**

DefMDIChildProc (3.0)

LRESULT DefMDIChildProc(*hwnd, uMsg, wParam, lParam***)**

```
HWND hwnd;          /* handle of child window      */
UINT uMsg;          /* message                     */
WPARAM wParam;      /* first message parameter     */
LPARAM lParam;      /* second message parameter    */
```

The **DefMDIChildProc** function provides default processing for any Windows messages that the window procedure of a multiple document interface (MDI) child window does not process. All window messages that are not explicitly processed by the window procedure must be passed to the **DefMDIChildProc** function, not the **DefWindowProc** function.

Parameter	Description
hwnd	Identifies the MDI child window.
uMsg	Specifies the message to be processed.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value specifies the result of the message processing and depends on the message sent.

Comments

This function assumes that the parent of the window identified by the *hwnd* parameter was created with the MDICLIENT class.

Typically, when an application's window procedure does not handle a message, it passes the message to the **DefWindowProc** function, which processes the message. MDI applications use the **DefFrameProc** and **DefMDIChildProc** functions instead of **DefWindowProc** to provide default message processing. All messages that an application would usually pass to **DefWindowProc** (such as nonclient messages and **WM_SETTEXT**) should be passed to **DefMDIChildProc** instead. In addition to handling these messages, **DefMDIChildProc** also handles the following messages:

Message	Response
WM_CHILDACTIVATE	Performs activation processing when child windows are sized, moved, or shown. This message must be passed.
WM_GETMINMAXINFO	Calculates the size of a maximized MDI child window based on the current size of the MDI client window.
WM_MENUCHAR	Sends the keystrokes to the frame window.
WM_MOVE	Recalculates MDI client scroll bars, if they are present.
WM_SETFOCUS	Activates the child window if it is not the active MDI child window.
WM_SIZE	Performs necessary operations when changing the size of a window, especially when maximizing or restoring an MDI child window. Failing to pass this message to **DefMDIChildProc** will produce highly undesirable results.
WM_SYSCOMMAND	Also handles the next window command.

See Also

DefFrameProc, **DefWindowProc**

DefWindowProc (2.x)

LRESULT DefWindowProc(*hwnd, uMsg, wParam, lParam***)**

```
HWND hwnd;      /* handle of window       */
UINT uMsg;      /* type of message        */
WPARAM wParam;  /* first message parameter */
LPARAM lParam;  /* second message parameter */
```

The **DefWindowProc** function calls the default window procedure. The default window procedure provides default processing for any window messages that an application does not process. This function ensures that every message is processed. It should be called with the same parameters as those received by the window procedure.

Parameter	Description
hwnd	Identifies the window that received the message.
uMsg	Specifies the message.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value is the result of the message processing and depends on the message sent.

Example

The following example shows a typical window procedure. A switch statement is used to process individual messages. All messages not processed are passed on to the **DefWindowProc** function.

```
LRESULT CALLBACK MainWndProc(hwnd, msg, wParam, lParam)
HWND hwnd;      /* handle of window       */
UINT msg;       /* type of message        */
WPARAM wParam;  /* additional information */
LPARAM lParam;  /* additional information */
{
    switch (msg) {

        /*
         * Process whatever messages you want here and send the
         * rest to DefWindowProc.
         */

        default:
            return (DefWindowProc(hwnd, message, wParam, lParam));
```

See Also

DefDlgProc

DeleteMenu (3.0)

BOOL DeleteMenu(*hmenu, idItem, fuFlags***)**

```
HMENU hmenu;      /* handle of menu       */
UINT idItem;      /* menu-item identifier */
UINT fuFlags;     /* menu flags           */
```

The **DeleteMenu** function deletes an item from a menu. If the menu item has an associated pop-up menu, **DeleteMenu** destroys the handle of the pop-up menu and frees the memory used by the pop-up menu.

Parameter	Description
hmenu	Identifies the menu to be deleted.
idItem	Specifies the menu item to be deleted, as determined by the *fuFlags* parameter.
fuFlags	Specifies how the *idItem* parameter is interpreted. This parameter can be one of the following values:

Value	Meaning
MF_BYCOMMAND	The *idItem* parameter specifies the menu-item identifier.
MF_BYPOSITION	The *idItem* parameter specifies the zero-based relative position of the menu item.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

Whenever a menu changes (whether or not the menu is in a window that is displayed), the application should call the **DrawMenuBar** function.

See Also

AppendMenu, **CreateMenu**, **DrawMenuBar**, **InsertMenu**, **RemoveMenu**

MF_BYCOMMAND 0x0000

The *idItem* parameter specifies the menu-item identifier.

MF_BYCOMMAND 0x0000

MF_BYPOSITION 0x0400

The *idItem* parameter specifies the zero-based relative position of the menu item.

MF_BYPOSITION 0x0400

DestroyCaret (2.x)

void DestroyCaret(void)

The **DestroyCaret** function destroys the current caret shape, frees the caret from the window that currently owns it, and removes the caret from the screen if it is visible. The **DestroyCaret** function checks the ownership of the caret and destroys the caret only if a window in the current task owns it.

If the caret shape was previously a bitmap, **DestroyCaret** does not free the bitmap.

Returns
This function does not return a value.

Comments
The caret is a shared resource. If a window has created a caret shape, it should destroy that shape before it loses the input focus or becomes inactive.

See Also
CreateCaret, **HideCaret**, **ShowCaret**

DestroyCursor (3.0)

BOOL DestroyCursor(*hcur***)**

HCURSOR *hcur;* /* handle of cursor to destroy */

The **DestroyCursor** function destroys a cursor that was previously created by the **CreateCursor** or **LoadCursor** function and frees any memory that the cursor occupied.

Parameter	Description
hcur	Identifies the cursor to be destroyed. The cursor must not be in current use.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also
CreateCursor, **CreateIcon**, **DestroyIcon**, **LoadCursor**

DestroyIcon (3.0)

BOOL DestroyIcon(*hicon***)**

HICON *hicon;* /* handle of icon to destroy */

The **DestroyIcon** function destroys an icon that was created by the **CreateIcon** or **LoadIcon** function and frees any memory that the icon occupied.

Parameter	Description
hicon	Identifies the icon to be destroyed.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also
CreateCursor, **CreateIcon**, **DestroyCursor**, **LoadIcon**

DestroyMenu (2.x)

BOOL DestroyMenu(*hmenu***)**

HMENU *hmenu;* /* handle of menu to destroy */

The **DestroyMenu** function destroys a menu and frees any memory that the menu occupied.

Parameter	Description
hmenu	Identifies the menu to be destroyed.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also
CreateMenu

DestroyWindow (2.x)

BOOL DestroyWindow(*hwnd***)**

HWND *hwnd;* /* handle of window to destroy */

The **DestroyWindow** function destroys the specified window. The function sends appropriate messages to the window to deactivate it and remove the input focus. It also destroys the window's menu, flushes the application queue, destroys outstanding timers, removes clipboard ownership, and breaks the clipboard-viewer chain (if the window is at the top of the viewer chain). It sends **WM_DESTROY** and **WM_NCDESTROY** messages to the window.

If the given window is the parent of any windows, **DestroyWindow** automatically destroys these child windows when it destroys the parent window. The function destroys child windows first, and then the window itself.

The **DestroyWindow** function also destroys modeless dialog boxes created by the **CreateDialog** function.

Parameter	Description
hwnd	Identifies the window to be destroyed.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
Applications should always call the **DestroyWindow** function to destroy their top-level windows before terminating.

If the window being destroyed is a child window and does not have the WS_NOPARENTNOTIFY style set, a **WM_PARENTNOTIFY** message is sent to the parent.

Example
The following example responds to the application-defined menu command IDM_EXIT, and then calls **DestroyWindow** to destroy the window:

```
case IDM_EXIT:
    DestroyWindow(hwnd);
    return 0;
```

See Also
CreateDialog, **CreateWindow**, **CreateWindowEx**, **WM_DESTROY**, **WM_NCDESTROY**, **WM_PARENTNOTIFY**

DialogBox (2.x)

int DialogBox(*hinst, lpszDlgTemp, hwndOwner, dlgprc***)**

```
HINSTANCE hinst;        /* handle of application instance          */
LPCSTR lpszDlgTemp;     /* address of dialog box template name     */
HWND hwndOwner;         /* handle of owner window                  */
DLGPROC dlgprc;         /* instance address of dialog box procedure */
```

The **DialogBox** function creates a modal dialog box from a dialog box template resource.

Parameter	Description
hinst	Identifies an instance of the module whose executable file contains the dialog box template.
lpszDlgTemp	Points to a null-terminated string that names the dialog box template.
hwndOwner	Identifies the window that owns the dialog box.
dlgprc	Specifies the procedure-instance address of the dialog box procedure. The address must be created by using the **MakeProcInstance** function, except when the function and dialog box procedure are used in a DLL. For more information about the dialog box procedure, see the description of the **DialogProc** callback function.

Returns

The return value specifies the value of the *nResult* parameter specified in the **EndDialog** function that is used to terminate the dialog box. The system processes values returned by the dialog box procedure and does not return them to the application. The return value is -1 if the function cannot create the dialog box.

Comments

The **CreateWindowEx** function is called to create the dialog box. The dialog box procedure then receives a **WM_SETFONT** message (if DS_SETFONT style was specified) and a **WM_INITDIALOG** message, and then the dialog box is displayed.

The **DialogBox** function does not return control until the dialog box procedure terminates the modal dialog box by calling the **EndDialog** function.

A dialog box can contain up to 255 controls.

Example

The following example uses the **DialogBox** function to create a modal dialog box:

```
DLGPROC dlgprc;
HWND hwndParent;

case IDM_ABOUT:
    dlgprc = (DLGPROC) MakeProcInstance(About, hinst);
    DialogBox(hinst, "AboutBox", hwndParent, dlgprc);
    FreeProcInstance((FARPROC) dlgprc);
    break;
```

See Also

DialogBoxIndirect, **DialogBoxIndirectParam**, **DialogBoxParam**, **DialogProc**, **EndDialog**, **GetDC**, **MakeProcInstance**, **WM_INITDIALOG**

DialogBoxIndirect (2.x)

int DialogBoxIndirect(*hinst, hglbDlgTemp, hwndOwner, dlgprc***)**

```
HINSTANCE hinst;        /* handle of application instance          */
HGLOBAL hglbDlgTemp;    /* handle of memory with dialog box template */
HWND hwndOwner;         /* handle of owner window                  */
DLGPROC dlgprc;         /* instance address of dialog box procedure */
```

The **DialogBoxIndirect** function creates a modal dialog box from a dialog box template in memory.

Parameter	Description
hinst	Identifies the instance of the module that will create the dialog box.
hglbDlgTemp	Identifies the global memory object that contains a dialog box template used to create the dialog box. This template is in the form of a **DialogBoxHeader** structure. For more information about this structure, see the **Dialog Box Resource** topic.
hwndOwner	Identifies the window that owns the dialog box.
dlgprc	Specifies the procedure-instance address of the dialog box procedure. The address must be created by using the **MakeProcInstance** function, except when the function and dialog box procedure are used in a DLL. For more information about the dialog box procedure, see the description of the **DialogProc** callback function.

Returns

The return value is the value of the *nResult* parameter specified in the **EndDialog** function that is used to terminate the dialog box. The system processes values returned by the dialog box procedure and does not return them to the application. The return value is -1 if the function cannot create the dialog box.

Comments

The **CreateWindowEx** function is called to create the dialog box. The dialog box procedure then receives a **WM_SETFONT** message (if DS_SETFONT style was specified) and a **WM_INITDIALOG** message, and then the dialog box is displayed.

The **DialogBoxIndirect** function does not return control until the dialog box procedure terminates the modal dialog box by calling the **EndDialog** function.

A dialog box can contain up to 255 controls.

Example

The following example uses the **DialogBoxIndirect** function to create a dialog box from a dialog box template in memory:

```
#define TEMPLATE_SIZE 100
HGLOBAL hglbDlgTemp;
DLGPROC dlgprc;
int result;
HWND hwndParent;

/* Allocate a global memory object for the dialog box template. */

hglbDlgTemp = GlobalAlloc(GHND, TEMPLATE_SIZE);

.
. /* Build a DLGTEMPLATE structure in the memory object. */
.

dlgprc = (DLGPROC) MakeProcInstance(DialogProc, hinst);
result = DialogBoxIndirect(hinst, hglbDlgTemp, hwndParent, dlgprc);
```

See Also

DialogBox, **DialogBoxIndirectParam**, **DialogBoxParam**, **DialogProc**, **EndDialog**, **MakeProcInstance**, **WM_INITDIALOG**

DialogBoxIndirectParam (3.0)

int DialogBoxIndirectParam(*hinst, hglbDlgTemp, hwndOwner, dlgprc, lParamInit***)**

HINSTANCE *hinst;*	/* handle of application instance	*/
HGLOBAL *hglbDlgTemp;*	/* handle of memory with dialog box template	*/
HWND *hwndOwner;*	/* handle of owner window	*/
DLGPROC *dlgprc;*	/* instance address of dialog box procedure	*/
LPARAM *lParamInit;*	/* initialization value	*/

The **DialogBoxIndirectParam** function creates a modal dialog box from a dialog box template in memory. Before displaying the dialog box, the function passes an application-defined value to the dialog box procedure as the *lParam* parameter of the **WM_INITDIALOG** message. An application can use this value to initialize dialog box controls.

Parameter	Description
hinst	Identifies the instance of the module that will create the dialog box.
hglbDlgTemp	Identifies the global memory object that contains a dialog box template used to create the dialog box. This template is in the form of a **DialogBoxHeader** structure. For more information about this structure, see the **Dialog Box Resource** topic.
hwndOwner	Identifies the window that owns the dialog box.
dlgprc	Specifies the procedure-instance address of the dialog box procedure. The address must be created by using the **MakeProcInstance** function, except when the function and dialog box procedure are used in a DLL. For more information about the dialog box procedure, see the description of the **DialogProc** callback function.
lParamInit	Specifies a 32-bit value that **DialogBoxIndirectParam** passes to the dialog box when the **WM_INITDIALOG** message is being processed.

Returns

The return value is the value of the *nResult* parameter specified in the **EndDialog** function that is used to terminate the dialog box. The system processes values returned by the dialog box procedure and does not return them to the application. The return value is -1 if the function cannot create the dialog box.

Comments

The **CreateWindowEx** function is called to create the dialog box. The dialog box procedure then receives a **WM_SETFONT** message (if DS_SETFONT style was specified) and a **WM_INITDIALOG** message, and then the dialog box is displayed.

The **DialogBoxIndirectParam** function does not return control until the dialog box procedure terminates the modal dialog box by calling the **EndDialog** function.

A dialog box can contain up to 255 controls.

Example

The following example uses the **DialogBoxIndirectParam** function to create a modal dialog box from a dialog box template in memory. The example uses the *lParamInit* parameter to send two initialization parameters (wInitParm1 and wInitParm2) to the dialog box procedure when the **WM_INITDIALOG** message is being processed.

```
#define TEMPLATE_SIZE 100
HGLOBAL hglbDlgTemp;
DLGPROC dlgprc;
int result;
HWND hwndParent;
WORD wInitParm1, wInitParm2;

/* Allocate a global memory object for the dialog box template. */
```

```
hglbDlgTemp = GlobalAlloc(GHND, TEMPLATE_SIZE);

.
. /* Build a DLGTEMPLATE structure in the memory object. */
.

dlgprc = (DLGPROC) MakeProcInstance(DialogProc, hinst);
result = DialogBoxIndirectParam(hinst, hglbDlgTemp, hwndParent,
    dlgprc, (LPARAM) MAKELONG(wInitParm1, wInitParm2));
```

See Also

DialogBox, **DialogBoxIndirect**, **DialogBoxParam**, **DialogProc**, **EndDialog**, **MakeProcInstance**, **WM_INITDIALOG**

DialogBoxParam (3.0)

int DialogBoxParam(*hinst, lpszDlgTemp, hwndOwner, dlgprc, lParamInit***)**

HINSTANCE *hinst;*	/* handle of application instance	*/
LPCSTR *lpszDlgTemp;*	/* address of dialog box template name	*/
HWND *hwndOwner;*	/* handle of owner window	*/
DLGPROC *dlgprc;*	/* instance address of dialog box procedure	*/
LPARAM *lParamInit;*	/* initialization value	*/

The **DialogBoxParam** function creates a modal dialog box from a dialog box template resource. Before displaying the dialog box, the function passes an application-specified value to the dialog box procedure as the *lParam* parameter of the **WM_INITDIALOG** message. An application can use this value to initialize dialog box controls.

Parameter	Description
hinst	Identifies an instance of the module whose executable file contains the dialog box template.
lpszDlgTemp	Points to a null-terminated string that names the dialog box template.
hwndOwner	Identifies the window that owns the dialog box.
dlgprc	Specifies the procedure-instance address of the dialog box procedure. The address must be created by using the **MakeProcInstance** function, except when the function and dialog box procedure are used in a DLL. For more information about the dialog box procedure, see the description of the **DialogProc** callback function.
lParamInit	Specifies a 32-bit value that **DialogBoxParam** passes to the dialog box procedure when creating the dialog box.

Returns

The return value specifies the value of the *nResult* parameter specified in the **EndDialog** function that is used to terminate the dialog box. The system processes values returned by the dialog box procedure and does not return them to the application. The return value is -1 if the function cannot create the dialog box.

Comments

The **CreateWindowEx** function is called to create the dialog box. The dialog box procedure then receives a **WM_SETFONT** message (if DS_SETFONT style was specified) and a **WM_INITDIALOG** message, and then the dialog box is displayed.

The **DialogBoxParam** function does not return control until the dialog box procedure terminates the modal dialog box by calling the **EndDialog** function.

A dialog box can contain up to 255 controls.

Example

The following example uses the **DialogBoxParam** function to create a modal dialog box. The function passes the dialog box a pointer to a string when the **WM_INITDIALOG** message is being processed.

```
DLGPROC dlgprc;
HWND hwndParent;
PSTR pszFileName;
int result;

case IDM_OPEN:

    dlgprc = (DLGPROC) MakeProcInstance(FileOpenProc, hinst);
    result = DialogBoxParam(hinst, "FileOpenBox", hwndParent,
        dlgprc, MAKELPARAM(pszFileName, 0));
    FreeProcInstance((FARPROC) dlgprc);
```

```
    break;
```

See Also

DialogBox, **DialogBoxIndirect**, **DialogBoxIndirectParam**, **DialogProc**, **EndDialog**, **MakeProcInstance**, **WM_INITDIALOG**

DispatchMessage (2.x)

LONG DispatchMessage(*lpmsg***)**

const MSG FAR* *lpmsg;* /* address of structure with message */

The **DispatchMessage** function dispatches a message to a window. It is typically used to dispatch a message retrieved by the **GetMessage** function.

Parameter	Description
lpmsg	Points to an **MSG** structure that contains the message. The **MSG** structure must contain valid message values. If the *lpmsg* parameter points to a **WM_TIMER** message and the *lParam* parameter of the WM_TIMER message is not NULL, then *lParam* points to a function that is called instead of the window procedure.

Returns

The return value specifies the value returned by the window procedure. Although its meaning depends on the message being dispatched, generally the return value is ignored.

Example

The following example shows a typical use of the **DispatchMessage** function in an application's main message loop:

```
MSG msg;
HWND hwnd;
HWND hwndDlgModeless;
HANDLE haccl;

while (GetMessage(&msg, NULL, 0, 0)) {
    if ((hwndDlgModeless == NULL ||
            !IsDialogMessage(hwndDlgModeless, &msg)) &&
            !TranslateAccelerator(hwnd, haccl, &msg)) {
        TranslateMessage(&msg);
        DispatchMessage(&msg);
    }
}
```

See Also

GetMessage, **PeekMessage**, **PostAppMessage**, **PostMessage**, **TranslateMessage**, **MSG**, **WM_TIMER**

DlgDirList (2.x)

int DlgDirList(*hwndDlg, lpszPath, idListBox, idStaticPath, uFileType***)**

```
HWND hwndDlg;       /* handle of dialog box with list box   */
LPSTR lpszPath;     /* address of path or filename string */
int idListBox;      /* identifier of list box               */
int idStaticPath;   /* identifier of static control         */
UINT uFileType;     /* file attributes to display           */
```

The **DlgDirList** function fills a list box with a file or directory listing. It fills the list box with the names of all files matching the specified path or filename.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the list box.
lpszPath	Points to a null-terminated string that contains the path or filename. **DlgDirList** modifies this string, which should be long enough to contain the modifications. For more information, see the following Comments section.
idListBox	Specifies the identifier of a list box. If this parameter is zero, **DlgDirList** assumes that no list box exists and does not attempt to fill one.
idStaticPath	Specifies the identifier of the static control used for displaying the current drive and directory. If this parameter is zero, **DlgDirList** assumes that no such control is present.
uFileType	Specifies the attributes of the filenames to be displayed. This parameter can be a combination of the following values:

Value	Meaning
DDL_READWRITE	Read-write data files with no additional attributes.
DDL_READONLY	Read-only files.
DDL_HIDDEN	Hidden files.
DDL_SYSTEM	System files.
DDL_DIRECTORY	Directories.
DDL_ARCHIVE	Archives.
DDL_POSTMSGS	**LB_DIR** flag. If the LB_DIR flag is set, Windows places the messages generated by **DlgDirList** in the application's queue; otherwise, they are sent directly to the dialog box procedure.
DDL_DRIVES	Drives. If the **DDL_DRIVES** flag is set, the **DDL_EXCLUSIVE** flag is set automatically. Therefore, to create a directory listing that includes drives and files, the developer must call **DlgDirList** twice: once with the DDL_DRIVES flag set and once with the flags for the rest of the list.
DDL_EXCLUSIVE	Exclusive bit. If the exclusive bit is set, only files of the specified type are listed; otherwise, files of the specified type are listed in addition to normal files.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

If you specify a zero-length string for the *lpszPath* parameter or if you specify only a directory name but do not include any filename, the string will be changed to *.*.

The **DlgDirList** function shows directories enclosed in brackets ([ ]) and shows drives in the form [-*x*-], where *x* is the drive letter.

The *lpszPath* parameter has the following form:

[*drive*:][[\]*directory*[*directory*]...\][*filename*]

In this example, *drive* is a drive letter, *directory* is a valid MS-DOS directory name, and *filename* is a valid MS-DOS filename that must contain at least one wildcard. The wildcards are a question mark (?), meaning match any character, and an asterisk (*), meaning match any number of characters.

If the *lpszPath* parameter includes a drive or directory name, or both, the current drive and directory are changed to the specified drive and directory before the list box is filled. The static control identified by the *idStaticPath* parameter is also updated with the new drive or directory name, or both.

After the list box is filled, *lpszPath* is updated by removing the drive or directory portion, or both, of the path and filename.

DlgDirList sends **LB_RESETCONTENT** and **LB_DIR** messages to the list box.

See Also
DlgDirListComboBox, **DlgDirSelect**, **DlgDirSelectComboBox**, **LB_DIR**, **LB_RESETCONTENT**

DlgDirListComboBox (3.0)

int DlgDirListComboBox(*hwndDlg, lpszPath, idComboBox, idStaticPath, uFileType***)**

```
HWND hwndDlg;      /* handle of dialog box with combo box */
LPSTR lpszPath;    /* address of path or filename string  */
int idComboBox;    /* identifier of combo box             */
int idStaticPath;  /* identifier of static control        */
UINT uFileType;    /* file attributes to display          */
```

The **DlgDirListComboBox** function fills the list box of a combo box with a file or directory listing. It fills the list box with the names of all files matching the specified path and filename.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the combo box.
lpszPath	Points to a null-terminated string that contains the path and filename. For more information, see the following Comments section.
idComboBox	Specifies the identifier of a combo box in a dialog box. If this parameter is zero, **DlgDirListComboBox** assumes that no combo box exists and does not attempt to fill one.
idStaticPath	Specifies the identifier of the static control used for displaying the current drive and directory. If this parameter is zero, **DlgDirListComboBox** assumes that no such control is present.
uFileType	Specifies the attributes of the filenames to be displayed. This parameter can be a combination of the following values:

Value	Meaning
DDL_READWRITE	Read-write data files with no additional attributes.
DDL_READONLY	Read-only files.
DDL_HIDDEN	Hidden files.
DDL_SYSTEM	System files.
DDL_DIRECTORY	Directories.
DDL_ARCHIVE	Archives.
DDL_POSTMSGS	**CB_DIR** flag. If the CB_DIR flag is set, Windows places the messages generated by **DlgDirListComboBox** in the application's queue; otherwise, they are sent directly to the dialog box procedure.
DDL_DRIVES	Drives. If the **DDL_DRIVES** flag is set, the **DDL_EXCLUSIVE** flag is set automatically. Therefore, to create a directory listing that includes drives and files, the developer must call **DlgDirListComboBox** twice: once with the DDL_DRIVES flag set and once with the flags for the rest of the list.
DDL_EXCLUSIVE	Exclusive bit. If the exclusive bit is set, only files of the specified type are listed; otherwise, files of the specified type are listed in addition to normal files.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **DlgDirListComboBox** function shows directories enclosed in brackets ([ ]) and shows drives in the form [-*x*-], where *x* is the drive letter.

The *lpszPath* parameter has the following form:

[*drive*:][[\]*directory*[*directory*]...\][*filename*]

In this example, *drive* is a drive letter, *directory* is a valid MS-DOS directory name, and *filename* is a valid MS-DOS filename that must contain at least one wildcard. The wildcards are a question mark (?), meaning match any character, and an asterisk (*), meaning match any number of characters.

If the *lpszPath* parameter includes a drive or directory name, or both, the current drive and directory are changed to the specified drive and directory before the list box is filled. The static control identified by the *idStaticPath* parameter is also updated with the new drive or directory name, or both.

After the list box of the combo box is filled, *lpszPath* is updated by removing the drive or directory portion, or both, of the path and filename.

DlgDirListComboBox sends **CB_RESETCONTENT** and **CB_DIR** messages to the combo box.

See Also
DlgDirList, **DlgDirSelect**, **DlgDirSelectComboBox**, **CB_DIR**, **CB_RESETCONTENT**

DDL_READWRITE 0x0000

Read-write data files with no additional attributes.

DDL_READWRITE 0x0000

DDL_READONLY 0x0001

Read-only files.

DDL_READONLY 0x0001

DDL_HIDDEN 0x0002

Hidden files.

DDL_HIDDEN 0x0002

DDL_SYSTEM 0x0004

System files.

DDL_SYSTEM 0x0004

DDL_DIRECTORY 0x0010

Directories.

DDL_DIRECTORY 0x0010

DDL_ARCHIVE 0x0020

Archives.

DDL_ARCHIVE 0x0020

DDL_POSTMSGS 0x2000

CB_DIR flag. If the CB_DIR flag is set, Windows places the messages generated by **DlgDirListComboBox** in the application's queue; otherwise, they are sent directly to the dialog box procedure.

DDL_POSTMSGS 0x2000

DDL_DRIVES 0x4000

Drives. If the DDL_DRIVES flag is set, the **DDL_EXCLUSIVE** flag is set automatically. Therefore, to create a directory listing that includes drives and files, the developer must call **DlgDirListComboBox** twice: once with the DDL_DRIVES flag set and once with the flags for the rest of the list.

DDL_DRIVES 0x4000

DDL_EXCLUSIVE 0x8000

Exclusive bit. If the exclusive bit is set, only files of the specified type are listed; otherwise, files of the specified type are listed in addition to normal files.

DDL_EXCLUSIVE 0x8000

DlgDirSelect (2.x)

BOOL DlgDirSelect(*hwndDlg, lpszPath, idListBox***)**

```
HWND hwndDlg;      /* handle of dialog box with list box          */
LPSTR lpszPath;    /* address of buffer for path or filename string */
int idListBox;     /* identifier of list box                      */
```

The **DlgDirSelect** function retrieves the current selection from a list box. It assumes that the list box has been filled by the **DlgDirList** function and that the selection is a drive letter, a file, or a directory name.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the list box.
lpszPath	Points to a buffer that will receive the selected path or filename. This buffer should be 128 bytes long.
idListBox	Specifies the integer identifier of a list box in the dialog box.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

If the current selection is a directory name or drive letter, **DlgDirSelect** removes the enclosing brackets (and hyphens, for drive letters) so that the name or letter is ready to be inserted into a new path or filename. If there is no selection, the contents of the buffer pointed to by the *lpszPath* parameter do not change.

The **DlgDirSelect** function does not allow more than one filename to be returned from a list box.

The list box must not be a multiple-selection list box. If it is, this function will not return a zero value and *lpszPath* will remain unchanged.

DlgDirSelect sends **LB_GETCURSEL** and **LB_GETTEXT** messages to the list box.

See Also

DlgDirList, **DlgDirListComboBox**, **DlgDirSelectComboBox**, **DlgDirSelectEx**, **LB_GETCURSEL**, **LB_GETTEXT**

DlgDirSelectEx (2.x)

BOOL DlgDirSelectEx(*hwndDlg, lpszPath, cbPath, idListBox***)**

```
HWND hwndDlg;      /* handle of dialog box with list box */
LPSTR lpszPath;    /* address of buffer for path string  */
int cbPath;        /* number of bytes in path string     */
int idListBox;     /* identifier of list box             */
```

The **DlgDirSelectEx** function retrieves the current selection from a list box. The specified list box should have been filled by the **DlgDirList** function, and the selection should be a drive letter, a file, or a directory name.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the list box.
lpszPath	Points to a buffer that receives the selected path or filename.
cbPath	Specifies the length, in bytes, of the path or filename pointed to by the *lpszPath* parameter. This value should not be larger than 128.
idListBox	Specifies the integer identifier of a list box in the dialog box.

Returns

The return value is nonzero if the current list box selection is a directory name. Otherwise, it is zero.

Comments

If the current selection is a directory name or drive letter, **DlgDirSelectEx** removes the enclosing square brackets (and hyphens, for drive letters) so that the name or letter is ready to be inserted into a new path or filename. If there is no selection, the contents of buffer pointed to by the *lpszPath* parameter do not change.

The **DlgDirSelectEx** function does not allow more than one filename to be returned from a list box.

The list box must not be a multiple-selection list box. If it is, this function will not return a zero value and *lpszPath* will remain unchanged.

DlgDirSelectEx sends **LB_GETCURSEL** and **LB_GETTEXT** messages to the list box.

See Also

DlgDirList, **DlgDirListComboBox**, **DlgDirSelect**, **DlgDirSelectComboBox**, **LB_GETCURSEL**, **LB_GETTEXT**

DlgDirSelectComboBox (3.0)

BOOL DlgDirSelectComboBox(*hwndDlg, lpszPath, idComboBox***)**

```
HWND hwndDlg;      /* handle of dialog box with list box          */
LPSTR lpszPath;    /* address of buffer for path or filename string */
int idComboBox;    /* identifier of combo box                     */
```

The **DlgDirSelectComboBox** function retrieves the current selection from the list box of a combo box. It assumes that the list box has been filled by the **DlgDirListComboBox** function and that the selection is a drive letter, a file, or a directory name.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the combo box.
lpszPath	Points to a buffer that will receive the selected path or filename. This buffer should be 128 bytes long.
idComboBox	Specifies the integer identifier of the combo box in the dialog box.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **DlgDirSelectComboBox** function does not allow more than one selection to be returned from a combo box.

If the current selection is a directory name or drive letter, **DlgDirSelectComboBox** removes the enclosing brackets (and hyphens, for drive letters) so that the name or letter is ready to be inserted into a new path or filename. If there is no selection, the contents of buffer pointed to by the *lpszPath* parameter do not change.

DlgDirSelectComboBox sends **CB_GETCURSEL** and **CB_GETLBTEXT** messages to the combo box.

See Also

DlgDirList, **DlgDirListComboBox**, **DlgDirSelect**, **DlgDirSelectComboBoxEx**, **DlgDirSelectEx**, **CB_GETCURSEL**, **CB_GETLBTEXT**

Windows 3.1 Changes

The **DlgDirSelectComboBox** function now works with combo boxes that have the **CBS_DROPDOWN** or **CBS_DROPDOWNLIST** style.

DlgDirSelectComboBoxEx (3.0)

BOOL DlgDirSelectComboBoxEx(*hwndDlg, lpszPath, cbPath, idComboBox***)**

```
HWND hwndDlg;      /* handle of dialog box with list box */
LPSTR lpszPath;    /* address of buffer for path string  */
int cbPath;        /* number of bytes in path string     */
int idComboBox;    /* identifier of combo box            */
```

The **DlgDirSelectComboBoxEx** function retrieves the current selection from the list box of a combo box. The list box should have been filled by the **DlgDirListComboBox** function, and the selection should be a drive letter, a file, or a directory name.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the combo box.
lpszPath	Points to a buffer that receives the selected path or filename.
cbPath	Specifies the length, in bytes, of the path or filename pointed to by the *lpszPath* parameter. This value should not be larger than 128.
idComboBox	Specifies the integer identifier of the combo box in the dialog box.

Returns

The return value is nonzero if the current combo box selection is a directory name. Otherwise, it is zero.

Comments

The **DlgDirSelectComboBoxEx** function does not allow more than one filename to be returned from a combo box.

If the current selection is a directory name or drive letter, **DlgDirSelectComboBoxEx** removes the enclosing square brackets (and hyphens, for drive letters) so that the name or letter is ready to be inserted into a new path or filename. If there is no selection, the contents of buffer pointed to by the *lpszPath* parameter do not change.

DlgDirSelectComboBoxEx sends **CB_GETCURSEL** and **CB_GETLBTEXT** messages to the combo box.

See Also

DlgDirList, **DlgDirListComboBox**, **DlgDirSelect**, **DlgDirSelectEx**, **DlgDirSelectComboBox**, **CB_GETCURSEL**, **CB_GETLBTEXT**

DrawFocusRect (3.0)

void DrawFocusRect(*hdc, lprc***)**

```
HDC hdc;                    /* handle of device context          */
const RECT FAR* lprc;       /* address of structure with rectangle */
```

The **DrawFocusRect** function draws a rectangle in the style used to indicate that the rectangle has the focus.

Parameter	Description
hdc	Identifies the device context.
lprc	Points to a **RECT** structure that contains the logical coordinates of the rectangle.

Returns
This function does not return a value.

Comments
Because this is an XOR function, calling it a second time and specifying the same rectangle removes the rectangle from the screen.

The rectangle this function draws cannot be scrolled. To scroll an area containing a rectangle drawn by this function, call **DrawFocusRect** to remove the rectangle from the screen, scroll the area, and then call **DrawFocusRect** to draw the rectangle in the new position.

See Also
FrameRect, **RECT**

DrawIcon (2.x)

BOOL DrawIcon(*hdc, x, y, hicon***)**

```
HDC hdc;        /* handle of device context          */
int x;          /* x-coordinate of upper-left corner */
int y;          /* y-coordinate of upper-left corner */
HICON hicon;    /* handle of icon to draw            */
```

The **DrawIcon** function draws an icon on the given device. The **DrawIcon** function places the icon's upper-left corner at the specified location.

Parameter	Description
hdc	Identifies the device context for a window.
x	Specifies the logical x-coordinate of the upper-left corner of the icon.
y	Specifies the logical y-coordinate of the upper-left corner of the icon.
hicon	Identifies the icon to be drawn.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The icon resource must have been loaded by using the **LoadIcon** function. The MM_TEXT mapping mode must be selected before using this function.

See Also

GetMapMode, **LoadIcon**, **SetMapMode**

DrawMenuBar (2.x)

void DrawMenuBar(*hwnd***)**

HWND *hwnd;* /* handle of window with menu bar to redraw */

The **DrawMenuBar** function redraws the menu bar of the given window. If a menu bar is changed after Windows has created the window, an application should call this function to draw the changed menu bar.

Parameter	Description
hwnd	Identifies the window whose menu must be redrawn.

Returns
This function does not return a value.

DrawText (2.x)

int DrawText(*hdc, lpsz, cb, lprc, fuFormat***)**

```
HDC hdc;          /* handle of device context                          */
LPCSTR lpsz;      /* address of string to draw                         */
int cb;           /* string length                                     */
RECT FAR* lprc;   /* address of structure with formatting dimensions   */
UINT fuFormat;    /* text-drawing flags                                */
```

The **DrawText** function draws formatted text into a given rectangle. It formats text by expanding tabs into appropriate spaces, aligning text to the left, right, or center of the rectangle, and breaking text into lines that fit within the rectangle.

The **DrawText** function uses the device context's selected font, text color, and background color to draw the text. Unless the **DT_NOCLIP** format is specified, **DrawText** clips the text so that the text does not appear outside the given rectangle. All formatting is assumed to have multiple lines unless the **DT_SINGLELINE** format is specified.

Parameter	Description
hdc	Identifies the device context. This cannot be a metafile device context.
lpsz	Points to the string to be drawn. If the *cb* parameter is -1, the string must be null-terminated.
cb	Specifies the number of bytes in the string. If this parameter is -1, then the *lpsz* parameter is assumed to be a long pointer to a null-terminated string and **DrawText** computes the character count automatically.
lprc	Points to a **RECT** structure that contains the logical coordinates of the upper-left and lower-right corners of the rectangle in which the text is to be formatted.
fuFormat	Specifies an array of flags that determine how to draw the text. This parameter can be a combination of the following values:

Value	Meaning
DT_BOTTOM	Specifies bottom-aligned text. This value must be combined with DT_SINGLELINE.
DT_CALCRECT	Determines the width and height of the rectangle. If there are multiple lines of text, **DrawText** will use the width of the rectangle pointed to by the *lprc* parameter and extend the base of the rectangle to bound the last line of text. If there is only one line of text, **DrawText** will modify the right side of the rectangle so that it bounds the last character in the line. In either case, **DrawText** returns the height of the formatted text but does not draw the text.
DT_CENTER	Centers text horizontally.
DT_EXPANDTABS	Expands tab characters. The default number of characters per tab is eight.
DT_EXTERNALLEADING	Includes the font external leading in line height. Normally, external leading is not included in the height of a line of text.
DT_LEFT	Left-aligns text.
DT_NOCLIP	Draws without clipping. **DrawText** is somewhat faster when **DT_NOCLIP** is used.
DT_NOPREFIX	Turns off processing of prefix characters. Normally, **DrawText** interprets the mnemonic & as a directive

	to underscore the character that follows, and the mnemonic && as a directive to print a single &. By specifying **DT_NOPREFIX**, this processing is turned off.
DT_RIGHT	Right-aligns text.
DT_SINGLELINE	Specifies single line only. Carriage returns and linefeeds do not break the line.
DT_TABSTOP	Sets tab stops. The high-order byte of the *fuFormat* parameter is the number of characters for each tab. The default number of characters per tab is eight.
DT_TOP	Specifies top-aligned text (single line only).
DT_VCENTER	Specifies vertically centered text (single line only).
DT_WORDBREAK	Specifies word breaking. Lines are automatically broken between words if a word would extend past the edge of the rectangle specified by the *lprc* parameter. A carriage return–linefeed sequence will also break the line.

Note that the **DT_CALCRECT**, **DT_EXTERNALLEADING**, DT_INTERNAL, **DT_NOCLIP**, and **DT_NOPREFIX** values cannot be used with the **DT_TABSTOP** value.

Returns

The return value specifies the height of the text if the function is successful.

Comments

If the selected font is too large for the specified rectangle, the **DrawText** function does not attempt to substitute a smaller font.

If the **DT_CALCRECT** flag is specified, the **RECT** structure pointed to by the *lprc* parameter will be updated to reflect the width and height needed to draw the text.

If the **TA_UPDATECP** text-alignment flag has been set (see the **SetTextAlign** function), **DrawText** will display text starting at the current position, rather than at the left of the given rectangle. **DrawText** will not wrap text when the TA_UPDATECP flag has been set (the **DT_WORDBREAK** flag will have no effect).

The text color must be set by the **SetTextColor** function.

See Also

ExtTextOut, **SetTextColor**, **TabbedTextOut**, **TextOut**, **RECT**

DT_BOTTOM 0x0008

Specifies bottom-aligned text. This value must be combined with DT_SINGLELINE.

DT_BOTTOM 0x0008

DT_CALCRECT 0x0400

Determines the width and height of the rectangle. If there are multiple lines of text, **DrawText** will use the width of the rectangle pointed to by the *lprc* parameter and extend the base of the rectangle to bound the last line of text. If there is only one line of text, **DrawText** will modify the right side of the rectangle so that it bounds the last character in the line. In either case, **DrawText** returns the height of the formatted text but does not draw the text.

DT_CALCRECT 0x0400

DT_CENTER 0x0001

Centers text horizontally.

DT_CENTER 0x0001

DT_EXPANDTABS 0x0040

Expands tab characters. The default number of characters per tab is eight.

DT_EXPANDTABS 0x0040

DT_EXTERNALLEADING 0x0200

Includes the font external leading in line height. Normally, external leading is not included in the height of a line of text.

DT_EXTERNALLEADING 0x0200

DT_LEFT 0x0000

Left-aligns text.

DT_LEFT 0x0000

DT_NOCLIP 0x0100

Draws without clipping. **DrawText** is somewhat faster when DT_NOCLIP is used.

DT_NOCLIP 0x0100

DT_NOPREFIX 0x0800

Turns off processing of prefix characters. Normally, **DrawText** interprets the mnemonic & as a directive to underscore the character that follows, and the mnemonic && as a directive to print a single &. By specifying DT_NOPREFIX, this processing is turned off.

DT_NOPREFIX 0x0800

DT_RIGHT 0x0002

Right-aligns text.

DT_RIGHT 0x0002

DT_SINGLELINE 0x0020

Specifies single line only. Carriage returns and linefeeds do not break the line.

DT_SINGLELINE 0x0020

DT_TABSTOP 0x0080

Sets tab stops. The high-order byte of the *fuFormat* parameter is the number of characters for each tab. The default number of characters per tab is eight.

DT_TABSTOP 0x0080

DT_TOP 0x0000

Specifies top-aligned text (single line only).

DT_TOP 0x0000

DT_VCENTER 0x0004

Specifies vertically centered text (single line only).

DT_VCENTER 0x0004

DT_WORDBREAK 0x0010

Specifies word breaking. Lines are automatically broken between words if a word would extend past the edge of the rectangle specified by the *lprc* parameter. A carriage return–linefeed sequence will also break the line.

DT_WORDBREAK 0x0010

EmptyClipboard (2.x)

BOOL EmptyClipboard(void)

The **EmptyClipboard** function empties the clipboard and frees handles to data in the clipboard. It then assigns ownership of the clipboard to the window that currently has the clipboard open.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The clipboard must be open when the **EmptyClipboard** function is called.

See Also
OpenClipboard, **WM_DESTROYCLIPBOARD**

EnableCommNotification (3.1)

BOOL EnableCommNotification(*idComDev, hwnd, cbWriteNotify, cbOutQueue***)**

```
int idComDev;       /* communications-device identifier          */
HWND hwnd;          /* handle of window receiving messages       */
int cbWriteNotify;  /* number of bytes written before notification*/
int cbOutQueue;     /* minimum number of bytes in output queue*/
```

The **EnableCommNotification** function enables or disables **WM_COMMNOTIFY** message posting to the given window.

Parameter	Description
idComDev	Specifies the communications device that is posting notification messages to the window identified by the *hwnd* parameter. The **OpenComm** function returns the value for the *idComDev* parameter.
hwnd	Identifies the window whose **WM_COMMNOTIFY** message posting will be enabled or disabled. If this parameter is NULL, **EnableCommNotification** disables message posting to the current window.
cbWriteNotify	Indicates the number of bytes the COM driver must write to the application's input queue before sending a notification message. The message signals the application to read information from the input queue.
cbOutQueue	Indicates the minimum number of bytes in the output queue. When the number of bytes in the output queue falls below this number, the COM driver sends the application a notification message, signaling it to write information to the output queue.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero, indicating an invalid COM port identifier, a port that is not open, or a function not supported by COMM.DRV.

Comments

If an application specifies -1 for the *cbWriteNotify* parameter, the **WM_COMMNOTIFY** message is sent to the specified window for CN_EVENT and CN_TRANSMIT notifications but not for CN_RECEIVE notifications. If -1 is specified for the *cbOutQueue* parameter, CN_EVENT and CN_RECEIVE notifications are sent but CN_TRANSMIT notifications are not.

If a timeout occurs before as many bytes as specified by the *cbWriteNotify* parameter are written to the input queue, a **WM_COMMNOTIFY** message is sent with the CN_RECEIVE flag set. When this occurs, another message will not be sent until the number of bytes in the input queue falls below the number specified in the *cbWriteNotify* parameter. Similarly, a WM_COMMNOTIFY message in which the CN_RECEIVE flag is set is sent only when the output queue is larger than the number of bytes specified in the *cbOutQueue* parameter.

The Windows 3.0 version of COMM.DRV does not support this function.

See Also

WM_COMMNOTIFY

EnableHardwareInput (2.x)

BOOL EnableHardwareInput(*fEnableInput***)**

BOOL *fEnableInput;* /* for enabling or disabling queuing */

The **EnableHardwareInput** function enables or disables queuing of mouse and keyboard input.

Parameter	Description
fEnableInput	Specifies whether to enable or disable queuing of input. If this parameter is TRUE, keyboard and mouse input are queued. If the parameter is FALSE, keyboard and mouse input are disabled.

Returns

The return value is nonzero if queuing of input was previously enabled. Otherwise, it is zero.

Comments

This function does not disable input from installable drivers, nor does it disable device drivers.

See Also

GetInputState

EnableMenuItem (2.x)

BOOL EnableMenuItem(*hmenu, idEnableItem, uEnable***)**

```
HMENU hmenu;          /* handle of menu       */
UINT idEnableItem;    /* menu-item identifier */
UINT uEnable;         /* action flag          */
```

The **EnableMenuItem** function enables, disables, or grays (dims) a menu item.

Parameter	Description
hmenu	Identifies the menu.
idEnableItem	Specifies the menu item to be enabled, disabled, or grayed. This parameter can specify pop-up menu items as well as standard menu items. The interpretation of this parameter depends on the value of the *uEnable* parameter.
uEnable	Specifies the action to take. This parameter can be **MF_DISABLED**, **MF_ENABLED**, or **MF_GRAYED**, combined with **MF_BYCOMMAND** or MF_BYPOSITION. These values have the following meanings:

Value	Meaning
MF_BYCOMMAND	Specifies that the *idEnableItem* parameter gives the menu-item identifier.
MF_BYPOSITION	Specifies that the *idEnableItem* parameter gives the position of the menu item (the first item is at position zero).
MF_DISABLED	Specifies that the menu item is disabled.
MF_ENABLED	Specifies that the menu item is enabled.
MF_GRAYED	Specifies that the menu item is grayed.

Returns

The return value is 0 if the menu item was previously disabled, 1 if the menu item was previously enabled, and -1 if the menu item does not exist.

Comments

To disable or enable input to a menu bar, see the **WM_SYSCOMMAND** message.

The **CreateMenu**, **InsertMenu**, **ModifyMenu**, and **LoadMenuIndirect** functions can also set the state (enabled, disabled, or grayed) of a menu item.

Using the **MF_BYPOSITION** value requires an application to specify the correct menu handle. If the menu handle of the menu bar is specified, a top-level menu item (an item in the menu bar) is affected. To set the state of an item in a pop-up or nested pop-up menu by position, an application must specify the handle of the pop-up menu.

When an application specifies the **MF_BYCOMMAND** flag, Windows checks all pop-up menu items that are subordinate to the menu identified by the specified menu handle; therefore, unless duplicate menu items are present, specifying the menu handle of the menu bar is sufficient.

See Also

CheckMenuItem, **HiliteMenuItem**, **WM_SYSCOMMAND**

EnableScrollBar (3.1)

BOOL EnableScrollBar(*hwnd, fnSBFlags, fuArrowFlags***)**

```
HWND hwnd;          /* handle of window or scroll bar */
int fnSBFlags;      /* scroll-bar type flag           */
UINT fuArrowFlags;  /* scroll-bar arrow flag          */
```

The **EnableScrollBar** function enables or disables one or both arrows of a scroll bar.

Parameter	Description
hwnd	Identifies a window or a scroll bar, depending on the value of the *fnSBFlags* parameter.
fnSBFlags	Specifies the scroll bar type. This parameter can be one of the following values:

Value	Meaning
SB_BOTH	Enables or disables the arrows of the horizontal and vertical scroll bars associated with the given window. The *hwnd* parameter identifies the window.
SB_CTL	Identifies the scroll bar as a scroll bar control. The *hwnd* parameter must identify a scroll bar control.
SB_HORZ	Enables or disables the arrows of the horizontal scroll bar associated with the given window. The *hwnd* parameter identifies the window.
SB_VERT	Enables or disables the arrows of the vertical scroll bar associated with the given window. The *hwnd* parameter identifies the window.

fuArrowFlags	Specifies whether the scroll bar arrows are enabled or disabled, and which arrows are enabled or disabled. This parameter can be one of the following values:

Value	Meaning
ESB_ENABLE_BOTH	Enables both arrows of a scroll bar.
ESB_DISABLE_LTUP	Disables the left arrow of a horizontal scroll bar, or the up arrow of a vertical scroll bar.
ESB_DISABLE_RTDN	Disables the right arrow of a horizontal scroll bar, or the down arrow of a vertical scroll bar.
ESB_DISABLE_BOTH	Disables both arrows of a scroll bar.

Returns

The return value is nonzero if the arrows are enabled or disabled as specified. Otherwise, it is zero, indicating that the arrows are already in the requested state or that an error occurred.

Example

The following example enables an edit control's vertical scroll bar when the control receives the input focus, and disables the scroll bar when the control loses the focus:

```
case EN_SETFOCUS:
    EnableScrollBar(hwndMLEdit, SB_VERT, ESB_ENABLE_BOTH);
    break;

case EN_KILLFOCUS:
    EnableScrollBar(hwndMLEdit, SB_VERT, ESB_DISABLE_BOTH);
    break;
```

See Also

ShowScrollBar

SB_BOTH 3

Enables or disables the arrows of the horizontal and vertical scroll bars associated with the given window. The *hwnd* parameter identifies the window.

SB_BOTH 3

SB_CTL 2

Identifies the scroll bar as a scroll bar control. The *hwnd* parameter must identify a scroll bar control.

SB_CTL 2

SB_HORZ 0

Enables or disables the arrows of the horizontal scroll bar associated with the given window. The *hwnd* parameter identifies the window.

SB_HORZ 0

SB_VERT 1

Enables or disables the arrows of the vertical scroll bar associated with the given window. The *hwnd* parameter identifies the window.

SB_VERT 1

ESB_ENABLE_BOTH 0x0000

Enables both arrows of a scroll bar.

ESB_ENABLE_BOTH 0x0000

ESB_DISABLE_LTUP ESB_DISABLE_LEFT

Disables the left arrow of a horizontal scroll bar, or the up arrow of a vertical scroll bar.

ESB_DISABLE_LTUP ESB_DISABLE_LEFT

ESB_DISABLE_RTDN ESB_DISABLE_RIGHT

Disables the right arrow of a horizontal scroll bar, or the down arrow of a vertical scroll bar.

ESB_DISABLE_RTDN ESB_DISABLE_RIGHT

ESB_DISABLE_BOTH 0x0003

Disables both arrows of a scroll bar.

ESB_DISABLE_BOTH 0x0003

EnableWindow (2.x)

BOOL EnableWindow(*hwnd, fEnable***)**

HWND *hwnd;* /* handle of window */
BOOL *fEnable;* /* flag for enabling or disabling input */

The **EnableWindow** function enables or disables mouse and keyboard input to the given window or control. When input is disabled, the window ignores input such as mouse clicks and key presses. When input is enabled, the window processes all input.

Parameter	Description
hwnd	Identifies the window to be enabled or disabled.
fEnable	Specifies whether to enable or disable the window. If this parameter is TRUE, the window is enabled. If the parameter is FALSE, the window is disabled.

Returns
The return value is nonzero if the window was previously disabled. Otherwise, the return value is zero.

Comments
If the enabled state of the window is changing, a **WM_ENABLE** message is sent before this function returns. If a window is already disabled, all its child windows are implicitly disabled, although they are not sent a WM_ENABLE message.

A window must be enabled before it can be activated. For example, if an application is displaying a modeless dialog box and has disabled its main window, the application must enable the main window before destroying the dialog box. Otherwise, another window will receive the input focus and be activated. If a child window is disabled, it is ignored when Windows tries to determine which window should receive mouse messages.

By default, a window is enabled when it is created. An application can specify the **WS_DISABLED** style in the **CreateWindow** or **CreateWindowEx** function to create a window that is initially disabled. After a window has been created, an application can use the **EnableWindow** function to enable or disable the window.

An application can use this function to enable or disable a control in a dialog box. A disabled control cannot receive the input focus, nor can a user access it.

Example
The following example enables a Save push button in a dialog box, depending on whether a user-specified filename exists:

```
static char szFileName[128];

case WM_INITDIALOG:

    /* If a filename is specified, enable the Save push button. */

    EnableWindow(GetDlgItem(hdlg, IDOK),
        (szFileName[0] == '\0' ? FALSE : TRUE));
    return TRUE;
```

See Also
IsWindowEnabled, **WM_ENABLE**

EndDeferWindowPos (3.0)

BOOL EndDeferWindowPos(*hdwp***)**

HDWP *hdwp;* /* handle of internal structure*/

The **EndDeferWindowPos** function simultaneously updates the position and size of one or more windows in a single screen-refresh cycle.

Parameter	Description
hdwp	Identifies an internal structure that contains size and position information for one or more windows. This structure is returned by the **BeginDeferWindowPos** function or by the most recent call to the **DeferWindowPos** function.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

This function sends the **WM_WINDOWPOSCHANGING** and **WM_WINDOWPOSCHANGED** messages to each window identified in the internal structure.

See Also

BeginDeferWindowPos, **DeferWindowPos**, **WM_WINDOWPOSCHANGED**, **WM_WINDOWPOSCHANGING**

EndDialog (2.x)

void EndDialog(*hwndDlg, nResult***)**

```
HWND hwndDlg;     /* handle of dialog box  */
int nResult;      /* value to return       */
```

The **EndDialog** function hides a modal dialog box and causes the **DialogBox** function to return.

Parameter	Description
hwndDlg	Identifies the dialog box to be destroyed.
nResult	Specifies the value that is returned to the caller of **DialogBox**.

Returns
This function does not return a value.

Comments
The **EndDialog** function is required to complete processing of a modal dialog box created by the **DialogBox** function. An application calls **EndDialog** from within the dialog box procedure.

A dialog box procedure can call **EndDialog** at any time, even during the processing of the **WM_INITDIALOG** message. If the function is called while WM_INITDIALOG is being processed, the dialog box is hidden before it is shown and before the input focus is set.

EndDialog does not destroy the dialog box immediately. Instead, it sets a flag that directs Windows to destroy the dialog box when the **DialogBox** function returns.

See Also
DialogBox, **WM_INITDIALOG**

EndPaint (2.x)

void EndPaint(*hwnd, lpps***)**

```
HWND hwnd;                          /* handle of window                */
const PAINTSTRUCT FAR* lpps;        /* address of structure for paint data */
```

The **EndPaint** function marks the end of painting in the given window. This function is required for each call to the **BeginPaint** function, but only after painting is complete.

Parameter	Description
hwnd	Identifies the window that has been repainted.
lpps	Points to a **PAINTSTRUCT** structure that contains the painting information retrieved by the **BeginPaint** function.

Returns

This function does not return a value.

Comments

If the caret was hidden by the **BeginPaint** function, the **EndPaint** function restores the caret to the screen.

See Also

BeginPaint, **PAINTSTRUCT**

EnumChildWindows (2.x)

BOOL EnumChildWindows(*hwndParent, wndenmprc, lParam***)**

```
HWND hwndParent;        /* handle of parent window      */
WNDENUMPROC wndenmprc;  /* address of callback function */
LPARAM lParam;          /* application-defined value    */
```

The **EnumChildWindows** function enumerates the child windows that belong to the given parent window by passing the handle of each child window, in turn, to an application-defined callback function. **EnumChildWindows** continues until the last child window is enumerated or the callback function returns zero.

Parameter	Description
hwndParent	Identifies the parent window whose child windows are to be enumerated.
wndenmprc	Specifies the procedure-instance address of the application-supplied callback function. The address must have been created by using the **MakeProcInstance** function. For more information about the callback function, see the description of the **EnumChildProc** callback function.
lParam	Specifies a 32-bit application-defined value to pass to the callback function.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

This function does not enumerate top-level windows that belong to the parent window.

If a child window has created child windows of its own, the function enumerates those windows as well.

A child window that is moved or repositioned in the Z-order during the enumeration process will be properly enumerated. The function will not enumerate a child window that is destroyed before it is enumerated or that is created during the enumeration process. These measures ensure that the **EnumChildWindows** function is reliable even when the application causes odd side effects, whereas an application that uses a **GetWindow** loop risks being caught in an infinite loop or referencing a handle to a window that has been destroyed.

See Also

EnumChildProc, **MakeProcInstance**

EnumClipboardFormats (2.x)

UINT EnumClipboardFormats(*uFormat***)**

UINT *uFormat;* /* known clipboard format */

The **EnumClipboardFormats** function enumerates the formats found in a list of available formats that belong to the clipboard. Each call to this function specifies a known available format; the function returns the format that appears next in the list.

Parameter	Description
uFormat	Specifies a known format. If this parameter is zero, the function returns the first format in the list.

Returns

The return value specifies the next known clipboard data format if the function is successful. It is zero if the *uFormat* parameter specifies the last format in the list of available formats, or if the clipboard is not open.

Comments

Before it enumerates the formats by using the **EnumClipboardFormats** function, an application must open the clipboard by using the **OpenClipboard** function.

An application puts (or "donates") alternative formats for the same data into the clipboard in the same order that the enumerator uses when returning them to the pasting application. The pasting application should use the first format enumerated in the list that it can handle. This gives the donor application an opportunity to recommend formats that involve the least loss of data.

See Also

CountClipboardFormats, **GetClipboardFormatName**, **GetPriorityClipboardFormat**, **IsClipboardFormatAvailable**, **OpenClipboard**, **RegisterClipboardFormat**

EnumProps (2.x)

int EnumProps(*hwnd, prpenmprc***)**

HWND *hwnd;* /* handle of window */
PROPENUMPROC *prpenmprc;* /* address of callback function */

The **EnumProps** function enumerates all entries in the property list of the given window. It enumerates the entries by passing them, one by one, to the specified callback function. **EnumProps** continues until the last entry is enumerated or the callback function returns zero.

Parameter	Description
hwnd	Identifies the window whose property list is enumerated.
prpenmprc	Specifies the procedure-instance address of the callback function. For more information, see the descriptions of the **EnumPropFixedProc** and **EnumPropMovableProc** callback functions.

Returns

The return value specifies the last value returned by the callback function. It is -1 if the function did not find a property to enumerate.

Comments

The form of the callback function depends on whether the application or dynamic-link library (DLL) uses fixed or movable data segments. If the application or library uses fixed data segments (or if the library uses movable data segments that do not contain a stack), see the description of the **EnumPropFixedProc** callback function. If the application uses movable data segments (or if the library uses movable data segments that also contain a stack), see the description of the **EnumPropMovableProc** callback function.

An application's **EnumPropFixedProc** or **EnumPropMovableProc** callback function should not add new properties to a window. If the callback function deletes a window's properties, it should delete only the property currently being enumerated. The callback function should not delete other properties belonging to the window; if it does, the enumeration process terminates early.

The address passed in the *prpenmprc* parameter must be created by using the **MakeProcInstance** function.

See Also

EnumPropFixedProc, **EnumPropMovableProc**, **GetProp**, **MakeProcInstance**, **RemoveProp**, **SetProp**

EnumTaskWindows (2.x)

BOOL EnumTaskWindows(*htask, wndenmprc, lParam***)**

```
HTASK htask;                    /* handle of task                */
WNDENUMPROC wndenmprc;          /* address of callback function  */
LPARAM lParam;                  /* application-defined value     */
```

The **EnumTaskWindows** function enumerates all windows associated with a given task. (A task is any program that executes as an independent unit. All applications are executed as tasks, and each instance of an application is a task.) The function enumerates the windows by passing their handles, one by one, to the specified callback function. **EnumTaskWindows** continues until the last entry is enumerated or the callback function returns zero.

Parameter	Description
htask	Identifies the task. The task handle must be retrieved by a previous call to the **GetCurrentTask** function.
wndenmprc	Specifies the procedure-instance address of the callback function. For more information, see the description of the **EnumTaskWndProc** callback function.
lParam	Specifies a 32-bit application-defined value that is passed to the callback function along with each window handle.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

This function enumerates all top-level windows but does not enumerate child windows.

The **EnumTaskWindows** function is reliable even when the application causes odd side effects, whereas an application that uses a **GetWindow** loop risks being caught in an infinite loop or referencing a handle to a window that has been destroyed.

The address passed in the *wndenmprc* parameter must be created by using the **MakeProcInstance** function.

See Also

EnumTaskWndProc, **GetCurrentTask**

EnumWindows (2.x)

BOOL EnumWindows(*wndenmprc, lParam***)**

WNDENUMPROC *wndenmprc;* /* address of callback function */
LPARAM *lParam;* /* application-defined value */

The **EnumWindows** function enumerates all parent windows on the screen by passing the handle of each window, in turn, to an application-defined callback function. **EnumWindows** continues until the last parent window is enumerated or the callback function returns zero.

Parameter	Description
wndenmprc	Specifies the procedure-instance address of the callback function. For more information, see the description of the **EnumWindowsProc** callback function.
lParam	Specifies a 32-bit application-defined value that is passed to the callback function.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The **EnumWindows** function does not enumerate child windows.

EnumWindows is reliable even when the application causes odd side effects, whereas an application that uses a **GetWindow** loop risks being caught in an infinite loop or referencing a handle to a window that has been destroyed.

The address passed as the *wndenmprc* parameter must be created by using the **MakeProcInstance** function.

See Also
EnumWindowsProc, **MakeProcInstance**

EqualRect (2.x)

BOOL EqualRect(*lprc1, lprc2***)**

const RECT FAR* *lprc1;* /* address of structure with first rectangle */
const RECT FAR* *lprc2;* /* address of structure with second rectangle */

The **EqualRect** function determines whether the two given rectangles are equal by comparing the coordinates of their upper-left and lower-right corners.

Parameter	Description
lprc1	Points to a **RECT** structure that contains the logical coordinates of the first rectangle.
lprc2	Points to a **RECT** structure that contains the logical coordinates of the second rectangle.

Returns

The return value is nonzero if the two rectangles are identical. Otherwise, it is zero.

See Also

RECT

EscapeCommFunction (2.x)

LONG EscapeCommFunction(*idComDev, nFunction***)**

int *idComDev;* /* identifies communications device */
int *nFunction;* /* code of extended function */

The **EscapeCommFunction** function directs the specified communications device to carry out an extended function.

Parameter	Description
idComDev	Specifies the communications device that will carry out the extended function. The **OpenComm** function returns this value.
nFunction	Specifies the function code of the extended function. It can be one of the following values:

Value	Meaning
CLRDTR	Clears the DTR (data-terminal-ready) signal.
CLRRTS	Clears the RTS (request-to-send) signal.
GETMAXCOM	Returns the maximum COM port identifier supported by the system. This value ranges from 0x00 to 0x7F, such that 0x00 corresponds to COM1, 0x01 to COM2, 0x02 to COM3, and so on.
GETMAXLPT	Returns the maximum LPT port identifier supported by the system. This value ranges from 0x80 to 0xFF, such that 0x80 corresponds to LPT1, 0x81 to LPT2, 0x82 to LPT3, and so on.
RESETDEV	Resets the printer device if the *idComDev* parameter specifies an LPT port. No function is performed if *idComDev* specifies a COM port.
SETDTR	Sends the DTR (data-terminal-ready) signal.
SETRTS	Sends the RTS (request-to-send) signal.
SETXOFF	Causes transmission to act as if an XOFF character has been received.
SETXON	Causes transmission to act as if an XON character has been received.

Returns

The return value is zero if the function is successful. Otherwise, it is less than zero.

ExcludeUpdateRgn (2.x)

int ExcludeUpdateRgn(*hdc, hwnd***)**

HDC *hdc;* /* handle of device context */
HWND *hwnd;* /* handle of window */

The **ExcludeUpdateRgn** function prevents drawing within invalid areas of a window by excluding an updated region in the window from a clipping region.

Parameter	Description
hdc	Identifies the device context associated with the clipping region.
hwnd	Identifies the window to be updated.

Returns

The return value is SIMPLEREGION (region has no overlapping borders), COMPLEXREGION (region has overlapping borders), or NULLREGION (region is empty), if the function is successful. Otherwise, the return value is ERROR (no region is created).

See Also

BeginPaint, **GetUpdateRect**, **GetUpdateRgn**, **UpdateWindow**

ExitWindows (3.0)

BOOL ExitWindows(*dwReturnCode, reserved***)**

DWORD *dwReturnCode;* /* return or restart code */
UINT *reserved;* /* reserved; must be zero */

The **ExitWindows** function can restart Windows, terminate Windows and return control to MS-DOS, or terminate Windows and restart the system. Windows sends the **WM_QUERYENDSESSION** message to notify all applications that a request has been made to restart or terminate Windows. If all applications "agree" to terminate, Windows sends the **WM_ENDSESSION** message to all applications before terminating.

Parameter	Description
dwReturnCode	Specifies whether Windows should restart, terminate and return control to MS-DOS, or terminate and restart the system. The high-order word of this parameter should be zero. The low-order word specifies the return value to be passed to MS-DOS when Windows terminates. The low-order word can be one of the following values:

Value	Meaning
EW_REBOOTSYSTEM	Causes Windows to terminate and the system to restart.
EW_RESTARTWINDOWS	Causes Windows to restart.

reserved	Reserved; must be zero.

Returns

The return value is zero if one or more applications refuse to terminate. The function does not return a value if all applications agree to be terminated.

See Also

ExitWindowsExec, **WM_ENDSESSION**, **WM_QUERYENDSESSION**

Windows 3.1 changes

An application can restart Windows by specifying a value of **EW_RESTARTWINDOWS** as the *dwReturnCode* parameter of the **ExitWindows** function. This change is supported in Windows version 3.0 and 3.1.

The **EW_REBOOTSYSTEM** flag can be specified as the low-order word of the *dwReturnCode* parameter. This flag causes Windows to terminate and the system to restart.

EW_REBOOTSYSTEM 0x43

Causes Windows to terminate and the system to restart.

EW_REBOOTSYSTEM 0x43

EW_RESTARTWINDOWS 0x42

Causes Windows to restart.

EW_RESTARTWINDOWS 0x42

ExitWindowsExec (3.0)

BOOL ExitWindowsExec(*lpszExe, lpszParams***)**

LPCSTR *lpszExe;*
LPCSTR *lpszParams;*

The **ExitWindowsExec** function terminates Windows, runs a specified MS-DOS application, and then restarts Windows.

Parameter	Description
lpszExe	Points to a null-terminated string specifying the path and filename of the executable file for the system to run after Windows has been terminated. This string must not be longer than 128 bytes (including the null terminating character).
lpszParams	Points to a null-terminated string specifying any parameters for the executable file specified by the *lpszExe* parameter. This string must not be longer than 127 bytes (including the null terminating character). This value can be NULL.

Returns

The return value is FALSE if the function fails. (The function could fail because of a memory-allocation error or if one of the applications in the system does not terminate.)

Comments

The **ExitWindowsExec** function is typically used by installation programs to replace components of Windows which are active when Windows is running.

See Also

ExitWindows

FillRect (2.x)

int FillRect(*hdc, lprc, hbr***)**

```
HDC hdc;                    /* handle of device context              */
const RECT FAR* lprc;       /* address of structure with rectangle*/
HBRUSH hbr;                 /* handle of brush                       */
```

The **FillRect** function fills a given rectangle by using the specified brush. The **FillRect** function fills the complete rectangle, including the left and top borders, but does not fill the right and bottom borders.

Parameter	Description
hdc	Identifies the device context.
lprc	Points to a **RECT** structure that contains the logical coordinates of the rectangle to be filled.
hbr	Identifies the brush used to fill the rectangle.

Returns

The return value is not used and has no meaning.

Comments

The brush must be created by using either the **CreateHatchBrush**, **CreatePatternBrush**, or **CreateSolidBrush** function, or retrieved by using the **GetStockObject** function.

When filling the specified rectangle, the **FillRect** function does not include the rectangle's right and bottom sides. Graphics device interface (GDI) fills a rectangle up to, but not including, the right column and bottom row, regardless of the current mapping mode.

FillRect compares the values of the **top**, **bottom**, **left**, and **right** members of the specified **RECT** structure. If **bottom** is less than or equal to **top**, or if **right** is less than or equal to **left**, the function does not draw the rectangle.

See Also

CreateHatchBrush, **CreatePatternBrush**, **CreateSolidBrush**, **GetStockObject**, **InvertRect**, **RECT**

FindWindow (2.x)

HWND FindWindow(*lpszClassName, lpszWindow***)**

LPCSTR *lpszClassName;* /* address of class-name string */
LPCSTR *lpszWindow;* /* address of window-name string */

The **FindWindow** function retrieves the handle of the window whose class name and window name match the specified strings. This function does not search child windows.

Parameter	Description
lpszClassName	Points to a null-terminated string that contains the window's class name. If this parameter is NULL, all class names match.
lpszWindow	Points to a null-terminated string that specifies the window name (the window's title). If this parameter is NULL, all window names match.

Returns

The return value is the handle of the window that has the specified class name and window name if the function is successful. Otherwise, it is NULL.

Example

The following example searches for the main window of Windows Control Panel (CONTROL.EXE) and, if it does not find it, starts Control Panel:

```
if (FindWindow("CtlPanelClass", "Control Panel") == NULL)
    WinExec("control.exe", SW_SHOWNA);
```

See Also

EnumWindows, **GetWindow**, **WindowFromPoint**

FlashWindow (2.x)

BOOL FlashWindow(*hwnd, fInvert***)**

```
HWND hwnd;      /* handle of window to flash */
BOOL fInvert;   /* invert flag               */
```

The **FlashWindow** function flashes the given window once. Flashing a window means changing the appearance of its title bar as if the window were changing from inactive to active status or vice versa. (An inactive title bar changes to an active title bar or an active title bar changes to an inactive title bar.)

Typically, a window is flashed to inform the user that the window requires attention but that it does not currently have the input focus.

Parameter	Description
hwnd	Identifies the window to be flashed. The window can be either open or minimized.
fInvert	Specifies whether to flash the window or return it to its original state. If this parameter is TRUE, the window is flashed from one state to the other. If the parameter is FALSE, the window is returned to its original state (either active or inactive).

Returns

The return value is nonzero if the window was active before the call to the **FlashWindow** function. Otherwise, it is zero.

Comments

The **FlashWindow** function flashes the window only once; for successive flashing, the application should create a system timer.

The *fInvert* parameter should be FALSE only when the window is receiving the input focus and will no longer be flashing; it should be TRUE on successive calls while waiting to get the input focus.

This function always returns nonzero for minimized windows. If the window is minimized, **FlashWindow** simply flashes the window's icon; *fInvert* is ignored for minimized windows.

See Also

MessageBeep

FlushComm (2.x)

int FlushComm(*idComDev, fnQueue***)**

```
int idComDev;     /* communications-device identifier */
int fnQueue;      /* queue to flush                   */
```

The **FlushComm** function flushes all characters from the transmission or receiving queue of the specified communications device.

Parameter	Description
idComDev	Specifies the communication device to be flushed. The **OpenComm** function returns this value.
fnQueue	Specifies the queue to be flushed. If this parameter is zero, the transmission queue is flushed. If the parameter is 1, the receiving queue is flushed.

Returns

The return value is zero if the function is successful. It is less than zero if *idComDev* is not a valid device or if *fnQueue* is not a valid queue. The return value is positive if there is an error for the specified device. For a list of the possible error values, see the **GetCommError** function.

See Also

GetCommError, **OpenComm**

FrameRect (2.x)

int FrameRect(*hdc, lprc, hbr***)**

```
HDC hdc;                    /* handle of device context          */
const RECT FAR* lprc;       /* address of structure with rectangle*/
HBRUSH hbr;                 /* handle of brush                   */
```

The **FrameRect** function draws a border around a rectangle, using the specified brush. The width and height of the border are always one logical unit.

Parameter	Description
hdc	Identifies the device context in which to draw the border.
lprc	Points to a **RECT** structure that contains the logical coordinates of the upper-left and lower-right corners of the rectangle.
hbr	Identifies the brush that will be used to draw the border.

Returns

The return value is not used and has no meaning.

Comments

The border drawn by the **FrameRect** function is in the same position as a border drawn by the **Rectangle** function using the same coordinates (if **Rectangle** uses a pen that is one logical unit wide). The interior of the rectangle is not filled when an application calls **FrameRect**.

FrameRect compares the values of the **top**, **bottom**, **left**, and **right** members of the specified **RECT** structure. If **bottom** is less than or equal to **top**, or if **right** is less than or equal to **left**, **FrameRect** does not draw the rectangle.

See Also

CreateHatchBrush, **CreatePatternBrush**, **CreateSolidBrush**, **DrawFocusRect**, **RECT**

GetActiveWindow (2.x)

HWND GetActiveWindow(void)

The **GetActiveWindow** function retrieves the window handle of the active window. The active window is either the top-level window associated with the input focus or the window explicitly made active by the **SetActiveWindow** function.

Returns
The return value is the handle of the active window or NULL if no window was active at the time of the call.

See Also
GetCapture, **GetFocus**, **GetLastActivePopup**, **SetActiveWindow**

GetAsyncKeyState (2.x)

int GetAsyncKeyState(*vkey***)**

int *vkey;* /* virtual-key code */

The **GetAsyncKeyState** function determines whether a key is up or down at the time the function is called and whether the key was pressed after a previous call to the **GetAsyncKeyState** function.

Parameter	Description
vkey	Specifies one of 256 possible virtual-key codes.

Returns

The return value specifies whether the key was pressed since the last call to the **GetAsyncKeyState** function and whether the key is currently up or down. If the most significant bit is set, the key is down, and if the least significant bit is set, the key was pressed after a preceding **GetAsyncKeyState** call.

Comments

If VK_LBUTTON or VK_RBUTTON is specified in the *vkey* parameter, this function returns the state of the physical left or right mouse button regardless of whether the **SwapMouseButton** function has been used to reverse the meaning of the buttons.

See Also

GetKeyboardState, **GetKeyState**, **SetKeyboardState**, **SwapMouseButton**

GetCapture (2.x)

HWND GetCapture(void)

The **GetCapture** function retrieves a handle of the window that has the mouse capture. Only one window has the mouse capture at any given time; this window receives mouse input whether or not the cursor is within its borders.

Returns

The return value is a handle identifying the window that has the mouse capture if the function is successful. It is NULL if no window has the mouse capture.

Comments

A window receives the mouse capture when its handle is passed as the *hwnd* parameter of the **SetCapture** function.

See Also

SetCapture

GetCaretBlinkTime (2.x)

UINT GetCaretBlinkTime(void)

The **GetCaretBlinkTime** function retrieves the caret blink rate. The blink rate is the elapsed time, in milliseconds, between flashes of the caret.

Returns
The return value specifies the blink rate, in milliseconds, if the function is successful.

See Also
SetCaretBlinkTime

GetCaretPos (2.x)

void GetCaretPos(*lppt***)**

POINT FAR* *lppt;* /* address of structure to receive coordinates */

The **GetCaretPos** function retrieves the current position of the caret.

Parameter	Description
lppt	Points to a **POINT** structure that receives the client coordinates of the caret's current position.

Returns
This function does not return a value.

Comments
The caret position is always given in the client coordinates of the window that contains the caret.

See Also
SetCaretPos, **POINT**

GetClassInfo (3.0)

BOOL GetClassInfo(*hinst, lpszClassName, lpwc***)**

```
HINSTANCE hinst;        /* handle of application instance      */
LPCSTR lpszClassName;   /* address of class-name string        */
WNDCLASS FAR* lpwc;     /* address of structure for class data */
```

The **GetClassInfo** function retrieves information about a window class. This function is used for creating subclasses of a given class.

Parameter	Description
hinst	Identifies the instance of the application that created the class. To retrieve information about classes defined by Windows (such as buttons or list boxes), set this parameter to NULL.
lpszClassName	Points to a null-terminated string containing the class name. The class name is either an application-specified name as defined by the **RegisterClass** function or the name of a preregistered window class. If the high-order word of this parameter is NULL, the low-order word is assumed to be a value returned by the **MAKEINTRESOURCE** macro used when the class was created.
lpwc	Points to a **WNDCLASS** structure that receives the information about the class.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero, indicating the function did not find a matching class.

Comments

The **GetClassInfo** function does not set the **lpszClassName** and **lpszMenuName** members of the **WNDCLASS** structure. The menu name is not stored internally and cannot be returned. The class name is already known, since it is passed to this function. **GetClassInfo** returns all other members with the values used when the class was registered.

See Also

GetClassLong, **GetClassName**, **GetClassWord**, **RegisterClass**, **MAKEINTRESOURCE**, **WNDCLASS**

GetClassLong (2.x)

LONG GetClassLong(*hwnd, offset***)**

HWND *hwnd;* /* handle of window */
int *offset;* /* offset of value to retrieve */

The **GetClassLong** function retrieves a 32-bit (long) value at the specified offset into the extra class memory for the window class to which the given window belongs. Extra class memory is reserved by specifying a nonzero value in the **cbClsExtra** member of the **WNDCLASS** structure used with the **RegisterClass** function.

Parameter	Description
hwnd	Identifies the window.
offset	Specifies the zero-based byte offset of the value to be retrieved. Valid values are in the range zero through the number of bytes of class memory minus four (for example, if 12 or more bytes of extra class memory was specified, a value of 8 would be an index to the third 32-bit integer) or one of the following values:

Value	Meaning
GCL_MENUNAME	Retrieves a 32-bit pointer to the menu-name string.
GCL_WNDPROC	Retrieves a 32-bit pointer to the window procedure.

Returns

The return value is the specified 32-bit value in the extra class memory if the function is successful. Otherwise, it is zero, indicating the *hwnd* or *offset* parameter is invalid.

Comments

To access any extra four-byte values allocated when the window-class structure was created, use a positive byte offset as the index specified by the *offset* parameter, starting at 0 for the first four-byte value in the extra space, 4 for the next four-byte value, and so on.

See Also

GetClassInfo, **GetClassName**, **GetClassWord**, **RegisterClass**, **SetClassLong**, **WNDCLASS**

Windows 3.1 changes

Value	Meaning
GCL_MENUNAME	Retrieves a 32-bit pointer to the menu-name string.

GCL_MENUNAME (-8)

Retrieves a 32-bit pointer to the menu-name string.

GCL_MENUNAME (-8)

GCL_WNDPROC (-24)

Retrieves a 32-bit pointer to the window procedure.

GCL_WNDPROC (-24)

GetClassName (2.x)

int GetClassName(*hwnd, lpszClassName, cchClassName***)**

```
HWND hwnd;          /* handle of window                */
LPSTR lpszClassName; /* address of buffer for class name */
int cchClassName;   /* size of buffer                  */
```

The **GetClassName** function retrieves the class name of a window.

Parameter	Description
hwnd	Identifies the window.
lpszClassName	Points to a buffer that receives the null-terminated class name string.
cchClassName	Specifies the length of the buffer pointed to by the *lpszClassName* parameter. The class name string is truncated if it is longer than the buffer.

Returns

The return value is the length, in bytes, of the returned class name, not including the terminating null character. The return value is zero if the specified window handle is invalid.

GetClassWord (2.x)

WORD GetClassWord(*hwnd, offset***)**

HWND *hwnd;* /* handle of window */
int *offset;* /* offset of value to retrieve */

The **GetClassWord** function retrieves a 16-bit (word) value at the specified offset into the extra class memory for the window class to which the given window belongs. Extra class memory is reserved by specifying a nonzero value in the **cbClsExtra** member of the **WNDCLASS** structure used with the **RegisterClass** function.

Parameter	Description
hwnd	Identifies the window.
offset	Specifies the zero-based byte offset of the value to be retrieved. Valid values are in the range zero through the number of bytes of class memory minus two (for example, if 10 or more bytes of extra class memory was specified, a value of 8 would be an index to the fifth 16-bit integer) or one of the following values:

Value	Meaning
GCW_CBCLSEXTRA	Retrieves the number of bytes of additional class information. For information about how to access this memory, see the following Comments section.
GCW_CBWNDEXTRA	Retrieves the number of bytes of additional window information. For information about how to access this memory, see the following Comments section.
GCW_HBRBACKGROUND	Retrieves the handle of the background brush.
GCW_HCURSOR	Retrieves the handle of the cursor.
GCW_HICON	Retrieves the handle of the icon.
GCW_HMODULE	Retrieves the handle of the module.
GCW_STYLE	Retrieves the window-class style bits.

Returns

The return value is the 16-bit value in the window's reserved memory, if the function is successful. Otherwise, it is zero, indicating the *hwnd* or *offset* parameter is invalid.

Comments

To access any extra two-byte values allocated when the window-class structure was created, use a positive byte offset as the index specified by the *offset* parameter, starting at 0 for the first two-byte value in the extra space, 2 for the next two-byte value, and so on.

See Also

GetClassInfo, **GetClassLong**, **GetClassName**, **RegisterClass**, **SetClassWord**, **WNDCLASS**

GCW_CBCLSEXTRA (-20)

Retrieves the number of bytes of additional class information. For information about how to access this memory, see the following Comments section.

GCW_CBCLSEXTRA (-20)

GCW_CBWNDEXTRA (-18)

Retrieves the number of bytes of additional window information. For information about how to access this memory, see the following Comments section.

GCW_CBWNDEXTRA (-18)

GCW_HBRBACKGROUND (-10)

Retrieves the handle of the background brush.

GCW_HBRBACKGROUND (-10)

GCW_HCURSOR (-12)

Retrieves the handle of the cursor.

GCW_HCURSOR (-12)

GCW_HICON (-14)

Retrieves the handle of the icon.

GCW_HICON (-14)

GCW_HMODULE (-16)

Retrieves the handle of the module.

GCW_HMODULE (-16)

GCW_STYLE (-26)

Retrieves the window-class style bits.

GCW_STYLE (-26)

GetClientRect (2.x)

void GetClientRect(*hwnd, lprc***)**

```
HWND hwnd;          /* handle of window                  */
RECT FAR* lprc;     /* address of structure for rectangle */
```

The **GetClientRect** function retrieves the client coordinates of a window's client area. The client coordinates specify the upper-left and lower-right corners of the client area. Because client coordinates are relative to the upper-left corner of a window's client area, the coordinates of the upper-left corner are (0,0).

Parameter	Description
hwnd	Identifies the window whose client coordinates are to be retrieved.
lprc	Points to a **RECT** structure that receives the client coordinates. The **left** and **top** members will be zero. The **right** and **bottom** members will contain the width and height of the window.

Returns

This function does not return a value.

See Also

GetWindowRect, **RECT**

GetClipboardData (2.x)

HANDLE GetClipboardData(*uFormat***)**

UINT *uFormat;* /* data format */

The **GetClipboardData** function retrieves a handle of the current clipboard data having a specified format. The clipboard must have been opened previously.

Parameter	Description
uFormat	Specifies the format of the data accessed by this function. For a description of the possible data formats, see the description of the **SetClipboardData** function.

Returns

The return value is a handle of the clipboard data in the specified format, if the function is successful. Otherwise, it is NULL.

Comments

The available formats can be enumerated in advance by using the **EnumClipboardFormats** function.

The data handle returned by the **GetClipboardData** function is controlled by the clipboard, not by the application. The application should copy the data immediately, instead of relying on the data handle for long-term use. The application should not free the data handle or leave it locked.

Windows supports two formats for text: CF_TEXT (the default Windows text clipboard format) and CF_OEMTEXT (the format Windows uses for text in non-Windows applications). If you call **GetClipboardData** to retrieve data in one text format and the other text format is the only available text format, Windows automatically converts the text to the requested format before supplying it to your application.

If the clipboard contains data in the CF_PALETTE (logical color palette) format, the application should assume that any other data in the clipboard is realized against that logical palette.

See Also

CloseClipboard, **EnumClipboardFormats**, **IsClipboardFormatAvailable**, **OpenClipboard**, **SetClipboardData**

GetClipboardFormatName (2.x)

int GetClipboardFormatName(*uFormat, lpszFormatName, cbMax***)**

```
UINT uFormat;          /* format to retrieve          */
LPSTR lpszFormatName;  /* address of buffer for name */
int cbMax;             /* length of name string       */
```

The **GetClipboardFormatName** function retrieves the name of a registered clipboard format.

Parameter	Description
uFormat	Specifies the registered format to retrieve. This parameter must not specify any of the predefined clipboard formats.
lpszFormatName	Points to a buffer that receives the format name.
cbMax	Specifies the maximum length, in bytes, of the format-name string. The format-name string is truncated if it is longer.

Returns

The return value is the length, in bytes, of the returned format name if the function is successful. Otherwise, it is zero, indicating the requested format does not exist or is predefined.

See Also

CountClipboardFormats, **EnumClipboardFormats**, **GetPriorityClipboardFormat**, **IsClipboardFormatAvailable**, **RegisterClipboardFormat**

GetClipboardOwner (2.x)

HWND GetClipboardOwner(void)

The **GetClipboardOwner** function retrieves the handle of the window that currently owns the clipboard, if any.

Returns
The return value identifies the window that owns the clipboard if the function is successful. Otherwise, it is NULL.

Comments
The clipboard can still contain data even if the clipboard is not currently owned.

See Also
CloseClipboard, **GetClipboardData**, **GetClipboardViewer**, **OpenClipboard**

GetClipboardViewer (2.x)

HWND GetClipboardViewer(void)

The **GetClipboardViewer** function retrieves the handle of the first window in the clipboard-viewer chain.

Returns
The return value identifies the window currently responsible for displaying the clipboard, if the function is successful. Otherwise, it is NULL (if there is no viewer, for example).

See Also
CloseClipboard, **GetClipboardData**, **GetClipboardOwner**, **OpenClipboard**

GetClipCursor (3.1)

void GetClipCursor(*lprc***)**

RECT FAR* *lprc;* /* address of structure for rectangle */

The **GetClipCursor** function retrieves the screen coordinates of the rectangle to which the cursor has been confined by a previous call to the **ClipCursor** function.

Parameter	Description
lprc	Points to a **RECT** structure that receives the screen coordinates of the confining rectangle. The structure receives the dimensions of the screen if the cursor is not confined to a rectangle.

Returns

This function does not return a value.

See Also

ClipCursor, **GetCursorPos**, **RECT**

GetCommError (2.x)

int GetCommError(*idComDev, lpStat***)**

int *idComDev;* /* communications device identifier */
COMSTAT FAR* *lpStat;* /* address of device-status buffer */

The **GetCommError** function retrieves the most recent error value and current status for the specified device.

When a communications error occurs, Windows locks the communications port until **GetCommError** clears the error.

Parameter	Description
idComDev	Specifies the communications device to be examined. The **OpenComm** function returns this value.
lpStat	Points to the **COMSTAT** structure that is to receive the device status. If this parameter is NULL, the function returns only the error values.

Returns

The return value specifies the error value for the most recent communications-function call to the specified device, if **GetCommError** is successful.

Errors

The return value can be a combination of the following values:

Value	Meaning
CE_BREAK	Hardware detected a break condition.
CE_CTSTO	CTS (clear-to-send) timeout. While a character was being transmitted, CTS was low for the duration specified by the **fCtsHold** member of the **COMSTAT** structure.
CE_DNS	Parallel device was not selected.
CE_DSRTO	DSR (data-set-ready) timeout. While a character was being transmitted, DSR was low for the duration specified by the **fDsrHold** member of **COMSTAT**.
CE_FRAME	Hardware detected a framing error.
CE_IOE	I/O error occurred during an attempt to communicate with a parallel device.
CE_MODE	Requested mode is not supported, or the *idComDev* parameter is invalid. If set, **CE_MODE** is the only valid error.
CE_OOP	Parallel device signaled that it is out of paper.
CE_OVERRUN	Character was not read from the hardware before the next character arrived. The character was lost.
CE_PTO	Timeout occurred during an attempt to communicate with a parallel device.
CE_RLSDTO	RLSD (receive-line-signal-detect) timeout. While a character was being transmitted, RLSD was low for the duration specified by the **fRlsdHold** member of **COMSTAT**.
CE_RXOVER	Receiving queue overflowed. There was either no room in the input queue or a character was received after the end-of-file character was received.
CE_RXPARITY	Hardware detected a parity error.
CE_TXFULL	Transmission queue was full when a function attempted to queue a character.

See Also

OpenComm, **COMSTAT**

CE_BREAK 0x0010

Hardware detected a break condition.

CE_BREAK 0x0010

CE_CTSTO 0x0020

CTS (clear-to-send) timeout. While a character was being transmitted, CTS was low for the duration specified by the **fCtsHold** member of the **COMSTAT** structure.

CE_CTSTO 0x0020

CE_DNS 0x0800

Parallel device was not selected.

CE_DNS 0x0800

CE_DSRTO 0x0040

DSR (data-set-ready) timeout. While a character was being transmitted, DSR was low for the duration specified by the **fDsrHold** member of **COMSTAT**.

CE_DSRTO 0x0040

CE_FRAME 0x0008

Hardware detected a framing error.

CE_FRAME 0x0008

CE_IOE 0x0400

I/O error occurred during an attempt to communicate with a parallel device.

CE_IOE 0x0400

CE_MODE 0x8000

Requested mode is not supported, or the *idComDev* parameter is invalid. If set, CE_MODE is the only valid error.

CE_MODE 0x8000

CE_OOP 0x1000

Parallel device signaled that it is out of paper.

CE_OOP 0x1000

CE_OVERRUN 0x0002

Character was not read from the hardware before the next character arrived. The character was lost.

CE_OVERRUN 0x0002

CE_PTO 0x0200

Timeout occurred during an attempt to communicate with a parallel device.

CE_PTO 0x0200

CE_RLSDTO 0x0080

RLSD (receive-line-signal-detect) timeout. While a character was being transmitted, RLSD was low for the duration specified by the **fRlsdHold** member of **COMSTAT**.

CE_RLSDTO 0x0080

CE_RXOVER 0x0001

Receiving queue overflowed. There was either no room in the input queue or a character was received after the end-of-file character was received.

CE_RXOVER 0x0001

CE_RXPARITY 0x0004

Hardware detected a parity error.

CE_RXPARITY 0x0004

CE_TXFULL 0x0100

Transmission queue was full when a function attempted to queue a character.

CE_TXFULL 0x0100

GetCommEventMask (2.x)

UINT GetCommEventMask(*idComDev, fnEvtClear***)**

int *idComDev;* /* communications device identifier */
int *fnEvtClear;* /* events to clear in the event word */

The **GetCommEventMask** function retrieves and then clears the event word for a communications device.

Parameter	Description
idComDev	Specifies the communication device to be examined. The **OpenComm** function returns this value.
fnEvtClear	Specifies which events are to be cleared in the event word. For a list of the event values, see the description of the **SetCommEventMask** function.

Returns

The return value specifies the current event-word value for the specified communications device if the function is successful. Each bit in the event word specifies whether a given event has occurred; a bit is set (to 1) if the event has occurred.

Comments

Before the **GetCommEventMask** function can record the occurrence of an event, an application must enable the event by using the **SetCommEventMask** function.

If the communication device event is a line-status or printer error, the application should call the **GetCommError** function after calling **GetCommEventMask**.

See Also

GetCommError, **OpenComm**, **SetCommEventMask**

GetCommState (2.x)

int GetCommState(*idComDev, lpdcb***)**

```
int idComDev;       /* communications device identifier          */
DCB FAR* lpdcb;     /* address of structure for device control block */
```

The **GetCommState** function retrieves the device control block for the specified device.

Parameter	Description
idComDev	Specifies the device to be examined. The **OpenComm** function returns this value.
lpdcb	Points to the **DCB** structure that is to receive the current device control block. The **DCB** structure defines the control settings for the device.

Returns

The return value is zero if the function is successful. Otherwise, it is less than zero.

See Also

OpenComm, **SetCommState**, **DCB**

GetCurrentTime (2.x)

DWORD GetCurrentTime(void)

The **GetCurrentTime** function retrieves the number of milliseconds that have elapsed since Windows was started.

Returns

The return value is the number of milliseconds that have elapsed since Windows was started, if the function was successful.

Comments

The **GetCurrentTime** function is identical to the **GetTickCount** function. Applications should use the **GetTickCount** function, since its name matches more closely with what the function does.

See Also

GetTickCount

GetCursor (3.1)

HCURSOR GetCursor(void)

The **GetCursor** function retrieves the handle of the current cursor.

Parameter	Description
This function has no parameters.	

Returns
The return value is the handle of the current cursor if a cursor exists. Otherwise, it is NULL.

See Also
SetCursor

GetCursorPos (2.x)

void GetCursorPos(*lppt***)**

POINT FAR* *lppt;* /* address of structure for cursor position */

The **GetCursorPos** function retrieves the screen coordinates of the cursor's current position.

Parameter	Description
lppt	Points to the **POINT** structure that receives the cursor position, in screen coordinates.

Returns
This function does not return a value.

Comments
The cursor position is always given in screen coordinates and is not affected by the mapping mode of the window that contains the cursor.

See Also
ClipCursor, **SetCursorPos**, **POINT**

GetDC (2.x)

HDC GetDC(*hwnd***)**

HWND *hwnd;* /* handle of window */

The **GetDC** function retrieves the handle of a device context for the client area of the given window. The device context can be used in subsequent graphics device interface (GDI) functions to draw in the client area.

The **GetDC** function retrieves a common, class, or private device context, depending on the class style specified for the given window. For common device contexts, **GetDC** assigns default attributes to the context each time it is retrieved. For class and private contexts, **GetDC** leaves the previously assigned attributes unchanged.

Parameter	Description
hwnd	Identifies the window where drawing will occur. If this parameter is NULL, the function returns a device context for the screen.

Returns

The return value is a handle of the device context for the given window's client area, if the function is successful. Otherwise, it is NULL.

Comments

Unless the device context belongs to a window class, the **ReleaseDC** function must be called to release the context after drawing. Since only five common device contexts are available at any given time, failure to release a device context can prevent other applications from accessing a device context. If the *hwnd* parameter of the **GetDC** function is NULL, the first parameter of **ReleaseDC** should also be NULL.

A device context with special characteristics is returned by the **GetDC** function if **CS_CLASSDC**, **CS_OWNDC**, or **CS_PARENTDC** style was specified in the **WNDCLASS** structure when the class was registered. For more information about these characteristics, see the description of the **WNDCLASS** structure.

See Also

BeginPaint, **GetDCEx**, **GetWindowDC**, **ReleaseDC**, **WNDCLASS**

GetDCEx (3.1)

HDC GetDCEx(*hwnd, hrgnClip, fdwOptions***)**

```
register HWND hwnd;     /* window where drawing will occur       */
HRGN hrgnClip;          /* clipping region that may be combined  */
DWORD fdwOptions;       /* device-context options                */
```

The **GetDCEx** function retrieves the handle of a device context for the given window. The device context can be used in subsequent graphics device interface (GDI) functions to draw in the client area.

This function, which is an extension to the **GetDC** function, gives an application more control over how and whether a device context for a window is clipped.

Parameter	Description
hwnd	Identifies the window where drawing will occur.
hrgnClip	Identifies a clipping region that may be combined with the visible region of the client window.
fdwOptions	Specifies how the device context is created. This parameter can be a combination of the following values:

Value	Meaning
DCX_CACHE	Returns a device context from the cache, rather than the OWNDC or CLASSDC window. Essentially overrides **CS_OWNDC** and CS_CLASSDC.
DCX_CLIPCHILDREN	Excludes the visible regions of all child windows below the window identified by the *hwnd* parameter.
DCX_CLIPSIBLINGS	Excludes the visible regions of all sibling windows above the window identified by the *hwnd* parameter.
DCX_EXCLUDERGN	Excludes the clipping region identified by the *hrgnClip* parameter from the visible region of the returned device context.
DCX_INTERSECTRGN	Intersects the clipping region identified by the *hrgnClip* parameter with the visible region of the returned device context.
DCX_LOCKWINDOWUPDATE	Allows drawing even if there is a **LockWindowUpdate** call in effect that would otherwise exclude this window. This value is used for drawing during tracking.
DCX_PARENTCLIP	Uses the visible region of the parent window, ignoring the parent window's **WS_CLIPCHILDREN** and WS_PARENTDC style bits. This value sets the device context's origin to the upper-left corner of the window identified by the *hwnd* parameter.
DCX_WINDOW	Returns a device context corresponding to the window rectangle rather than the client rectangle.

Returns

The return value is a handle of the device context for the specified window, if the function is successful. Otherwise, it is NULL.

Comments

Unless the device context belongs to a window class, the **ReleaseDC** function must be called to release

the context after drawing. Since only five common device contexts are available at any given time, failure to release a device context can prevent other applications from accessing a device context.

In order to obtain a cached device context, an application must specify DCX_CACHE. If **DCX_CACHE** is not specified and the window is neither **CS_OWNDC** nor **CS_CLASSDC**, this function returns NULL.

A device context with special characteristics is returned by the **GetDC** function if **CS_CLASSDC**, **CS_OWNDC**, or **CS_PARENTDC** style was specified in the **WNDCLASS** structure when the class was registered. For more information about these characteristics, see the description of the **WNDCLASS** structure.

See Also
BeginPaint, **GetDC**, **GetWindowDC**, **ReleaseDC**, **WNDCLASS**

DCX_CACHE 0x00000002L

Returns a device context from the cache, rather than the OWNDC or CLASSDC window. Essentially overrides **CS_OWNDC** and CS_CLASSDC.

DCX_CACHE 0x00000002L

DCX_CLIPCHILDREN 0x00000008L

Excludes the visible regions of all child windows below the window identified by the *hwnd* parameter.

DCX_CLIPCHILDREN 0x00000008L

DCX_CLIPSIBLINGS 0x00000010L

Excludes the visible regions of all sibling windows above the window identified by the *hwnd* parameter.

DCX_CLIPSIBLINGS 0x00000010L

DCX_EXCLUDERGN 0x00000040L

Excludes the clipping region identified by the *hrgnClip* parameter from the visible region of the returned device context.

DCX_EXCLUDERGN 0x00000040L

DCX_INTERSECTRGN 0x00000080L

Intersects the clipping region identified by the *hrgnClip* parameter with the visible region of the returned device context.

DCX_INTERSECTRGN 0x00000080L

DCX_LOCKWINDOWUPDATE 0x00000400L

Allows drawing even if there is a **LockWindowUpdate** call in effect that would otherwise exclude this window. This value is used for drawing during tracking.

DCX_LOCKWINDOWUPDATE 0x00000400L

DCX_PARENTCLIP 0x00000020L

Uses the visible region of the parent window, ignoring the parent window's **WS_CLIPCHILDREN** and WS_PARENTDC style bits. This value sets the device context's origin to the upper-left corner of the window identified by the *hwnd* parameter.

DCX_PARENTCLIP 0x00000020L

DCX_WINDOW 0x00000001L

Returns a device context corresponding to the window rectangle rather than the client rectangle.

DCX_WINDOW 0x00000001L

GetDesktopWindow (3.0)

HWND GetDesktopWindow(void)

The **GetDesktopWindow** function retrieves the handle of the desktop window. The desktop window covers the entire screen and is the area on top of which all icons and other windows are painted.

Returns
The return value is a handle of the desktop window.

See Also
GetTopWindow, **GetWindow**

GetDialogBaseUnits (3.0)

DWORD GetDialogBaseUnits(void)

The **GetDialogBaseUnits** function returns the dialog box base units used by Windows when creating dialog boxes. An application should use these values to calculate the average width of characters in the system font.

Returns

The low-order word of the return value contains the width, in pixels, of the current dialog box base-width unit, if the function is successful (this base unit is derived from the system font); the high-order word of the return value contains the height, in pixels.

Comments

The values returned represent dialog box base units before being scaled to dialog box units. The dialog box unit in the x-direction is one-fourth of the width returned by the **GetDialogBaseUnits** function. The dialog box unit in the y-direction is one-eighth of the height returned by the function.

To use **GetDialogBaseUnits** to determine the height and width, in pixels, of a control, given the width (x) and height (y) in dialog box units and the return value (lDlgBaseUnits), use the following formulas:

```
(x * LOWORD(lDlgBaseUnits)) / 4
(y * HIWORD(lDlgBaseUnits)) / 8
```

To avoid rounding problems, perform the multiplication before the division, in case the dialog box base units are not evenly divisible by four.

Example

The following example calculates tab stops based on the dialog box base units:

```
HMENU hmenu;
WORD DlgWidthUnits;
WORD TabStopList[4];

case WM_CREATE:
    hmenu = LoadMenu(hinst, "TabStopsMenu");
    SetMenu(hwnd, hmenu);
    DlgWidthUnits = LOWORD(GetDialogBaseUnits()) / 4;
    TabStopList[0] = (DlgWidthUnits * 16 * 2);
    TabStopList[1] = (DlgWidthUnits * 32 * 2);
    TabStopList[2] = (DlgWidthUnits * 58 * 2);
    TabStopList[3] = (DlgWidthUnits * 84 * 2);
    break;
```

GetDlgCtrlID (3.0)

int GetDlgCtrlID(*hwnd***)**

HWND *hwnd;* /* handle of child window */

The **GetDlgCtrlID** function returns a handle of a child window.

Parameter	Description
hwnd	Identifies the child window.

Returns
The return value is a handle of the child window if the function is successful. Otherwise, it is NULL.

Comments
This function returns a handle of any child window, not just that of a control in a dialog box.

Since top-level windows do not have an identifier, the **GetDlgCtrlID** function's return value is invalid if the *hwnd* parameter identifies a top-level window.

See Also
GetDlgItem, **GetDlgItemInt**, **GetDlgItemText**

GetDlgItem (2.x)

HWND GetDlgItem(*hwndDlg, idControl***)**

```
HWND hwndDlg;      /* handle of dialog box  */
int idControl;     /* identifier of control */
```

The **GetDlgItem** function retrieves the handle of a control that is in the given dialog box.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the control.
idControl	Specifies the identifier of the control to be retrieved.

Returns

The return value is the handle of the given control if the function is successful. Otherwise, it is NULL, indicating either an invalid dialog box handle or a nonexistent control.

Comments

The **GetDlgItem** function can be used with any parent-child window pair, not just dialog boxes. As long as the *hwndDlg* parameter identifies a parent window and the child window has a unique identifier (as specified by the *hmenu* parameter in the **CreateWindow** function that created the child window), **GetDlgItem** returns the handle of the child window.

See Also

CreateWindow, **GetDlgCtrlID**, **GetDlgItemInt**, **GetDlgItemText**, **GetWindow**

GetDlgItemInt (2.x)

UINT GetDlgItemInt(*hwndDlg, idControl, lpfTranslated, fSigned***)**

```
HWND hwndDlg;          /* handle of dialog box              */
int idControl;         /* identifier of control             */
BOOL FAR* lpfTranslated;  /* address of variable for error flag */
BOOL fSigned;          /* signed or unsigned indicator      */
```

The **GetDlgItemInt** function translates the text of a control in the given dialog box into an integer value.

Parameter	Description
hwndDlg	Identifies the dialog box.
idControl	Specifies the identifier of the dialog box control to be translated.
lpfTranslated	Points to the Boolean variable that is to receive the translated flag.
fSigned	Specifies whether the value to be retrieved is signed.

Returns

The return value specifies the translated value of the dialog box item text if the function is successful. Since zero is a valid return value, the *lpfTranslated* parameter must be used to detect errors. If an application requires a signed return value, it should cast the return value as an **int** type.

Comments

The function retrieves the text of the given control by sending the control a **WM_GETTEXT** message. The function then translates the text by stripping any extra spaces at the beginning of the text and converting decimal digits. The function stops translating when it reaches the end of the text or encounters a nonnumeric character. If the *fSigned* parameter is TRUE, the **GetDlgItemInt** function checks for a minus sign (–) at the beginning of the text and translates the text into a signed number. Otherwise, it creates an unsigned value.

GetDlgItemInt returns zero if the translated number is greater than 32,767 (for signed numbers) or 65,535 (for unsigned numbers). When a error occurs, such as encountering nonnumeric characters and exceeding the given maximum, **GetDlgItemInt** copies zero to the location pointed to by the *lpfTranslated* parameter. If there are no errors, *lpfTranslated* receives a nonzero value. If *lpfTranslated* is NULL, **GetDlgItemInt** does not warn about errors.

See Also

GetDlgCtrlID, **GetDlgItem**, **GetDlgItemText**

GetDlgItemText (2.x)

int GetDlgItemText(*hwndDlg, idControl, lpsz, cbMax***)**

```
HWND hwndDlg;     /* handle of dialog box      */
int idControl;    /* identifier of control     */
LPSTR lpsz;       /* address of buffer for text*/
int cbMax;        /* maximum size of string    */
```

The **GetDlgItemText** function retrieves the title or text associated with a control in a dialog box.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the control.
idControl	Specifies the identifier of the control whose title is to be retrieved.
lpsz	Points to a buffer that is to receive the control's title or text.
cbMax	Specifies the maximum length, in bytes, of the string to be copied to the buffer pointed to by the *lpsz* parameter. The string is truncated if it is longer.

Returns

The return value specifies the number of bytes copied to the buffer, not including the terminating null character, if the function is successful. Otherwise, it is zero.

Comments

The **GetDlgItemText** function sends a **WM_GETTEXT** message to the control.

See Also

GetDlgCtrlID, **GetDlgItem**, **GetDlgItemInt**, **WM_GETTEXT**

GetDoubleClickTime (2.x)

UINT GetDoubleClickTime(void)

The **GetDoubleClickTime** function retrieves the current double-click time for the mouse. A double-click is a series of two clicks of the mouse button, the second occurring within a specified time after the first. The double-click time is the maximum number of milliseconds that may occur between the first and second click of a double-click.

Returns
The return value specifies the current double-click time, in milliseconds.

See Also
GetCapture, **SetDoubleClickTime**

GetDriverModuleHandle (3.1)

HINSTANCE GetDriverModuleHandle(*hdrvr***)**

HDRVR *hdrvr;* /* handle of installable driver */

The **GetDriverModuleHandle** function retrieves the instance handle of a module that contains an installable driver.

Parameter	Description
hdrvr	Identifies the installable driver. This parameter must be retrieved by the **OpenDriver** function.

Returns

The return value is an instance handle of the driver module if the function is successful. Otherwise, it is NULL.

See Also

OpenDriver

GetDriverInfo (3.1)

BOOL GetDriverInfo(*hdrvr, lpdis***)**

```
HDRVR hdrvr;                        /* handle of installable driver  */
DRIVERINFOSTRUCT FAR* lpdis;        /* address of structure for info */
```

The **GetDriverInfo** function retrieves information about an installable driver.

Parameter	Description
hdrvr	Identifies the installable driver. This handle must be retrieved by the **OpenDriver** function.
lpdis	Points to a **DRIVERINFOSTRUCT** structure that receives the driver information.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

GetFocus (2.x)

HWND GetFocus(void)

The **GetFocus** function retrieves the handle of the window that currently has the input focus.

Returns
The return value is the handle of the focus window. If no window has the focus, it is NULL.

See Also
GetActiveWindow, **GetCapture**, **SetFocus**

GetFreeSystemResources (3.1)

UINT GetFreeSystemResources(*fuSysResource***)**

UINT *fuSysResource;* /* type of resource to check */

The **GetFreeSystemResources** function returns the percentage of free space for system resources.

Parameter	Description
fuSysResource	Specifies the type of resource to be checked. This parameter can be one of the following values:

Value	Meaning
GFSR_SYSTEMRESOURCES	Returns the percentage of free space for system resources.
GFSR_GDIRESOURCES	Returns the percentage of free space for GDI resources. GDI resources include device-context handles, brushes, pens, regions, fonts, and bitmaps.
GFSR_USERRESOURCES	Returns the percentage of free space for **USER** resources. These resources include window and menu handles.

Returns

The return value specifies the percentage of free space for resources, if the function is successful.

Comments

Since the return value from this function does not guarantee that an application will be able to create a new object, applications should not use this function to determine whether it will be possible to create an object.

See Also

GetFreeSpace

GFSR_SYSTEMRESOURCES 0x0000

Returns the percentage of free space for system resources.

GFSR_SYSTEMRESOURCES 0x0000

GFSR_GDIRESOURCES 0x0001

Returns the percentage of free space for GDI resources. GDI resources include device-context handles, brushes, pens, regions, fonts, and bitmaps.

GFSR_GDIRESOURCES 0x0001

GFSR_USERRESOURCES 0x0002

Returns the percentage of free space for **USER** resources. These resources include window and menu handles.

GFSR_USERRESOURCES 0x0002

GetInputState (2.x)

BOOL GetInputState(void)

The **GetInputState** function determines whether there are mouse clicks or keyboard events in the system queue that require processing. Keyboard events occur when a user presses one or more keys. The system queue is the location in which Windows stores mouse and keyboard events.

Returns
The return value is nonzero if the function detects a mouse click or keyboard event in the system queue. Otherwise, it is zero.

See Also
EnableHardwareInput

GetKeyboardState (2.x)

void GetKeyboardState(*lpbKeyState***)**

BYTE FAR* *lpbKeyState;* /* address of array to receive virtual-key codes */

The **GetKeyboardState** function copies the status of the 256 virtual-keyboard keys to the specified buffer.

Parameter	Description
lpbKeyState	Points to the 256-byte buffer that will receive the virtual-key codes.

Returns
This function does not return a value.

Comments
An application calls the **GetKeyboardState** function in response to a keyboard-input message. This function retrieves the state of the keyboard at the time the input message was generated.

If the high-order bit is 1, the key is down; otherwise, it is up. If the low-order bit is 1, the key is toggled. A toggle key, such as the CAPSLOCK key, is toggled if it has been pressed an odd number of times since the system was started. The key is untoggled if the low-order bit is 0.

Example
The following example simulates a pressed CTRL key:

```
BYTE pbKeyState[256];

GetKeyboardState((LPBYTE) &pbKeyState);
pbKeyState[VK_CONTROL] |= 0x80;
SetKeyboardState((LPBYTE) &pbKeyState);
```

See Also
GetKeyState, **SetKeyboardState**

GetKeyState (2.x)

int GetKeyState(*vkey***)**

int *vkey;* /* virtual key */

The **GetKeyState** function retrieves the state of the specified virtual key. The state specifies whether the key is up, down, or toggled (on, off--alternating each time the key is pressed).

Parameter	Description
vkey	Specifies a virtual key. If the requested virtual key is a letter or digit (A through Z, a through z, or 0 through 9), *vkey* must be set to the ASCII value of that character. For other keys, it must be a virtual-key code.

Returns

The return value specifies the state of the given virtual key. If the high-order bit is 1, the key is down; otherwise, it is up. If the low-order bit is 1, the key is toggled. A toggle key, such as the CAPSLOCK key, is toggled if it has been pressed an odd number of times since the system was started. The key is untoggled if the low-order bit is 0.

Comments

An application calls the **GetKeyState** function in response to a keyboard-input message. This function retrieves the state of the key at the time the input message was generated.

See Also

GetAsyncKeyState, **GetKeyboardState**

GetLastActivePopup (3.0)

HWND GetLastActivePopup(*hwndOwner***)**

HWND *hwndOwner;* /* handle of owner window */

The **GetLastActivePopup** function determines which pop-up window owned by the given window was most recently active.

Parameter	Description
hwndOwner	Identifies the owner window.

Returns
The return value is the handle of most-recently active pop-up window if the function is successful.

Comments
The return value handle will be the same as the handle in the *hwndOwner* parameter if any of the following conditions are met:

- The window identified by *hwndOwner* was most recently active.
- The window identified by *hwndOwner* does not own any pop-up windows.
- The window identified by *hwndOwner* is not a top-level window or is owned by another window.

See Also
AnyPopup, **GetActiveWindow**, **ShowOwnedPopups**

GetMenu (2.x)

HMENU GetMenu(*hwnd***)**

HWND *hwnd;* /* handle of window */

The **GetMenu** function retrieves the handle of the menu associated with the given window.

Parameter	Description
hwnd	Identifies the window whose menu handle is retrieved.

Returns

The return value is the handle of the menu if the function is successful. It is NULL if the given window has no menu. It is undefined if the window is a child window.

See Also

GetSubMenu, **SetMenu**

GetMenuCheckMarkDimensions (3.0)

DWORD GetMenuCheckMarkDimensions(void)

The **GetMenuCheckMarkDimensions** function returns the dimensions of the default check mark bitmap. Windows displays this bitmap next to checked menu items. Before calling the **SetMenuItemBitmaps** function to replace the default check mark, an application should determine the correct size for the bitmaps by calling the **GetMenuCheckMarkDimensions** function.

Returns

The low-order word of the return value contains the width, in pixels, of the default check mark bitmap, if the function is successful; the high-order word contains the height.

See Also

SetMenuItemBitmaps

GetMenuItemCount (2.x)

int GetMenuItemCount(*hmenu***)**

HMENU *hmenu;* /* handle of menu */

The **GetMenuItemCount** function determines the number of items in a pop-up or top-level menu.

Parameter	Description
hmenu	Identifies the handle of the menu to be examined.

Returns

The return value specifies the number of items in the menu if the function is successful. Otherwise, it is -1.

Example

The following example initializes the items in a pop-up menu:

```
WORD wCount;
WORD wItem;
WORD wID;

case WM_INITMENUPOPUP:
    wCount = GetMenuItemCount((HMENU) wParam);
    for (wItem = 0; wItem < wCount; wItem++) {
        wID = GetMenuItemID((HMENU) wParam, wItem);
        .
        . /* Initialize menu items. */
        .
    }
    break;
```

See Also

GetMenu, **GetMenuItemID**, **GetSubMenu**

GetMenuItemID (2.x)

UINT GetMenuItemID(*hmenu, pos***)**

HMENU *hmenu;* /* handle of menu */
int *pos;* /* position of menu item */

The **GetMenuItemID** function retrieves the identifier for a menu item located at the given position.

Parameter	Description
hmenu	Identifies the pop-up menu that contains the item whose identifier is to be retrieved.
pos	Specifies the zero-based position of the menu item whose identifier is to be retrieved.

Returns

The return value specifies the identifier of the pop-up menu item if the function is successful. If the *hmenu* parameter is NULL or if the specified item is a pop-up menu (as opposed to an item within the pop-up menu), the return value is -1. If the *pos* parameter corresponds to a **SEPARATOR** menu item, the return value is zero.

Example

The following example initializes the items in a pop-up menu:

```
WORD wCount;
WORD wItem;
WORD wID;

case WM_INITMENUPOPUP:
    wCount = GetMenuItemCount((HMENU) wParam);
    for (wItem = 0; wItem < wCount; wItem++) {
        wID = GetMenuItemID((HMENU) wParam, wItem);
        .
        . /* Initialize menu items. */
        .
    }
    break;
```

See Also

GetMenu, **GetMenuItemCount**, **GetSubMenu**

GetMenuState (2.x)

UINT GetMenuState(*hmenu, idItem, fuFlags***)**

HMENU *hmenu;* /* handle of menu */
UINT *idItem;* /* menu-item identifier */
UINT *fuFlags;* /* menu flags */

The **GetMenuState** function retrieves the status flags associated with the specified menu item. If the menu item is a pop-up menu, this function also returns the number of items in the pop-up menu.

Parameter	Description
hmenu	Identifies the menu.
idItem	Specifies the menu item for which the state is retrieved, as determined by the *fuFlags* parameter.
fuFlags	Specifies the nature of the *idItem* parameter. It can be one of the following values:

Value	Meaning
MF_BYCOMMAND	Specifies the menu-item identifier.
MF_BYPOSITION	Specifies the zero-based position of the menu item.

Returns

The return value is -1 if the specified item does not exist. If the *idItem* parameter identifies a pop-up menu, the high-order byte of the return value contains the number of items in the pop-up menu, and the low order byte contains the menu flags associated with the pop-up menu. Otherwise, the return value is a mask (Boolean OR) of the values from the following list (this mask describes the status of the menu item that *idItem* identifies):

Value	Meaning
MF_BITMAP	Item is a bitmap.
MF_CHECKED	Check mark is placed next to item (pop-up menus only).
MF_DISABLED	Item is disabled.
MF_ENABLED	Item is enabled. Note that the value of this constant is zero; an application should not test against zero for failure when using this value.
MF_GRAYED	Item is disabled and grayed.
MF_MENUBARBREAK	Same as **MF_MENUBREAK**, except for pop-up menus where the new column is separated from the old column by a vertical dividing line.
MF_MENUBREAK	Item is placed on a new line (static menus) or in a new column (pop-up menus) without separating columns.
MF_SEPARATOR	Horizontal dividing line is drawn (pop-up menus only). This line cannot be enabled, checked, grayed, or highlighted. The *idItem* and *fuFlags* parameters are ignored.
MF_UNCHECKED	Check mark is not placed next to item (default). Note that the value of this constant is zero; an application should not test against zero for failure when using this value.

Example

The following example retrieves the handle of a pop-up menu, retrieves the checked state of a menu item in the menu, and then toggles the checked state of the item:

```
HMENU hmenu;
BOOL fOwnerDraw;

/* Retrieve a handle to the Colors menu. */
```

```
hmenu = GetSubMenu(GetMenu(hwnd), ID_COLORS_POS);

/* Retrieve the current state of the item. */

fOwnerDraw = GetMenuState(hmenu, IDM_COLOROWNERDR,
    MF_BYCOMMAND) & MF_CHECKED;

/* Toggle the state of the item. */

CheckMenuItem(hmenu, IDM_COLOROWNERDR,
    MF_BYCOMMAND | (fOwnerDraw ? MF_UNCHECKED : MF_CHECKED));
```

See Also

GetMenu, GetMenuItemCount, GetSubMenu

GetMenuString (2.x)

int GetMenuString(*hmenu, idItem, lpsz, cbMax, fwFlags***)**

```
HMENU hmenu;     /* handle of menu              */
UINT idItem;     /* menu-item identifier        */
LPSTR lpsz;      /* address of buffer for label */
int cbMax;       /* maximum length of label     */
UINT fwFlags;    /* menu flags                  */
```

The **GetMenuString** function copies the label of a menu item into a buffer.

Parameter	Description
hmenu	Identifies the menu.
idItem	Specifies the menu item whose label is to be copied, as determined by the *fwFlags* parameter.
lpsz	Points to a buffer that will receive the null-terminated label string.
cbMax	Specifies the maximum length, in bytes, of the label string. The label string is truncated if it is longer.
fwFlags	Specifies the nature of the *idItem* parameter. It can be one of the following values:

Value	Meaning
MF_BYCOMMAND	Specifies the menu-item identifier.
MF_BYPOSITION	Specifies the zero-based position of the menu item.

Returns

The return value is the length, in bytes, of the returned label, if the function is successful. The length does not include the terminating null character.

Comments

The *cbMax* parameter should be one larger than the number of characters in the label to accommodate the null character that terminates the string.

See Also

GetMenu, **GetMenuItemID**

GetMessage (2.x)

BOOL GetMessage(*lpmsg, hwnd, uMsgFilterMin, uMsgFilterMax***)**

```
MSG FAR* lpmsg;       /* address of structure with message */
HWND hwnd;            /* handle of the window              */
UINT uMsgFilterMin;   /* first message                     */
UINT uMsgFilterMax;   /* last message                      */
```

The **GetMessage** function retrieves a message from the application's message queue and places the message in a **MSG** structure. If no message is available, **GetMessage** yields control to other applications until a message becomes available.

GetMessage retrieves messages associated only with the given window and within the given range of message values. The function does not retrieve messages for windows that belong to other applications.

Parameter	Description
lpmsg	Points to an **MSG** structure that contains message information from the application's message queue.
hwnd	Identifies the window whose messages are to be retrieved. If this parameter is NULL, **GetMessage** retrieves messages for any window that belongs to the application making the call.
uMsgFilterMin	Specifies the integer value of the lowest message value to be retrieved.
uMsgFilterMax	Specifies the integer value of the highest message value to be retrieved.

Returns

The return value is nonzero if a message other than **WM_QUIT** is retrieved. It is zero if the WM_QUIT message is retrieved.

Comments

The return value is usually used to decide whether to terminate the application's main loop and exit the program.

The WM_KEYFIRST and WM_KEYLAST constants can be used as filter values to retrieve all messages related to keyboard input; the WM_MOUSEFIRST and WM_MOUSELAST constants can be used to retrieve all mouse-related messages. If the *uMsgFilterMin* and *uMsgFilterMax* parameters are both zero, the **GetMessage** function returns all available messages (without performing any filtering).

In addition to yielding control to other applications when no messages are available, the **GetMessage** and **PeekMessage** functions also yield control when **WM_PAINT** or **WM_TIMER** messages for other tasks are available.

The **GetMessage**, **PeekMessage**, and **WaitMessage** functions are the only ways to let other applications run. If your application does not call any of these functions for long periods of time, other applications cannot run.

Example

The following example uses the **GetMessage** function to retrieve messages from a message queue, translates virtual-key messages into character messages, and dispatches messages to the appropriate window procedures:

```
MSG msg;

while (GetMessage(&msg, (HWND) NULL, 0, 0)) {
    TranslateMessage(&msg);
    DispatchMessage(&msg);
}
```

See Also

GetMessageExtraInfo, **PeekMessage**, **PostQuitMessage**, **SetMessageQueue**, **WaitMessage**, **MSG**, **WM_PAINT**, **WM_QUIT**, **WM_TIMER**

GetMessageExtraInfo (3.1)

LONG GetMessageExtraInfo(void)

The **GetMessageExtraInfo** function retrieves the extra information associated with the last message retrieved by the **GetMessage** or **PeekMessage** function. This extra information may be added to a message by the driver for a pointing device or keyboard.

Returns
The return value specifies the extra information if the function is successful. The meaning of the extra information is device-specific.

See Also
GetMessage, **hardware_event**, **PeekMessage**

GetMessagePos (2.x)

DWORD GetMessagePos(void)

The **GetMessagePos** function returns a long value that represents a cursor position, in screen coordinates. This position is the point occupied by the cursor when the last message retrieved by the **GetMessage** function occurred.

Returns
The return value specifies the x- and y-coordinates of the cursor position if the function is successful.

Comments
To retrieve the current position of the cursor instead of the position at the time the last message occurred, use the **GetCursorPos** function.

The x-coordinate is in the low-order word of the return value; the y-coordinate is in the high-order word. If the return value is assigned to a variable, you can use the **MAKEPOINT** macro to obtain a **POINT** structure from the return value. You can also use the **LOWORD** or **HIWORD** macro to extract the x- or the y-coordinate.

See Also
GetCursorPos, **GetMessage**, **GetMessageTime**, **MAKEPOINT**, **LOWORD**, **HIWORD**, **POINT**

GetMessageTime (2.x)

LONG GetMessageTime(void)

The **GetMessageTime** function returns the message time for the last message retrieved by the **GetMessage** function. The time is a long integer that specifies the elapsed time, in milliseconds, from the time the system was started to the time the message was created (placed in the application queue).

Returns
The return value specifies the message time if the function is successful.

Comments
The return value of the **GetMessageTime** function does not necessarily increase between subsequent messages, because the value wraps to zero if the timer count exceeds the maximum value for long integers.

To calculate time delays between messages, verify that the time of the second message is greater than the time of the first message and then subtract the time of the first message from the time of the second message.

See Also
GetMessage, **GetMessagePos**

GetNextDlgGroupItem (2.x)

HWND GetNextDlgGroupItem(*hwndDlg, hwndCtrl, fPrevious***)**

HWND *hwndDlg;* /* handle of dialog box */
HWND *hwndCtrl;* /* handle of control */
BOOL *fPrevious;* /* direction flag */

The **GetNextDlgGroupItem** function searches for the previous (or next) control within a group of controls in a dialog box. A group of controls begins with a control with the **WS_GROUP** style and ends with the last control that does not contain a WS_GROUP style.

Parameter	Description
hwndDlg	Identifies the dialog box to be searched.
hwndCtrl	Identifies the control to be used as the starting point for the search.
fPrevious	Specifies how the function is to search the group of controls in the dialog box. If this parameter is TRUE, the function searches for the previous control in the group. If this parameter is FALSE, the function searches for the next control in the group.

Returns

The return value is the window handle of the previous (or next) control in the group, if the function is successful.

Comments

If the *hwndCtrl* parameter identifies the last control in the group and the *fPrevious* parameter is FALSE, the **GetNextDlgGroupItem** function returns the window handle of the first control in the group. If *hwndCtrl* identifies the first control in the group and *fPrevious* is TRUE, **GetNextDlgGroupItem** returns the window handle of the last control in the group.

Example

The following example sets the check state of a group of radio buttons. It is assumed that the group contains only radio buttons and no other type of control:

```
HWND hwndStart, hwndCurrent;

case WM_COMMAND:
    switch (HIWORD(lParam)) {
        case BN_CLICKED:

            /*
             * If a radio button was clicked, clear the current
             * selection and select the one that was clicked.
             */

            hwndStart = GetDlgItem(hdlg, wParam);
            if (LOWORD(GetWindowLong(hwndStart,
                    GWL_STYLE) == BS_RADIOBUTTON)) {
                hwndCurrent = hwndStart;

                do {
                    hwndCurrent = GetNextDlgGroupItem(hdlg,
                        hwndCurrent, TRUE);
                    SendMessage(hwndCurrent, BM_SETCHECK,
                        hwndCurrent == hwndStart, 0L);
                } while (hwndCurrent != hwndStart);
            }
        .
```

```
        . /* Process other notification codes. */
        .
    }
```

See Also
GetDlgItem, **GetNextDlgTabItem**

GetNextDlgTabItem (2.x)

HWND GetNextDlgTabItem(*hwndDlg, hwndCtrl, fPrevious***)**

HWND *hwndDlg;* /* handle of dialog box */
HWND *hwndCtrl;* /* handle of known control */
BOOL *fPrevious;* /* direction flag */

The **GetNextDlgTabItem** function retrieves the handle of the first control that has the **WS_TABSTOP** style that precedes (or follows) the specified control.

Parameter	Description
hwndDlg	Identifies the dialog box to be searched.
hwndCtrl	Identifies the control to be used as the starting point for the search.
fPrevious	Specifies how the function is to search the dialog box. If this parameter is TRUE, the function searches for the previous control in the dialog box. If this parameter is FALSE, the function searches for the next control in the dialog box.

Returns
The return value is the window handle of the previous (or next) control that has the **WS_TABSTOP** style, if the function is successful.

Example
The following example retrieves the handle of the previous control that has the **WS_TABSTOP** style, relative to the control that has the input focus:

```
HWND hdlg;
HWND hwndControl;

hwndControl = GetNextDlgTabItem(hdlg, GetFocus(), TRUE);
```

See Also
GetDlgItem, **GetNextDlgGroupItem**

GetNextDriver (3.1)

HDRVR GetNextDriver(*hdrvr, fdwFlag***)**

HDRVR *hdrvr;* /* handle of installable driver */
DWORD *fdwFlag;* /* search flag */

The **GetNextDriver** function enumerates instances of an installable driver.

Parameter	Description
hdrvr	Identifies the installable driver for which instances should be enumerated. This parameter must be retrieved by the **OpenDriver** function. If this parameter is NULL, the enumeration begins at either the beginning or end of the list of installable drivers (depending on the setting of the flags in the *fdwFlag* parameter).
fdwFlag	Specifies whether the function should return a handle identifying only the first instance of a driver and whether the function should return handles identifying the instances of the driver in the order in which they were loaded. This parameter can be one or more of the following flags:

Value	Meaning
GND_FIRSTINSTANCEONLY	Returns a handle identifying the first instance of an installable driver. When this flag is set, the function will enumerate only the first instance of an installable driver, no matter how many times the driver has been installed.
GND_FORWARD	Enumerates subsequent instances of the driver. (Using this flag has the same effect as not using the **GND_REVERSE** flag.)
GND_REVERSE	Enumerates instances of the driver as it was loaded--each subsequent call to the function returns the handle of the next instance.

Returns
The return value is the instance handle of the installable driver if the function is successful.

GND_FIRSTINSTANCEONLY 0x00000001

Returns a handle identifying the first instance of an installable driver. When this flag is set, the function will enumerate only the first instance of an installable driver, no matter how many times the driver has been installed.

GND_FIRSTINSTANCEONLY 0x00000001

GND_FORWARD 0x00000000

Enumerates subsequent instances of the driver. (Using this flag has the same effect as not using the **GND_REVERSE** flag.)

GND_FORWARD 0x00000000

GND_REVERSE 0x00000002

Enumerates instances of the driver as it was loaded--each subsequent call to the function returns the handle of the next instance.

GND_REVERSE 0x00000002

GetNextWindow (2.x)

HWND GetNextWindow(*hwnd, uFlag***)**

```
HWND hwnd;      /* handle of current window*/
UINT uFlag;     /* direction flag          */
```

The **GetNextWindow** function searches for the handle of the next (or previous) window in the window manager's list. The window manager's list contains entries for all top-level windows, their associated child windows, and the child windows of any child windows. If the given window is a top-level window, the function searches for the next (or previous) handle of a top-level window. If the given window is a child window, the function searches for the handle of the next (or previous) child window.

Parameter	Description
hwnd	Identifies the current window.
uFlag	Specifies whether the function should return a handle to the next window or to the previous window. It can be either of the following values:

Value	Meaning
GW_HWNDNEXT	Returns a handle of the next window.
GW_HWNDPREV	Returns a handle of the previous window.

Returns

The return value is the handle of the next (or previous) window in the window manager's list if the function is successful.

See Also

GetTopWindow, **GetWindow**

GetOpenClipboardWindow (3.1)

HWND GetOpenClipboardWindow(void)

The **GetOpenClipboardWindow** function retrieves the handle of the window that currently has the clipboard open.

Returns
The return value is the handle of the window that has the clipboard open, if the function is successful. Otherwise, it is NULL.

See Also
GetClipboardOwner, **GetClipboardViewer**, **OpenClipboard**

GetParent (2.x)

HWND GetParent(*hwnd***)**

HWND *hwnd;* /* handle of window */

The **GetParent** function retrieves the handle of the given window's parent window (if any).

Parameter	Description
hwnd	Identifies the window whose parent window handle is to be retrieved.

Returns

The return value is the handle of the parent window if the function is successful. Otherwise, it is NULL, indicating an error or no parent window.

See Also

SetParent

GetPriorityClipboardFormat (3.0)

int GetPriorityClipboardFormat(*lpuPriorityList, cEntries***)**

UINT FAR* *lpuPriorityList;* /* address of priority list */
int *cEntries;* /* count of entries in list */

The **GetPriorityClipboardFormat** function retrieves the first clipboard format in a list for which data exists in the clipboard.

Parameter	Description
lpuPriorityList	Points to an integer array that contains a list of clipboard formats in priority order. For a description of the data formats, see the description of the **SetClipboardData** function.
cEntries	Specifies the number of entries in the priority list. This value must not be greater than the number of entries in the list.

Returns

The return value is the highest priority clipboard format in the list for which data exists. If no data exists in the clipboard, the return value is NULL. If data exists in the clipboard that does not match any format in the list, the return value is -1.

See Also

CountClipboardFormats, **EnumClipboardFormats**, **GetClipboardFormatName**, **IsClipboardFormatAvailable**, **RegisterClipboardFormat**, **SetClipboardData**

GetProp (2.x)

HANDLE GetProp(*hwnd, lpsz***)**

```
HWND hwnd;      /* handle of window          */
LPCSTR lpsz;    /* atom or address of string */
```

The **GetProp** function retrieves a data handle from the property list of a window. The character string pointed to by the *lpsz* parameter identifies the handle to be retrieved. The string and handle must be added to the property list by a previous call to the **SetProp** function.

Parameter	Description
hwnd	Identifies the window whose property list is to be searched.
lpsz	Points to a null-terminated string or an atom that identifies a string. If an atom is given, it must be a global atom created by a previous call to the **GlobalAddAtom** function. The atom, a 16-bit value, must be placed in the low-order word of the *lpsz* parameter; the high-order word must be zero.

Returns

The return value is the associated data handle if the property list contains the given string. Otherwise, it is NULL.

Comments

The value retrieved by the **GetProp** function can be any 16-bit value useful to the application.

See Also

GlobalAddAtom, **RemoveProp**, **SetProp**

GetQueueStatus (3.1)

DWORD GetQueueStatus(*fuFlags***)**

UINT *fuFlags;* /* queue-status flags */

The **GetQueueStatus** function returns a value that indicates the type of messages in the queue.

This function is very fast and is typically used inside speed-critical loops to determine whether the **GetMessage** or **PeekMessage** function should be called to process input.

GetQueueStatus returns two sets of information: whether any new messages have been added to the queue since **GetQueueStatus**, **GetMessage**, or **PeekMessage** was last called, and what kinds of events are currently in the queue.

Parameter	Description
fuFlags	Specifies the queue-status flags to be retrieved. This parameter can be a combination of the following values:

Value	Meaning
QS_KEY	**WM_CHAR** message is in the queue.
QS_MOUSE	**WM_MOUSEMOVE** or WM_*BUTTON* message is in the queue.
QS_MOUSEMOVE	**WM_MOUSEMOVE** message is in the queue.
QS_MOUSEBUTTON	WM_*BUTTON* message is in the queue.
QS_PAINT	**WM_PAINT** message is in the queue.
QS_POSTMESSAGE	Posted message other than those listed above is in the queue.
QS_SENDMESSAGE	Message sent by another application is in the queue.
QS_TIMER	**WM_TIMER** message is in the queue.

Returns

The high-order word of the return value indicates the types of messages currently in the queue. The low-order word shows the types of messages added to the queue and are still in the queue since the last call to the **GetQueueStatus**, **GetMessage**, or **PeekMessage** function.

Comments

The existence of a QS_ flag in the return value does not guarantee that a subsequent call to the **PeekMessage** or **GetMessage** function will return a message. **GetMessage** and **PeekMessage** perform some internal filtering computation that may cause the message to be processed internally. For this reason, the return value from **GetQueueStatus** should be considered only a hint as to whether **GetMessage** or **PeekMessage** should be called.

See Also

GetInputState, **GetMessage**, **PeekMessage**

QS_KEY 0x0001

WM_CHAR message is in the queue.

QS_KEY 0x0001

QS_MOUSE (**QS_MOUSEMOVE** | **QS_MOUSEBUTTON**)

WM_MOUSEMOVE or WM_*BUTTON* message is in the queue.

QS_MOUSE (QS_MOUSEMOVE | QS_MOUSEBUTTON)

QS_MOUSEMOVE 0x0002

WM_MOUSEMOVE message is in the queue.

QS_MOUSEMOVE 0x0002

QS_MOUSEBUTTON 0x0004

WM_*BUTTON* message is in the queue.

QS_MOUSEBUTTON 0x0004

QS_PAINT 0x0020

WM_PAINT message is in the queue.

QS_PAINT 0x0020

QS_POSTMESSAGE 0x0008

Posted message other than those listed above is in the queue.

QS_POSTMESSAGE 0x0008

QS_SENDMESSAGE 0x0040

Message sent by another application is in the queue.

QS_SENDMESSAGE 0x0040

QS_TIMER 0x0010

WM_TIMER message is in the queue.

QS_TIMER 0x0010

GetScrollPos (2.x)

int GetScrollPos(*hwnd, fnBar***)**

```
HWND hwnd;      /* handle of window with scroll bar */
int fnBar;      /* scroll bar flags                 */
```

The **GetScrollPos** function retrieves the current position of the scroll box (thumb) of a scroll bar. The current position is a relative value that depends on the current scrolling range. For example, if the scrolling range is 0 through 100 and the scroll box is in the middle of the bar, the current position is 50.

Parameter	Description
hwnd	Identifies a window that has standard scroll bars or a scroll bar control, depending on the value of the *fnBar* parameter.
fnBar	Specifies the scroll bar to examine. It can be one of the following values:

Value	Meaning
SB_CTL	Retrieves the position of a scroll bar control. In this case, the *hwnd* parameter must be the window handle of a scroll bar control.
SB_HORZ	Retrieves the position of a window's horizontal scroll bar.
SB_VERT	Retrieves the position of a window's vertical scroll bar.

Returns

The return value specifies the current position of the scroll box in the scroll bar, if the function is successful. Otherwise, it is zero, indicating that the *hwnd* parameter is invalid or that the window does not have a scroll bar.

See Also

GetScrollRange, **SetScrollPos**, **SetScrollRange**

GetScrollRange (2.x)

void GetScrollRange(*hwnd, fnBar, lpnMinPos, lpnMaxPos***)**

```
HWND hwnd;          /* handle of window with scroll bar */
int fnBar;          /* scroll bar flags                 */
int FAR* lpnMinPos; /* receives minimum position        */
int FAR* lpnMaxPos; /* receives maximum position        */
```

The **GetScrollRange** function retrieves the current minimum and maximum scroll bar positions for the given scroll bar.

Parameter	Description
hwnd	Identifies a window that has standard scroll bars or a scroll bar control, depending on the value of the *fnBar* parameter.
fnBar	Specifies which scroll bar to retrieve. This parameter can be one of the following values:

Value	Meaning
SB_CTL	Retrieves the position of a scroll bar control; in this case, the *hwnd* parameter must be the handle of a scroll bar control.
SB_HORZ	Retrieves the position of a window's horizontal scroll bar.
SB_VERT	Retrieves the position of a window's vertical scroll bar.

lpnMinPos	Points to the integer variable that receives the minimum position.
lpnMaxPos	Points to the integer variable that receives the maximum position.

Returns

This function does not return a value.

Comments

If the given window does not have standard scroll bars or is not a scroll bar control, the **GetScrollRange** function copies zero to the *lpnMinPos* and *lpnMaxPos* parameters.

The default range for a standard scroll bar is 0 through 100. The default range for a scroll bar control is empty (both values are zero).

See Also

GetScrollPos, **SetScrollPos**, **SetScrollRange**

GetSubMenu (2.x)

HMENU GetSubMenu(*hmenu, nPos***)**

```
HMENU hmenu;     /* handle of menu with pop-up menu*/
int nPos;        /* position of pop-up menu        */
```

The **GetSubMenu** function retrieves the handle of a pop-up menu.

Parameter	Description
hmenu	Identifies the menu with the pop-up menu whose handle is to be retrieved.
nPos	Specifies the position in the given menu of the pop-up menu. Position values start at zero (zero-based) for the first menu item. The pop-up menu's identifier cannot be used in this function.

Returns

The return value is the handle of the given pop-up menu if the function is successful. Otherwise, it is NULL, indicating that no pop-up menu exists at the given position.

See Also

CreatePopupMenu, **GetMenu**

GetSysColor (2.x)

COLORREF GetSysColor(*nDspElement***)**

int *nDspElement;* /* display element */

The **GetSysColor** function retrieves the current color of the specified display element. Display elements are the various parts of a window and the Windows display that appear on the system screen.

Parameter	Description
nDspElement	Specifies the display element whose color is to be retrieved. This parameter can be one of the following values:

Value	Meaning
COLOR_ACTIVEBORDER	Active window border.
COLOR_ACTIVECAPTION	Active window title.
COLOR_APPWORKSPACE	Background color of multiple document interface (MDI) applications.
COLOR_BACKGROUND	Desktop.
COLOR_BTNFACE	Face shading on push buttons.
COLOR_BTNHIGHLIGHT	Selected button in a control.
COLOR_BTNSHADOW	Edge shading on push buttons.
COLOR_BTNTEXT	Text on push buttons.
COLOR_CAPTIONTEXT	Text in title bar, size button, scroll-bar arrow button.
COLOR_GRAYTEXT	Grayed (dimmed) text. This color is zero if the current display driver does not support a solid gray color.
COLOR_HIGHLIGHT	Background of selected item in a control.
COLOR_HIGHLIGHTTEXT	Text of selected item in a control.
COLOR_INACTIVEBORDER	Inactive window border.
COLOR_INACTIVECAPTION	Inactive window title.
COLOR_INACTIVECAPTIONTEXT	Color of text in an inactive title.
COLOR_MENU	Menu background.
COLOR_MENUTEXT	Text in menus.
COLOR_SCROLLBAR	Scroll-bar gray area.
COLOR_WINDOW	Window background.
COLOR_WINDOWFRAME	Window frame.
COLOR_WINDOWTEXT	Text in windows.

Returns

The return value is a red, green, blue (**RGB**) color value for the specified display element, if the function is successful.

Comments

An application can use the **GetRValue**, **GetGValue**, and **GetBValue** macros to extract the various colors from the return value.

See Also

GetSystemMetrics, **SetSysColors**, **GetRValue**, **GetGValue**, **GetBValue**

GetSysModalWindow (2.x)

HWND GetSysModalWindow(void)

The **GetSysModalWindow** function retrieves the handle of the system-modal window, if one is present.

Returns
The return value is the handle of the system-modal window, if one is present. Otherwise, it is NULL.

See Also
SetSysModalWindow

GetSystemDebugState (3.1)

LONG GetSystemDebugState(void)

The **GetSystemDebugState** function retrieves information about the state of the system. A Windows-based debugger can use this information to determine whether to enter hard mode or soft mode upon encountering a breakpoint.

Returns

The return value can be one or more of the following values:

Value	Meaning
SDS_MENU	Menu is displayed.
SDS_SYSMODAL	System-modal dialog box is displayed.
SDS_NOTASKQUEUE	Application queue does not exist yet and, therefore, the application cannot accept posted messages.
SDS_DIALOG	Dialog box is displayed.
SDS_TASKLOCKED	Current task is locked and, therefore, no other task is permitted to run.

SDS_MENU 0x0001

Menu is displayed.

SDS_MENU 0x0001

SDS_SYSMODAL 0x0002

System-modal dialog box is displayed.

SDS_SYSMODAL 0x0002

SDS_NOTASKQUEUE 0x0004

Application queue does not exist yet and, therefore, the application cannot accept posted messages.

SDS_NOTASKQUEUE 0x0004

SDS_DIALOG 0x0008

Dialog box is displayed.

SDS_DIALOG 0x0008

SDS_TASKLOCKED 0x0010

Current task is locked and, therefore, no other task is permitted to run.

SDS_TASKLOCKED 0x0010

GetSystemMenu (2.x)

HMENU GetSystemMenu(*hwnd, fRevert***)**

HWND *hwnd;* /* handle of window to own the System menu */
BOOL *fRevert;* /* reset flag */

The **GetSystemMenu** function allows the application to access the System menu for copying and modification.

Parameter	Description
hwnd	Identifies the window that will own a copy of the System menu.
fRevert	Specifies the action to be taken. If this parameter is FALSE, the **GetSystemMenu** function returns a handle of a copy of the System menu currently in use. This copy is initially identical to the System menu, but can be modified. If the parameter is TRUE, **GetSystemMenu** resets the System menu back to the Windows default state. The previous System menu, if any, is destroyed. The return value is undefined in this case.

Returns
The return value is the handle of a copy of the System menu, if the *fRevert* parameter is FALSE. If *fRevert* is TRUE, the return value is undefined.

Comments
Any window that does not use the **GetSystemMenu** function to make its own copy of the System menu receives the standard System menu.

The handle that **GetSystemMenu** returns can be used with the **AppendMenu**, **InsertMenu**, or **ModifyMenu** function to change the System menu. The System menu initially contains items identified by various identifier values such as SC_CLOSE, SC_MOVE, and SC_SIZE. Menu items on the System menu send **WM_SYSCOMMAND** messages. All predefined System-menu items have identifier numbers greater than 0xF000. If an application adds commands to the System menu, it should use identifier numbers less than 0xF000.

Windows automatically grays (dims) items on the standard System menu, depending on the situation. The application can carry out its own checking or graying by responding to the **WM_INITMENU** message, which is sent before any menu is displayed.

Example
The following example appends the About item to the System menu:

```
HMENU hmenu;

hmenu = GetSystemMenu(hwnd, FALSE);
AppendMenu(hmenu, MF_SEPARATOR, 0, (LPSTR) NULL);
AppendMenu(hmenu, MF_STRING, IDM_ABOUT, "About...");
```

See Also
AppendMenu, **InsertMenu**, **ModifyMenu**, **WM_INITMENU**

GetSystemMetrics (2.x)

int GetSystemMetrics(*nIndex***)**

int *nIndex;* /* system measurement to retrieve */

The **GetSystemMetrics** function retrieves the system metrics. The system metrics are the widths and heights of the various elements displayed by Windows. **GetSystemMetrics** can also return flags that indicate whether the current version of the Windows operating system is a debugging version, whether a mouse is present, or whether the meanings of the left and right mouse buttons have been exchanged.

Parameter	Description
nIndex	Specifies the system measurement to be retrieved. All measurements are given in pixels. The system measurement must be one of the following values:

Value	Meaning
SM_CXBORDER	Width of window frame that cannot be sized.
SM_CYBORDER	Height of window frame that cannot be sized.
SM_CYCAPTION	Height of window title. This is the title height plus the height of the window frame that cannot be sized (**SM_CYBORDER**).
SM_CXCURSOR	Width of cursor.
SM_CYCURSOR	Height of cursor.
SM_CXDOUBLECLK	Width of the rectangle around the location of the first click in a double-click sequence. The second click must occur within this rectangle for the system to consider the two clicks a double-click.
SM_CYDOUBLECLK	Height of the rectangle around the location of the first click in a double-click sequence. The second click must occur within this rectangle for the system to consider the two clicks a double-click.
SM_CXDLGFRAME	Width of frame when window has the **WS_DLGFRAME** style.
SM_CYDLGFRAME	Height of frame when window has the **WS_DLGFRAME** style.
SM_CXFRAME	Width of window frame that can be sized.
SM_CYFRAME	Height of window frame that can be sized.
SM_CXFULLSCREEN	Width of window client area for a full-screen window.
SM_CYFULLSCREEN	Height of window client area for a full-screen window (equivalent to the height of the screen minus the height of the window title).
SM_CXICON	Width of icon.
SM_CYICON	Height of icon.
SM_CXICONSPACING	Width of rectangles the system uses to position tiled icons.
SM_CYICONSPACING	Height of rectangles the system uses to position tiled icons.
SM_CYKANJIWINDOW	Height of Kanji window.
SM_CYMENU	Height of single-line menu bar. This is the menu height minus the height of the window frame that

	cannot be sized (**SM_CYBORDER**).
SM_CXMIN	Minimum width of window.
SM_CYMIN	Minimum height of window.
SM_CXMINTRACK	Minimum tracking width of window.
SM_CYMINTRACK	Minimum tracking height of window.
SM_CXSCREEN	Width of screen.
SM_CYSCREEN	Height of screen.
SM_CXHSCROLL	Width of arrow bitmap on a horizontal scroll bar.
SM_CYHSCROLL	Height of arrow bitmap on a horizontal scroll bar.
SM_CXVSCROLL	Width of arrow bitmap on a vertical scroll bar.
SM_CYVSCROLL	Height of arrow bitmap on a vertical scroll bar.
SM_CXSIZE	Width of bitmaps contained in the title bar.
SM_CYSIZE	Height of bitmaps contained in the title bar.
SM_CXHTHUMB	Width of scroll box (thumb) on horizontal scroll bar.
SM_CYVTHUMB	Height of scroll box on vertical scroll bar.
SM_DBCSENABLED	Nonzero if current version of Windows uses double-byte characters; otherwise, this value returns zero.
SM_DEBUG	Nonzero if the Windows version is a debugging version.
SM_MENUDROPALIGNMENT	Alignment of pop-up menus. If this value is zero, the left side of a pop-up menu is aligned with the left side of the corresponding menu-bar item. If this value is nonzero, the left side of a pop-up menu is aligned with the right side of the corresponding menu-bar item.
SM_MOUSEPRESENT	Nonzero if the mouse hardware is installed.
SM_PENWINDOWS	Handle of the Pen Windows dynamic-link library (DLL) if Pen Windows is installed.
SM_SWAPBUTTON	Nonzero if the left and right mouse buttons are swapped.

Returns
The return value specifies the requested system metric if the function is successful.

Comments
System metrics depend on the type of screen and may vary from screen to screen.

See Also
GetSysColor, **SystemParametersInfo**

Windows 3.1 changes

The following system-metric values have been added:

Value	Meaning
SM_CXDOUBLECLK	Width (in pixels) of the rectangle around the location of the first click in a double-click sequence. The second click must occur within this rectangle for the system to consider the two clicks a double click.
SM_CYDOUBLECLK	Height (in pixels) of the rectangle around the location of the first click in a double-click sequence. The second click must occur within this rectangle for the system to consider the two clicks a double click.
SM_CXICONSPACING	Width of the rectangles that the system uses to position tiled icons.
SM_CYICONSPACING	Height of the rectangles that the system uses to position tiled icons.
SM_DBCSENABLED	Nonzero if current version of Windows uses double-byte characters; otherwise, returns zero.
SM_MENUDROPALIGHMENT	Alignment of popup menus. If this value is 0, the left side of a popup menu is aligned with the left side of the corresponding menu-bar item. If this value is nonzero, the left side of a popup menu is aligned with the right side of the corresponding menu-bar item.
SM_PENWINDOWS	Handle of the Pen Windows dynamic-link library (DLL) if Pen Windows is installed.

SM_CXBORDER 5

Width of window frame that cannot be sized.

SM_CXBORDER 5

SM_CYBORDER 6

Height of window frame that cannot be sized.

SM_CYBORDER 6

SM_CYCAPTION 4

Height of window title. This is the title height plus the height of the window frame that cannot be sized (**SM_CYBORDER**).

SM_CYCAPTION 4

SM_CXCURSOR 13

Width of cursor.

SM_CXCURSOR 13

SM_CYCURSOR 14

Height of cursor.

SM_CYCURSOR 14

SM_CXDOUBLECLK 36

Width of the rectangle around the location of the first click in a double-click sequence. The second click must occur within this rectangle for the system to consider the two clicks a double-click.

SM_CXDOUBLECLK 36

SM_CYDOUBLECLK 37

Height of the rectangle around the location of the first click in a double-click sequence. The second click must occur within this rectangle for the system to consider the two clicks a double-click.

SM_CYDOUBLECLK 37

SM_CXDLGFRAME 7

Width of frame when window has the **WS_DLGFRAME** style.

SM_CXDLGFRAME 7

SM_CYDLGFRAME 8

Height of frame when window has the **WS_DLGFRAME** style.

SM_CYDLGFRAME 8

SM_CXFRAME 32

Width of window frame that can be sized.

SM_CXFRAME 32

SM_CYFRAME 33

Height of window frame that can be sized.

SM_CYFRAME 33

SM_CXFULLSCREEN 16

Width of window client area for a full-screen window.

SM_CXFULLSCREEN 16

SM_CYFULLSCREEN 17

Height of window client area for a full-screen window (equivalent to the height of the screen minus the height of the window title).

SM_CYFULLSCREEN 17

SM_CXICON 11

Width of icon.

SM_CXICON 11

SM_CYICON 12

Height of icon.

SM_CYICON 12

SM_CXICONSPACING 38

Width of rectangles the system uses to position tiled icons.

SM_CXICONSPACING 38

SM_CYICONSPACING 39

Height of rectangles the system uses to position tiled icons.

SM_CYICONSPACING 39

SM_CYKANJIWINDOW 18

Height of Kanji window.

SM_CYKANJIWINDOW 18

SM_CYMENU 15

Height of single-line menu bar. This is the menu height minus the height of the window frame that cannot be sized (**SM_CYBORDER**).

SM_CYMENU 15

SM_CXMIN 28

Minimum width of window.

SM_CXMIN 28

SM_CYMIN 29

Minimum height of window.

SM_CYMIN 29

SM_CXMINTRACK 34

Minimum tracking width of window.

SM_CXMINTRACK 34

SM_CYMINTRACK 35

Minimum tracking height of window.

SM_CYMINTRACK 35

SM_CXSCREEN 0

Width of screen.

SM_CXSCREEN 0

SM_CYSCREEN 1

Height of screen.

SM_CYSCREEN 1

SM_CXHSCROLL 21

Width of arrow bitmap on a horizontal scroll bar.

SM_CXHSCROLL 21

SM_CYHSCROLL 3

Height of arrow bitmap on a horizontal scroll bar.

SM_CYHSCROLL 3

SM_CXVSCROLL 2

Width of arrow bitmap on a vertical scroll bar.

SM_CXVSCROLL 2

SM_CYVSCROLL 20

Height of arrow bitmap on a vertical scroll bar.

SM_CYVSCROLL 20

SM_CXSIZE 30

Width of bitmaps contained in the title bar.

SM_CXSIZE 30

SM_CYSIZE 31

Height of bitmaps contained in the title bar.

SM_CYSIZE 31

SM_CXHTHUMB 10

Width of scroll box (thumb) on horizontal scroll bar.

SM_CXHTHUMB 10

SM_CYVTHUMB 9

Height of scroll box on vertical scroll bar.

SM_CYVTHUMB 9

SM_DBCSENABLED 42

Nonzero if current version of Windows uses double-byte characters; otherwise, this value returns zero.

SM_DBCSENABLED 42

SM_DEBUG 22

Nonzero if the Windows version is a debugging version.

SM_DEBUG 22

SM_MENUDROPALIGNMENT 40

Alignment of pop-up menus. If this value is zero, the left side of a pop-up menu is aligned with the left side of the corresponding menu-bar item. If this value is nonzero, the left side of a pop-up menu is aligned with the right side of the corresponding menu-bar item.

SM_MENUDROPALIGNMENT 40

SM_MOUSEPRESENT 19

Nonzero if the mouse hardware is installed.

SM_MOUSEPRESENT 19

SM_PENWINDOWS 41

Handle of the Pen Windows dynamic-link library (DLL) if Pen Windows is installed.

SM_PENWINDOWS 41

SM_SWAPBUTTON 23

Nonzero if the left and right mouse buttons are swapped.

SM_SWAPBUTTON 23

GetTabbedTextExtent (3.0)

DWORD GetTabbedTextExtent(*hdc, lpszString, cChars, cTabs, lpnTabs***)**

HDC *hdc;* /* handle of device context */
LPCSTR *lpszString;* /* address of string */
int *cChars;* /* number of characters in string */
int *cTabs;* /* number of tab positions */
int FAR* *lpnTabs;* /* address of array of tab positions */

The **GetTabbedTextExtent** function computes the width and height of a character string. If the string contains one or more tab characters, the width of the string is based upon the specified tab stops. **GetTabbedTextExtent** uses the currently selected font to compute the dimensions of the string.

Parameter	Description
hdc	Identifies the device context.
lpszString	Points to a character string.
cChars	Specifies the number of characters in the text string.
cTabs	Specifies the number of tab-stop positions in the array pointed to by the *lpnTabs* parameter.
lpnTabs	Points to an array containing the tab-stop positions, in device units. The tab stops must be sorted in increasing order; the smallest x-value should be the first item in the array.

Returns
The low-order word of the return value contains the string width, in logical units, if the function is successful; the high-order word contains the string height.

Comments
The current clipping region does not affect the width and height returned by the **GetTabbedTextExtent** function.

Since some devices do not place characters in regular cell arrays (that is, they kern the characters), the sum of the extents of the characters in a string may not be equal to the extent of the string.

If the *cTabs* parameter is zero and the *lpnTabs* parameter is NULL, tabs are expanded to eight times the average character width. If *cTabs* is 1, the tab stops are separated by the distance specified by the first value in the array to which *lpnTabs* points.

Example
The following example uses the **LOWORD** and **HIWORD** macros to retrieve the width and height of the string from the value returned by the **GetTabbedTextExtent** function:

```
LPSTR lpszTabbedText = "Column 1\tColumn 2\tTest of TabbedTextOut";
int aTabs[2] = { 150, 300 };
DWORD dwTabExtent;
WORD wStringWidth, wStringHeight;

dwTabExtent = GetTabbedTextExtent(hdc, /* handle of device context */
    lpszTabbedText,                    /* address of text          */
    lstrlen(lpszTabbedText),           /* number of characters     */
    sizeof(aTabs) / sizeof(int),       /* number of tabs in array  */
    aTabs);                            /* array for tab positions  */

wStringWidth = LOWORD(dwTabExtent);  /* gets width of string    */
wStringHeight = HIWORD(dwTabExtent); /* gets height of string   */
```

See Also
GetTextExtent, **TabbedTextOut**, **HIWORD**, **LOWORD**

GetTickCount (2.x)

DWORD GetTickCount(void)

The **GetTickCount** function retrieves the number of milliseconds that have elapsed since Windows was started.

Returns

The return value specifies the number of milliseconds that have elapsed since Windows was started.

Comments

The internal timer will wrap around to zero if Windows is run continuously for approximately 49 days.

The **GetTickCount** function is identical to the **GetCurrentTime** function. Applications should use **GetTickCount**, because its name matches more closely with what the function does.

Example

The following example calls **GetTickCount** to determine the number of milliseconds that Windows has been running, converts the value into seconds, and displays the value in a message box:

```
char szBuf[255];

sprintf(szBuf, "Windows has been running for %lu seconds\n",
    GetTickCount() / 1000L);
MessageBox(hwnd, szBuf, "", MB_OK);
```

GetTimerResolution (3.1)

DWORD GetTimerResolution(void)

The **GetTimerResolution** function retrieves the number of microseconds per timer tick.

Returns
The return value is the number of microseconds per timer tick.

See Also
GetTickCount, **SetTimer**

GetTopWindow (2.x)

HWND GetTopWindow(*hwnd***)**

HWND *hwnd;* /* handle of parent window */

The **GetTopWindow** function retrieves the handle of the top-level child window that belongs to the given parent window. If the parent window has no child windows, this function returns NULL.

Parameter	Description
hwnd	Identifies the parent window. If this parameter is NULL, the function returns the first child window of the desktop window.

Returns

The return value is the handle of the top-level child window in a parent window's linked list of child windows. The return value is NULL if no child windows exist.

See Also

EnumWindows, **GetParent**, **GetWindow**, **IsChild**

GetUpdateRect (2.x)

BOOL GetUpdateRect(*hwnd, lprc, fErase***)**

```
HWND hwnd;          /* handle of window                          */
RECT FAR* lprc;     /* address of structure for update rectangle */
BOOL fErase;        /* erase flag                                */
```

The **GetUpdateRect** function retrieves the coordinates of the smallest rectangle that completely encloses the update region of the given window. If the window was created with the **CS_OWNDC** style and the mapping mode is not MM_TEXT, **GetUpdateRect** gives the rectangle in logical coordinates; otherwise, **GetUpdateRect** gives the rectangle in client coordinates. If there is no update region, **GetUpdateRect** makes the rectangle empty (sets all coordinates to zero).

Parameter	Description
hwnd	Identifies the window whose update region is to be retrieved.
lprc	Points to the **RECT** structure that receives the client coordinates of the enclosing rectangle. An application can set this parameter to NULL to determine whether an update region exists for the window. If this parameter is NULL, the **GetUpdateRect** function returns nonzero if an update region exists, and zero if one does not. This provides a simple and efficient means of determining whether a **WM_PAINT** message resulted from an invalid area.
fErase	Specifies whether to erase the background in the update region. If this parameter is TRUE and the update region is not empty, the background is erased. To erase the background, the **GetUpdateRect** function sends a **WM_ERASEBKGND** message to the given window.

Returns

The return value is nonzero if the update region is not empty. Otherwise, it is zero.

Comments

The update rectangle retrieved by the **BeginPaint** function is identical to that retrieved by the **GetUpdateRect** function.

BeginPaint automatically validates the update region, so any call to **GetUpdateRect** made immediately after the call to **BeginPaint** retrieves an empty update region.

See Also

BeginPaint, **GetUpdateRgn**, **InvalidateRect**, **UpdateWindow**, **ValidateRect**, **WM_ERASEBKGND**, **RECT**

Windows 3.1 changes

An application can set the *lprc* parameter to NULL to determine whether an update region exists for the window. If this parameter is NULL, **GetUpdateRect** returns nonzero if an update region exists, and zero if one does not. This provides a simple and efficient means of determining whether a **WM_PAINT** message resulted from an invalid area.

GetUpdateRgn (2.x)

int GetUpdateRgn(*hwnd, hrgn, fErase***)**

HWND *hwnd;* /* handle of window */
HRGN *hrgn;* /* handle of region */
BOOL *fErase;* /* erase flag */

The **GetUpdateRgn** function retrieves the update region of a window. The coordinates of the update region are relative to the upper-left corner of the window (that is, they are client coordinates).

Parameter	Description
hwnd	Identifies the window whose update region is to be retrieved.
hrgn	Identifies the update region.
fErase	Specifies whether the window background should be erased and whether nonclient areas of child windows should be drawn. If this parameter is FALSE, no drawing is done.

Returns

The return value is SIMPLEREGION (region has no overlapping borders), COMPLEXREGION (region has overlapping borders), or NULLREGION (region is empty), if the function is successful. Otherwise, the return value is ERROR.

Comments

The **BeginPaint** function automatically validates the update region, so any call to the **GetUpdateRgn** function made immediately after the call to **BeginPaint** retrieves an empty update region.

See Also

BeginPaint, **GetUpdateRect**, **InvalidateRgn**, **UpdateWindow**, **ValidateRgn**

GetWindow (2.x)

HWND GetWindow(*hwnd, fuRel***)**

```
HWND hwnd;      /* handle of original window */
UINT fuRel;     /* relationship flag         */
```

The **GetWindow** function retrieves the handle of a window that has the specified relationship to the given window. The function searches the system's list of top-level windows, their associated child windows, the child windows of any child windows, and any siblings of the owner of a window.

Parameter	Description
hwnd	Identifies the original window.
fuRel	Specifies the relationship between the original window and the returned window. This parameter can be one of the following values:

Value	Meaning
GW_CHILD	Identifies the window's first child window.
GW_HWNDFIRST	Returns the first sibling window for a child window; otherwise, it returns the first top-level window in the list.
GW_HWNDLAST	Returns the last sibling window for a child window; otherwise, it returns the last top-level window in the list.
GW_HWNDNEXT	Returns the sibling window that follows the given window in the window manager's list.
GW_HWNDPREV	Returns the previous sibling window in the window manager's list.
GW_OWNER	Identifies the window's owner.

Returns

The return value is the handle of the window if the function is successful. Otherwise, it is NULL, indicating either the end of the system's list or an invalid *fuRel* parameter.

See Also

EnumWindows, **FindWindow**

GW_CHILD 5

Identifies the window's first child window.

GW_CHILD 5

GW_HWNDFIRST 0

Returns the first sibling window for a child window; otherwise, it returns the first top-level window in the list.

GW_HWNDFIRST 0

GW_HWNDLAST 1

Returns the last sibling window for a child window; otherwise, it returns the last top-level window in the list.

GW_HWNDLAST 1

GW_HWNDNEXT 2

Returns the sibling window that follows the given window in the window manager's list.

GW_HWNDNEXT 2

GW_HWNDPREV 3

Returns the previous sibling window in the window manager's list.

GW_HWNDPREV 3

GW_OWNER 4

Identifies the window's owner.

GW_OWNER 4

GetWindowDC (2.x)

HDC GetWindowDC(*hwnd***)**

HWND *hwnd;* /* handle of window */

The **GetWindowDC** function retrieves a device context for the entire window, including title bar, menus, and scroll bars. A window device context permits painting anywhere in the window, because the origin of the context is the upper-left corner of the window instead of the client area.

GetWindowDC assigns default attributes to the device context each time it retrieves the context. Previous attributes are lost.

Parameter	Description
hwnd	Identifies the window whose device context is to be retrieved.

Returns

The return value is the handle of the device context for the given window, if the function is successful. Otherwise, it is NULL, indicating an error or an invalid *hwnd* parameter.

Comments

The **GetWindowDC** function is intended to be used for special painting effects within a window's nonclient area. Painting in nonclient areas of any window is not recommended.

The **GetSystemMetrics** function can be used to retrieve the dimensions of various parts of the nonclient area, such as the title bar, menu, and scroll bars.

After painting is complete, the **ReleaseDC** function must be called to release the device context. Failure to release a window device context will have serious effects on painting requested by applications.

See Also

BeginPaint, **GetDC**, **GetSystemMetrics**, **ReleaseDC**

GetWindowLong (2.x)

LONG GetWindowLong(*hwnd, nOffset***)**

```
HWND hwnd;      /* handle of window          */
int nOffset;    /* offset of value to retrieve */
```

The **GetWindowLong** function retrieves a long value at the specified offset into the extra window memory of the given window. Extra window memory is reserved by specifying a nonzero value in the **cbWndExtra** member of the **WNDCLASS** structure used with the **RegisterClass** function.

Parameter	Description
hwnd	Identifies the window.
nOffset	Specifies the zero-based byte offset of the value to be retrieved. Valid values are in the range zero through the number of bytes of extra window memory, minus four (for example, if 12 or more bytes of extra memory was specified, a value of 8 would be an index to the third long integer), or one of the following values:

Value	Meaning
GWL_EXSTYLE	Extended window style
GWL_STYLE	Window style
GWL_WNDPROC	Long pointer to the window procedure

The following values are also available when the *hwnd* parameter identifies a dialog box:

Value	Meaning
DWL_DLGPROC	Specifies the address of the dialog box procedure.
DWL_MSGRESULT	Specifies the return value of a message processed in the dialog box procedure.
DWL_USER	Specifies extra information that is private to the application, such as handles or pointers.

Returns

The return value specifies information about the given window if the function is successful.

Comments

To access any extra 4-byte values allocated when the window-class structure was created, use a positive byte offset as the index specified by the *nOffset* parameter, starting at 0 for the first 4-byte value in the extra space, 4 for the next 4-byte value, and so on.

See Also

GetWindowWord, **SetWindowLong**, **SetWindowWord**

GWL_EXSTYLE (-20)

Extended window style

GWL_EXSTYLE (-20)

GWL_STYLE (-16)

Window style

GWL_STYLE (-16)

GWL_WNDPROC (-4)

Long pointer to the window procedure

GWL_WNDPROC (-4)

DWL_DLGPROC 4

Specifies the address of the dialog box procedure.

DWL_MSGRESULT 0

Specifies the return value of a message processed in the dialog box procedure.

DWL_MSGRESULT 0

DWL_USER 8

Specifies extra information that is private to the application, such as handles or pointers.

DWL_USER 8

GetWindowPlacement (3.1)

BOOL GetWindowPlacement(*hwnd, lpwndpl***)**

```
HWND hwnd;                          /* handle of window                    */
WINDOWPLACEMENT FAR* lpwndpl;       /* address of structure for position data */
```

The **GetWindowPlacement** function retrieves the show state and the normal (restored), minimized, and maximized positions of a window.

Parameter	Description
hwnd	Identifies the window.
lpwndpl	Points to the **WINDOWPLACEMENT** structure that receives the show state and position information.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **flags** member of the **WINDOWPLACEMENT** structure retrieved by this function is always zero. If the window identified by the *hwnd* parameter is maximized, the **showCmd** member of **WINDOWPLACEMENT** is SW_SHOWMAXIMIZED; if the window is minimized, it is SW_SHOWMINIMIZED; and it is SW_SHOWNORMAL otherwise.

See Also

SetWindowPlacement, **WINDOWPLACEMENT**

GetWindowRect (2.x)

void GetWindowRect(*hwnd, lprc***)**

HWND *hwnd;* /* handle of window */
RECT FAR* *lprc;* /* address of structure for window coordinates */

The **GetWindowRect** function retrieves the dimensions of the bounding rectangle of a given window. The dimensions are given in screen coordinates, relative to the upper-left corner of the display screen, and include the title bar, border, and scroll bars, if present.

Parameter	Description
hwnd	Identifies the window.
lprc	Points to a **RECT** structure that receives the screen coordinates of the upper-left and lower-right corners of the window.

Returns

This function does not return a value.

Example

The following example calls the **GetWindowRect** function to retrieve the dimensions of the desktop window, and uses the dimensions to create a window that fills the right third of the desktop window:

```
RECT rc;
WORD wWidth;

GetWindowRect(GetDesktopWindow(), &rc);

/* Set the width to be 1/3 of the desktop window's width. */

wWidth = (rc.right - rc.left) / 3;

/* Create a main window for this application instance. */

hwndFrame = CreateWindow("MyClass", "My Title", WS_OVERLAPPEDWINDOW,
    rc.right - wWidth,      /* horizontal position */
    0,                      /* vertical position   */
    wWidth,                 /* width               */
    rc.bottom,              /* height              */
    (HWND) NULL, (HMENU) NULL, hinst, (LPSTR) NULL);
```

See Also

GetClientRect, **MoveWindow**, **SetWindowPos**, **RECT**

GetWindowTask (2.x)

HTASK GetWindowTask(*hwnd***)**

HWND *hwnd;* /* handle of window */

The **GetWindowTask** function searches for the handle of a task associated with a window. A task is any program that executes as an independent unit. All applications are executed as tasks. Each instance of an application is a task.

Parameter	Description
hwnd	Identifies the window for which to retrieve a task handle.

Returns

The return value is the handle of the task associated with a particular window, if the function is successful. Otherwise, it is NULL.

See Also

EnumTaskWindows, **GetCurrentTask**

GetWindowText (2.x)

int GetWindowText(*hwnd, lpsz, cbMax***)**

```
HWND hwnd;      /* handle of window                 */
LPSTR lpsz;     /* address of buffer for text       */
int cbMax;      /* maximum number of bytes to copy */
```

The **GetWindowText** function copies text of the given window's title bar (if it has one) into a buffer. If the given window is a control, the text within the control is copied.

Parameter	Description
hwnd	Identifies the window or control containing the title bar or text.
lpsz	Points to a buffer that will receive the title bar or text.
cbMax	Specifies the maximum number of characters to copy to the buffer. The title bar or text is truncated if it is longer than the number of characters specified in *cbMax.*

Returns

The return value specifies the length, in bytes, of the copied string, not including the terminating null character. It is zero if the window has no title bar, the title bar is empty, or the *hwnd* parameter is invalid.

Comments

This function causes a **WM_GETTEXT** message to be sent to the given window or control.

See Also

GetWindowTextLength, **WM_GETTEXT**

GetWindowTextLength (2.x)

int GetWindowTextLength(*hwnd***)**

HWND *hwnd;* /* handle of window with text */

The **GetWindowTextLength** function retrieves the length, in bytes, of the text in the given window's title bar. If the window is a control, the length of the text within the control is retrieved.

Parameter	Description
hwnd	Identifies the window or control.

Returns

The return value specifies the text length, in bytes, not including any null terminating character, if the function is successful. Otherwise, it is zero.

Comments

This function causes the **WM_GETTEXTLENGTH** message to be sent to the given window or control.

See Also

GetWindowText, **WM_GETTEXT**, **WM_GETTEXTLENGTH**

GetWindowWord (2.x)

WORD GetWindowWord(*hwnd, nOffset***)**

```
HWND hwnd;      /* handle of window          */
int nOffset;    /* offset of value to retrieve */
```

The **GetWindowWord** function retrieves a word value at the specified offset into the extra window memory of the given window. Extra window memory is reserved by specifying a nonzero value in the **cbWndExtra** member of the **WNDCLASS** structure used with the **RegisterClass** function.

Parameter	Description
hwnd	Identifies the window.
nOffset	Specifies the zero-based byte offset of the value to be retrieved. Valid values are in the range zero through the number of bytes of extra window memory, minus two (for example, if 10 or more bytes of extra memory was specified, a value of 8 would be an index to the fifth integer), or one of the following values:

Value	Meaning
GWW_HINSTANCE	Specifies the instance handle of the module that owns the window.
GWW_HWNDPARENT	Specifies the handle of the parent window, if any. The **SetParent** function changes the parent window of a child window. An application should not call the **SetWindowWord** function to change the parent of a child window.
GWW_ID	Specifies the identifier of the child window.

Returns

The return value specifies information about the given window if the function is successful.

Comments

To access any extra two-byte values allocated when the window-class structure was created, use a positive byte offset as the index specified by the *nOffset* parameter, starting at 0 for the first two-byte value in the extra space, 2 for the next two-byte value, and so on.

See Also

GetWindowLong, **SetParent**, **SetWindowLong**, **SetWindowWord**

GWW_HINSTANCE (-6)

Specifies the instance handle of the module that owns the window.

GWW_HINSTANCE (-6)

GWW_HWNDPARENT (-8)

Specifies the handle of the parent window, if any. The **SetParent** function changes the parent window of a child window. An application should not call the **SetWindowWord** function to change the parent of a child window.

GWW_HWNDPARENT (-8)

GWW_ID (-12)

Specifies the identifier of the child window.

GWW_ID (-12)

GlobalAddAtom (2.x)

ATOM GlobalAddAtom(*lpszString***)**

LPCSTR *lpszString;* /* address of string to add */

The **GlobalAddAtom** function adds a string to the system atom table and returns a unique value identifying the string.

Parameter	Description
lpszString	Points to the null-terminated string to be added. The case of the first string added is preserved and returned by the **GlobalGetAtomName** function. Strings that differ only in case are considered identical.

Returns

The return value identifies the string if the function is successful. Otherwise, it is zero.

Comments

If the string exists already in the system atom table, the atom for the existing string will be returned and the atom's reference count will be incremented (increased by one). The string associated with the atom will not be deleted from memory until its reference count is zero. For more information, see the description of the **GlobalDeleteAtom** function.

Global atoms are not deleted automatically when the application terminates. For every call to the **GlobalAddAtom** function, there must be a corresponding call to the **GlobalDeleteAtom** function.

Example

The following example adds the string "This is a global atom" to the system atom table:

```
ATOM atom;
char szMsg[80];

atom = GlobalAddAtom("This is a global atom");

if (atom == 0)
    MessageBox(hwnd, "GlobalAddAtom failed", "",
          MB_ICONSTOP);
else {
    wsprintf(szMsg, "GlobalAddAtom returned %u", atom);
    MessageBox(hwnd, szMsg, "", MB_OK);
}
```

See Also

AddAtom, **GlobalDeleteAtom**, **GlobalGetAtomName**

GlobalDeleteAtom (2.x)

ATOM GlobalDeleteAtom(*atm***)**

ATOM *atm;* /* atom to delete */

The **GlobalDeleteAtom** function decrements (decreases by one) the reference count of a global atom. If the atom's reference count reaches zero, the string associated with the atom is removed from the system atom table.

Parameter	Description
atm	Identifies the atom to be deleted.

Returns

The return value is zero if the function is successful. The return value is equal to the *atm* parameter if the function failed to decrement the reference count for the specified atom.

Comments

An atom's reference count specifies the number of times the string has been added to the atom table. The **GlobalAddAtom** function increments (increases by one) the reference count each time it is called with a string that already exists in the system atom table.

The only way to ensure that an atom has been deleted from the atom table is to call this function repeatedly until it fails. When the count is decremented to zero, the next **GlobalFindAtom** or **GlobalDeleteAtom** function call will fail.

Example

The following example repeatedly calls the **GlobalDeleteAtom** function to decrement the reference count for the atom until the atom is deleted and the **GlobalDeleteAtom** function does not return zero:

```
int cRef;
ATOM atom;
char szMsg[80];

for (cRef = 0; ((atom = GlobalFindAtom("This is a global atom")) != 0);
        cRef++)
    GlobalDeleteAtom(atom);

wsprintf(szMsg, "reference count was %d", cRef);
MessageBox(hwnd, szMsg, "GlobalDeleteAtom", MB_OK);
```

See Also

DeleteAtom, **GlobalAddAtom**, **GlobalFindAtom**

GlobalFindAtom (2.x)

ATOM GlobalFindAtom(*lpszString***)**

LPCSTR *lpszString;* /* address of string to find */

The **GlobalFindAtom** function searches the system atom table for the specified character string and retrieves the global atom associated with that string. (A global atom is an atom that is available to all Windows applications.)

Parameter	Description
lpszString	Points to the null-terminated character string to search for.

Returns

The return value identifies the global atom associated with the given string, if the function is successful. Otherwise, if the string is not in the table, the return value is zero.

Example

The following example repeatedly calls the **GlobalFindAtom** function to retrieve the atom associated with the string "This is a global atom". The example uses the **GlobalDeleteAtom** function to decrement (decrease by one) the reference count for the atom until the atom is deleted and **GlobalFindAtom** returns zero.

```
int cRef;
ATOM atom;
char szMsg[80];

for (cRef = 0; ((atom = GlobalFindAtom("This is a global atom")) != 0);
        cRef++)
    GlobalDeleteAtom(atom);

wsprintf(szMsg, "reference count was %d", cRef);
MessageBox(hwnd, szMsg, "GlobalDeleteAtom", MB_OK);
```

See Also

FindAtom, **GlobalAddAtom**, **GlobalDeleteAtom**

GlobalGetAtomName (2.x)

UINT GlobalGetAtomName(*atom, lpszBuffer, cbBuffer***)**

ATOM *atom;* /* atom identifier */
LPSTR *lpszBuffer;* /* address of buffer for atom string */
int *cbBuffer;* /* size of buffer */

The **GlobalGetAtomName** function retrieves a copy of the character string associated with the given global atom. (A global atom is an atom that is available to all Windows applications.)

Parameter	Description
atom	Identifies the global atom associated with the character string to be retrieved.
lpszBuffer	Points to the buffer for the character string.
cbBuffer	Specifies the size, in bytes, of the buffer.

Returns
The return value specifies the number of bytes copied to the buffer, not including the null-terminating character, if the function is successful.

Example
The following example uses the **GlobalGetAtomName** function to retrieve the character string associated with a global atom:

```
char szBuf[80];

GlobalGetAtomName(atGlobal, szBuf, sizeof(szBuf));

MessageBox(hwnd, szBuf, "GlobalGetAtomName", MB_OK);
```

See Also
GetAtomName

GrayString (2.x)

BOOL GrayString(*hdc, hbr, gsprc, lParam, cch, x, y, cx, cy***)**

```
HDC hdc;                    /* handle of device context              */
HBRUSH hbr;                 /* handle of brush for graying           */
GRAYSTRINGPROC gsprc;       /* address of callback function          */
LPARAM lParam;              /* address of application-defined data   */
int cch;                    /* number of characters to output        */
int x;                      /* horizontal position                   */
int y;                      /* vertical position                     */
int cx;                     /* width                                 */
int cy;                     /* height                                */
```

The **GrayString** function draws gray (dim) text at the given location by writing the text in a memory bitmap, graying the bitmap, and then copying the bitmap to the display. The function grays the text regardless of the selected brush and background. **GrayString** uses the font currently selected for the given device context.

Parameter	Description
hdc	Identifies the device context.
hbr	Identifies the brush to be used for graying.
gsprc	Specifies the procedure-instance address of the application-supplied callback function that will draw the string. The address must be created by the **MakeProcInstance** function. For more information about the callback function, see the description of the **GrayStringProc** callback function. If this parameter is NULL, the system uses the **TextOut** function to draw the string, and the *lParam* parameter is assumed to be a long pointer to the character string to be output.
lParam	Points to data to be passed to the output function. If the *gsprc* parameter is NULL, the *lParam* parameter must point to the string to be output.
cch	Specifies the number of characters to be output. If this parameter is zero, the **GrayString** function calculates the length of the string (assuming that the *lParam* parameter is a pointer to the string). If *cch* is -1 and the function pointed to by the *gsprc* parameter returns zero, the image is shown but not grayed.
x	Specifies the logical x-coordinate of the starting position of the rectangle that encloses the string.
y	Specifies the logical y-coordinate of the starting position of the rectangle that encloses the string.
cx	Specifies the width, in logical units, of the rectangle that encloses the string. If this parameter is zero, the **GrayString** function calculates the width of the area, assuming the *lParam* parameter is a pointer to the string.
cy	Specifies the height, in logical units, of the rectangle that encloses the string. If this parameter is zero, the **GrayString** function calculates the height of the area, assuming the *lParam* parameter is a pointer to the string.

Returns

The return value is nonzero if the function is successful. It is zero if either the **TextOut** function or the application-supplied output function returns zero, or if there is insufficient memory to create a memory bitmap for graying.

Comments

An application must select the MM_TEXT mapping mode before using this function.

If **TextOut** cannot handle the string to be output (for example, if the string is stored as a bitmap), the

gsprc parameter must point to a callback function that will draw the string.

An application can draw grayed strings on devices that support a solid gray color without calling the **GrayString** function. The system color **COLOR_GRAYTEXT** is the solid-gray system color used to draw disabled text. The application can call the **GetSysColor** function to retrieve the color value of COLOR_GRAYTEXT. If the color is other than zero (black), the application can call the **SetTextColor** function to set the text color to the color value and then draw the string directly. If the retrieved color is black, the application must call **GrayString** to gray the text.

See Also
GetSysColor, **MakeProcInstance**, **SetTextColor**, **TextOut**

hardware_event (3.1)

```
extrn hardware_event :far

mov   ax, Msg          ; message
mov   cx, ParamL       ; low-order word of lParam of the message
mov   dx, ParamH       ; high-order word of lParam of the message
mov   si, hwnd         ; handle of the destination window
mov   di, wParam       ; wParam of the message
cCall hardware_event
```

The **hardware_event** function places a hardware-related message into the system message queue. This function allows a driver for a non-standard hardware device to place a message into the queue.

Parameter	Description
Msg	Specifies the message to place in the system message queue.
ParamL	Specifies the low-order word of the *lParam* parameter of the message.
lParamH	Specifies the high-order word of the *lParam* parameter of the message.
hwnd	Identifies the window to which the message is directed. This parameter also becomes the low-order word of the *dwExtraInfo* parameter associated with the message. An application can determine the value of this parameter by calling the **GetMessageExtraInfo** function.
wParam	Specifies the *wParam* parameter of the message.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

An application should not use this function to place keyboard or mouse messages into the system message queue.

An application may only call the **hardware_event** function from an assembly language routine. The application must declare the function as follows:

```
extrn hardware_event :far
```

If the application includes CMACROS.INC, the application can declare the function as follows:

```
extrnFP hardware_event.
```

See Also

GetMessageExtraInfo, **MOUSEHOOKSTRUCT**

HideCaret (2.x)

void HideCaret(*hwnd***)**

HWND *hwnd;* /* handle of window with caret*/

The **HideCaret** function hides the caret by removing it from the screen. Although the caret is no longer visible, it can be displayed again by using the **ShowCaret** function. Hiding the caret does not destroy its current shape.

Parameter	Description
hwnd	Identifies the window that owns the caret. This parameter can be set to NULL to specify indirectly the window in the current task that owns the caret.

Returns
This function does not return a value.

Comments
The **HideCaret** function hides the caret only if the given window owns the caret. If the *hwnd* parameter is NULL, the function hides the caret only if a window in the current task owns the caret.

Hiding is cumulative. If **HideCaret** has been called five times in a row, **ShowCaret** must be called five times before the caret will be shown.

See Also
CreateCaret, **ShowCaret**

HiliteMenuItem (2.x)

BOOL HiliteMenuItem(*hwnd, hmenu, idHiliteItem, fuHilite***)**

```
HWND hwnd;          /* handle of window with menu */
HMENU hmenu;        /* handle of menu             */
UINT idHiliteItem;  /* menu-item identifier       */
UINT fuHilite;      /* highlight flags            */
```

The **HiliteMenuItem** function highlights or removes the highlighting from a top-level (menu-bar) menu item.

Parameter	Description
hwnd	Identifies the window that contains the menu.
hmenu	Identifies the top-level menu that contains the item to be highlighted.
idHiliteItem	Specifies the menu item to be highlighted, as determined by the *fuHilite* parameter.
fuHilite	Specifies whether the menu item is highlighted or the highlight is removed. It can be a combination of the MF_HILITE or MF_UNHILITE value with the **MF_BYCOMMAND** or **MF_BYPOSITION** value. These values have the following meanings:

Value	Meaning
MF_BYCOMMAND	Menu-item identifier is specified by the *idHiliteItem* parameter (the default interpretation).
MF_BYPOSITION	Zero-based position of the menu item is specified by the *idHiliteItem* parameter.
MF_HILITE	Menu item is highlighted. If this value is not given, highlighting is removed from the menu item.
MF_UNHILITE	Highlighting is removed from the menu item.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The MF_HILITE and MF_UNHILITE flags can be used only with the **HiliteMenuItem** function; they cannot be used with the **ModifyMenu** function.

See Also

CheckMenuItem, **EnableMenuItem**, **ModifyMenu**

InflateRect (2.x)

void InflateRect(*lprc, xAmt, yAmt***)**

```
RECT FAR* lprc;      /* address of rectangle                 */
int xAmt;            /* amount to increase or decrease width */
int yAmt;            /* amount to increase or decrease height */
```

The **InflateRect** function increases or decreases the width and height of a rectangle. The **InflateRect** function adds *xAmt* units to the left and right ends of the rectangle and adds *yAmt* units to the top and bottom. The *xAmt* and *yAmt* parameters are signed values; positive values increase the width and height, and negative values decrease them.

Parameter	Description
lprc	Points to the **RECT** structure that increases or decreases in size.
xAmt	Specifies the amount to increase or decrease the rectangle width. It must be negative to decrease the width.
yAmt	Specifies the amount to increase or decrease the rectangle height. It must be negative to decrease the height.

Returns

This function does not return a value.

Comments

The width and height of a rectangle must not be greater than 32,767 units or less than -32,768 units.

See Also

IntersectRect, **OffsetRect**, **UnionRect**, **RECT**

InSendMessage (2.x)

BOOL InSendMessage(void)

The **InSendMessage** function specifies whether the current window procedure is processing a message that was sent from another task by a call to the **SendMessage** function.

Returns

The return value is nonzero if the window procedure is processing a message sent to it from another task by the **SendMessage** function. Otherwise, the return value is zero.

Comments

Applications use the **InSendMessage** function to determine how to handle errors that occur when an inactive window processes messages. For example, if the active window uses the **SendMessage** function to send a request for information to another window, the other window cannot become active until it returns control from the **SendMessage** call. The only method an inactive window has to inform the user of an error is to create a message box.

See Also

PostAppMessage, **SendMessage**

InsertMenu (3.0)

BOOL InsertMenu(*hmenu, idItem, fuFlags, idNewItem, lpNewItem***)**

```
HMENU hmenu;        /* handle of menu                          */
UINT idItem;        /* menu item that new menu item is to precede*/
UINT fuFlags;       /* menu flags                              */
UINT idNewItem;     /* item identifier or pop-up menu handle   */
LPCSTR lpNewItem;   /* item content                            */
```

The **InsertMenu** function inserts a new menu item into a menu, moving other items down the menu. The function also sets the state of the menu item.

Parameter	Description
hmenu	Identifies the menu to be changed.
idItem	Specifies the menu item before which the new menu item is to be inserted, as determined by the *fuFlags* parameter.
fuFlags	Specifies how the *idItem* parameter is interpreted and information about the state of the new menu item when it is added to the menu. This parameter consists of a combination of one of the following values and the values listed in the Comments section.

Value	Meaning
MF_BYCOMMAND	The *idItem* parameter specifies the menu-item identifier.
MF_BYPOSITION	The *idItem* parameter specifies the zero-based position of the menu item. If *idItem* is -1, the new menu item is appended to the end of the menu.

idNewItem	Specifies either the identifier of the new menu item or, if *fuFlags* is set to **MF_POPUP**, the menu handle of the pop-up menu.
lpNewItem	Specifies the contents of the new menu item. If *fuFlags* is set to **MF_STRING** (the default value), this parameter points to a null-terminated string. If *fuFlags* is set to **MF_BITMAP** instead, *lpNewItem* contains a bitmap handle in its low-order word. If *fuFlags* is set to **MF_OWNERDRAW**, *lpNewItem* specifies an application-defined 32-bit value, which the application can use to maintain additional data associated with the menu item. This 32-bit value is available to the application in the **itemData** member of the structure pointed to by the *lParam* parameter of the **WM_MEASUREITEM** and **WM_DRAWITEM** messages. These messages are sent when the menu item is initially displayed or is changed.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

If the active multiple document interface (MDI) child window is maximized and an application inserts a pop-up menu into the MDI application's menu by calling this function and specifying the **MF_BYPOSITION** flag, the menu is inserted one position farther left than expected. This occurs because the System menu of the active MDI child window is inserted into the first position of the MDI frame window's menu bar. To avoid this behavior, the application must add 1 to the position value that would otherwise be used. An application can use the **WM_MDIGETACTIVE** message to determine whether the currently active child window is maximized.

Whenever a menu changes (whether or not the menu is in a window that is displayed), the application should call the **DrawMenuBar** function.

Each of the following groups lists flags that should not be used together:

- **MF_BYCOMMAND** and **MF_BYPOSITION**
- **MF_DISABLED**, **MF_ENABLED**, and **MF_GRAYED**
- **MF_BITMAP**, **MF_STRING**, **MF_OWNERDRAW**, and **MF_SEPARATOR**

- **MF_MENUBARBREAK** and **MF_MENUBREAK**
- **MF_CHECKED** and **MF_UNCHECKED**

The following list describes the flags that may be set in the *fuFlags* parameter:

Value	Meaning
MF_BITMAP	Uses a bitmap as the item. The low-order word of the *lpNewItem* parameter contains the handle of the bitmap.
MF_BYCOMMAND	Specifies that the *idItem* parameter gives the menu-item identifier (default).
MF_BYPOSITION	Specifies that the *idItem* parameter gives the position of the menu item rather than the menu-item identifier.
MF_CHECKED	Places a check mark next to (selects) the menu item. If the application has supplied check-mark bitmaps (see the **SetMenuItemBitmaps** function), setting this flag displays the check-mark bitmap next to the menu item.
MF_DISABLED	Disables the menu item so that it cannot be selected, but does not gray (dim) it.
MF_ENABLED	Enables the menu item so that it can be selected, and restores it from its grayed state.
MF_GRAYED	Disables the menu item so that it cannot be selected, and grays it.
MF_MENUBARBREAK	Same as **MF_MENUBREAK** except, for pop-up menus, separates the new column from the old column by using a vertical line.
MF_MENUBREAK	Places the menu item on a new line for static menu-bar items. For pop-up menus, places the menu item in a new column, with no dividing line between the columns.
MF_OWNERDRAW	Specifies that the item is an owner-drawn item. The window that owns the menu receives a **WM_MEASUREITEM** message (when the menu is displayed for the first time) to retrieve the height and width of the menu item. The **WM_DRAWITEM** message is then sent to the owner whenever the owner must update the visual appearance of the menu item. This option is not valid for a top-level menu item.
MF_POPUP	Specifies that the menu item has a pop-up menu associated with it. The *idNewItem* parameter specifies a handle of a pop-up menu to be associated with the item. Use the **MF_OWNERDRAW** flag to add either a top-level pop-up menu or a hierarchical pop-up menu to a pop-up menu item.
MF_SEPARATOR	Draws a horizontal dividing line. You can use this flag in a pop-up menu. This line cannot be grayed, disabled, or highlighted. Windows ignores the *lpNewItem* and *idNewItem* parameters.
MF_STRING	Specifies that the menu item is a character string; the *lpNewItem* parameter points to the string for the item.
MF_UNCHECKED	Does not place a check mark next to the item (default value). If the application has supplied check-mark bitmaps (see **SetMenuItemBitmaps**), setting this flag displays the check-mark-off bitmap next to the menu item.

See Also

AppendMenu, **CreateMenu**, **DrawMenuBar**, **RemoveMenu**, **SetMenuItemBitmaps**, **DRAWITEMSTRUCT**, **MEASUREITEMSTRUCT**, **WM_DRAWITEM**, **WM_MDIGETACTIVE**, **WM_MEASUREITEM**

IntersectRect (2.x)

BOOL IntersectRect(*lprcDst, lprcSrc1, lprcSrc2***)**

```
RECT FAR* lprcDst;          /* address of structure for intersection     */
const RECT FAR* lprcSrc1;   /* address of structure with 1st rectangle */
const RECT FAR* lprcSrc2;   /* address of structure with 2nd rectangle*/
```

The **IntersectRect** function calculates the intersection of two source rectangles and places the coordinates of the intersection rectangle into the destination rectangle. If the rectangles do not intersect, an empty rectangle (0, 0, 0, 0) is placed into the destination rectangle.

Parameter	Description
lprcDst	Points to a **RECT** structure that receives the intersection of the rectangles pointed to by the *lprcSrc1* and *lprcSrc2* parameters.
lprcSrc1	Points to the **RECT** structure that contains the first source rectangle.
lprcSrc2	Points to the **RECT** structure that contains the second source rectangle.

Returns

The return value is nonzero if the rectangles intersect. Otherwise, it is zero.

See Also

InflateRect, **SubtractRect**, **UnionRect**, **RECT**

InvalidateRect (2.x)

void InvalidateRect(*hwnd, lprc, fErase***)**

```
HWND hwnd;              /* handle of window with changed update region */
const RECT FAR* lprc;   /* address of structure with rectangle         */
BOOL fErase;            /* erase-background flag                       */
```

The **InvalidateRect** function adds a rectangle to a window's update region. The update region represents the client area of the window that must be redrawn.

Parameter	Description
hwnd	Identifies the window whose update region has changed.
lprc	Points to a **RECT** structure that contains the client coordinates of the rectangle to be added to the update region. If the *lprc* parameter is NULL, the entire client area is added to the update region.
fErase	Specifies whether the background within the update region is to be erased when the update region is processed. It this parameter is TRUE, the background is erased when the **BeginPaint** function is called. If this parameter is FALSE, the background remains unchanged.

Returns

This function does not return a value.

Comments

The invalidated areas accumulate in the update region until the region is processed when the next **WM_PAINT** message occurs, or until the region is validated by using the **ValidateRect** or **ValidateRgn** function.

Windows sends a **WM_PAINT** message to a window whenever its update region is not empty and there are no other messages in the application queue for that window.

If the *fErase* parameter is TRUE for any part of the update region, the background is erased in the entire region, not just in the given part.

See Also

BeginPaint, **InvalidateRgn**, **ValidateRect**, **ValidateRgn**, **RECT**, **WM_PAINT**

InvalidateRgn (2.x)

void InvalidateRgn(*hwnd, hrgn, fErase***)**

```
HWND hwnd;      /* handle of window with changed update region */
HRGN hrgn;      /* handle of region to add                     */
BOOL fErase;    /* erase-background flag                       */
```

The **InvalidateRgn** function adds a region to a window's update region. The update region represents the client area of the window that must be redrawn.

Parameter	Description
hwnd	Identifies the window whose update region has changed.
hrgn	Identifies the region to be added to the update region. The region is assumed to have client coordinates. If this parameter is NULL, the entire client area is added to the update region.
fErase	Specifies whether the background within the update region is to be erased when the update region is processed. If this parameter is TRUE, the background is erased when the **BeginPaint** function is called. If the parameter is FALSE, the background remains unchanged.

Returns

This function does not return a value.

Comments

The invalidated regions accumulate in the update region until the region is processed when the next **WM_PAINT** message occurs, or until the region is validated by using the **ValidateRect** or **ValidateRgn** function.

Windows sends a **WM_PAINT** message to a window whenever its update region is not empty and there are no other messages in the application queue for that window.

If the *fErase* parameter is TRUE for any part of the update region, the background is erased in the entire region, not just in the given part.

See Also

BeginPaint, **InvalidateRect**, **ValidateRect**, **ValidateRgn**, **WM_PAINT**

InvertRect (2.x)

void InvertRect(*hdc, lprc***)**

```
HDC hdc;                    /* handle of device context          */
const RECT FAR* lprc;       /* address of structure with rectangle*/
```

The **InvertRect** function inverts a rectangular area. Inversion is a logical NOT operation and flips the bits of each pixel.

Parameter	Description
hdc	Identifies the device context.
lprc	Points to a **RECT** structure that contains the logical coordinates of the rectangle to be inverted.

Returns

This function does not return a value.

Comments

On monochrome screens, the **InvertRect** function makes white pixels black and black pixels white. On color screens, the inversion depends on how colors are generated for the screen. Calling **InvertRect** twice, specifying the same rectangle, restores the display to its previous colors.

The **InvertRect** function compares the values of the **top**, **bottom**, **left**, and **right** members of the specified rectangle. If **bottom** is less than or equal to **top**, or if **right** is less than or equal to **left**, the function does not draw the rectangle.

See Also

FillRect, **RECT**

IsCharAlpha (3.0)

BOOL IsCharAlpha(*chTest***)**

char *chTest;* /* character to test */

The **IsCharAlpha** function determines whether a character is in the set of language-defined alphabetic characters.

Parameter	Description
chTest	Specifies the character to be tested.

Returns
The return value is nonzero if the character is in the set of alphabetic characters. Otherwise, it is zero.

Comments
The language driver for the current language (the language the user selected at setup or by using Control Panel) determines whether the character is in the set. If no language has been set, Windows uses an internal function.

Example
The following example uses the **IsCharAlpha** function to find the first nonalphabetic character in a string:

```
for (lpszNon = lpsz; IsCharAlpha(*lpszNon);
    lpszNon = AnsiNext(lpszNon));
```

See Also
IsCharAlphaNumeric

IsCharAlphaNumeric (3.0)

BOOL IsCharAlphaNumeric(*chTest***)**

char *chTest;* /* character to test */

The **IsCharAlphaNumeric** function determines whether a character is in the set of language-defined alphabetic or numeric characters.

Parameter	Description
chTest	Specifies the character to be tested.

Returns

The return value is nonzero if the character is in either the set of alphabetic characters or the set of numeric characters. Otherwise, it is zero.

Comments

The language driver for the current language (the language the user selected at setup or by using Control Panel) determines whether the character is in the set. If no language driver is selected, Windows uses an internal function.

Example

The following example uses the **IsCharAlphaNumeric** function to find the first nonalphanumeric character in a string:

```
for (lpszNon = lpsz; IsCharAlphaNumeric(*lpszNon);
        lpszNon = AnsiNext(lpszNon));
```

See Also

IsCharAlpha

IsCharLower (3.0)

BOOL IsCharLower(*chTest***)**

char *chTest;* /* character to test */

The **IsCharLower** function determines whether a character is in the set of language-defined lowercase characters.

Parameter	Description
chTest	Specifies the character to be tested.

Returns
The return value is nonzero if the character is lowercase. Otherwise, it is zero.

Comments
The language driver for the current language (the language selected at setup or by using Control Panel) determines whether the character is in the set. If no language driver is selected, Windows uses an internal function.

Example
The following example uses the **IsCharLower** function to find the first lowercase character in a string:

```
/* Look through string for a lowercase character. */

for (lpszLower = lpsz;
        !IsCharLower(*lpszLower) && lpszLower != '\0';
        lpszLower = AnsiNext(lpszLower));

/* Return NULL if no lowercase character is found. */

if (lpszLower == '\0')
    lpszLower = NULL;
```

See Also
IsCharUpper

IsCharUpper (3.0)

BOOL IsCharUpper(*chTest***)**

char *chTest;* /* character to test */

The **IsCharUpper** function determines whether a character is in the set of language-defined uppercase characters.

Parameter	Description
chTest	Specifies the character to be tested.

Returns
The return value is nonzero if the character is uppercase. Otherwise, it is zero.

Comments
The language driver for the current language (the language the user selected at setup or by using Control Panel) determines whether the character is in the set. If no language driver is selected, Windows uses an internal function.

Example
The following example uses the **IsCharUpper** function to find the first uppercase character in a string:

```
/* Look through the string for an uppercase character. */

for (lpszUpper = lpsz;
        !IsCharUpper(*lpszUpper) && lpszUpper != '\0';
        lpszUpper = AnsiNext(lpszUpper));

/* Return NULL if no uppercase character is found. */

if (lpszUpper == '\0')
    lpszUpper = NULL;
```

See Also
IsCharLower

IsChild (2.x)

BOOL IsChild(*hwndParent, hwndChild***)**

HWND *hwndParent;* /* handle of parent window */
HWND *hwndChild;* /* handle of child window */

The **IsChild** function tests whether a given window is a child or other direct descendant of a given parent window. A child window is the direct descendant of a given parent window if that parent window is in the chain of parent windows leading from the original pop-up window to the child window.

Parameter	Description
hwndParent	Identifies the parent window.
hwndChild	Identifies the child window to be tested.

Returns
The return value is nonzero if the child window is a descendant of the parent window. Otherwise, it is zero.

See Also
SetParent

IsClipboardFormatAvailable (2.x)

BOOL IsClipboardFormatAvailable(*uFormat***)**

UINT *uFormat;* /* registered clipboard format */

The **IsClipboardFormatAvailable** function specifies whether data of a certain format exists on the clipboard.

Parameter	Description
uFormat	Specifies a registered clipboard format. For information about clipboard formats, see the description of the **SetClipboardData function**.

Returns

The return value is nonzero if data of the specified format is on the clipboard. Otherwise, the return value is zero.

Comments

This function is typically called during processing of the **WM_INITMENU** or **WM_INITMENUPOPUP** message to determine whether the clipboard contains data that the application can paste. If such data is present, the application typically enables the Paste command (in its Edit menu).

See Also

CountClipboardFormats, **EnumClipboardFormats**, **GetClipboardFormatName**, **GetPriorityClipboardFormat**, **RegisterClipboardFormat**, **SetClipboardData**, **WM_INITMENU**, **WM_INITMENUPOPUP**

IsDialogMessage (2.x)

BOOL IsDialogMessage(*hwndDlg, lpmsg***)**

```
HWND hwndDlg;       /* handle of dialog box                */
MSG FAR* lpmsg;     /* address of structure with message */
```

The **IsDialogMessage** function determines whether the specified message is intended for the given modeless dialog box and, if it is, processes the message.

Parameter	Description
hwndDlg	Identifies the dialog box.
lpmsg	Points to an **MSG** structure that contains the message to be checked.

Returns

The return value is nonzero if the message has been processed. Otherwise, it is zero.

Comments

Although **IsDialogMessage** is intended for modeless dialog boxes, it can be used with any window that contains controls, enabling such windows to provide the same keyboard selection as in a dialog box.

When **IsDialogMessage** processes a message, it checks for keyboard messages and converts them into selection commands for the corresponding dialog box. For example, the TAB key, when pressed, selects the next control or group of controls, and the DOWN ARROW key, when pressed, selects the next control in a group.

If a message is processed by **IsDialogMessage**, it must not be passed to the **TranslateMessage** or **DispatchMessage** function. This is because **IsDialogMessage** performs all necessary translating and dispatching of messages.

IsDialogMessage sends **WM_GETDLGCODE** messages to the dialog box procedure to determine which keys should be processed.

IsDialogMessage can send **DM_GETDEFID** and **DM_SETDEFID** messages to the window. These messages are defined in the WINDOWS.H header file as **WM_USER** and WM_USER+1, so conflicts are possible with application-defined messages having the same values.

See Also

DispatchMessage, **SendDlgItemMessage**, **TranslateMessage**, **MSG**, **WM_GETDLGCODE**

IsDlgButtonChecked (2.x)

UINT IsDlgButtonChecked(*hwndDlg, idButton***)**

```
HWND hwndDlg;     /* handle of dialog box  */
int idButton;     /* button identifier     */
```

The **IsDlgButtonChecked** function determines whether a button has a check mark next to it and whether a three-state button is grayed, checked, or neither.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the button.
idButton	Specifies the identifier of the button.

Returns

The return value is nonzero if the specified button is checked, 0 if it is not, or -1 if the *hwndDlg* parameter is invalid. For three-state buttons, the return value is 2 if the button is grayed, 1 if the button is checked, 0 if it is unchecked, or -1 if *hwndDlg* is invalid.

Comments

The **IsDlgButtonChecked** function sends a **BM_GETCHECK** message to the button.

See Also

CheckDlgButton, **CheckRadioButton**, **BM_GETCHECK**

IsIconic (2.x)

BOOL IsIconic(*hwnd***)**

HWND *hwnd;* /* handle of window */

The **IsIconic** function determines whether the given window is minimized (iconic).

Parameter	Description
hwnd	Identifies the window.

Returns
The return value is nonzero if the window is minimized. Otherwise, it is zero.

See Also
CloseWindow, **IsZoomed**

IsMenu (3.1)

BOOL IsMenu(*hmenu***)**

HMENU *hmenu;* /* handle of menu */

The **IsMenu** function determines whether the given handle is a menu handle.

Parameter	Description
hmenu	Identifies the handle to be tested.

Returns

The return value is zero if the handle is definitely *not* a menu handle. A nonzero return value does not guarantee that the handle is a menu handle, however; for nonzero return values, the application should conduct further tests to verify the handle.

Comments

An application should use this function only to ensure that a given handle is *not* a menu handle.

See Also

CreateMenu, **CreatePopupMenu**, **DestroyMenu**, **GetMenu**

IsRectEmpty (2.x)

BOOL IsRectEmpty(*lprc***)**

const RECT FAR* *lprc;* /* address of structure with rectangle */

The **IsRectEmpty** function determines whether the specified rectangle is empty. A rectangle is empty if its width or height is zero, or if both are zero.

Parameter	Description
lprc	Points to a **RECT** structure that contains the coordinates of the rectangle.

Returns

The return value is nonzero if the rectangle is empty. Otherwise, it is zero.

Example

The following example uses the **IsRectEmpty** function to determine whether a rectangle is empty and then displays a message box giving the status of the rectangle:

```
RECT rc;

if (IsRectEmpty((LPRECT) &rc))
    MessageBox(hwnd, "Rectangle is empty.",
        "Rectangle Status", MB_OK);
else
    MessageBox(hwnd, "Rectangle is not empty.",
        "Rectangle Status", MB_OK);
```

See Also

RECT

IsWindow (2.x)

BOOL IsWindow(*hwnd***)**

HWND *hwnd;* /* handle of window */

The **IsWindow** function determines whether the given window handle is valid.

Parameter	Description
hwnd	Identifies a window.

Returns
The return value is nonzero if the window handle is valid. Otherwise, it is zero.

See Also
IsWindowEnabled, **IsWindowVisible**

IsWindowEnabled (2.x)

BOOL IsWindowEnabled(*hwnd***)**

HWND *hwnd;* /* handle of window to test */

The **IsWindowEnabled** function determines whether the given window is enabled for mouse and keyboard input.

Parameter	Description
hwnd	Identifies the window.

Returns
The return value is nonzero if the window is enabled. Otherwise, it is zero.

Comments
A child window receives input only if it is both enabled and visible.

See Also
EnableWindow, **IsWindowVisible**

IsWindowVisible (2.x)

BOOL IsWindowVisible(*hwnd***)**

HWND *hwnd;* /* handle of window to test */

The **IsWindowVisible** function determines the visibility state of the given window.

Parameter	Description
hwnd	Identifies the window.

Returns

The return value is nonzero if the specified window is visible on the screen (has the **WS_VISIBLE** style bit set). The return value is zero if the window is not visible. Because the return value reflects the value of the window's WS_VISIBLE flag, it may be nonzero even if the window is totally obscured by other windows.

Comments

A window possesses a visibility state indicated by the **WS_VISIBLE** style bit. When this style bit is set, the window is displayed and subsequent drawing into the window is displayed as long as the window has the style bit set.

Any drawing to a window that has the **WS_VISIBLE** style will not be displayed if the window is covered by other windows or is clipped by its parent window.

See Also

ShowWindow

IsZoomed (2.x)

BOOL IsZoomed(*hwnd***)**

HWND *hwnd;* /* handle of window */

The **IsZoomed** function determines whether the given window is maximized.

Parameter	Description
hwnd	Identifies the window.

Returns
The return value is nonzero if the window is maximized. Otherwise, it is zero.

See Also
IsIconic

KillTimer (2.x)

BOOL KillTimer(*hwnd, idTimer***)**

HWND *hwnd;* /* handle of window that installed timer */
UINT *idTimer;* /* timer identifier */

The **KillTimer** function removes the specified timer. Any pending **WM_TIMER** messages associated with the timer are removed from the message queue.

Parameter	Description
hwnd	Identifies the window associated with the timer to be removed. This must be the same value passed as the *hwnd* parameter of the **SetTimer** function that created the timer.
idTimer	Identifies the timer to be removed. If the application called **SetTimer** with the *hwnd* parameter set to NULL, this parameter must be the timer identifier returned by **SetTimer**. If the *hwnd* parameter of **SetTimer** was a valid window handle, this parameter must be the value of the *idTimer* parameter passed to **SetTimer**.

Returns

The return value is nonzero if the function is successful. It is zero if the **KillTimer** function could not find the specified timer.

See Also

SetTimer, **WM_TIMER**

LoadAccelerators (2.x)

HACCEL LoadAccelerators(*hinst, lpszTableName***)**

```
HINSTANCE hinst;          /* handle of module to load from */
LPCSTR lpszTableName;     /* address of table name         */
```

The **LoadAccelerators** function loads the specified accelerator table.

Parameter	Description
hinst	Identifies an instance of the module whose executable file contains the accelerator table to be loaded.
lpszTableName	Points to a null-terminated string that names the accelerator table to be loaded.

Returns

The return value is the handle of the loaded accelerator table if the function is successful. Otherwise, it is NULL.

Comments

If the accelerator table has not yet been loaded, the function loads it from the given executable file.

Accelerator tables loaded from resources are freed automatically when the application terminates.

LoadBitmap (2.x)

HBITMAP LoadBitmap(*hinst, lpszBitmap***)**

```
HINSTANCE hinst;        /* handle of application instance  */
LPCSTR lpszBitmap;      /* address of bitmap name          */
```

The **LoadBitmap** function loads the specified bitmap resource from the given module's executable file.

Parameter	Description
hinst	Identifies the instance of the module whose executable file contains the bitmap to be loaded.
lpszBitmap	Points to a null-terminated string that contains the name of the bitmap resource to be loaded. Alternatively, this parameter can consist of the resource identifier in the low-order word and zero in the high-order word. The **MAKEINTRESOURCE** macro can be used to create this value.

Returns

The return value is the handle of the specified bitmap if the function is successful. Otherwise, it is NULL.

Comments

If the bitmap pointed to by *lpszBitmap* does not exist or if there is insufficient memory to load the bitmap, the function fails.

The application must call the **DeleteObject** function to delete each bitmap handle returned by the **LoadBitmap** function. This also applies to the following predefined bitmaps.

An application can use the **LoadBitmap** function to access the predefined bitmaps used by Windows. To do so, the application must set the *hinst* parameter to NULL and the *lpszBitmap* parameter to one of the following values:

OBM_BTNCORNERS	OBM_OLD_RESTORE
OBM_BTSIZE	OBM_OLD_RGARROW
OBM_CHECK	OBM_OLD_UPARROW
OBM_CHECKBOXES	OBM_OLD_ZOOM
OBM_CLOSE	OBM_REDUCE
OBM_COMBO	OBM_REDUCED
OBM_DNARROW	OBM_RESTORE
OBM_DNARROWD	OBM_RESTORED
OBM_DNARROWI	OBM_RGARROW
OBM_LFARROW	OBM_RGARROWD
OBM_LFARROWD	OBM_RGARROWI
OBM_LFARROWI	OBM_SIZE
OBM_MNARROW	OBM_UPARROW
OBM_OLD_CLOSE	OBM_UPARROWD
OBM_OLD_DNARROW	OBM_UPARROWI
OBM_OLD_LFARROW	OBM_ZOOM
OBM_OLD_REDUCE	OBM_ZOOMD

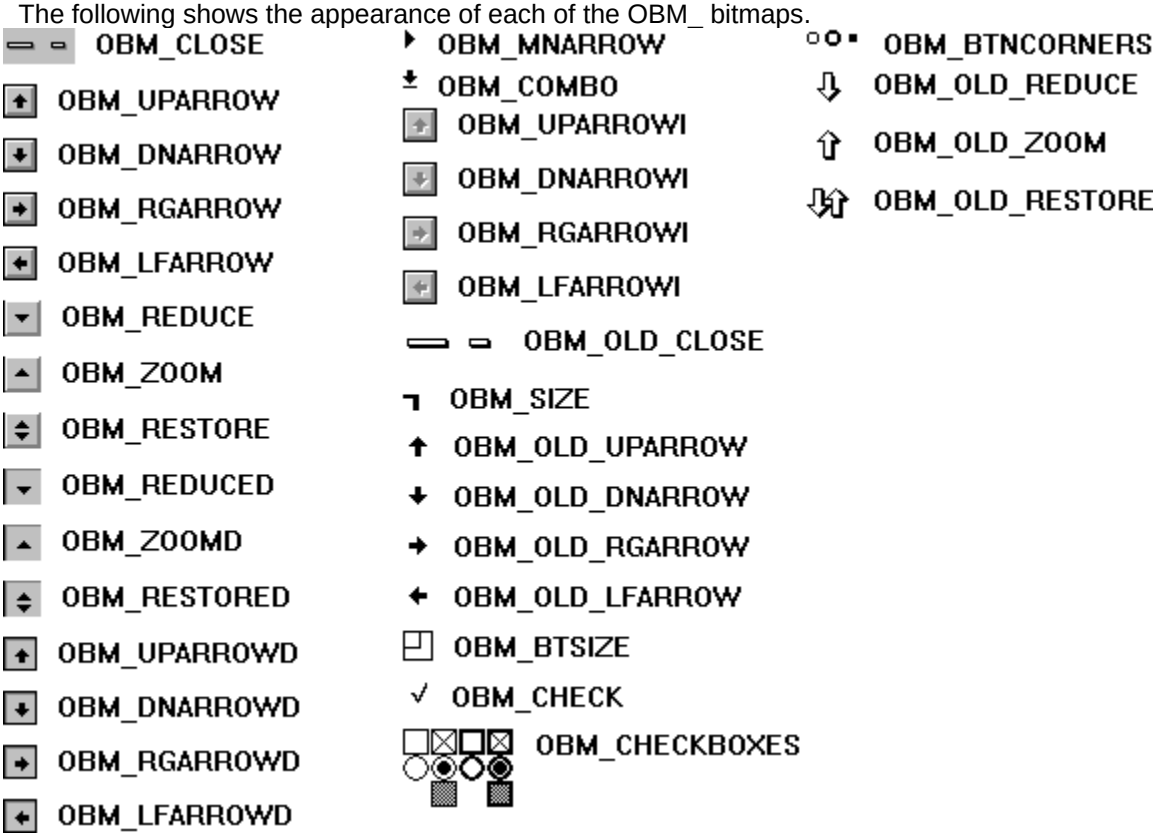
Bitmap names that begin with OBM_OLD represent bitmaps used by Windows versions earlier than 3.0.

The bitmaps identified by OBM_DNARROWI, OBM_LFARROWI, OBM_RGARROWI, and OBM_UPARROWI are new for Windows 3.1. These bitmaps are not found in device drivers for previous

versions of Windows.

Note that for an application to use any of the OBM_ constants, the constant OEMRESOURCE must be defined before the WINDOWS.H header file is included.

The following shows the appearance of each of the OBM_ bitmaps.



See Also
DeleteObject

Windows 3.1 changes

The following bitmaps have been added:

OBM_UPARROWI
OBM_DNARROWI
OBM_RGARROWI
OBM_LFARROWI

LoadCursor (2.x)

HCURSOR LoadCursor(*hinst, pszCursor***)**

```
HINSTANCE hinst;        /* handle of application instance                */
LPCSTR pszCursor;       /* cursor-name string or cursor resource identifier*/
```

The **LoadCursor** function loads the specified cursor resource from the executable file associated with the given application instance.

Parameter	Description
hinst	Identifies an instance of the module whose executable file contains the cursor to be loaded.
pszCursor	Points to a null-terminated string that contains the name of the cursor resource to be loaded. Alternatively, this parameter can consist of the resource identifier in the low-order word and zero in the high-order word. The **MAKEINTRESOURCE** macro can be used to create this value.

Returns

The return value is the handle of the newly loaded cursor if the function is successful. Otherwise, it is NULL.

Comments

The function loads the cursor resource only if it has not been loaded; otherwise, it retrieves a handle of the existing resource. The **LoadCursor** function returns a valid cursor handle only if the *pszCursor* parameter points to a cursor resource. If *pszCursor* points to any type of resource other than a cursor (such as an icon), the return value will not be NULL, even though it is not a valid cursor handle.

An application can use the **LoadCursor** function to access the predefined cursors used by Windows. To do this, the application must set the *hinst* parameter to NULL and the *pszCursor* parameter to one the following values:

Value	Meaning
IDC_ARROW	Standard arrow cursor.
IDC_CROSS	Crosshair cursor.
IDC_IBEAM	Text I-beam cursor.
IDC_ICON	Empty icon.
IDC_SIZE	A square with a smaller square inside its lower-right corner.
IDC_SIZENESW	Double-pointed cursor with arrows pointing northeast and southwest.
IDC_SIZENS	Double-pointed cursor with arrows pointing north and south.
IDC_SIZENWSE	Double-pointed cursor with arrows pointing northwest and southeast.
IDC_SIZEWE	Double-pointed cursor with arrows pointing west and east.
IDC_UPARROW	Vertical arrow cursor.
IDC_WAIT	Hourglass cursor.

It is not necessary to destroy these system cursors. An application should use the **DestroyCursor** function to destroy any private cursors it loads.

See Also

DestroyCursor, **SetCursor**, **ShowCursor**, **MAKEINTRESOURCE**

IDC_ARROW **MAKEINTRESOURCE**(32512)

Standard arrow cursor.

IDC_ARROW MAKEINTRESOURCE(32512)

IDC_CROSS **MAKEINTRESOURCE**(32515)

Crosshair cursor.

IDC_CROSS MAKEINTRESOURCE(32515)

IDC_IBEAM **MAKEINTRESOURCE**(32513)

Text I-beam cursor.

IDC_IBEAM MAKEINTRESOURCE(32513)

IDC_ICON **MAKEINTRESOURCE**(32641)

Empty icon.

IDC_ICON MAKEINTRESOURCE(32641)

IDC_SIZE **MAKEINTRESOURCE**(32640)

A square with a smaller square inside its lower-right corner.

IDC_SIZE MAKEINTRESOURCE(32640)

IDC_SIZENESW **MAKEINTRESOURCE**(32643)

Double-pointed cursor with arrows pointing northeast and southwest.

IDC_SIZENESW MAKEINTRESOURCE(32643)

IDC_SIZENS **MAKEINTRESOURCE**(32645)

Double-pointed cursor with arrows pointing north and south.

IDC_SIZENS MAKEINTRESOURCE(32645)

IDC_SIZENWSE **MAKEINTRESOURCE**(32642)

Double-pointed cursor with arrows pointing northwest and southeast.

IDC_SIZENWSE MAKEINTRESOURCE(32642)

IDC_SIZEWE **MAKEINTRESOURCE**(32644)

Double-pointed cursor with arrows pointing west and east.

IDC_SIZEWE MAKEINTRESOURCE(32644)

IDC_UPARROW **MAKEINTRESOURCE**(32516)

Vertical arrow cursor.

IDC_UPARROW MAKEINTRESOURCE(32516)

IDC_WAIT **MAKEINTRESOURCE**(32514)

Hourglass cursor.

IDC_WAIT MAKEINTRESOURCE(32514)

LoadIcon (2.x)

HICON LoadIcon(*hinst, pszIcon***)**

HINSTANCE *hinst;* /* handle of application instance */
LPCSTR *pszIcon;* /* icon-name string or icon resource identifier */

The **LoadIcon** function loads the specified icon resource from the executable file associated with the given application instance.

Parameter	Description
hinst	Identifies an instance of the module whose executable file contains the icon to be loaded. This parameter must be NULL when a system icon is being loaded.
pszIcon	Points to a null-terminated string that contains the name of the icon resource to be loaded. Alternatively, this parameter can consist of the resource identifier in the low-order word and zero in the high-order word. The **MAKEINTRESOURCE** macro can be used to create this value.

Returns
The return value is the handle of the newly loaded icon if the function is successful. Otherwise, it is NULL.

Comments
This function loads the icon resource only if it has not been loaded; otherwise, it retrieves a handle of the existing resource.

An application can use the **LoadIcon** function to access the predefined icons used by Windows. To do this, the application must set the *hinst* parameter to NULL and the *pszIcon* parameter to one of the following values:

Value	Meaning
IDI_APPLICATION	Default application icon.
IDI_ASTERISK	Asterisk (used in informative messages).
IDI_EXCLAMATION	Exclamation point (used in warning messages).
IDI_HAND	Hand-shaped icon (used in serious warning messages).
IDI_QUESTION	Question mark (used in prompting messages).

It is not necessary to destroy these system icons. An application should use the **DestroyIcon** function to destroy any private icons it loads.

The following shows all of the system icons.

sysico

See Also
DestroyIcon, **DrawIcon**, **MAKEINTRESOURCE**

IDI_APPLICATION **MAKEINTRESOURCE**(32512)

Default application icon.

IDI_APPLICATION MAKEINTRESOURCE(32512)

IDI_ASTERISK **MAKEINTRESOURCE**(32516)

Asterisk (used in informative messages).

IDI_ASTERISK MAKEINTRESOURCE(32516)

IDI_EXCLAMATION **MAKEINTRESOURCE**(32515)

Exclamation point (used in warning messages).

IDI_EXCLAMATION MAKEINTRESOURCE(32515)

IDI_HAND **MAKEINTRESOURCE**(32513)

Hand-shaped icon (used in serious warning messages).

IDI_HAND MAKEINTRESOURCE(32513)

IDI_QUESTION **MAKEINTRESOURCE**(32514)

Question mark (used in prompting messages).

IDI_QUESTION MAKEINTRESOURCE(32514)

LoadMenu (2.x)

HMENU LoadMenu(*hinst, lpszMenuName***)**

HINSTANCE *hinst;* /* handle of application instance */
LPCSTR *lpszMenuName;* /* menu-name string or menu resource identifier*/

The **LoadMenu** function loads the specified menu resource from the executable file associated with the given application instance.

Parameter	Description
hinst	Identifies an instance of the module whose executable file contains the menu to be loaded.
lpszMenuName	Points to a null-terminated string that contains the name of the menu resource to be loaded. Alternatively, this parameter can consist of the resource identifier in the low-order word and zero in the high-order word. The **MAKEINTRESOURCE** macro can be used to create this value.

Returns
The return value is the handle of the menu resource if the function is successful. Otherwise, it is NULL.

Comments
Before exiting, an application must free system resources associated with a menu if the menu is not assigned to a window. An application frees a menu by calling the **DestroyMenu** function.

Example
The following example loads a menu resource, and then assigns the menu to a window:

```
HMENU hmenu;

hmenu = LoadMenu(hinst, "ColorMenu");
SetMenu(hwnd, hmenu);
```

See Also
DestroyMenu, **LoadMenuIndirect**, **SetMenu**, **MAKEINTRESOURCE**

LoadMenuIndirect (2.x)

HMENU LoadMenuIndirect(*lpmith***)**

const void FAR* *lpmith;* /* address of menu template */

The **LoadMenuIndirect** function loads the specified menu template in memory. A menu template is a header followed by a collection of one or more **MENUITEMTEMPLATE** structures, each of which may contain one or more menu items and pop-up menus.

Parameter	Description
lpmith	Points to a menu template, which consists of a menu-template header and one or more menu item templates. The menu template header consists of a **MENUITEMTEMPLATEHEADER** structure. Each menu item template consists of a **MENUITEMTEMPLATE** structure.

Returns

The return value is the handle of a menu if the function is successful. Otherwise, it is NULL.

Comments

Before exiting, an application must free system resources associated with a menu if the menu is not assigned to a window. An application frees a menu by calling the **DestroyMenu** function.

Example

The following example retrieves a menu handle for a menu template resource that has been loaded into memory, gives the menu handle to a window, and then unlocks and frees the resource:

```
HRSRC hrsrcResInfo;
HGLOBAL hglbResMenu;
char FAR* lpResMenu;
HMENU hmenu;

case IDM_NEWMENU:
    hrsrcResInfo = FindResource(hinst, "DynaMenu", RT_MENU);
    hglbResMenu = LoadResource(hinst, hrsrcResInfo);
    lpResMenu = LockResource(hglbResMenu);
    hmenu = LoadMenuIndirect(lpResMenu);

    DestroyMenu(GetMenu(hwnd));
    SetMenu(hwnd, hmenu);

    UnlockResource(hglbResMenu);
    FreeResource(hglbResMenu);

    break;
```

See Also

DestroyMenu, **LoadMenu**, **SetMenu**, **MENUITEMTEMPLATE**

LoadString (2.x)

int LoadString(*hinst, idResource, lpszBuffer, cbBuffer***)**

```
HINSTANCE hinst;      /* handle of module containing string resource */
UINT idResource;      /* resource identifier                         */
LPSTR lpszBuffer;     /* address of buffer for resource              */
int cbBuffer;         /* size of buffer                              */
```

The **LoadString** function loads the specified string resource.

Parameter	Description
hinst	Identifies an instance of the module whose executable file contains the string resource to be loaded.
idResource	Specifies the integer identifier of the string to be loaded.
lpszBuffer	Points to the buffer that will receive the null-terminated string.
cbBuffer	Specifies the buffer size, in bytes. The buffer should be large enough for the string and its terminating null character. The string is truncated if it is longer than the number of bytes specified.

Returns

The return value specifies the number of bytes copied into the buffer, if the function is successful. It is zero if the string resource does not exist.

LockInput (3.1)

BOOL LockInput(*hReserved, hwndInput, fLock***)**

```
HANDLE hReserved;      /* reserved, must be NULL                */
HWND hwndInput;        /* handle of window to receive all input */
BOOL fLock;            /* the lock/unlock flag                  */
```

The **LockInput** function locks input to all tasks except the current one, if the *fLock* parameter is TRUE. The given window is made system modal; that is, it will receive all input. If *fLock* is FALSE, **LockInput** unlocks input and restores the system to its unlocked state.

Parameter	Description
hReserved	This parameter is reserved and must be NULL.
hwndInput	Identifies the window that is to receive all input. This window must be in the current task. If *fLock* is FALSE, this parameter should be NULL.
fLock	Indicates whether to lock or unlock input. A value of TRUE locks input; a value of FALSE unlocks input.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

Before entering hard mode, a Windows-based debugger calls **LockInput**, specifying TRUE for the *fLock* parameter. This action saves the current global state. To exit hard mode, the debugger calls **LockInput**, specifying FALSE for *fLock.* This restores the global state to the conditions that existed when the debugger entered hard mode. A debugger must restore the global state before exiting. Calls to **LockInput** cannot be nested.

See Also

DirectedYield

LockWindowUpdate (3.1)

BOOL LockWindowUpdate(*hwndLock***)**

HWND *hwndLock;* /* handle of window */

The **LockWindowUpdate** function disables or reenables drawing in the given window. A locked window cannot be moved. Only one window can be locked at a time.

Parameter	Description
hwndLock	Identifies the window in which drawing will be disabled. If this parameter is NULL, drawing in the locked window is enabled.

Returns

The return value is nonzero if the function is successful. It is zero if a failure occurs or if the **LockWindowUpdate** function has been used to lock another window.

Comments

If an application with a locked window (or any locked child windows) calls the **GetDC**, **GetDCEx**, or **BeginPaint** function, the called function returns a device context whose visible region is empty. This will occur until the application unlocks the window by calling **LockWindowUpdate**, specifying a value of NULL for *hwndLock.*

While window updates are locked, the system keeps track of the bounding rectangle of any drawing operations to device contexts associated with a locked window. When drawing is reenabled, this bounding rectangle is invalidated in the locked window and its child windows to force an eventual **WM_PAINT** message to update the screen. If no drawing has occurred while the window updates were locked, no area is invalidated.

The **LockWindowUpdate** function does not make the given window invisible and does not clear the **WS_VISIBLE** style bit.

lstrcmp (3.0)

int lstrcmp(*lpszString1, lpszString2***)**

LPCSTR *lpszString1;* /* address of first string */
LPCSTR *lpszString2;* /* address of second string */

The **lstrcmp** function compares two character strings. The comparison is case-sensitive.

Parameter	Description
lpszString1	Points to the first null-terminated string to be compared.
lpszString2	Points to the second null-terminated string to be compared.

Returns

The return value is less than zero if the string specified in *lpszString1* is less than the string specified in *lpszString2,* is greater than zero if *lpszString1* is greater than *lpszString2,* and is zero if the two strings are equal.

Comments

The **lstrcmp** function compares two strings by checking the first characters against each other, the second characters against each other, and so on, until it finds an inequality or reaches the ends of the strings. The function returns the difference of the values of the first unequal characters it encounters. For example, **lstrcmp** determines that "abcz" is greater than "abcdefg" and returns the difference of "z" and "d".

The language driver for the language selected by the user determines which string is greater (or whether the strings are the same). If no language driver is selected, Windows uses an internal function. With the Windows United States language functions, uppercase characters have lower values than lowercase characters.

With a double-byte character set (DBCS) version of Windows, this function can compare two DBCS strings.

Both strings must be less than 64K in size.

See Also

lstrcmpi

lstrcmpi (3.0)

int lstrcmpi(*lpszString1, lpszString2***)**

LPCSTR *lpszString1;* /* address of first string */
LPCSTR *lpszString2;* /* address of second string */

The **lstrcmpi** function compares the two strings. The comparison is not case-sensitive.

Parameter	Description
lpszString1	Points to the first null-terminated string to be compared.
lpszString2	Points to the second null-terminated string to be compared.

Returns

The return value is less than zero if the string specified in *lpszString1* is less than the string specified in *lpszString2,* is greater than zero if *lpszString1* is greater than *lpszString2,* and is zero if the two strings are equal.

Comments

The **lstrcmpi** function compares two strings by checking the first characters against each other, the second characters against each other, and so on, until it finds an inequality or reaches the ends of the strings. The function returns the difference of the values of the first unequal characters it encounters. For example, **lstrcmpi** determines that "abcz" is greater than "abcdefg" and returns the difference of "z" and "d".

The language driver for the language selected by the user determines which string is greater (or whether the strings are the same). If no language driver is selected, Windows uses an internal function.

With a double-byte character set (DBCS) version of Windows, this function can compare two DBCS strings.

Both strings must be less than 64K in size.

See Also

lstrcmp

MapDialogRect (2.x)

void MapDialogRect(*hwndDlg, lprc***)**

```
HWND hwndDlg;       /* handle of dialog box                 */
RECT FAR* lprc;     /* address of structure with rectangle */
```

The **MapDialogRect** function converts (maps) the specified dialog box units to screen units (pixels).

Parameter	Description
hwndDlg	Identifies a dialog box. This dialog box must have been created by using the **CreateDialog** or **DialogBox** function.
lprc	Points to a **RECT** structure that contains the dialog box coordinates to be converted.

Returns

This function does not return a value.

Comments

The **MapDialogRect** function converts the dialog box units of a rectangle to screen units. Dialog box units are defined in terms of the current dialog base unit, which is derived from the average width and height of characters in the font used for dialog box text. Typically, dialog boxes use the System font, but an application can specify a different font by using the DS_SETFONT style in the resource-definition file.

One horizontal unit is one-fourth of the dialog box base width unit, and one vertical unit is one-eighth of the dialog box base height unit. The **GetDialogBaseUnits** function retrieves the dialog box base units in pixels.

See Also

CreateDialog, **DialogBox**, **GetDialogBaseUnits**, **RECT**

MessageBeep (2.x)

void MessageBeep(*uAlert***)**

UINT *uAlert;* /* alert level */

The **MessageBeep** function plays a waveform sound corresponding to a given system alert level. The sound for each alert level is identified by an entry in the [sounds] section of the WIN.INI initialization file.

Parameter	Description
uAlert	Specifies the alert level. This parameter can be one of the following values:

Value	Meaning
-1	Produces a standard beep sound by using the computer speaker.
MB_ICONASTERISK	Plays the sound identified by the SystemAsterisk entry in the [sounds] section of WIN.INI.
MB_ICONEXCLAMATION	Plays the sound identified by the SystemExclamation entry in the [sounds] section of WIN.INI.
MB_ICONHAND	Plays the sound identified by the SystemHand entry in the [sounds] section of WIN.INI.
MB_ICONQUESTION	Plays the sound identified by the SystemQuestion entry in the [sounds] section of WIN.INI.
MB_OK	Plays the sound identified by the SystemDefault entry in the [sounds] section of WIN.INI.

Returns

This function does not return a value.

Comments

MessageBeep returns control to the caller after queuing the sound and plays the sound asynchronously.

If it cannot play the specified alert sound, **MessageBeep** attempts to play the system default sound. If it cannot play the system default sound, the function produces a standard beep sound by using the computer speaker.

The user can disable the warning beep by using the Windows Control Panel application Sounds.

See Also

FlashWindow, **MessageBox**

Windows 3.1 changes

The **MessageBeep** function for Windows version 3.0 and earlier did not accept values for the *uAlert* parameter.

MessageBox (2.x)

int MessageBox(*hwndParent, lpszText, lpszTitle, fuStyle***)**

```
HWND hwndParent;     /* handle of parent window          */
LPCSTR lpszText;     /* address of text in message box   */
LPCSTR lpszTitle;    /* address of title of message box  */
UINT fuStyle;        /* style of message box             */
```

The **MessageBox** function creates, displays, and operates a message-box window. The message box contains an application-defined message and title, plus any combination of the predefined icons and push buttons described in the *fuStyle* parameter.

Parameter	Description
hwndParent	Identifies the parent window of the message box to be created. If this parameter is NULL, the message box will have no parent window.
lpszText	Points to a null-terminated string containing the message to be displayed.
lpszTitle	Points to a null-terminated string to be used for the dialog box title. If this parameter is NULL, the default title Error is used.
fuStyle	Specifies the contents and behavior of the dialog box. This parameter can be a combination of the following values:

Value	Meaning
MB_ABORTRETRYIGNORE	The message box contains three push buttons: Abort, Retry, and Ignore.
MB_APPLMODAL	The user must respond to the message box before continuing work in the window identified by the *hwndParent* parameter. However, the user can move to the windows of other applications and work in those windows. **MB_APPLMODAL** is the default if neither **MB_SYSTEMMODAL** nor **MB_TASKMODAL** is specified.
MB_DEFBUTTON1	The first button is the default. Note that the first button is always the default unless MB_DEFBUTTON2 or MB_DEFBUTTON3 is specified.
MB_DEFBUTTON2	The second button is the default.
MB_DEFBUTTON3	The third button is the default.
MB_ICONASTERISK	Same as MB_ICONINFORMATION.
MB_ICONEXCLAMATION	An exclamation-point icon appears in the message box.
MB_ICONHAND	Same as MB_ICONSTOP.
MB_ICONINFORMATION	An icon consisting of a lowercase letter "I" in a circle appears in the message box.
MB_ICONQUESTION	A question-mark icon appears in the message box.
MB_ICONSTOP	A stop-sign icon appears in the message box.
MB_OK	The message box contains one push button: OK.
MB_OKCANCEL	The message box contains two push buttons: OK and Cancel.
MB_RETRYCANCEL	The message box contains two push buttons: Retry and Cancel.
MB_SYSTEMMODAL	All applications are suspended until the user

	responds to the message box. Unless the application specifies **MB_ICONHAND**, the message box does not become modal until after it is created; consequently, the parent window and other windows continue to receive messages resulting from its activation. System-modal message boxes are used to notify the user of serious, potentially damaging errors that require immediate attention (for example, running out of memory).
MB_TASKMODAL	Same as **MB_APPLMODAL** except that all the top-level windows belonging to the current task are disabled if the *hwndParent* parameter is NULL. This flag should be used when the calling application or library does not have a window handle available but still needs to prevent input to other windows in the current application without suspending other applications.
MB_YESNO	The message box contains two push buttons: Yes and No.
MB_YESNOCANCEL	The message box contains three push buttons: Yes, No, and Cancel.

Returns

The return value is zero if there is not enough memory to create the message box. Otherwise, it is one of the following menu-item values returned by the dialog box:

Value	Meaning
IDABORT	Abort button was selected.
IDCANCEL	Cancel button was selected.
IDIGNORE	Ignore button was selected.
IDNO	No button was selected.
IDOK	OK button was selected.
IDRETRY	Retry button was selected.
IDYES	Yes button was selected.

If a message box has a Cancel button, the **IDCANCEL** value will be returned if either the ESC key is pressed or the Cancel button is selected. If the message box has no Cancel button, pressing ESC has no effect.

Comments

When a system-modal message box is created to indicate that the system is low on memory, the strings pointed to by the *lpszText* and *lpszTitle* parameters should not be taken from a resource file, because an attempt to load the resource may fail.

When an application calls the **MessageBox** function and specifies the **MB_ICONHAND** and **MB_SYSTEMMODAL** flags for the *fuStyle* parameter, Windows displays the resulting message box regardless of available memory. When these flags are specified, Windows limits the length of the message-box text to three lines. Windows does *not* automatically break the lines to fit in the message box, however, so the message string must contain carriage returns to break the lines at the appropriate places.

If a message box is created while a dialog box is present, use the handle of the dialog box as the *hwndParent* parameter. The *hwndParent* parameter should not identify a child window, such as a control in a dialog box.

Following are the various system icons that can be used in a message box:

MB_HAND and MB_ICONSTOP

MB_QUESTION

MB_EXCLAMATION

MB_ASTERISK and MB_ICONINFORMATION

See Also
FlashWindow, **MessageBeep**

MB_ABORTRETRYIGNORE 0x0002

The message box contains three push buttons: Abort, Retry, and Ignore.

MB_ABORTRETRYIGNORE 0x0002

MB_APPLMODAL 0x0000

The user must respond to the message box before continuing work in the window identified by the *hwndParent* parameter. However, the user can move to the windows of other applications and work in those windows. MB_APPLMODAL is the default if neither **MB_SYSTEMMODAL** nor **MB_TASKMODAL** is specified.

MB_APPLMODAL 0x0000

MB_DEFBUTTON1 0x0000

The first button is the default. Note that the first button is always the default unless MB_DEFBUTTON2 or MB_DEFBUTTON3 is specified.

MB_DEFBUTTON1 0x0000

MB_DEFBUTTON2 0x0100

The second button is the default.

MB_DEFBUTTON2 0x0100

MB_DEFBUTTON3 0x0200

The third button is the default.

MB_DEFBUTTON3 0x0200

MB_ICONASTERISK 0x0040

Same as MB_ICONINFORMATION.

MB_ICONASTERISK 0x0040

MB_ICONEXCLAMATION 0x0030

An exclamation-point icon appears in the message box.

MB_ICONEXCLAMATION 0x0030

MB_ICONHAND 0x0010

Same as MB_ICONSTOP.

MB_ICONHAND 0x0010

MB_ICONINFORMATION **MB_ICONASTERISK**

An icon consisting of a lowercase letter "I" in a circle appears in the message box.

MB_ICONINFORMATION MB_ICONASTERISK

MB_ICONQUESTION 0x0020

A question-mark icon appears in the message box.

MB_ICONQUESTION 0x0020

MB_ICONSTOP **MB_ICONHAND**

A stop-sign icon appears in the message box.

MB_ICONSTOP MB_ICONHAND

MB_OK 0x0000

The message box contains one push button: OK.

MB_OK 0x0000

MB_OKCANCEL 0x0001

The message box contains two push buttons: OK and Cancel.

MB_OKCANCEL 0x0001

MB_RETRYCANCEL 0x0005

The message box contains two push buttons: Retry and Cancel.

MB_RETRYCANCEL 0x0005

MB_SYSTEMMODAL 0x1000

All applications are suspended until the user responds to the message box. Unless the application specifies **MB_ICONHAND**, the message box does not become modal until after it is created; consequently, the parent window and other windows continue to receive messages resulting from its activation. System-modal message boxes are used to notify the user of serious, potentially damaging errors that require immediate attention (for example, running out of memory).

MB_SYSTEMMODAL 0x1000

MB_TASKMODAL 0x2000

Same as **MB_APPLMODAL** except that all the top-level windows belonging to the current task are disabled if the *hwndParent* parameter is NULL. This flag should be used when the calling application or library does not have a window handle available but still needs to prevent input to other windows in the current application without suspending other applications.

MB_TASKMODAL 0x2000

MB_YESNO 0x0004

The message box contains two push buttons: Yes and No.

MB_YESNO 0x0004

MB_YESNOCANCEL 0x0003

The message box contains three push buttons: Yes, No, and Cancel.

MB_YESNOCANCEL 0x0003

IDABORT 3

Abort button was selected.

IDABORT 3

IDCANCEL 2

Cancel button was selected.

IDCANCEL 2

IDIGNORE 5

Ignore button was selected.

IDIGNORE 5

IDNO 7

No button was selected.

IDNO 7

IDOK 1

OK button was selected.

IDOK 1

IDRETRY 4

Retry button was selected.

IDRETRY 4

IDYES 6

Yes button was selected.

IDYES 6

MapWindowPoints (3.1)

void MapWindowPoints(*hwndFrom, hwndTo, lppt, cPoints***)**

```
HWND hwndFrom;          /* handle of window to be mapped from          */
HWND hwndTo;            /* handle of window to be mapped to            */
POINT FAR* lppt;        /* address of structure array with points to map*/
UINT cPoints;           /* number of structures in array               */
```

The **MapWindowPoints** function converts (maps) a set of points from a coordinate space relative to one window to a coordinate space relative to another window.

Parameter	Description
hwndFrom	Identifies the window from which points are converted. If this parameter is NULL or HWND_DESKTOP, the points are assumed to be in screen coordinates.
hwndTo	Identifies the window to which points are converted. If this parameter is NULL or HWND_DESKTOP, the points are converted to screen coordinates.
lppt	Points to an array of **POINT** structures that contain the set of points to be converted. This parameter can also point to a **RECT** structure, in which case the *cPoints* parameter should be set to 2.
cPoints	Specifies the number of **POINT** structures in the array pointed to by the *lppt* parameter.

Returns

This function does not return a value.

See Also

ClientToScreen, **ScreenToClient**

ModifyMenu (3.0)

BOOL ModifyMenu(*hmenu, idItem, fuFlags, idNewItem, lpNewItem***)**

```
HMENU hmenu;          /* handle of menu          */
UINT idItem;          /* menu-item identifier    */
UINT fuFlags;         /* menu-item flags         */
UINT idNewItem;       /* new menu-item identifier*/
LPCSTR lpNewItem;     /* menu-item content       */
```

The **ModifyMenu** function changes an existing menu item.

Parameter	Description
hmenu	Identifies the menu to change.
idItem	Specifies the menu item to change, as determined by the *fuFlags* parameter. When the *fuFlags* parameter is **MF_BYCOMMAND**, the *idItem* parameter specifies the menu-item identifier. When the *fuFlags* parameter is **MF_BYPOSITION**, the *idItem* parameter specifies the zero-based position of the menu item.
fuFlags	Specifies how the *idItem* parameter is interpreted and information about the changes to be made to the menu item. It consists of one or more values listed in the following Comments section.
idNewItem	Specifies either the identifier of the modified menu item or, if *fuFlags* is set to **MF_POPUP**, the menu handle of the pop-up menu.
lpNewItem	Specifies the content of the changed menu item. If *fuFlags* is set to **MF_STRING** (the default), *lpNewItem* is a long pointer to a null-terminated string. If *fuFlags* is set to **MF_BITMAP** instead, *lpNewItem* contains a bitmap handle in its low-order word. If *fuFlags* is set to **MF_OWNERDRAW**, *lpNewItem* specifies an application-defined 32-bit value that the application can use to maintain additional data associated with the menu item. This 32-bit value is available to the application in the **itemData** member of the **MEASUREITEMSTRUCT** or **DRAWITEMSTRUCT** structure pointed to by the *lParam* parameter of the **WM_MEASUREITEM** or **WM_DRAWITEM** message. These messages are sent when the menu item is initially displayed or is changed.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

If the **ModifyMenu** function replaces a pop-up menu associated with the menu item, it destroys the old pop-up menu and frees the memory used by the pop-up menu.

Whenever a menu changes (whether or not it is in a window that is displayed), the application should call **DrawMenuBar**. To change the attributes of existing menu items, it is much faster to use the **CheckMenuItem** and **EnableMenuItem** functions.

Each of the following groups lists flags that should not be used together:

- **MF_BYCOMMAND** and **MF_BYPOSITION**
- **MF_DISABLED**, **MF_ENABLED**, and **MF_GRAYED**
- **MF_BITMAP**, **MF_STRING**, **MF_OWNERDRAW**, and **MF_SEPARATOR**
- **MF_MENUBARBREAK** and **MF_MENUBREAK**
- **MF_CHECKED** and **MF_UNCHECKED**

The following list describes the flags that may be set in the *fuFlags* parameter:

Value	Meaning
MF_BITMAP	Uses a bitmap as the menu item. The low-order word of the *lpNewItem* parameter contains the handle of the bitmap.
MF_BYCOMMAND	Specifies that the *idItem* parameter gives the menu-item identifier. This is the default if neither **MF_BYCOMMAND** nor MF_POSITION is set.

MF_BYPOSITION	Specifies that the *idItem* parameter gives the position of the menu item to be changed rather than the menu-item identifier.
MF_CHECKED	Places a check mark next to the menu item. If the application has supplied check-mark bitmaps (see **SetMenuItemBitmaps**), setting this flag displays the check-mark bitmap next to the menu item.
MF_DISABLED	Disables the menu item so that it cannot be selected, but does not gray (dim) it.
MF_ENABLED	Enables the menu item so that it can be selected and restores it from its grayed state.
MF_GRAYED	Disables the menu item so that it cannot be selected and grays it.
MF_MENUBARBREAK	Same as **MF_MENUBREAK** except, for pop-up menus, separates the new column from the old column with a vertical line.
MF_MENUBREAK	Places the menu item on a new line for static menu-bar items. For pop-up menus, this flag places the item in a new column, with no dividing line between the columns.
MF_OWNERDRAW	Specifies that the menu item is an owner-drawn item. The window that owns the menu receives a **WM_MEASUREITEM** message when the menu is displayed for the first time to retrieve the height and width of the menu item. The **WM_DRAWITEM** message is then sent whenever the owner must update the visual appearance of the menu item. This option is not valid for a top-level menu item.
MF_POPUP	Specifies that the item has a pop-up menu associated with it. The *idNewItem* parameter specifies a handle of a pop-up menu to be associated with the menu item. Use this flag for adding either a top-level pop-up menu or a hierarchical pop-up menu to a pop-up menu item.
MF_SEPARATOR	Draws a horizontal dividing line. This line cannot be grayed, disabled, or highlighted. You can use this flag only in a pop-up menu. The *lpNewItem* and *idNewItem* parameters are ignored.
MF_STRING	Specifies that the menu item is a character string; the *lpNewItem* parameter points to the string for the menu item.
MF_UNCHECKED	Does not select (place a check mark next to) the menu item. No check mark is the default condition if neither **MF_CHECKED** nor **MF_UNCHECKED** is set. If the application has supplied check-mark bitmaps (see the **SetMenuItemBitmaps** function), setting this flag displays the "check mark off" bitmap next to the menu item.

See Also

CheckMenuItem, **DrawMenuBar**, **EnableMenuItem**, **SetMenuItemBitmaps**

MoveWindow (2.x)

BOOL MoveWindow(*hwnd, nLeft, nTop, nWidth, nHeight, fRepaint***)**

```
HWND hwnd;      /* handle of window */
int nLeft;      /* left coordinate  */
int nTop;       /* top coordinate   */
int nWidth;     /* width            */
int nHeight;    /* height           */
BOOL fRepaint;  /* repaint flag     */
```

The **MoveWindow** function changes the position and dimensions of a window. For top-level windows, the position and dimensions are relative to the upper-left corner of the screen. For child windows, they are relative to the upper-left corner of the parent window's client area.

Parameter	Description
hwnd	Identifies the window to be changed.
nLeft	Specifies the new position of the left side of the window.
nTop	Specifies the new position of the top of the window.
nWidth	Specifies the new width of the window.
nHeight	Specifies the new height of the window.
fRepaint	Specifies whether the window is to be repainted. If this parameter is TRUE, the window receives a **WM_PAINT** message as usual. If this parameter is FALSE, no repainting of any kind occurs. This applies to the client area, the non-client area (including the title and scroll bars), and any part of the parent window uncovered as a result of the moved window. When this parameter is FALSE, the application must explicitly invalidate or redraw any parts of the window and parent window that must be redrawn.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **MoveWindow** function sends a **WM_GETMINMAXINFO** message to the window being moved, giving it an opportunity to modify the default values for the largest and smallest possible windows. If the **MoveWindow** parameters exceed these values, they will be replaced by the minimum or maximum values specified in the WM_GETMINMAXINFO message.

Example

The following example changes the dimensions of a child window in response to a **WM_SIZE** message. In this example, the child window would always fill the client area of the parent window.

```
case WM_SIZE:
    MoveWindow(hwndChild, 0, 0, LOWORD(lParam), HIWORD(lParam),
        TRUE);
    break;
```

See Also

ClientToScreen, **GetWindowRect**, **ScreenToClient**, **SetWindowPos**, **WM_GETMINMAXINFO**, **WM_SIZE**

Windows 3.1 changes

For Windows version 3.0 applications, the **MoveWindow** function always paints the frame and erases the background of top-level windows, regardless of the setting of the *fRepaint* parameter.

OffsetRect (2.x)

void OffsetRect(*lprc, x, y***)**

```
RECT FAR* lprc;     /* address of structure with rectangle */
int x;              /* horizontal offset                   */
int y;              /* vertical offset                     */
```

The **OffsetRect** function moves the given rectangle by the specified offsets.

Parameter	Description
lprc	Points to a **RECT** structure that contains the coordinates of the rectangle to be moved.
x	Specifies the amount to move left or right. It must be negative to move left.
y	Specifies the amount to move up or down. It must be negative to move up.

Returns

This function does not return a value.

Comments

The coordinate values of a rectangle must not be greater than 32,767 or less than -32,768. The *x* and *y* parameters must be chosen carefully to prevent invalid rectangles.

See Also

InflateRect, **IntersectRect**, **UnionRect**, **RECT**

OpenClipboard (2.x)

BOOL OpenClipboard(*hwnd***)**

HWND *hwnd;* /* handle of window to associate ownership with */

The **OpenClipboard** function opens the clipboard. Other applications will not be able to modify the clipboard until the **CloseClipboard** function is called.

Parameter	Description
hwnd	Identifies the window to be associated with the open clipboard.

Returns

The return value is nonzero if the function is successful. It is zero if another application or window has the clipboard opened.

Comments

The window identified by the *hwnd* parameter will not become the owner of the clipboard until the **EmptyClipboard** function is called.

See Also

CloseClipboard, **EmptyClipboard**

OpenComm (2.x)

int OpenComm(*lpszDevControl, cbInQueue, cbOutQueue***)**

```
LPCSTR lpszDevControl;      /* address of device-control information */
UINT cbInQueue;             /* size of receiving queue               */
UINT cbOutQueue;            /* size of transmission queue            */
```

The **OpenComm** function opens a communications device.

Parameter	Description
lpszDevControl	Points to a null-terminated string that specifies the device in the form COM*n* or LPT*n,* where *n* is the device number.
cbInQueue	Specifies the size, in bytes, of the receiving queue. This parameter is ignored for LPT devices.
cbOutQueue	Specifies the size, in bytes, of the transmission queue. This parameter is ignored for LPT devices.

Returns

The return value identifies the open device if the function is successful. Otherwise, it is less than zero.

Errors

If the function fails, it may return one of the following error values:

Value	Meaning
IE_BADID	The device identifier is invalid or unsupported.
IE_BAUDRATE	The device's baud rate is unsupported.
IE_BYTESIZE	The specified byte size is invalid.
IE_DEFAULT	The default parameters are in error.
IE_HARDWARE	The hardware is not available (is locked by another device).
IE_MEMORY	The function cannot allocate the queues.
IE_NOPEN	The device is not open.
IE_OPEN	The device is already open.

If this function is called with both queue sizes set to zero, the return value is **IE_OPEN** if the device is already open or **IE_MEMORY** if the device is not open.

Comments

Windows allows COM ports 1 through 9 and LPT ports 1 through 3. If the device driver does not support a communications port number, the **OpenComm** function will fail.

The communications device is initialized to a default configuration. The **SetCommState** function should be used to initialize the device to alternate values.

The receiving and transmission queues are used by interrupt-driven device drivers. LPT ports are not interrupt driven--for these ports, the *cbInQueue* and *cbOutQueue* parameters are ignored and the queue size is set to zero.

Example

The following example uses the **OpenComm** function to open communications port 1:

```
idComDev = OpenComm("COM1", 1024, 128);
if (idComDev < 0) {
    ShowError(idComDev, "OpenComm");
    return 0;
}
```

```
err = BuildCommDCB("COM1:9600,n,8,1", &dcb);
if (err < 0) {
    ShowError(err, "BuildCommDCB");
    return 0;
}

err = SetCommState(&dcb);
if (err < 0) {
    ShowError(err, "SetCommState");
    return 0;
}
```

See Also
CloseComm, **SetCommState**

IE_BADID (-1)

The device identifier is invalid or unsupported.

IE_BADID (-1)

IE_BAUDRATE (-12)

The device's baud rate is unsupported.

IE_BAUDRATE (-12)

IE_BYTESIZE (-11)

The specified byte size is invalid.

IE_BYTESIZE (-11)

IE_DEFAULT (-5)

The default parameters are in error.

IE_DEFAULT (-5)

IE_HARDWARE (-10)

The hardware is not available (is locked by another device).

IE_HARDWARE (-10)

IE_MEMORY (-4)

The function cannot allocate the queues.

IE_MEMORY (-4)

IE_NOPEN (-3)

The device is not open.

IE_NOPEN (-3)

IE_OPEN (-2)

The device is already open.

IE_OPEN (-2)

OpenDriver (3.1)

HDRVR OpenDriver(*lpDriverName, lpSectionName, lParam***)**

```
LPCSTR lpDriverName;        /* address of driver name                */
LPCSTR lpSectionName;       /* address of .INI file section name     */
LPARAM lParam;              /* address of driver-specific information */
```

The **OpenDriver** function performs necessary initialization operations such as setting members in installable-driver structures to their default values.

Parameter	Description
lpDriverName	Points to a null-terminated string that specifies the name of an installable driver.
lpSectionName	Points to a null-terminated string that specifies the name of a section in the SYSTEM.INI file.
lParam	Specifies driver-specific information.

Returns

The return value is a handle of the installable driver, if the function is successful. Otherwise it is NULL.

Comments

The string to which *lpDriverName* points must be identical to the name of the installable driver as it appears in the SYSTEM.INI file.

If the name of the installable driver appears in the [driver] section of the SYSTEM.INI file, the string pointed to by *lpSectionName* should be NULL. Otherwise this string should specify the name of the section in SYSTEM.INI that contains the driver name.

When an application opens a driver for the first time, Windows calls the **DriverProc** function with the **DRV_LOAD**, **DRV_ENABLE**, and **DRV_OPEN** messages. When subsequent instances of the driver are opened, only DRV_OPEN is sent.

The value specified in the *lParam* parameter is passed to the *lParam2* parameter of the **DriverProc** function.

See Also

CloseDriver, **DriverProc**

OpenIcon (2.x)

BOOL OpenIcon(*hwnd***)**

HWND *hwnd;* /* handle of window */

The **OpenIcon** function activates and displays a minimized window. Windows restores the window to its original size and position.

Parameter	Description
hwnd	Identifies the window.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
Using **OpenIcon** is the same as specifying the SW_SHOWNORMAL flag in a call to the **ShowWindow** function.

See Also
CloseWindow, **IsIconic**, **ShowWindow**

PeekMessage (2.x)

BOOL PeekMessage(*lpmsg, hwnd, uFilterFirst, uFilterLast, fuRemove***)**

```
MSG FAR* lpmsg;     /* address of structure for message */
HWND hwnd;          /* handle of filter window          */
UINT uFilterFirst;  /* first message                    */
UINT uFilterLast;   /* last message                     */
UINT fuRemove;      /* removal flags                    */
```

The **PeekMessage** function checks the application's message queue for a message and places the message (if any) in the specified **MSG** structure.

Parameter	Description
lpmsg	Points to an **MSG** structure that will receive message information from the application's message queue.
hwnd	Identifies the window whose messages are to be examined.
uFilterFirst	Specifies the value of the first message in the range of messages to be examined.
uFilterLast	Specifies the value of the last message in the range of messages to be examined.
fuRemove	Specifies how messages are handled. This parameter can be a combination of the following values (**PM_NOYIELD** can be combined with either **PM_NOREMOVE** or **PM_REMOVE**):

Value	Meaning
PM_NOREMOVE	Messages are not removed from the queue after processing by **PeekMessage**.
PM_NOYIELD	Prevents the current task from halting and yielding system resources to another task.
PM_REMOVE	Messages are removed from the queue after processing by **PeekMessage**.

Returns

The return value is nonzero if a message is available. Otherwise, it is zero.

Comments

Unlike the **GetMessage** function, the **PeekMessage** function does not wait for a message to be placed in the queue before returning. **PeekMessage** yields control to other tasks, unless the **PM_NOYIELD** flag is set. However, if there is a **WM_TIMER** message pending, **PeekMessage** will yield regardless of the PM_NOYIELD flag.

PeekMessage retrieves only messages associated with the window identified by the *hwnd* parameter, or any of its children as specified by the **IsChild** function, and within the range of message values given by the *uFilterFirst* and *uFilterLast* parameters. If *hwnd* is NULL, **PeekMessage** retrieves messages for any window that belongs to the application making the call. (**PeekMessage** does not retrieve messages for windows that belong to other applications.) If *uFilterFirst* and *uFilterLast* are both zero, **PeekMessage** returns all available messages (no range filtering is performed).

The WM_KEYFIRST and WM_KEYLAST flags can be used as filter values to retrieve all key messages; the WM_MOUSEFIRST and WM_MOUSELAST flags can be used to retrieve all mouse messages.

PeekMessage does not remove **WM_PAINT** messages from the queue. The messages remain in the queue until processed. The **GetMessage**, **PeekMessage**, and **WaitMessage** functions yield control to other applications. These calls provide the only way to let other applications run. If your application does not call any of these functions for long periods of time, other applications cannot run.

As long as an application is in a **PeekMessage** loop, Windows cannot become idle. Therefore, an application should not remain in a **PeekMessage** loop after the application's background processing has

completed.

When an application uses the **PeekMessage** function without removing the message and then calls the **WaitMessage** function, **WaitMessage** does not return until the message is received. Applications that use the **PeekMessage** function should remove any retrieved messages from the queue before calling **WaitMessage**.

Example

The following example checks the message queue for keystrokes that have special meaning to the application. Note that the CheckSpecialKeys function is application-defined.

```
MSG msg;
BOOL fRetVal = TRUE;

while (PeekMessage(&msg, NULL, 0, 0, PM_REMOVE)) {

    if (msg.message == WM_QUIT)
        fRetVal = FALSE;

    if (CheckSpecialKeys(&msg)) /* application defined */
        continue;

    TranslateMessage(&msg);
    DispatchMessage(&msg);
}
return fRetVal;
```

See Also

GetMessage, **IsChild**, **PostAppMessage**, **SetMessageQueue**, **WaitMessage**

Corrections

Previous documentation incorrectly stated that a -1 could be used for the *hwnd* parameter. This parameter can only be NULL or a valid window handle.

PM_NOREMOVE 0x0000

Messages are not removed from the queue after processing by **PeekMessage**.

PM_NOREMOVE 0x0000

PM_NOYIELD 0x0002

Prevents the current task from halting and yielding system resources to another task.

PM_NOYIELD 0x0002

PM_REMOVE 0x0001

Messages are removed from the queue after processing by **PeekMessage**.

PM_REMOVE 0x0001

PostAppMessage (2.x)

BOOL PostAppMessage(*htask, uMsg, wParam, lParam***)**

```
HTASK htask;        /* handle of task to receive message */
UINT uMsg;          /* message to post                   */
WPARAM wParam;      /* first message parameter           */
LPARAM lParam;      /* second message parameter          */
```

The **PostAppMessage** function posts (places) a message in the message queue of the given application (task) and then returns without waiting for the application to process the message. The application to which the message is posted retrieves the message by calling the **GetMessage** or **PeekMessage** function. The **hwnd** member of the returned **MSG** structure is NULL.

Parameter	Description
htask	Identifies the task to which the message is posted. The **GetCurrentTask** function returns this handle.
uMsg	Specifies the type of message to be posted.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also

GetCurrentTask, **GetMessage**, **PeekMessage**, **PostMessage**, **MSG**

PostMessage (2.x)

BOOL PostMessage(*hwnd, uMsg, wParam, lParam***)**

```
HWND hwnd;      /* handle of the destination window */
UINT uMsg;      /* message to post                  */
WPARAM wParam;  /* first message parameter          */
LPARAM lParam;  /* second message parameter         */
```

The **PostMessage** function posts (places) a message in a window's message queue and then returns without waiting for the corresponding window to process the message. Messages in a message queue are retrieved by calls to the **GetMessage** or **PeekMessage** function.

Parameter	Description
hwnd	Identifies the window to which the message will be posted. If this parameter is HWND_BROADCAST, the message will be posted to all top-level windows, including disabled or invisible unowned windows.
uMsg	Specifies the message to be posted.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

An application should never use the **PostMessage** function to post a message to a control.

If the message is being posted to another application, and the *wParam* or *lParam* parameters are used to pass a handle or pointer to a global memory object, the memory should be allocated by the **GlobalAlloc** function, using the **GMEM_SHARE** flag.

The **PostMessage** function fails if the message queue for the receiving application is full. This is especially likely if an application posts several messages without allowing the receiving task to run. The **GetMessage**, **PeekMessage**, and **WaitMessage** functions yield control to other applications.

See Also

GetMessage, **PeekMessage**, **PostAppMessage**, **SendDlgItemMessage**, **SendMessage**

Windows 3.1 changes

In Windows 3.0, specifying a window handle of -1 would not send the message to disabled or invisible unowned windows. In Windows 3.1, if a window handle of HWND_BROADCAST (-1) is specified, the message is sent to diabled or invisible unowned windows.

PostQuitMessage (2.x)

void PostQuitMessage(*nExitCode***)**

int *nExitCode;* /* exit code */

The **PostQuitMessage** function posts a message to Windows indicating that an application is requesting to terminate execution (quit). This function is typically used in response to a **WM_DESTROY** message.

Parameter	Description
nExitCode	Specifies an application-defined exit code. It must be the *wParam* parameter of the **WM_QUIT** message.

Returns

This function does not return a value.

Comments

The **PostQuitMessage** function posts a **WM_QUIT** message to the application and returns immediately; the function simply indicates to the system that the application will request to quit some time in the future.

When the application receives the **WM_QUIT** message, it should exit the message loop in the main function and return control to Windows.

See Also

GetMessage, **WM_DESTROY**, **WM_QUIT**

PtInRect (2.x)

BOOL PtInRect(*lprc, pt***)**

```
const RECT FAR* lprc;      /* address of structure with rectangle */
POINT pt;                  /* structure with point                 */
```

The **PtInRect** function determines whether the specified point lies within a given rectangle. A point is within a rectangle if it lies on the left or top side or is within all four sides. A point on the right or bottom side is considered outside the rectangle.

Parameter	Description
lprc	Points to a **RECT** structure that contains the specified rectangle.
pt	Specifies a **POINT** structure that contains the specified point.

Returns

The return value is nonzero if the point lies within the given rectangle. Otherwise, it is zero.

See Also

EqualRect, **IsRectEmpty**, **POINT**, **RECT**

QuerySendMessage (3.1)

BOOL QuerySendMessage(*hreserved1, hreserved2, hreserved3, lpMessage***)**

HANDLE *hreserved1;*
HANDLE *hreserved2;*
HANDLE *hreserved3;*
LPMSG *lpMessage;* /* address of structure for message */

The **QuerySendMessage** function determines whether a message sent by **SendMessage** originated from within the current task. If the message is an intertask message, **QuerySendMessage** puts it into the specified **MSG** structure.

Parameter	Description
hreserved1	Reserved; must be NULL.
hreserved2	Reserved; must be NULL.
hreserved3	Reserved; must be NULL.
lpMessage	Specifies the **MSG** structure in which to place an intertask message.

Returns
The return value is zero if the message originated within the current task. Otherwise, it is nonzero.

Comments
If the Windows debugger is entering soft mode, the application being debugged should reply to intertask messages by using the **ReplyMessage** function.

The NULL parameters are reserved for future use.

See Also
SendMessage, **ReplyMessage**, **MSG**

ReadComm (2.x)

int ReadComm(*idComDev, lpvBuf, cbRead***)**

```
int idComDev;       /* identifier of device to read from  */
void FAR* lpvBuf;   /* address of buffer for read bytes */
int cbRead;         /* number of bytes to read          */
```

The **ReadComm** function reads up to a specified number of bytes from the given communications device.

Parameter	Description
idComDev	Specifies the communications device to be read from. The **OpenComm** function returns this value.
lpvBuf	Points to the buffer for the read bytes.
cbRead	Specifies the number of bytes to be read.

Returns

The return value is the number of bytes read, if the function is successful. Otherwise, it is less than zero and its absolute value is the number of bytes read.

For parallel I/O ports, the return value is always zero.

Comments

When an error occurs, the cause of the error can be determined by using the **GetCommError** function to retrieve the error value and status. Since errors can occur when no bytes are present, if the return value is zero, the **GetCommError** function should be used to ensure that no error occurred.

The return value is less than the number specified by the *cbRead* parameter only if the number of bytes in the receiving queue is less than that specified by *cbRead.* If the return value is equal to *cbRead,* additional bytes may be queued for the device. If the return value is zero, no bytes are present.

See Also

GetCommError, **OpenComm**

RealizePalette (3.0)

UINT RealizePalette(*hdc***)**

HDC *hdc;* /* handle of device context */

The **RealizePalette** function maps palette entries from the current logical palette to the system palette.

Parameter	Description
hdc	Identifies the device context containing a logical palette.

Returns

The return value indicates how many entries in the logical palette were mapped to different entries in the system palette. This represents the number of entries that this function remapped to accommodate changes in the system palette since the logical palette was last realized.

Comments

A logical color palette acts as a buffer between color-intensive applications and the system, allowing an application to use as many colors as necessary without interfering with either its own displayed color or with colors displayed by other windows. When a window has the input focus and calls the **RealizePalette** function, Windows ensures that the window will display all the requested colors (up to the maximum number simultaneously available on the screen) and Windows displays additional colors by matching them to available colors. In addition, Windows matches the colors requested by inactive windows that call **RealizePalette** as closely as possible to the available colors. This significantly reduces undesirable changes in the colors displayed in inactive windows.

Example

The following example uses the **SelectPalette** function to select a palette into a device context and then calls the **RealizePalette** function to map the colors to the system palette:

```
HPALETTE hpal, hPalPrevious;

hdc = GetDC(hwnd);

hPalPrevious = SelectPalette(hdc, hpal, FALSE);
if (RealizePalette(hdc) == NULL)
    MessageBox(hwnd, "Can't realize palette", "Error", MB_OK);

ReleaseDC(hwnd, hdc);
```

See Also

SelectPalette, **WM_PALETTECHANGED**

RedrawWindow (3.1)

BOOL RedrawWindow(*hwnd, lprcUpdate, hrgnUpdate, fuRedraw***)**

```
HWND hwnd;                      /* handle of window                    */
const RECT FAR* lprcUpdate;     /* address of structure with update rect.*/
HRGN hrgnUpdate;                /* handle of update region             */
UINT fuRedraw;                  /* redraw flags                        */
```

The **RedrawWindow** function updates the specified rectangle or region in the given window's client area.

Parameter	Description
hwnd	Identifies the window to be redrawn. If this parameter is NULL, the desktop window is updated.
lprcUpdate	Points to a **RECT** structure containing the coordinates of the update rectangle. This parameter is ignored if the *hrgnUpdate* parameter contains a valid region handle.
hrgnUpdate	Identifies the update region. If both the *hrgnUpdate* and *lprcUpdate* parameters are NULL, the entire client area is added to the update region.
fuRedraw	Specifies one or more redraw flags. This parameter can be a combination of flags: The following flags are used to invalidate the window:

Value	Meaning
RDW_ERASE	Causes the window to receive a **WM_ERASEBKGND** message when the window is repainted. The **RDW_INVALIDATE** flag must also be specified; otherwise, **RDW_ERASE** has no effect.
RDW_FRAME	Causes any part of the non-client area of the window that intersects the update region to receive a **WM_NCPAINT** message. The **RDW_INVALIDATE** flag must also be specified; otherwise, **RDW_FRAME** has no effect. The WM_NCPAINT message is typically not sent during the execution of the **RedrawWindow** function unless either **RDW_UPDATENOW** or **RDW_ERASENOW** is specified.
RDW_INTERNALPAINT	Causes a **WM_PAINT** message to be posted to the window regardless of whether the window contains an invalid region.
RDW_INVALIDATE	Invalidate *lprcUpdate* or *hrgnUpdate* (only one may be non-NULL). If both are NULL, the entire window is invalidated.

The following flags are used to validate the window:

Value	Meaning
RDW_NOERASE	Suppresses any pending **WM_ERASEBKGND** messages.
RDW_NOFRAME	Suppresses any pending **WM_NCPAINT** messages. This flag must be used with **RDW_VALIDATE** and is typically used with RDW_NOCHILDREN. This option should be used with care, as it could cause parts of a window from painting properly.
RDW_NOINTERNALPAINT	Suppresses any pending internal **WM_PAINT** messages. This flag does not affect WM_PAINT

	messages resulting from invalid areas.
RDW_VALIDATE	Validates *lprcUpdate* or *hrgnUpdate* (only one may be non-NULL). If both are NULL, the entire window is validated. This flag does not affect internal **WM_PAINT** messages.

The following flags control when repainting occurs. No painting is performed by the **RedrawWindow** function unless one of these bits is specified.

Value	Meaning
RDW_ERASENOW	Causes the affected windows (as specified by the **RDW_ALLCHILDREN** and **RDW_NOCHILDREN** flags) to receive **WM_NCPAINT** and **WM_ERASEBKGND** messages, if necessary, before the function returns. **WM_PAINT** messages are deferred.
RDW_UPDATENOW	Causes the affected windows (as specified by the **RDW_ALLCHILDREN** and **RDW_NOCHILDREN** flags) to receive **WM_NCPAINT**, **WM_ERASEBKGND**, and **WM_PAINT** messages, if necessary, before the function returns.

By default, the windows affected by the **RedrawWindow** function depend on whether the specified window has the **WS_CLIPCHILDREN** style. The child windows of WS_CLIPCHILDREN windows are not affected; however, non-WS_CLIPCHILDREN windows are recursively validated or invalidated until a WS_CLIPCHILDREN window is encountered. The following flags control which windows are affected by the **RedrawWindow** function:

Value	Meaning
RDW_ALLCHILDREN	Includes child windows, if any, in the repainting operation.
RDW_NOCHILDREN	Excludes child windows, if any, from the repainting operation.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

When the **RedrawWindow** function is used to invalidate part of the desktop window, the desktop window does not receive a **WM_PAINT** message. To repaint the desktop, an application should use the **RDW_ERASE** flag to generate a **WM_ERASEBKGND** message.

See Also

GetUpdateRect, **GetUpdateRgn**, **InvalidateRect**, **InvalidateRgn**, **UpdateWindow**, **WM_ERASEBKGND**, **WM_PAINT**

RDW_ERASE 0x0004

Causes the window to receive a **WM_ERASEBKGND** message when the window is repainted. The **RDW_INVALIDATE** flag must also be specified; otherwise, RDW_ERASE has no effect.

RDW_ERASE 0x0004

RDW_FRAME 0x0400

Causes any part of the non-client area of the window that intersects the update region to receive a **WM_NCPAINT** message. The **RDW_INVALIDATE** flag must also be specified; otherwise, RDW_FRAME has no effect. The WM_NCPAINT message is typically not sent during the execution of the **RedrawWindow** function unless either **RDW_UPDATENOW** or **RDW_ERASENOW** is specified.

RDW_FRAME 0x0400

RDW_INTERNALPAINT 0x0002

Causes a **WM_PAINT** message to be posted to the window regardless of whether the window contains an invalid region.

RDW_INTERNALPAINT 0x0002

RDW_INVALIDATE 0x0001

Invalidate *lprcUpdate* or *hrgnUpdate* (only one may be non-NULL). If both are NULL, the entire window is invalidated.

RDW_INVALIDATE 0x0001

RDW_NOERASE 0x0020

Suppresses any pending **WM_ERASEBKGND** messages.

RDW_NOERASE 0x0020

RDW_NOFRAME 0x0800

Suppresses any pending **WM_NCPAINT** messages. This flag must be used with **RDW_VALIDATE** and is typically used with RDW_NOCHILDREN. This option should be used with care, as it could cause parts of a window from painting properly.

RDW_NOFRAME 0x0800

RDW_NOINTERNALPAINT 0x0010

Suppresses any pending internal **WM_PAINT** messages. This flag does not affect WM_PAINT messages resulting from invalid areas.

RDW_NOINTERNALPAINT 0x0010

RDW_VALIDATE 0x0008

Validates *lprcUpdate* or *hrgnUpdate* (only one may be non-NULL). If both are NULL, the entire window is validated. This flag does not affect internal **WM_PAINT** messages.

RDW_VALIDATE 0x0008

RDW_ERASENOW 0x0200

Causes the affected windows (as specified by the **RDW_ALLCHILDREN** and **RDW_NOCHILDREN** flags) to receive **WM_NCPAINT** and **WM_ERASEBKGND** messages, if necessary, before the function returns. **WM_PAINT** messages are deferred.

RDW_ERASENOW 0x0200

RDW_UPDATENOW 0x0100

Causes the affected windows (as specified by the **RDW_ALLCHILDREN** and **RDW_NOCHILDREN** flags) to receive **WM_NCPAINT**, **WM_ERASEBKGND**, and **WM_PAINT** messages, if necessary, before the function returns.

RDW_UPDATENOW 0x0100

RDW_ALLCHILDREN 0x0080

Includes child windows, if any, in the repainting operation.

RDW_ALLCHILDREN 0x0080

RDW_NOCHILDREN 0x0040

Excludes child windows, if any, from the repainting operation.

RDW_NOCHILDREN 0x0040

RegisterClass (2.x)

ATOM RegisterClass(*lpwc***)**

const WNDCLASS FAR* *lpwc;* /* address of structure with class data */

The **RegisterClass** function registers a window class for subsequent use in calls to the **CreateWindow** or **CreateWindowEx** function.

Parameter	Description
lpwc	Points to a **WNDCLASS** structure. The structure must be filled with the appropriate class attributes before being passed to the function.

Returns

The return value is an atom that uniquely identifies the class being registered. For Windows versions 3.0 and earlier, the return value is nonzero if the function is successful or zero if an error occurs.

Comments

An application cannot register a global class if either a global class or a task-specific class already exists with the given name.

An application can register a task-specific class with the same name as a global class. The task-specific class overrides the global class for the current task only. A task cannot register two local classes with the same name. However, two different tasks can register task-specific classes using the same name.

Example

The following example registers a window class, then creates a window of that class:

```
WNDCLASS wc;
HINSTANCE hinst;
char szMyClass[] = "MyClass";
HWND hwndMyWindow;

/* Register the window class. */

wc.style         = 0;
wc.lpfnWndProc   = MyWndProc;
wc.cbClsExtra    = 0;
wc.cbWndExtra    = 0;
wc.hInstance     = hinst;
wc.hIcon         = LoadIcon(hinst, "MyIcon");
wc.hCursor       = LoadCursor(NULL, IDC_ARROW);
wc.hbrBackground = (HBRUSH) (COLOR_WINDOW + 1);
wc.lpszMenuName  = NULL;
wc.lpszClassName = szMyClass;

if (!RegisterClass(&wc))
    return FALSE;

/* Create the window. */

hwndMyWindow = CreateWindow(szMyClass, "MyApp",
    WS_OVERLAPPED | WS_SYSMENU, CW_USEDEFAULT, 0,
    CW_USEDEFAULT, 0, NULL, NULL,
    hinst, NULL );
```

See Also

CreateWindow, **CreateWindowEx**, **GetClassInfo**, **GetClassName**, **UnregisterClass**, **WindowProc**,

WNDCLASS

Windows 3.1 changes

The **RegisterClass** function returns an atom that uniquely identifies the class being registered. For Windows version 3.0 and earlier, the return value is nonzero if the function is successful or zero if an error occurs.

RegisterClipboardFormat (2.x)

UINT RegisterClipboardFormat(*lpszFormatName***)**

LPCSTR *lpszFormatName;* /* address of name string */

The **RegisterClipboardFormat** function registers a new clipboard format. The registered format can be used in subsequent clipboard functions as a valid format in which to render data, and it will appear in the clipboard's list of formats.

Parameter	Description
lpszFormatName	Points to a null-terminated string that names the new format.

Returns

The return value indicates the newly registered format. If the identical format name has been registered before, even by a different application, the format's reference count is incremented (increased by one) and the same value is returned as when the format was originally registered. The return value is zero if the format cannot be registered.

Comments

The format value returned by the **RegisterClipboardFormat** function is within the range 0xC000 through 0xFFFF.

See Also

CountClipboardFormats, **EnumClipboardFormats**, **GetClipboardFormatName**, **GetPriorityClipboardFormat**, **IsClipboardFormatAvailable**

RegisterWindowMessage (2.x)

UINT RegisterWindowMessage(*lpsz***)**

LPCSTR *lpsz;* /* address of message string */

The **RegisterWindowMessage** function defines a new window message that is guaranteed to be unique throughout the system. The returned message value can be used when calling the **SendMessage** or **PostMessage** function.

Parameter	Description
lpsz	Points to a null-terminated string that specifies the message to be registered.

Returns

The return value is an unsigned short integer in the range 0xC000 through 0xFFFF if the message is successfully registered. Otherwise, the return value is 0.

Comments

RegisterWindowMessage is typically used to register messages for communicating between two cooperating applications.

If two different applications register the same message string, the applications return the same message value. The message remains registered until the Windows session ends.

Use the **RegisterWindowMessage** function only when more than one application must process the same message. For sending private messages within a window class, an application can use any integer in the range **WM_USER** through 0x7FFF. (Messages in this range are private to a window class, not to an application. For example, such predefined control classes as BUTTON, EDIT, **LISTBOX**, and **COMBOBOX** may use values in this range.)

See Also

PostAppMessage, **PostMessage**, **SendMessage**

ReleaseCapture (2.x)

void ReleaseCapture(void)

The **ReleaseCapture** function releases the mouse capture and restores normal input processing. A window with the mouse capture receives all mouse input regardless of the position of the cursor.

Returns
This function does not return a value.

Comments
An application calls this function after calling the **SetCapture** function.

See Also
SetCapture

ReleaseDC (2.x)

int ReleaseDC(*hwnd, hdc***)**

```
HWND hwnd;      /* handle of window with device context */
HDC hdc;        /* handle of device context             */
```

The **ReleaseDC** function releases the given device context, freeing it for use by other applications.

Parameter	Description
hwnd	Identifies the window whose device context is to be released.
hdc	Identifies the device context to be released.

Returns

The return value is 1 if the function is successful. Otherwise, it is 0.

Comments

The effect of **ReleaseDC** depends on the type of device context. It frees only common and window device contexts. It has no effect on class or private device contexts.

The application must call the **ReleaseDC** function for each call to the **GetWindowDC** function and for each call to the **GetDC** function that retrieves a common device context.

See Also

BeginPaint, **EndPaint**, **GetDC**, **GetWindowDC**

RemoveMenu (3.0)

BOOL RemoveMenu(*hmenu, idItem, fuFlags***)**

```
HMENU hmenu;      /* handle of menu      */
UINT idItem;      /* menu item to delete */
UINT fuFlags;     /* menu flags          */
```

The **RemoveMenu** function deletes a menu item with an associated pop-up menu from a menu but does not destroy the handle of the pop-up menu, allowing the menu to be reused. Before calling this function, an application should call the **GetSubMenu** function to retrieve the pop-up menu handle.

Parameter	Description
hmenu	Identifies the menu to be changed.
idItem	Specifies the menu item to be removed, as determined by the *fuFlags* parameter.
fuFlags	Specifies how the *idItem* parameter is to be interpreted. This parameter can be one of the following values:

Value	Meaning
MF_BYCOMMAND	The *idItem* parameter specifies the menu-item identifier.
MF_BYPOSITION	The *idItem* parameter specifies the zero-based position of the menu item.

Returns

The return value is nonzero if the function is successful. Otherwise it is zero.

Comments

Whenever a menu changes (whether or not it is in a window that is displayed), the application should call the **DrawMenuBar** function.

See Also

AppendMenu, **CreateMenu**, **DeleteMenu**, **DrawMenuBar**, **GetSubMenu**, **InsertMenu**

RemoveProp (2.x)

HANDLE RemoveProp(*hwnd, lpsz***)**

HWND *hwnd;* /* handle of window */
LPCSTR *lpsz;* /* atom or address of string */

The **RemoveProp** function removes an entry from the property list of the given window. The **RemoveProp** function returns a data handle so that the application can free the data associated with the handle.

Parameter	Description
hwnd	Identifies the window whose property list is to be changed.
lpsz	Points to a null-terminated string or an atom that identifies a string. If an atom is given, it must be a global atom created by a previous call to the **GlobalAddAtom** function. The atom, a 16-bit value, must be placed in the low-order word of this parameter; the high-order word must be zero.

Returns

The return value is the handle of the given string if the function is successful. Otherwise, it is NULL--for example, if the string cannot be found in the given property list.

Comments

An application can remove only those properties it has added. It should not remove properties added by other applications or by Windows itself.

An application must free the data handles associated with entries removed from a property list. The application should remove only those properties it added to the property list.

See Also

GetProp, **GlobalAddAtom**

ReplyMessage (2.x)

void ReplyMessage(*lResult***)**

LRESULT *lResult;* /* message-dependent reply */

The **ReplyMessage** function is used to reply to a message sent through the **SendMessage** function without returning control to the function that called **SendMessage**.

Parameter	Description
lResult	Specifies the result of the message processing. The possible values depend on the message sent.

Returns

This function does not return a value.

Comments

By calling this function, the window procedure that receives the message allows the task that called **SendMessage** to continue to run as though the task that received the message had returned control. The task that calls **ReplyMessage** also continues to run.

Usually, a task that calls **SendMessage** to send a message to another task will not continue running until the window procedure that Windows calls to receive the message returns. However, if a task that is called to receive a message must perform some type of operation that might yield control (such as calling the **MessageBox** or **DialogBox** function), Windows could be deadlocked, as when the sending task must run and process messages but cannot because it is waiting for **SendMessage** to return. An application can avoid this problem if the task receiving the message calls **ReplyMessage** before performing any operation that could cause the task to yield.

The **ReplyMessage** function has no effect if the message was not sent through the **SendMessage** function or if the message was sent by the same task.

See Also

DialogBox, **MessageBox**, **SendMessage**

ScreenToClient (2.x)

void ScreenToClient(*hwnd, lppt***)**

HWND *hwnd;* /* window handle for source coordinates */
POINT FAR* *lppt;* /* address of structure with coordinates */

The **ScreenToClient** function converts the screen coordinates of a given point on the screen to client coordinates.

Parameter	Description
hwnd	Identifies the window whose client area is to be used for the conversion.
lppt	Points to a **POINT** structure that contains the screen coordinates to be converted.

Returns
This function does not return a value.

Comments
The **ScreenToClient** function replaces the screen coordinates in the **POINT** structure with client coordinates. The new coordinates are relative to the upper-left corner of the given window's client area.

Example
The following example uses the **GetWindowRect** function to retrieve the screen coordinates for a specified window, calls the **ScreenToClient** function to convert the upper-left and lower-right corners of the window rectangle to client coordinates, and then reports the results in a message box:

```
RECT  rc;           /* window's screen coordinates      */
POINT ptUpperLeft;  /* client coordinate of upper left  */
POINT ptLowerRight; /* client coordinate of lower right */
char  szText[128];  /* char buffer for wsprintf         */

GetWindowRect(hwnd, &rc);

ptUpperLeft.x   = rc.left;
ptUpperLeft.y   = rc.top;
ptLowerRight.x  = rc.right;
ptLowerRight.y  = rc.bottom;

ScreenToClient(hwnd, &ptUpperLeft );
ScreenToClient(hwnd, &ptLowerRight);

wsprintf(szText,
    "S: (%d,%d)-(%d,%d) --> C: (%d,%d)-(%d,%d)",
    rc.left, rc.top, rc.right, rc.bottom,
    ptUpperLeft.x, ptUpperLeft.y, ptLowerRight.x, ptLowerRight.y);

MessageBox(hwnd, szText, "ScreenToClient", MB_OK);
```

See Also
ClientToScreen, **MapWindowPoints**, **POINT**

ScrollDC (2.x)

BOOL ScrollDC(*hdc, dx, dy, lprcScroll, lprcClip, hrgnUpdate, lprcUpdate***)**

```
HDC hdc;                        /* handle of device context              */
int dx;                         /* horizontal scroll units               */
int dy;                         /* vertical scroll units                 */
const RECT FAR* lprcScroll;     /* address of scrolling rectangle        */
const RECT FAR* lprcClip;       /* address of clipping rectangle         */
HRGN hrgnUpdate;                /* handle of scrolling region            */
RECT FAR* lprcUpdate;           /* address of structure for update rect. */
```

The **ScrollDC** function scrolls a rectangle of bits horizontally and vertically.

Parameter	Description
hdc	Identifies the device context that contains the bits to be scrolled.
dx	Specifies the number of horizontal scroll units.
dy	Specifies the number of vertical scroll units.
lprcScroll	Points to the **RECT** structure that contains the coordinates of the scrolling rectangle.
lprcClip	Points to the **RECT** structure that contains the coordinates of the clipping rectangle. When this rectangle is smaller than the original one pointed to by the *lprcScroll* parameter, scrolling occurs only in the smaller rectangle.
hrgnUpdate	Identifies the region uncovered by the scrolling process. The **ScrollDC** function defines this region; it is not necessarily a rectangle.
lprcUpdate	Points to the **RECT** structure that receives the coordinates of the rectangle that bounds the scrolling update region. This is the largest rectangular area that requires repainting. The values in the structure when the function returns are in client coordinates, regardless of the mapping mode for the given device context.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

If the *lprcUpdate* parameter is NULL, Windows does not compute the update rectangle. If both the *hrgnUpdate* and *lprcUpdate* parameters are NULL, Windows does not compute the update region. If *hrgnUpdate* is not NULL, Windows assumes that it contains a valid handle of the region uncovered by the scrolling process (defined by the **ScrollDC** function).

When the **ScrollDC** function returns, the values in the structure pointed to by the *lprcUpdate* parameter are in client coordinates. This allows applications to use the update region in a call to the **InvalidateRgn** function, if required.

An application should use the **ScrollWindow** function when it is necessary to scroll the entire client area of a window; otherwise, it should use **ScrollDC**.

See Also

InvalidateRgn, **ScrollWindow**, **ScrollWindowEx**, **RECT**

ScrollWindow (2.x)

void ScrollWindow(*hwnd, dx, dy, lprcScroll, lprcClip***)**

```
HWND hwnd;                      /* handle of window to scroll          */
int dx;                         /* amount of horizontal scrolling      */
int dy;                         /* amount of vertical scrolling        */
const RECT FAR* lprcScroll;     /* address of structure with scroll rect.*/
const RECT FAR* lprcClip;       /* address of structure with clip rect.  */
```

The **ScrollWindow** function scrolls the contents of a window's client area.

Parameter	Description
hwnd	Identifies the window to be scrolled.
dx	Specifies the amount, in device units, of horizontal scrolling. This parameter must be a negative value to scroll to the left.
dy	Specifies the amount, in device units, of vertical scrolling. This parameter must be a negative value to scroll up.
lprcScroll	Points to a **RECT** structure that specifies the portion of the client area to be scrolled. If this parameter is NULL, the entire client area is scrolled. The caret is repositioned if the cursor rectangle intersects the scroll rectangle.
lprcClip	Points to a **RECT** structure that specifies the clipping rectangle to scroll. This structure takes precedence over the rectangle pointed to by the *lprcScroll* parameter. Only bits inside this rectangle are scrolled. Bits outside this rectangle are not affected even if they are in the *lprcScroll* rectangle. If this parameter is NULL, no clipping is performed on the scroll rectangle.

Returns

This function does not return a value.

Comments

If the caret is in the window being scrolled, **ScrollWindow** automatically hides the caret to prevent it from being erased, then restores the caret after the scroll is finished. The caret position is adjusted accordingly if the caret rectangle intersects the scroll rectangle.

The area uncovered by the **ScrollWindow** function is not repainted, but it is combined into the window's update region. The application will eventually receive a **WM_PAINT** message notifying it that the region needs repainting. To repaint the uncovered area at the same time the scrolling is done, call the **UpdateWindow** function immediately after calling **ScrollWindow**.

If the *lprcScroll* parameter is NULL, the positions of any child windows in the window are offset by the amount specified by the *dx* and *dy* parameters, and any invalid (unpainted) areas in the window are also offset. **ScrollWindow** is faster when *lprcScroll* is NULL.

If the *lprcScroll* parameter is not NULL, the positions of child windows are not changed and invalid areas in the window are not offset. To prevent updating problems when *lprcScroll* is not NULL, call the **UpdateWindow** function to repaint the window before calling **ScrollWindow**.

See Also

ScrollDC, **ScrollWindowEx**, **UpdateWindow**, **RECT**

ScrollWindowEx (3.1)

int ScrollWindowEx(*hwnd, dx, dy, lprcScroll, lprcClip, hrgnUpdate, lprcUpdate, fuScroll***)**

```
HWND hwnd;                      /* handle of window to scroll          */
int dx;                         /* amount of horizontal scrolling      */
int dy;                         /* amount of vertical scrolling        */
const RECT FAR* lprcScroll;     /* address of structure with scroll rect. */
const RECT FAR* lprcClip;       /* address of structure with clip rect.   */
HRGN hrgnUpdate;                /* handle of update region             */
RECT FAR* lprcUpdate;           /* address of structure for update rect. */
UINT fuScroll;                  /* scrolling flags                     */
```

The **ScrollWindowEx** function scrolls the contents of a window's client area. This function is similar to the **ScrollWindow** function, with some additional features.

Parameter	Description
hwnd	Identifies the window to be scrolled.
dx	Specifies the amount, in device units, of horizontal scrolling. This parameter must be a negative value to scroll to the left.
dy	Specifies the amount, in device units, of vertical scrolling. This parameter must be a negative value to scroll up.
lprcScroll	Points to a **RECT** structure that specifies the portion of the client area to be scrolled. If this parameter is NULL, the entire client area is scrolled.
lprcClip	Points to a **RECT** structure that specifies the clipping rectangle to scroll. This structure takes precedence over the rectangle pointed to by the *lprcScroll* parameter. Only bits inside this rectangle are scrolled. Bits outside this rectangle are not affected even if they are in the *lprcScroll* rectangle. If this parameter is NULL, no clipping is performed on the scroll rectangle.
hrgnUpdate	Identifies the region that is modified to hold the region invalidated by scrolling. This parameter may be NULL.
lprcUpdate	Points to a **RECT** structure that will receive the boundaries of the rectangle invalidated by scrolling. This parameter may be NULL.
fuScroll	Specifies flags that control scrolling. This parameter can be one of the following values:

Value	Meaning
SW_ERASE	When specified with **SW_INVALIDATE**, erases the newly invalidated region by sending a **WM_ERASEBKGND** message to the window.
SW_INVALIDATE	Invalidates the region identified by the *hrgnUpdate* parameter after scrolling.
SW_SCROLLCHILDREN	Scrolls all child windows that intersect the rectangle pointed to by *lprcScroll* by the number of pixels specified in the *dx* and *dy* parameters. Windows sends a **WM_MOVE** message to all child windows that intersect *lprcScroll,* even if they do not move. The caret is repositioned when a child window is scrolled and the cursor rectangle intersects the scroll rectangle.

Returns

The return value is SIMPLEREGION (rectangular invalidated region), COMPLEXREGION (nonrectangular invalidated region; overlapping rectangles), or NULLREGION (no invalidated region), if the function is successful. Otherwise, the return value is ERROR.

Comments

If **SW_INVALIDATE** and **SW_ERASE** are not specified, **ScrollWindowEx** does not invalidate the area that is scrolled away from. If either of these flags is set, **ScrollWindowEx** invalidates this area. The area is not updated until the application calls the **UpdateWindow** function, calls the **RedrawWindow** function (specifying **RDW_UPDATENOW** or **RDW_ERASENOW**), or retrieves the **WM_PAINT** message from the application queue.

If the window has the **WS_CLIPCHILDREN** style, the returned areas specified by *hrgnUpdate* and *lprcUpdate* represent the total area of the scrolled window that must be updated, including any areas in child windows that need qupdating.

If the **SW_SCROLLCHILDREN** flag is specified, Windows will not properly update the screen if part of a child window is scrolled. The part of the scrolled child window that lies outside the source rectangle will not be erased and will not be redrawn properly in its new destination. Use the **DeferWindowPos** function to move child windows that do not lie completely within the *lprcScroll* rectangle. The cursor is repositioned if the SW_SCROLLCHILDREN flag is set and the caret rectangle intersects the scroll rectangle.

All input and output coordinates (for *lprcScroll, lprcClip, lprcUpdate,* and *hrgnUpdate*) are assumed to be in client coordinates, regardless of whether the window has the **CS_OWNDC** or **CS_CLASSDC** class style. Use the **LPtoDP** and **DPtoLP** functions to convert to and from logical coordinates, if necessary.

See Also

RedrawWindow, **ScrollDC**, **ScrollWindow**, **UpdateWindow**, **RECT**

SW_ERASE 0x0004

When specified with **SW_INVALIDATE**, erases the newly invalidated region by sending a **WM_ERASEBKGND** message to the window.

SW_ERASE 0x0004

SW_INVALIDATE 0x0002

Invalidates the region identified by the *hrgnUpdate* parameter after scrolling.

SW_INVALIDATE 0x0002

SW_SCROLLCHILDREN 0x0001

Scrolls all child windows that intersect the rectangle pointed to by *lprcScroll* by the number of pixels specified in the *dx* and *dy* parameters. Windows sends a **WM_MOVE** message to all child windows that intersect *lprcScroll,* even if they do not move. The caret is repositioned when a child window is scrolled and the cursor rectangle intersects the scroll rectangle.

SW_SCROLLCHILDREN 0x0001

SelectPalette (3.0)

HPALETTE SelectPalette(*hdc, hpal, fPalBack***)**

HDC *hdc;* /* handle of device context */
HPALETTE *hpal;* /* handle of palette */
BOOL *fPalBack;* /* flag for forcing palette to background */

The **SelectPalette** function selects the specified logical palette into the given device context. The selected palette replaces the previous palette for that device context.

Parameter	Description
hdc	Identifies the device context.
hpal	Identifies the logical palette to be selected.
fPalBack	Specifies whether the logical palette is always to be a background palette. If this parameter is nonzero, the selected palette is always a background palette. If this parameter is zero and the device context is attached to a window, the logical palette is a foreground palette when the window has the input focus. (The device context is attached to a window if it was obtained by using the **GetDC** function or if the window-class style is CS_OWNDC.)

Returns
The return value is the handle of the previous logical palette for the given device context, if the function is successful. Otherwise, it is NULL.

Comments
An application can select a logical palette into more than one device context. However, changes to a logical palette will affect all device contexts for which it is selected. If an application selects a palette into more than one device context, the device contexts must all belong to the same physical device.

Example
The following example calls the **SelectPalette** function to select a logical palette into a device context and then calls the **RealizePalette** function to change the palette size:

```
HPALETTE hpal, hPalPrevious;

hdc = GetDC(hwnd);

hPalPrevious = SelectPalette(hdc, hpal, FALSE);
if (RealizePalette(hdc) == NULL)
    MessageBox(hwnd, "Can't realize palette", "Error", MB_OK);

ReleaseDC(hwnd, hdc);
```

See Also
CreatePalette, **GetDC**, **RealizePalette**

SendDlgItemMessage (2.x)

LRESULT SendDlgItemMessage(*hwndDlg, idDlgItem, uMsg, wParam, lParam***)**

```
HWND hwndDlg;       /* handle of dialog box          */
int idDlgItem;      /* identifier of dialog box item */
UINT uMsg;          /* message                       */
WPARAM wParam;      /* first message parameter       */
LPARAM lParam;      /* second message parameter      */
```

The **SendDlgItemMessage** function sends a message to a control in a dialog box.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the control.
idDlgItem	Specifies the identifier of the dialog item that will receive the message.
uMsg	Specifies the message to be sent.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value specifies the result of the message processing and depends on the message sent.

Comments

The **SendDlgItemMessage** function does not return until the message has been processed.

Using **SendDlgItemMessage** is identical to retrieving a handle of the given control and calling the **SendMessage** function.

See Also

PostMessage, **SendMessage**

SendDriverMessage (3.1)

LRESULT SendDriverMessage(*hdrvr, msg, lParam1, lParam2***)**

```
HDRVR hdrvr;        /* handle of installable driver   */
UINT msg;           /* message                        */
LPARAM lParam1;     /* first message parameter        */
LPARAM lParam2;     /* second message parameter       */
```

The **SendDriverMessage** function sends the specified message to the given installable driver.

Parameter	Description
hdrvr	Identifies the installable driver.
msg	Specifies the message that the driver must process. The following messages should never be sent by an application directly to the driver; they are sent only by the system: **DRV_CLOSE** **DRV_DISABLE** **DRV_ENABLE** **DRV_EXITAPPLICATION** **DRV_EXITSESSION** **DRV_FREE** **DRV_LOAD** **DRV_OPEN**
lParam1	Specifies 32 bits of additional message-dependent information.
lParam2	Specifies 32 bits of additional message-dependent information.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also

DefDriverProc

SendMessage (2.x)

LRESULT SendMessage(*hwnd, uMsg, wParam, lParam***)**

```
HWND hwnd;      /* handle of destination window */
UINT uMsg;      /* message to send              */
WPARAM wParam;  /* first message parameter      */
LPARAM lParam;  /* second message parameter     */
```

The **SendMessage** function sends the specified message to the given window or windows. The function calls the window procedure for the window and does not return until that window procedure has processed the message. This is in contrast to the **PostMessage** function, which places (posts) the message in the window's message queue and returns immediately.

Parameter	Description
hwnd	Identifies the window to which the message will be sent. If this parameter is HWND_BROADCAST, the message will be sent to all top-level windows, including disabled or invisible unowned windows.
uMsg	Specifies the message to be sent.
wParam	Specifies 16 bits of additional message-dependent information.
lParam	Specifies 32 bits of additional message-dependent information.

Returns

The return value specifies the result of the message processing and depends on the message sent.

Comments

If the message is being sent to another application and the *wParam* or *lParam* parameter is used to pass a handle or pointer to global memory, the memory should be allocated by the **GlobalAlloc** function using the **GMEM_SHARE** flag.

Example

The following example calls the **SendMessage** function to send an **EM_SETSEL** message to a multiline edit control, telling it to select all the text. It then calls **SendMessage** to send a **WM_COPY** message to copy the selected text to the clipboard.

```
SendMessage(hwndMle, EM_SETSEL, 0, MAKELONG(0, -1));
SendMessage(hwndMle, WM_COPY, 0, 0L);
```

See Also

InSendMessage, **PostMessage**, **SendDlgItemMessage**

Windows 3.1 changes

In Windows 3.0, specifying a window handle of -1 would not send the message to disabled or invisible unowned windows. In Windows 3.1, if a window handle of HWND_BROADCAST (-1) is specified, the message is sent to disabled or invisible unowned windows.

SetActiveWindow (2.x)

HWND SetActiveWindow(*hwnd***)**

HWND *hwnd;* /* handle of window to activate */

The **SetActiveWindow** function makes the specified top-level window the active window.

Parameter	Description
hwnd	Identifies the top-level window to be activated.

Returns
The return value identifies the window that was previously active, if the function is successful.

Comments
The **SetActiveWindow** function should be used with care, since it allows an application to arbitrarily take over the active window and input focus. Normally, Windows takes care of all activation.

See Also
GetActiveWindow, **SetCapture**, **SetFocus**

SetCapture (2.x)

HWND SetCapture(*hwnd***)**

HWND *hwnd;* /* handle of window to receive all mouse messages */

The **SetCapture** function sets the mouse capture to the specified window. With the mouse capture set to a window, all mouse input is directed to that window, regardless of whether the cursor is over that window. Only one window can have the mouse capture at a time.

Parameter	Description
hwnd	Identifies the window that is to receive all mouse messages.

Returns
The return value is the handle of the window that previously received all mouse input, if the function is successful. It is NULL if there is no such window.

Comments
When the window no longer requires all mouse input, the application should call the **ReleaseCapture** function so that other windows can receive mouse input.

See Also
ReleaseCapture

SetCaretBlinkTime (2.x)

void SetCaretBlinkTime(*uMSeconds***)**

UINT *uMSeconds;* /* blink rate in milliseconds */

The **SetCaretBlinkTime** function sets the caret blink rate. The blink rate is the elapsed time, in milliseconds, between caret flashes.

Parameter	Description
uMSeconds	Specifies the new blink rate, in milliseconds.

Returns
This function does not return a value.

Comments
The caret flashes on or off every *uMSeconds* milliseconds. One complete flash (off-on) takes twice *uMSeconds* milliseconds.

The caret is a shared resource. A window should set the caret blink rate only if it owns the caret. It should restore the previous rate before it loses the input focus or becomes inactive.

See Also
GetCaretBlinkTime

SetCaretPos (2.x)

void SetCaretPos(*x, y***)**

```
int x;      /* horizontal position */
int y;      /* vertical position   */
```

The **SetCaretPos** function sets the position of the caret.

Parameter	Description
x	Specifies the new x-coordinate, in client coordinates, of the caret.
y	Specifies the new y-coordinate, in client coordinates, of the caret.

Returns
This function does not return a value.

Comments
The **SetCaretPos** function moves the caret only if it is owned by a window in the current task. **SetCaretPos** moves the caret whether or not the caret is hidden.

The caret is a shared resource. A window should not move the caret if it does not own the caret.

See Also
GetCaretPos

SetClassLong (2.x)

LONG SetClassLong(*hwnd, nIndex, nVal***)**

```
HWND hwnd;      /* handle of window          */
int nIndex;     /* index of value to change */
LONG nVal;      /* new value                 */
```

The **SetClassLong** function sets a long value at the specified offset into the extra class memory for the window class to which the specified window belongs. Extra class memory is reserved by specifying a nonzero value in the **cbClsExtra** member of the **WNDCLASS** structure used with the **RegisterClass** function.

Parameter	Description
hwnd	Identifies the window.
nIndex	Specifies the zero-based byte offset of the long value to change. Valid values are in the range zero through the number of bytes of class memory, minus four. (For example, if 12 or more bytes of extra class memory were specified, a value of 8 would be an index to the third long integer.) This parameter can also be **GCL_WNDPROC**, which sets a new long pointer to the window procedure.
nVal	Specifies the replacement value.

Returns

The return value is the previous value of the specified long integer, if the function is successful. Otherwise, it is zero.

Comments

If the **SetClassLong** function and **GCL_WNDPROC** index are used to set a window procedure, the specified window procedure must have the window-procedure form and be exported in the module-definition file. For more information, see the description of the **RegisterClass** function.

Calling **SetClassLong** with the **GCL_WNDPROC** index creates a subclass of the window class that affects all windows subsequently created by using the class.

Applications should not call **SetClassLong** with the **GCL_MENUNAME** value.

To access any extra 4-byte values allocated when the window-class structure was created, use a positive byte offset as the index specified by the *nIndex* parameter, starting at 0 for the first 4-byte value in the extra space, 4 for the next 4-byte value, and so on.

See Also

GetClassLong, **RegisterClass**, **SetClassWord**, **WNDCLASS**

SetClassWord (2.x)

WORD SetClassWord(*hwnd, nIndex, wNewWord***)**

```
HWND hwnd;          /* handle of window          */
int nIndex;         /* index of value to change */
WORD wNewWord;      /* new value                 */
```

The **SetClassWord** function sets a word value at the specified offset into the extra class memory for the window class to which the given window belongs. Extra class memory is reserved by specifying a nonzero value in the **cbClsExtra** member of the **WNDCLASS** structure used with the **RegisterClass** function.

Parameter	Description
hwnd	Identifies the window.
nIndex	Specifies the zero-based byte offset of the word value to change. Valid values are in the range zero through the number of bytes of class memory, minus two (for example, if 10 or more bytes of extra class memory were specified, a value of 8 would be an index to the fifth integer), or one of the following values:

Value	Meaning
GCW_HBRBACKGROUND	Sets a new handle of a background brush.
GCW_HCURSOR	Sets a new handle of a cursor.
GCW_HICON	Sets a new handle of an icon.
GCW_STYLE	Sets a new style bit for the window class.

wNewWord	Specifies the replacement value.

Returns

The return value is the previous value of the specified word, if the function is successful. Otherwise, it is zero.

Comments

The **SetClassWord** function should be used with care. For example, it is possible to change the background color for a class by using **SetClassWord**, but this change does not cause all windows belonging to the class to be repainted immediately. Applications should not attempt to set the class word values of any class attribute except those listed for the *nIndex* parameter.

To access any extra 2-byte values allocated when the window-class structure was created, use a positive byte offset as the index specified by the *nIndex* parameter, starting at 0 for the first 2-byte value in the extra space, 2 for the next 2-byte value, and so on.

See Also

GetClassWord, **RegisterClass**, **SetClassLong**, **WNDCLASS**

SetClipboardData (2.x)

HANDLE SetClipboardData(*uFormat, hData***)**

UINT *uFormat;* /* clipboard format */
HANDLE *hData;* /* data handle */

The **SetClipboardData** function sets the data in the clipboard. The application must have called the **OpenClipboard** function before calling the **SetClipboardData** function.

Parameter	Description
uFormat	Specifies the format of the data. It can be any one of the system-defined formats or a format registered by the **RegisterClipboardFormat** function. For a list of system-defined formats, see the following Comments section.
hData	Identifies the data to be placed in the clipboard. For all formats except CF_BITMAP and CF_PALETTE, this parameter must be a handle of the memory allocated by the **GlobalAlloc** function. For CF_BITMAP format, the *hData* parameter is a bitmap handle (see the description of the **LoadBitmap** function). For the CF_PALETTE format, *hData* is a palette handle (see the description of the **CreatePalette** function). If this parameter is NULL, the owner of the clipboard will be sent a **WM_RENDERFORMAT** message when it must supply the data.

Returns
The return value is a handle of the data, if the function is successful. Otherwise, it is NULL.

Comments
If the *hData* parameter contains a handle of the memory allocated by the **GlobalAlloc** function, the application must not use this handle once it has called the **SetClipboardData** function.

Following are the system-defined clipboard formats:

Value	Meaning
CF_BITMAP	The data is a bitmap.
CF_DIB	The data is a memory object containing a **BITMAPINFO** structure followed by the bitmap data.
CF_DIF	The data is in Data Interchange Format (DIF).
CF_DSPBITMAP	The data is a bitmap representation of a private format. This data is displayed in bitmap format in lieu of the privately formatted data.
CF_DSPMETAFILEPICT	The data is a metafile representation of a private data format. This data is displayed in metafile-picture format in lieu of the privately formatted data.
CF_DSPTEXT	The data is a textual representation of a private data format. This data is displayed in text format in lieu of the privately formatted data.
CF_METAFILEPICT	The data is a metafile (see the description of the **METAFILEPICT** structure.
CF_OEMTEXT	The data is an array of text characters in the OEM character set. Each line ends with a carriage return–linefeed (CR-LF) combination. A null character signals the end of the data.
CF_OWNERDISPLAY	The data is in a private format that the clipboard owner must display.
CF_PALETTE	The data is a color palette.
CF_PENDATA	The data is for the pen extensions to the Windows operating system.
CF_RIFF	The data is in Resource Interchange File Format (RIFF).
CF_SYLK	The data is in Microsoft Symbolic Link (SYLK) format.
CF_TEXT	The data is an array of text characters. Each line ends with a carriage

	return–linefeed (CR-LF) combination. A null character signals the end of the data.
CF_TIFF	The data is in Tag Image File Format (TIFF).
CF_WAVE	The data describes a sound wave. This is a subset of the CF_RIFF data format; it can be used only for RIFF WAVE files.

Private data formats in the range CF_PRIVATEFIRST through CF_PRIVATELAST are not automatically freed when the data is removed from the clipboard. Data handles associated with these formats should be freed upon receiving a **WM_DESTROYCLIPBOARD** message.

Private data formats in the range CF_GDIOBJFIRST through CF_GDIOBJLAST will be automatically removed by a call to the **DeleteObject** function when the data is removed from the clipboard.

If Windows Clipboard is running, it will not update its window to show the data placed in the clipboard by the **SetClipboardData** until after the **CloseClipboard** function is called.

See Also

CloseClipboard, **GlobalAlloc**, **OpenClipboard**, **GetClipboardData**, **RegisterClipboardFormat**, **BITMAPINFO**, **WM_RENDERFORMAT**

SetClipboardViewer (2.x)

HWND SetClipboardViewer(*hwnd***)**

HWND *hwnd;* /* handle of clipboard viewer */

The **SetClipboardViewer** function adds the given window to the chain of windows that are notified (by means of the **WM_DRAWCLIPBOARD** message) whenever the contents of the clipboard are changed.

Parameter	Description
hwnd	Identifies the window to receive clipboard-viewer chain messages.

Returns
The return value is the handle of the next window in the clipboard-viewer chain, if the function is successful.

Comments
Applications should save this handle in static memory and use it when responding to clipboard-viewer chain messages.

Windows that are part of the clipboard-viewer chain must respond to **WM_CHANGECBCHAIN**, **WM_DRAWCLIPBOARD**, and **WM_DESTROY** messages.

To remove itself from the clipboard-viewer chain, an application must call the **ChangeClipboardChain** function.

See Also
ChangeClipboardChain, **GetClipboardViewer**, **WM_CHANGECBCHAIN**, **WM_DESTROY**, **WM_DRAWCLIPBOARD**

SetCommBreak (2.x)

int SetCommBreak(*idComDev***)**

int *idComDev;* /* device to suspend */

The **SetCommBreak** function suspends character transmission and places the communications device in a break state.

Parameter	Description
idComDev	Specifies the communications device to be suspended. The **OpenComm** function returns this value.

Returns

The return value is zero if the function is successful. Otherwise, it is less than zero.

Comments

The communications device remains suspended until the application calls the **ClearCommBreak** function.

See Also

ClearCommBreak, **OpenComm**

SetCommEventMask (2.x)

UINT FAR* SetCommEventMask(*idComDev, fuEvtMask***)**

int *idComDev;* /* device to enable */
UINT *fuEvtMask;* /* events to enable */

The **SetCommEventMask** function enables events in the event word of the specified communications device.

Parameter	Description
idComDev	Specifies the communications device to be enabled. The **OpenComm** function returns this value.
fuEvtMask	Specifies which events are to be enabled. This parameter can be any combination of the following values:

Value	Meaning
EV_BREAK	Set when a break is detected on input.
EV_CTS	Set when the CTS (clear-to-send) signal changes state.
EV_CTSS	Set to indicate the current state of the CTS signal.
EV_DSR	Set when the DSR (data-set-ready) signal changes state.
EV_ERR	Set when a line-status error occurs. Line-status errors are **CE_FRAME**, **CE_OVERRUN**, and CE_RXPARITY.
EV_PERR	Set when a printer error is detected on a parallel device. Errors are **CE_DNS**, **CE_IOE**, CE_LOOP, and CE_PTO.
EV_RING	Set to indicate the state of ring indicator during the last modem interrupt.
EV_RLSD	Set when the RLSD (receive-line-signal-detect) signal changes state.
EV_RLSDS	Set to indicate the current state of the RLSD signal.
EV_RXCHAR	Set when any character is received and placed in the receiving queue.
EV_RXFLAG	Set when the event character is received and placed in the receiving queue. The event character is specified in the device's control block.
EV_TXEMPTY	Set when the last character in the transmission queue is sent.

Returns

The return value is a pointer to the event word for the specified communications device, if the function is successful. Each bit in the event word specifies whether a given event has occurred. A bit is 1 if the event has occurred.

Comments

Only enabled events are recorded. The **GetCommEventMask** function retrieves and clears the event word.

See Also

GetCommEventMask, **OpenComm**

EV_BREAK 0x0040

Set when a break is detected on input.

EV_BREAK 0x0040

EV_CTS 0x0008

Set when the CTS (clear-to-send) signal changes state.

EV_CTS 0x0008

EV_CTSS 0x0400

Set to indicate the current state of the CTS signal.

EV_CTSS 0x0400

EV_DSR 0x0010

Set when the DSR (data-set-ready) signal changes state.

EV_DSR 0x0010

EV_ERR 0x0080

Set when a line-status error occurs. Line-status errors are **CE_FRAME**, **CE_OVERRUN**, and CE_RXPARITY.

EV_ERR 0x0080

EV_PERR 0x0200

Set when a printer error is detected on a parallel device. Errors are **CE_DNS**, **CE_IOE**, CE_LOOP, and CE_PTO.

EV_PERR 0x0200

EV_RING 0x0100

Set to indicate the state of ring indicator during the last modem interrupt.

EV_RING 0x0100

EV_RLSD 0x0020

Set when the RLSD (receive-line-signal-detect) signal changes state.

EV_RLSD 0x0020

EV_RLSDS 0x1000

Set to indicate the current state of the RLSD signal.

EV_RLSDS 0x1000

EV_RXCHAR 0x0001

Set when any character is received and placed in the receiving queue.

EV_RXCHAR 0x0001

EV_RXFLAG 0x0002

Set when the event character is received and placed in the receiving queue. The event character is specified in the device's control block.

EV_RXFLAG 0x0002

EV_TXEMPTY 0x0004

Set when the last character in the transmission queue is sent.

EV_TXEMPTY 0x0004

SetCommState (2.x)

int SetCommState(*lpdcb***)**

const DCB FAR* *lpdcb;* /* address of device control block */

The **SetCommState** function sets a communications device to the state specified by a device control block.

Parameter	Description
lpdcb	Points to a **DCB** structure that contains the desired communications settings for the device. The **Id** member of the **DCB** structure must identify the device.

Returns

The return value is zero if the function is successful. Otherwise, it is less than zero.

Example

The following example uses the **BuildCommDCB** and **SetCommState** functions to set up COM1 at 9600 baud, no parity, 8 data bits, and 1 stop bit:

```
idComDev = OpenComm("COM1", 1024, 128);
if (idComDev < 0) {
    ShowError(idComDev, "OpenComm");
    return 0;
}

err = BuildCommDCB("COM1:9600,n,8,1", &dcb);
if (err < 0) {
    ShowError(err, "BuildCommDCB");
    return 0;
}

err = SetCommState(&dcb);
if (err < 0) {
    ShowError(err, "SetCommState");
    return 0;
}
```

Comments

This function reinitializes all hardware and controls as defined by the **DCB** structure, but it does not empty transmission or receiving queues.

See Also

GetCommState, **DCB**

SetCursor (2.x)

HCURSOR SetCursor(*hcur***)**

HCURSOR *hcur;* /* handle of cursor */

The **SetCursor** function changes the given cursor.

Parameter	Description
hcur	Identifies the cursor resource. The resource must have been loaded by using the **LoadCursor** function. If this parameter is NULL, the cursor is removed from the screen.

Returns

The return value is the handle of the previous cursor, if the function is successful. It is NULL if there is no previous cursor.

Comments

The cursor is set only if the new cursor is different from the previous cursor; otherwise, the function returns immediately. The function is quite fast if the new cursor is the same as the old.

The cursor is a shared resource. A window should set the cursor only when the cursor is in the window's client area or when the window is capturing all mouse input. In systems without a mouse, the window should restore the previous cursor before the cursor leaves the client area or before the window relinquishes control to another window.

Any application that must set the cursor while it is in a window must ensure that the class cursor for the given window's class is set to NULL. If the class cursor is not NULL, the system restores the previous shape each time the mouse is moved.

Example

The following example sets the hourglass cursor during a time-consuming operation and restores the cursor afterward:

```
HCURSOR hcurSave;

/* Set the cursor to the hourglass and save the previous cursor. */

hcurSave = SetCursor(LoadCursor(NULL, IDC_WAIT));

    .
    . /* Perform some time-consuming operation */
    .

/* Restore the previous cursor. */

SetCursor(hcurSave);
```

See Also

GetCursor, **LoadCursor**, **ShowCursor**, **WM_SETCURSOR**

SetCursorPos (2.x)

void SetCursorPos(*x, y***)**

```
int x;      /* horizontal position */
int y;      /* vertical position   */
```

The **SetCursorPos** function sets the position, in screen coordinates, of the cursor. If the new coordinates are not within the screen rectangle set by the most recent **ClipCursor** function, Windows automatically adjusts the coordinates so that the cursor stays within the rectangle.

Parameter	Description
x	Specifies the new x-coordinate, in screen coordinates, of the cursor.
y	Specifies the new y-coordinate, in screen coordinates, of the cursor.

Returns

This function does not return a value.

Comments

The cursor is a shared resource. A window should move the cursor only when the cursor is in its client area.

See Also

ClipCursor, **GetCursorPos**

SetDlgItemInt (2.x)

void SetDlgItemInt(*hwndDlg, idControl, uValue, fSigned***)**

```
HWND hwndDlg;     /* handle of dialog box          */
int idControl;    /* identifier of control         */
UINT uValue;      /* value to set                  */
BOOL fSigned;     /* signed or unsigned indicator  */
```

The **SetDlgItemInt** function sets the text of a given control in a dialog box to the string representation of a specified integer value.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the control.
idControl	Specifies the control to be changed.
uValue	Specifies the integer value used to generate the item text.
fSigned	Specifies whether the *uValue* parameter is signed or unsigned. If this parameter is TRUE, *uValue* is signed. If this parameter is TRUE and *uValue* is less than zero, a minus sign is placed before the first digit in the string. If this parameter is FALSE, *uValue* is unsigned.

Returns

This function does not return a value.

Comments

SetDlgItemInt sends a **WM_SETTEXT** message to the given control.

See Also

GetDlgItemInt, **SetDlgItemText**, **WM_SETTEXT**

SetDlgItemText (2.x)

void SetDlgItemText(*hwndDlg, idControl, lpsz***)**

```
HWND hwndDlg;     /* handle of dialog box  */
int idControl;    /* identifier of control */
LPCSTR lpsz;      /* text to set           */
```

The **SetDlgItemText** function sets the title or text of a control in a dialog box.

Parameter	Description
hwndDlg	Identifies the dialog box that contains the control.
idControl	Identifies the control whose text is to be set.
lpsz	Points to the null-terminated string that contains the text to be copied to the control.

Returns
This function does not return a value.

Comments
The **SetDlgItemText** function sends a **WM_SETTEXT** message to the given control.

See Also
GetDlgItemText, **SetDlgItemInt**, **WM_SETTEXT**

SetDoubleClickTime (2.x)

void SetDoubleClickTime(*uInterval***)**

UINT *uInterval;* /* double-click interval */

The **SetDoubleClickTime** function sets the double-click time for the mouse. A double-click is a series of two clicks of the mouse button, the second occurring within a specified time after the first. The double-click time is the maximum number of milliseconds that may occur between the first and second clicks of a double-click.

Parameter	Description
uInterval	Specifies the number of milliseconds that can occur between double-clicks.

Returns
This function does not return a value.

Comments
If the *uInterval* parameter is zero, Windows uses the default double-click time of 500 milliseconds.

The **SetDoubleClickTime** function alters the double-click time for all windows in the system.

See Also
GetDoubleClickTime

SetFocus (2.x)

HWND SetFocus(*hwnd***)**

HWND *hwnd;* /* handle of window to receive focus */

The **SetFocus** function sets the input focus to the given window. All subsequent keyboard input is directed to this window. The window, if any, that previously had the input focus loses it.

Parameter	Description
hwnd	Identifies the window to receive the keyboard input. If this parameter is NULL, keystrokes are ignored.

Returns

The return value identifies the window that previously had the input focus, if the function is successful. It is NULL if there is no such window or if the specified handle is invalid.

Comments

The **SetFocus** function sends a **WM_KILLFOCUS** message to the window that loses the input focus and a **WM_SETFOCUS** message to the window that receives the input focus. It also activates either the window that receives the focus or the parent of the window that receives the focus.

If a window is active but does not have the focus (that is, no window has the focus), any key pressed will produce the **WM_SYSCHAR**, **WM_SYSKEYDOWN**, or **WM_SYSKEYUP** message. If the VK_MENU key is also pressed, the *lParam* parameter of the message will have bit 30 set. Otherwise, the messages that are produced do *not* have this bit set.

See Also

GetActiveWindow, **GetFocus**, **SetActiveWindow**, **SetCapture**, **WM_KILLFOCUS**, **WM_SETFOCUS**, **WM_SYSCHAR**, **WM_SYSKEYDOWN**, **WM_SYSKEYUP**

SetKeyboardState (2.x)

void SetKeyboardState(*lpbKeyState***)**

BYTE FAR* *lpbKeyState;* /* address of array with virtual-key codes */

The **SetKeyboardState** function copies a 256-byte array of keyboard key states into the Windows keyboard-state table.

Parameter	Description
lpbKeyState	Points to a 256-byte array that contains keyboard key states.

Returns
This function does not return a value.

Comments
In many cases, an application should call the **GetKeyboardState** function first to initialize the 256-byte array. The application should then change the desired bytes.

SetKeyboardState sets the LEDs and BIOS flags for the NUMLOCK, CAPSLOCK, and SCROLL LOCK keys according to the toggle state of the VK_NUMLOCK, VK_CAPITAL, and VK_SCROLL entries of the array.

For more information, see the description of the **GetKeyboardState** function.

Example
The following example simulates the pressing of the CTRL key:

```
BYTE pbKeyState[256];

GetKeyboardState((LPBYTE) &pbKeyState);
pbKeyState[VK_CONTROL] |= 0x80;
SetKeyboardState((LPBYTE) &pbKeyState);
```

See Also
GetKeyboardState

SetMenu (2.x)

BOOL SetMenu(*hwnd, hmenu***)**

HWND *hwnd;* /* handle of window */
HMENU *hmenu;* /* handle of menu */

The **SetMenu** function sets the given window's menu to the specified menu.

Parameter	Description
hwnd	Identifies the window whose menu is to be changed.
hmenu	Identifies the new menu. If this parameter is NULL, the window's current menu is removed.

Returns
The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments
The **SetMenu** function causes the window to be redrawn to reflect the menu change.

SetMenu will not destroy a previous menu. An application should call the **DestroyMenu** function to accomplish this task.

Example

```
HMENU hmenu;

hmenu = LoadMenu(hinst, "My Menu");
SetMenu(hwnd, hmenu);
```

See Also
DestroyMenu, **LoadMenu**, **LoadMenuIndirect**

SetMenuItemBitmaps (3.0)

BOOL SetMenuItemBitmaps(*hmenu, idItem, fuFlags, hbmUnchecked, hbmChecked***)**

```
HMENU hmenu;            /* handle of menu                */
UINT idItem;            /* menu-item identifier          */
UINT fuFlags;           /* menu-item flags               */
HBITMAP hbmUnchecked;   /* handle of unchecked bitmap    */
HBITMAP hbmChecked;     /* handle of checked bitmap      */
```

The **SetMenuItemBitmaps** function associates the given bitmaps with a menu item. Whether the menu item is checked or unchecked, Windows displays the appropriate check-mark bitmap next to the menu item.

Parameter	Description
hmenu	Identifies the menu.
idItem	Specifies the menu item to be changed, as determined by the *fuFlags* parameter.
fuFlags	Specifies how the *idItem* parameter is interpreted. This parameter can be one of the following values:

Value	Meaning
MF_BYCOMMAND	The *idItem* parameter specifies the menu-item identifier (default value).
MF_BYPOSITION	The *idItem* parameter specifies the zero-based position of the menu item.

hbmUnchecked	Identifies the check-mark bitmap to display when the menu item is not checked.
hbmChecked	Identifies the check-mark bitmap to display when the menu item is checked.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

If either the *hbmUnchecked* or the *hbmChecked* parameter is NULL, Windows displays nothing next to the menu item for the corresponding attribute. If both parameters are NULL, Windows uses the default check mark when the item is checked and removes the check mark when the item is unchecked.

When the menu is destroyed, these bitmaps are not destroyed; the application must destroy them.

The **GetMenuCheckMarkDimensions** function retrieves the dimensions of the default check mark used for menu items. The application should use these values to determine the appropriate size for the bitmaps supplied with this function.

See Also

GetMenuCheckMarkDimensions

SetMessageQueue (2.x)

BOOL SetMessageQueue(*cMsg***)**

int *cMsg;* /* size of message queue */

The **SetMessageQueue** function creates a new message queue. It is particularly useful in applications that require a queue that contains more than eight messages (the maximum size of the default queue).

Parameter	Description
cMsg	Specifies the maximum number of messages that the new queue may contain. This value must not be larger than 120.

Returns

The return value is nonzero if the function is successful. If the value specified in the *cMsg* parameter is larger than 120, the return value is nonzero but the message queue is not created. The return value is zero if an error occurs.

Comments

The function must be called from an application's **WinMain** function before any windows are created and before any messages are sent. The **SetMessageQueue** function destroys the old queue, along with messages it might contain.

If the return value is zero, the application has no queue, because the **SetMessageQueue** function deletes the original queue before attempting to create a new one. The application must continue calling **SetMessageQueue** with a smaller queue size until the function returns nonzero.

See Also

GetMessage, **PeekMessage**

SetParent (2.x)

HWND SetParent(*hwndChild, hwndNewParent***)**

```
HWND hwndChild;      /* handle of window whose parent is changing */
HWND hwndNewParent;  /* handle of new parent window               */
```

The **SetParent** function changes the parent window of the given child window.

Parameter	Description
hwndChild	Identifies the child window.
hwndNewParent	Identifies the new parent window.

Returns

The return value is the handle of the previous parent window, if the function is successful.

Comments

If the window identified by the *hwndChild* parameter is visible, Windows performs the appropriate redrawing and repainting.

See Also

GetParent, **IsChild**

SetProp (2.x)

BOOL SetProp(*hwnd, lpsz, hData***)**

```
HWND hwnd;      /* handle of window          */
LPCSTR lpsz;    /* atom or address of string */
HANDLE hData;   /* handle of data            */
```

The **SetProp** function adds a new entry or changes an existing entry in the property list of the given window. The function adds a new entry to the list if the given character string does not exist already in the list. The new entry contains the string and the handle. Otherwise, the function replaces the string's current handle with the given handle.

Parameter	Description
hwnd	Identifies the window whose property list receives the new entry.
lpsz	Points to a null-terminated string or an atom that identifies a string. If this parameter is an atom, it must be a global atom created by a previous call to the **GlobalAddAtom** function. The atom, a 16-bit value, must be placed in the low-order word of *lpsz;* the high-order word must be zero.
hData	Identifies data to be copied to the property list. The data handle can identify any 16-bit value useful to the application.

Returns

The return value is nonzero if the data handle and string are added to the property list. Otherwise, it is zero.

Comments

Before destroying a window (that is, before processing the **WM_DESTROY** message), an application must remove all entries it has added to the property list. The **RemoveProp** function must be used to remove entries from a property list.

See Also

GetProp, **GlobalAddAtom**, **RemoveProp**

SetRect (2.x)

void SetRect(*lprc, nLeft, nTop, nRight, nBottom***)**

```
RECT FAR* lprc;     /* address of structure with rectangle to set*/
int nLeft;          /* left side                                 */
int nTop;           /* top side                                  */
int nRight;         /* right side                                */
int nBottom;        /* bottom side                               */
```

The **SetRect** function sets rectangle coordinates. The action of this function is equivalent to assigning the left, top, right, and bottom arguments to the appropriate members of the **RECT** structure.

Parameter	Description
lprc	Points to the **RECT** structure that contains the rectangle to be set.
nLeft	Specifies the x-coordinate of the upper-left corner.
nTop	Specifies the y-coordinate of the upper-left corner.
nRight	Specifies the x-coordinate of the lower-right corner.
nBottom	Specifies the y-coordinate of the lower-right corner.

Returns

This function does not return a value.

Comments

The width of the rectangle, specified by the absolute value of *nRight - nLeft,* must not exceed 32,767 units. This limit also applies to the height of the rectangle.

See Also

CopyRect, **SetRectEmpty**

SetRectEmpty (2.x)

void SetRectEmpty(*lprc***)**

RECT FAR* *lprc;* /* address of struct. with rectangle to set to empty*/

The **SetRectEmpty** function creates an empty rectangle (all coordinates set to zero).

Parameter	Description
lprc	Points to the **RECT** structure that contains the rectangle to be set to empty.

Returns
This function does not return a value.

See Also
CopyRect, **SetRect**, **RECT**

SetScrollPos (2.x)

int SetScrollPos(*hwnd, fnBar, nPos, fRepaint***)**

```
HWND hwnd;      /* handle of window with scroll bar */
int fnBar;      /* scroll bar flag                  */
int nPos;       /* new position of scroll box       */
BOOL fRepaint;  /* redraw flag                      */
```

The **SetScrollPos** function sets the position of a scroll box (thumb) and, if requested, redraws the scroll bar to reflect the new position of the scroll box.

Parameter	Description
hwnd	Identifies the window whose scroll bar is to be set.
fnBar	Specifies the scroll bar to be set. This parameter can be one of the following values:

Value	Meaning
SB_CTL	Sets the position of the scroll box in a scroll bar. In this case, the *hwnd* parameter must be the handle of a scroll bar.
SB_HORZ	Sets the position of the scroll box in a window's horizontal scroll bar.
SB_VERT	Sets the position of the scroll box in a window's vertical scroll bar.

nPos	Specifies the new position of the scroll box. It must be within the scrolling range.
fRepaint	Specifies whether the scroll bar should be repainted to reflect the new scroll box position. If this parameter is TRUE, the scroll bar is repainted. If it is FALSE, the scroll bar is not repainted.

Returns

The return value is the previous position of the scroll box, if the function is successful. Otherwise, it is zero.

Comments

Setting the *fRepaint* parameter to FALSE is useful whenever the scroll bar will be redrawn by a subsequent call to another function.

See Also

GetScrollPos, **GetScrollRange**, **ScrollWindow**, **SetScrollRange**

SetScrollRange (2.x)

void SetScrollRange(*hwnd, fnBar, nMin, nMax, fRedraw***)**

```
HWND hwnd;      /* handle of window with scroll bar */
int fnBar;      /* scroll bar flag                  */
int nMin;       /* minimum scrolling position       */
int nMax;       /* maximum scrolling position       */
BOOL fRedraw;   /* redraw flag                      */
```

The **SetScrollRange** function sets minimum and maximum position values for the given scroll bar. It can also be used to hide or show standard scroll bars.

Parameter	Description
hwnd	Identifies a window or a scroll bar, depending on the value of the *fnBar* parameter.
fnBar	Specifies the scroll bar to be set. This parameter can be one of the following values:

Value	Meaning
SB_CTL	Sets the range of a scroll bar. In this case, the *hwnd* parameter must be the handle of a scroll bar.
SB_HORZ	Sets the range of a window's horizontal scroll bar.
SB_VERT	Sets the range of a window's vertical scroll bar.

nMin	Specifies the minimum scrolling position.
nMax	Specifies the maximum scrolling position.
fRedraw	Specifies whether the scroll bar should be redrawn to reflect the change. If this parameter is TRUE, the scroll bar is redrawn. If it is FALSE, the scroll bar is not redrawn.

Returns

This function does not return a value.

Comments

An application should not call this function to hide a scroll bar while processing a scroll-bar notification message.

If the call to **SetScrollRange** immediately follows the call to the **SetScrollPos** function, the *fRedraw* parameter in **SetScrollPos** should be zero, to prevent the scroll bar from being drawn twice.

The default range for a standard scroll bar is 0 through 100. The default range for a scroll bar control is empty (both the *nMin* and *nMax* values are zero). The difference between the values specified by the *nMin* and *nMax* parameters must not be greater than 32,767.

See Also

GetScrollPos, **GetScrollRange**, **ScrollWindow**, **SetScrollPos**

SetSysColors (2.x)

void SetSysColors(*cDspElements, lpnDspElements, lpdwRgbValues***)**

```
int cDspElements;                    /* number of elements to change   */
const int FAR* lpnDspElements;       /* address of array of elements   */
const COLORREF FAR* lpdwRgbValues;   /* address of array of RGB values */
```

The **SetSysColors** function sets the system colors for one or more display elements. Display elements are the various parts of a window and the Windows background that appear on the screen.

The **SetSysColors** function sends a **WM_SYSCOLORCHANGE** message to all windows to inform them of the change in color. It also directs Windows to repaint the affected portions of all currently visible windows.

Parameter	Description
cDspElements	Specifies the number of display elements in the array pointed to by the *lpnDspElements* parameter.
lpnDspElements	Points to an array of integers that specify the display elements to be changed. For a list of possible display elements, see the following Comments section.
lpdwRgbValues	Points to an array of unsigned long integers that contains the new **RGB** (red-green-blue) color value for each display element in the array pointed to by the *lpnDspElements* parameter.

Returns

This function does not return a value.

Comments

The **SetSysColors** function changes the current Windows session only. The new colors are not saved when Windows terminates.

Following are the display elements that may be used in the *lpnDspElements* array:

Value	Meaning
COLOR_ACTIVEBORDER	Active window border.
COLOR_ACTIVECAPTION	Active window title.
COLOR_APPWORKSPACE	Background color of multiple document interface (MDI) applications.
COLOR_BACKGROUND	Desktop.
COLOR_BTNFACE	Face shading on push buttons.
COLOR_BTNHIGHLIGHT	Selected button in a control.
COLOR_BTNSHADOW	Edge shading on push buttons.
COLOR_BTNTEXT	Text on push buttons.
COLOR_CAPTIONTEXT	Text in title bar, size button, scroll-bar arrow button.
COLOR_GRAYTEXT	Grayed (dimmed) text. This color is zero if the current display driver does not support a solid gray color.
COLOR_HIGHLIGHT	Background of selected item in a control.
COLOR_HIGHLIGHTTEXT	Text of selected item in a control.
COLOR_INACTIVEBORDER	Inactive window border.
COLOR_INACTIVECAPTION	Inactive window title.
COLOR_INACTIVECAPTIONTEXT	Color of text in an inactive title.
COLOR_MENU	Menu background.
COLOR_MENUTEXT	Text in menus.

COLOR_SCROLLBAR	Scroll-bar gray area.
COLOR_WINDOW	Window background.
COLOR_WINDOWFRAME	Window frame.
COLOR_WINDOWTEXT	Text in windows.

Example

The following example changes the window background to black and the text in the window to green:

```
int aiDspElements[2];
DWORD aRgbValues[2];

aiDspElements[0] = COLOR_WINDOW;
aRgbValues[0] = RGB(
    0x00,   /* red   */
    0x00,   /* green */
    0x00);  /* blue  */
aiDspElements[1] = COLOR_WINDOWTEXT;
aRgbValues[1] = RGB(
    0x00,   /* red   */
    0xff,   /* green */
    0x00);  /* blue  */
SetSysColors(2, aiDspElements, aRgbValues);
```

See Also

GetSysColor, **WM_SYSCOLORCHANGE**

Windows 3.1 changes

The following constants have been added:

Value	Meaning
COLOR_BTNHIGHLIGHT	Selected button in a control.
COLOR_INACTIVECAPTIONTEXT	Color of text in an inactive caption.

COLOR_ACTIVEBORDER 10

Active window border.

COLOR_ACTIVEBORDER 10

COLOR_ACTIVECAPTION 2

Active window title.

COLOR_ACTIVECAPTION 2

COLOR_APPWORKSPACE 12

Background color of multiple document interface (MDI) applications.

COLOR_APPWORKSPACE 12

COLOR_BACKGROUND 1

Desktop.

COLOR_BACKGROUND 1

COLOR_BTNFACE 15

Face shading on push buttons.

COLOR_BTNFACE 15

COLOR_BTNHIGHLIGHT 20

Selected button in a control.

COLOR_BTNHIGHLIGHT 20

COLOR_BTNSHADOW 16

Edge shading on push buttons.

COLOR_BTNSHADOW 16

COLOR_BTNTEXT 18

Text on push buttons.

COLOR_BTNTEXT 18

COLOR_CAPTIONTEXT 9

Text in title bar, size button, scroll-bar arrow button.

COLOR_CAPTIONTEXT 9

COLOR_GRAYTEXT 17

Grayed (dimmed) text. This color is zero if the current display driver does not support a solid gray color.

COLOR_GRAYTEXT 17

COLOR_HIGHLIGHT 13

Background of selected item in a control.

COLOR_HIGHLIGHT 13

COLOR_HIGHLIGHTTEXT 14

Text of selected item in a control.

COLOR_HIGHLIGHTTEXT 14

COLOR_INACTIVEBORDER 11

Inactive window border.

COLOR_INACTIVEBORDER 11

COLOR_INACTIVECAPTION 3

Inactive window title.

COLOR_INACTIVECAPTION 3

COLOR_INACTIVECAPTIONTEXT 19

Color of text in an inactive title.

COLOR_INACTIVECAPTIONTEXT 19

COLOR_MENU 4

Menu background.

COLOR_MENU 4

COLOR_MENUTEXT 7

Text in menus.

COLOR_MENUTEXT 7

COLOR_SCROLLBAR 0

Scroll-bar gray area.

COLOR_SCROLLBAR 0

COLOR_WINDOW 5

Window background.

COLOR_WINDOW 5

COLOR_WINDOWFRAME 6

Window frame.

COLOR_WINDOWFRAME 6

COLOR_WINDOWTEXT 8

Text in windows.

COLOR_WINDOWTEXT 8

SetSysModalWindow (2.x)

HWND SetSysModalWindow(*hwnd***)**

HWND *hwnd;* /* handle of window to become system modal */

The **SetSysModalWindow** function makes the given window the system-modal window.

Parameter	Description
hwnd	Identifies the window to be made system modal.

Returns

The return value is the handle of the window that was previously the system-modal window, if the function is successful.

Comments

If another window is made the active window (for example, the system-modal window creates a dialog box that becomes the active window), the active window becomes the system-modal window. When the original window becomes active again, it is once again the system-modal window. To end the system-modal state, destroy the system-modal window.

If a **WH_JOURNALRECORD** hook is in place when **SetSysModalWindow** is called, the hook is called with a hook code of HC_SYSMODALON (for turning on the system-modal window) or HC_SYSMODALOFF (for turning off the system-modal window).

See Also

GetSysModalWindow

SetTimer (2.x)

UINT SetTimer(*hwnd, idTimer, uTimeout, tmprc***)**

```
HWND hwnd;          /* handle of window for timer messages */
UINT idTimer;       /* timer identifier                    */
UINT uTimeout;      /* time-out duration                   */
TIMERPROC tmprc;    /* instance address of timer procedure */
```

The **SetTimer** function installs a system timer. A time-out value is specified, and every time a time-out occurs, the system posts a **WM_TIMER** message to the installing application's message queue or passes the message to an application-defined **TimerProc** callback function.

Parameter	Description
hwnd	Identifies the window to be associated with the timer. If the *tmprc* parameter is NULL, the window procedure associated with this window receives the **WM_TIMER** messages generated by the timer. If this parameter is NULL, no window is associated with the timer.
idTimer	Specifies a nonzero timer identifier. If the *hwnd* parameter is NULL, this parameter is ignored.
uTimeout	Specifies the time-out value, in milliseconds.
tmprc	Specifies the procedure-instance address of the callback function that processes the **WM_TIMER** messages. If this parameter is NULL, the WM_TIMER messages are placed in the application's message queue and the **hwnd** member of the **MSG** structure contains the window handle specified in *hwnd.* For more information, see the description of the **TimerProc** callback function.

Returns

The return value is the identifier of the new timer if *hwnd* is NULL and the function is successful. An application passes this value to the **KillTimer** function to kill the timer. The return value is nonzero if *hwnd* is a valid window handle and the function is successful. Otherwise, the return value is zero.

Comments

Timers are a limited global resource; therefore, it is important that an application check the value returned by the **SetTimer** function to verify that a timer is available.

The *tmprc* parameter must specify a procedure-instance address of the callback function, and the callback function must be exported in the application's module-definition file. A procedure-instance address can be created by using the **MakeProcInstance** function. The callback function must use the Pascal calling convention and must be declared as **FAR**.

Example

The following example installs a system timer. The system will pass **WM_TIMER** messages generated by the timer to the "MyTimerProc" callback function.

```
TIMERPROC lpfnMyTimerProc;

lpfnMyTimerProc = (TIMERPROC) MakeProcInstance(MyTimerProc, hinst);
SetTimer(hwnd, ID_MYTIMER, 5000, lpfnMyTimerProc);
```

See Also

KillTimer, **MakeProcInstance**, **TimerProc**, **MSG**, **WM_TIMER**

SetWindowLong (2.x)

LONG SetWindowLong(*hwnd, nOffset, nVal***)**

HWND *hwnd;* /* handle of window */
int *nOffset;* /* offset of value to set */
LONG *nVal;* /* new value */

The **SetWindowLong** function places a long value at the specified offset into the extra window memory of the given window. Extra window memory is reserved by specifying a nonzero value in the **cbWndExtra** member of the **WNDCLASS** structure used with the **RegisterClass** function.

Parameter	Description
hwnd	Identifies the window.
nOffset	Specifies the zero-based byte offset of the value to change. Valid values are in the range zero through the number of bytes of extra window memory, minus four (for example, if 12 or more bytes of extra memory were specified, a value of 8 would be an index to the third long integer), or one of the following values:

Value	Meaning
GWL_EXSTYLE	Extended window style
GWL_STYLE	Window style
GWL_WNDPROC	Long pointer to the window procedure

The following values are also available when the *hwnd* parameter identifies a dialog box:

Value	Meaning
DWL_DLGPROC	Specifies the address of the dialog box procedure.
DWL_MSGRESULT	Specifies the return value of a message processed in the dialog box procedure.
DWL_USER	Specifies extra information that is private to the application, such as handles or pointers.

nVal	Specifies the long value to place in the window's reserved memory.

Returns

The return value is the previous value of the specified long integer, if the function is successful. Otherwise, it is zero.

Comments

If the **SetWindowLong** function and the **GWL_WNDPROC** index are used to set a new window procedure, that procedure must have the window-procedure form and be exported in the module-definition file of the application. For more information, see the description of the **RegisterClass** function.

Calling **SetWindowLong** with the **GCL_WNDPROC** index creates a subclass of the window class used to create the window. An application should not attempt to create a window subclass for standard Windows controls such as combo boxes and buttons.

An application should not use this function to set the WS_DISABLE style for a window. Instead, the application should use the **EnableWindow** function.

To access any extra 4-byte values allocated when the window-class structure was created, use a positive byte offset as the index specified by the *nOffset* parameter, starting at 0 for the first 4-byte value in the extra space, 4 for the next 4-byte value, and so on.

An application can use the **DWL_MSGRESULT** value to return values from a dialog box procedure's window procedure. Typically, a dialog box procedure must return TRUE in order for a value to be returned to the sender of the message. Some messages, however, return a value in the Boolean return value of the dialog box procedure. The following messages return values in the return value of the dialog

box procedure:

WM_CHARTOITEM
WM_COMPAREITEM
WM_CTLCOLOR
WM_INITDIALOG
WM_QUERYDRAGICON
WM_VKEYTOITEM

Example

The following example shows how to use the **SetWindowLong** function with the **DWL_MSGRESULT** value to return a value from a dialog box procedure. Applications often include a **switch** statement to handle the messages that return values in the Boolean return value of the dialog box procedure, even when the dialog box procedure does not process these messages. This practice makes it easy to revise the dialog box procedure to handle the message and has a negligible effect on speed and memory.

```
BOOL CALLBACK MyDlgProc(hwndDlg, msg, wParam, lParam)
HWND hwndDlg;
UINT msg;
WPARAM wParam;
LPARAM lParam;
{
    BOOL fProcessed = FALSE;
    LRESULT lResult;

    /*
     * To return a value for a specific message, set lResult to the
     * return value and fProcessed to TRUE.
     */

    switch (msg) {
        .
        .  /* process messages */
        .

    case WM_QUERYENDSESSION:

        /*
         * Example: Do not allow the system to terminate
         * while the dialog box is displayed.
         */

        fProcessed = TRUE;
        lResult = (LRESULT) (UINT) FALSE;
        break;

    default:
        break;
    }

    if (fProcessed) {
        switch (msg) {
        case WM_CTLCOLOR:
        case WM_COMPAREITEM:
        case WM_VKEYTOITEM:
        case WM_CHARTOITEM:
        case WM_QUERYDRAGICON:
```

```
        case WM_INITDIALOG:
            return (BOOL) LOWORD(lResult);
        default:
            SetWindowLong(hwndDlg, DWL_MSGRESULT, (LPARAM) lResult);
        }
    }
    return fProcessed;
}
```

See Also

EnableWindow, **GetWindowLong**, **RegisterClass**, **SetWindowWord**

SetWindowPlacement (3.1)

BOOL SetWindowPlacement(*hwnd, lpwndpl***)**

```
HWND hwnd;                              /* handle of the window      */
const WINDOWPLACEMENT FAR* lpwndpl;     /* address of position data  */
```

The **SetWindowPlacement** function sets the show state and the normal (restored), minimized, and maximized positions for a window.

Parameter	Description
hwnd	Identifies the window.
lpwndpl	Points to a **WINDOWPLACEMENT** structure that specifies the new show state and positions.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

See Also

GetWindowPlacement, **WINDOWPLACEMENT**

SetWindowPos (2.x)

BOOL SetWindowPos(*hwnd, hwndInsertAfter, x, y, cx, cy, fuFlags***)**

```
HWND hwnd;              /* handle of window          */
HWND hwndInsertAfter;   /* placement-order handle    */
int x;                  /* horizontal position       */
int y;                  /* vertical position         */
int cx;                 /* width                     */
int cy;                 /* height                    */
UINT fuFlags;           /* window-positioning flags  */
```

The **SetWindowPos** function changes the size, position, and Z-order of child, pop-up, and top-level windows. These windows are ordered according to their appearance on the screen; the window on top receives the highest rank and is the first window in the Z-order.

Parameter	Description
hwnd	Identifies the window to be positioned.
hwndInsertAfter	Identifies the window to precede the positioned window in the Z-order. This parameter must be a window handle or one of the following values:

Value	Meaning
HWND_BOTTOM	Places the window at the bottom of the Z-order. If *hwnd* identifies a topmost window, the window loses its topmost status; the system places the window at the bottom of all other windows.
HWND_TOP	Places the window at the top of the Z-order.
HWND_TOPMOST	Places the window above all non-topmost windows. The window maintains its topmost position even when it is deactivated.
HWND_NOTOPMOST	Repositions the window to the top of all non-topmost windows (that is, behind all topmost windows). This flag has no effect if the window is already a non-topmost window.

See the following Comments section for rules about how this parameter is used.

x	Specifies the new position of the left side of the window.
y	Specifies the new position of the top of the window.
cx	Specifies the new width of the window.
cy	Specifies the new height of the window.
fuFlags	Specifies the window sizing and positioning options. This parameter can be a combination of the following values:

Value	Meaning
SWP_DRAWFRAME	Draws a frame (defined in the window's class description) around the window.
SWP_HIDEWINDOW	Hides the window.
SWP_NOACTIVATE	Does not activate the window. If this flag is not set, the window is activated and moved to the top of either the topmost or non-topmost group (depending on the setting of the *hwndInsertAfter* parameter).
SWP_NOMOVE	Retains the current position (ignores the *x* and *y* parameters).

SWP_NOSIZE	Retains the current size (ignores the *cx* and *cy* parameters).
SWP_NOREDRAW	Does not redraw changes. If this flag is set, no repainting of any kind occurs. This applies to the client area, the non-client area (including the title and scroll bars), and any part of the parent window uncovered as a result of the moved window. When this flag is set, the application must explicitly invalidate or redraw any parts of the window and parent window that must be redrawn.
SWP_NOZORDER	Retains the current ordering (ignores the *hwndInsertAfter* parameter).
SWP_SHOWWINDOW	Displays the window.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

If the **SWP_SHOWWINDOW** or the **SWP_HIDEWINDOW** flags are set, the window cannot be moved or sized.

All coordinates for child windows are client coordinates (relative to the upper-left corner of the parent window's client area).

A window can be made a topmost window either by setting the *hwndInsertAfter* parameter to **HWND_TOPMOST** and ensuring that the **SWP_NOZORDER** flag is not set, or by setting a window's Z-order so that it is above any existing topmost windows. When a non-topmost window is made topmost, its owned windows are also made topmost. Its owners are not changed.

If neither **SWP_NOACTIVATE** nor **SWP_NOZORDER** is specified (that is, when the application requests that a window be simultaneously activated and placed in the specified Z-order), the value specified in *hwndInsertAfter* is used only in the following circumstances:

- Neither **HWND_TOPMOST** or **HWND_NOTOPMOST** is specified in the *hwndInsertAfter* parameter.
- The window specified in the *hwnd* parameter is not the active window.

An application cannot activate an inactive window without also bringing it to the top of the Z-order. Applications can change the Z-order of an activated window without restrictions or activate a window and then move it to the top of the topmost or non-topmost windows.

A topmost window is no longer topmost if it is repositioned to the bottom (**HWND_BOTTOM**) of the Z-order or after any non-topmost window. When a topmost window is made non-topmost, all of its owners and its owned windows are also made non-topmost windows.

A non-topmost window may own a topmost window, but not vice versa. Any window (for example, a dialog box) owned by a topmost window is itself made a topmost window, to ensure that all owned windows stay above their owner.

Example

The following example sets the size of a window equal to one-fourth the size of the desktop and then positions the window in the upper-left corner of the desktop:

```
RECT rect;

GetWindowRect(GetDesktopWindow(), &rect);
SetWindowPos(hwnd, (HWND) NULL, 0, 0,
    rect.right / 2, rect.bottom / 2,
    SWP_NOZORDER | SWP_NOACTIVATE);
```

See Also

BringWindowToTop, **GetWindowRect**, **MoveWindow**

Windows 3.1 changes

If the *hwndInsertAfter* parameter is **HWND_TOPMOST**, the system places the window identified by the *hwnd* parameter above all non-topmost windows. The window maintains its topmost position even when the window is deactivated. If the *hwndInsertAfter* parameter is **HWND_BOTTOM** and *hwnd* identifies a topmost window, the window loses its topmost status--the system places the window at the bottom of all other windows.

The following window-positioning flags are new for Windows version 3.1:

Value	Meaning
HWND_BOTTOM	Places the window at the bottom of the Z-order. If *hwnd* identifies a topmost window, the window loses its topmost status--the system places the window at the bottom of all other windows.
HWND_TOP	Places the window at the top of the Z-order.
HWND_TOPMOST	Places the window above all non-topmost windows. The window maintains its topmost position even when the window is deactivated.
HWND_NOTOPMOST	Repositions the window to the top of all non-topmost windows (that is, behind all topmost window).

HWND_BOTTOM

Places the window at the bottom of the Z-order. If *hwnd* identifies a topmost window, the window loses its topmost status; the system places the window at the bottom of all other windows.

HWND_TOP

Places the window at the top of the Z-order.

HWND_TOPMOST

Places the window above all non-topmost windows. The window maintains its topmost position even when it is deactivated.

HWND_NOTOPMOST

Repositions the window to the top of all non-topmost windows (that is, behind all topmost windows). This flag has no effect if the window is already a non-topmost window.

SetWindowsHook (2.x)

HHOOK SetWindowsHook(*idHook, hkprc***)**

```
int idHook;          /* type of hook to install                    */
HOOKPROC hkprc;      /* filter function procedure-instance address */
```

The **SetWindowsHook** function is obsolete but has been retained for backward compatibility with Windows versions 3.0 and earlier. Applications written for Windows version 3.1 should use the **SetWindowsHookEx** function.

The **SetWindowsHook** function installs an application-defined hook function into a hook chain.

Parameter	Description
idHook	Specifies the type of hook to be installed. This parameter can be one of the following values:

Value	Meaning
WH_CALLWNDPROC	Installs a window-procedure filter. For more information, see the description of the **CallWndProc** callback function.
WH_CBT	Installs a computer-based training (CBT) filter. For more information, see the description of the **CBTProc** callback function.
WH_DEBUG	Installs a debugging filter. For more information, see the description of the **DebugProc** callback function.
WH_GETMESSAGE	Installs a message filter. For more information, see the description of the **GetMsgProc** callback function.
WH_HARDWARE	Installs a nonstandard hardware-message filter. For more information, see the description of the **HardwareProc** callback function.
WH_JOURNALPLAYBACK	Installs a journaling playback filter. For more information, see the description of the **JournalPlaybackProc** callback function.
WH_JOURNALRECORD	Installs a journaling record filter. For more information, see the description of the **JournalRecordProc** callback function.
WH_KEYBOARD	Installs a keyboard filter. For more information, see the description of the **KeyboardProc** callback function.
WH_MOUSE	Installs a mouse-message filter. For more information, see the description of the **MouseProc** callback function.
WH_MSGFILTER	Installs a message filter. For more information, see the description of the **MessageProc** callback function.
WH_SHELL	Installs a shell-application filter. For more information, see the description of the **ShellProc** callback function.
WH_SYSMSGFILTER	Installs a system-wide message filter. For more information, see the description of the **SysMsgProc** callback function.

hkprc	Specifies the procedure-instance address of the application-defined hook procedure to be installed.

Returns

The return value is a handle of the installed hook, if the function is successful. Otherwise, it is NULL.

Comments

Before terminating, an application must call the **UnhookWindowsHook** function to free system resources associated with the hook.

The **WH_CALLWNDPROC** hook affects system performance. It is supplied for debugging purposes only.

The system hooks are a shared resource. Installing a hook affects all applications. Most hook functions must be in libraries. The only exception is **WH_MSGFILTER**, which is task-specific. System hooks should be restricted to special-purpose applications or to use as a development aid during debugging of an application. Libraries that no longer need the hook should remove the filter function.

To install a filter function, the **SetWindowsHook** function must receive a procedure-instance address of the function and the function must be exported in the library's module-definition file. A task must use the **MakeProcInstance** function to get a procedure-instance address. A dynamic-link library can pass the procedure address directly.

See Also

DefHookProc, **GetProcAddress**, **MakeProcInstance**, **MessageBox**, **PeekMessage**, **PostMessage**, **SendMessage**, **SetWindowsHookEx**, **UnhookWindowsHook**

Windows 3.1 changes

This function returns an **HHOOK** value for Windows 3.1. Prior to Windows 3.1 it returned a **HOOKPROC** value.

The following new hook types have been added:

Value	Meaning
WH_CBT	Installs a Computer-Based Training (CBT) filter. For more information, see the description of the **CBTProc** callback function.
WH_DEBUG	Installs a debugging filter. For more information, see the description of the **DebugProc** callback function.
WH_HARDWARE	Installs a non-standard hardware-message filter. For more information, see the description of the **HardwareProc** callback function.
WH_MOUSE	Installs a mouse-message filter. For more information, see the description of the **MouseProc** callback function.
WH_SHELL	Installs a shell-application filter. For more information, see the description of the **ShellProc** callback function.

WH_CALLWNDPROC 4

Installs a window-procedure filter. For more information, see the description of the **CallWndProc** callback function.

WH_CALLWNDPROC 4

WH_CBT 5

Installs a computer-based training (CBT) filter. For more information, see the description of the **CBTProc** callback function.

WH_DEBUG 9

Installs a debugging filter. For more information, see the description of the **DebugProc** callback function.

WH_DEBUG 9

WH_GETMESSAGE 3

Installs a message filter. For more information, see the description of the **GetMsgProc** callback function.

WH_HARDWARE 8

Installs a nonstandard hardware-message filter. For more information, see the description of the **HardwareProc** callback function.

WH_JOURNALPLAYBACK 1

Installs a journaling playback filter. For more information, see the description of the **JournalPlaybackProc** callback function.

WH_JOURNALRECORD 0

Installs a journaling record filter. For more information, see the description of the **JournalRecordProc** callback function.

WH_JOURNALRECORD 0

WH_KEYBOARD 2

Installs a keyboard filter. For more information, see the description of the **KeyboardProc** callback function.

WH_KEYBOARD 2

WH_MOUSE 7

Installs a mouse-message filter. For more information, see the description of the **MouseProc** callback function.

WH_MOUSE 7

WH_MSGFILTER (-1)

Installs a message filter. For more information, see the description of the **MessageProc** callback function.

WH_MSGFILTER (-1)

WH_SHELL 10

Installs a shell-application filter. For more information, see the description of the **ShellProc** callback function.

WH_SYSMSGFILTER 6

Installs a system-wide message filter. For more information, see the description of the **SysMsgProc** callback function.

SetWindowsHookEx (3.1)

HHOOK SetWindowsHookEx(*idHook, hkprc, hinst, htask***)**

```
int idHook;          /* type of hook to install                      */
HOOKPROC hkprc;      /* procedure-instance address of filter function */
HINSTANCE hinst;     /* handle of application instance               */
HTASK htask;         /* task to install the hook for                 */
```

The **SetWindowsHookEx** function installs an application-defined hook function into a hook chain. This function is an extended version of the **SetWindowsHook** function.

Parameter	Description
idHook	Specifies the type of hook to be installed. This parameter can be one of the following values:

Value	Meaning
WH_CALLWNDPROC	Installs a window-procedure filter. For more information, see the description of the **CallWndProc** callback function.
WH_CBT	Installs a computer-based training (CBT) filter. For more information, see the description of the **CBTProc** callback function.
WH_DEBUG	Installs a debugging filter. For more information, see the description of the **DebugProc** callback function.
WH_GETMESSAGE	Installs a message filter. For more information, see the description of the **GetMsgProc** callback function.
WH_HARDWARE	Installs a nonstandard hardware-message filter. For more information, see the description of the **HardwareProc** callback function.
WH_JOURNALPLAYBACK	Installs a journaling playback filter. For more information, see the description of the **JournalPlaybackProc** callback function.
WH_JOURNALRECORD	Installs a journaling record filter. For more information, see the description of the **JournalRecordProc** callback function.
WH_KEYBOARD	Installs a keyboard filter. For more information, see the description of the **KeyboardProc** callback function.
WH_MOUSE	Installs a mouse-message filter. For more information, see the description of the **MouseProc** callback function.
WH_MSGFILTER	Installs a message filter. For more information, see the description of the **MessageProc** callback function.
WH_SHELL	Installs a shell-application filter. For more information, see the description of the **ShellProc** callback function.
WH_SYSMSGFILTER	Installs a system-wide message filter. For more information, see the description of the **SysMsgProc** callback function.

hkprc	Specifies the procedure-instance address of the application-defined hook procedure to be installed.
hinst	Identifies the instance of the module containing the hook function.
htask	Identifies the task for which the hook is to be installed. If this parameter is NULL, the installed hook function has system scope and may be called in the context of any

process or task in the system.

Returns

The return value is a handle of the installed hook, if the function is successful. The application or library must use this handle to identify the hook when it calls the **CallNextHookEx** and **UnhookWindowsHookEx** functions. The return value is NULL if an error occurs.

Comments

An application or library can use the **GetCurrentTask** or **GetWindowTask** function to obtain task handles for use in hooking a particular task.

Hook procedures used with **SetWindowsHookEx** must be declared as follows:

```
DWORD CALLBACK HookProc(code, wParam, lParam)
int code;
WPARAM wParam;
LPARAM lParam;
{
    if (...)
        return CallNextHookEx(hhook, code, wParam, lParam);
}
```

Chaining to the next hook procedure (that is, calling the **CallNextHookProc** function) is optional. An applicaiton or library can call the next hook procedure either before or after any processing in its own hook procedure.

Before terminating, an application must call the **UnhookWindowsHookEx** function to free system resources associated with the hook.

Some hooks may be set with system scope only, and others may be set only for a specific task, as shown in the following list:

Hook	Scope
WH_CALLWNDPROC	Task or system
WH_CBT	Task or system
WH_DEBUG	Task or system
WH_GETMESSAGE	Task or system
WH_HARDWARE	Task or system
WH_JOURNALRECORD	System only
WH_JOURNALPLAYBACK	System only
WH_KEYBOARD	Task or system
WH_MOUSE	Task or system
WH_MSGFILTER	Task or system
WH_SYSMSGFILTER	System only

For a given hook type, task hooks are called first, then system hooks.

The **WH_CALLWNDPROC** hook affects system performance. It is supplied for debugging purposes only.

The system hooks are a shared resource. Installing one affects all applications. All system hook functions must be in libraries. System hooks should be restricted to special-purpose applications or to use as a development aid during debugging of an application. Libraries that no longer need the hook should remove the filter function.

It is a good idea for several reasons to use task hooks rather than system hooks: They do not incur a system-wide overhead in applications that are not affected by the call (or that ignore the call); they do not require packaging the hook-procedure implementation in a separate dynamic-link library; they will continue to work even when future versions of Windows prevent applications from installing system-wide

hooks for security reasons.

To install a filter function, the **SetWindowsHookEx** function must receive a procedure-instance address of the function and the function must be exported in the library's module-definition file. Libraries can pass the procedure address directly. Tasks must use the **MakeProcInstance** function to get a procedure-instance address. Dynamic-link libraries must use the **GetProcAddress** function to get a procedure-instance address.

For a given hook type, task hooks are called first, then system hooks.

The **WH_SYSMSGFILTER** hooks are called before the **WH_MSGFILTER** hooks. If any of the WH_SYSMSGFILTER hook functions return TRUE, the WH_MSGFILTER hooks are not called.

See Also

CallNextHookEx, **GetProcAddress**, **MakeProcInstance**, **MessageBox**, **PeekMessage**, **PostMessage**, **SendMessage**, **UnhookWindowsHookEx**

SetWindowText (2.x)

void SetWindowText(*hwnd, lpsz***)**

HWND *hwnd;* /* handle of window */
LPCSTR *lpsz;* /* address of string */

The **SetWindowText** function sets the given window's title to the specified text.

Parameter	Description
hwnd	Identifies the window or control whose text is to be set.
lpsz	Points to a null-terminated string to be used as the new title or control text.

Returns
This function does not return a value.

Comments
This function causes a **WM_SETTEXT** message to be sent to the given window or control.

If the window specified by the *hwnd* parameter is a control, the text within the control is set. If the specified window is a list-box control created with **WS_CAPTION** style, however, **SetWindowText** will set the caption for the control, not for the list-box entries.

Example
The following example sets a window title:

```
char szBuf[64];
char szFileName[64];

wsprintf((LPSTR) szBuf, "PrntFile - %s", (LPSTR) szFileName);
SetWindowText(hwnd, (LPSTR) szBuf);
```

See Also
GetWindowText, **WM_SETTEXT**

SetWindowWord (2.x)

WORD SetWindowWord(*hwnd, nOffset, nVal***)**

```
HWND hwnd;      /* handle of window     */
int nOffset;    /* offset of value to set */
WORD nVal;      /* new value            */
```

The **SetWindowWord** function places a word value at the specified offset into the extra window memory of the given window. Extra window memory is reserved by specifying a nonzero value in the **cbWndExtra** member of the **WNDCLASS** structure used with the **RegisterClass** function.

Parameter	Description
hwnd	Identifies the window.
nOffset	Specifies the zero-based byte offset of the value to change. Valid values are in the range zero through the number of bytes of extra window memory, minus two (for example, if 10 or more bytes of extra memory were specified, a value of 8 would be an index to the fifth integer), or one of the following values:

Value	Meaning
GWW_HINSTANCE	Specifies the instance handle of the module that owns the window.
GWW_ID	Specifies the identifier of the child window.

nVal	Specifies the word value to be placed in the window's reserved memory.

Returns

The return value is the previous value of the specified word, if the function is successful. Otherwise, it is zero.

Comments

To access any extra 2-byte values allocated when the window-class structure was created, use a positive byte offset as the index specified by the *nOffset* parameter, starting at 0 for the first 2-byte value in the extra space, 2 for the next 2-byte value, and so on.

An application should call the **SetParent** function, not the **SetWindowWord** function, to change the parent of a child window.

See Also

GetWindowLong, **GetWindowWord**, **RegisterClass**, **SetParent**, **SetWindowLong**

ShowCaret (2.x)

void ShowCaret(*hwnd***)**

HWND *hwnd;* /* handle of window with caret*/

The **ShowCaret** function shows the caret on the screen at the caret's current position. Once shown, the caret begins flashing automatically.

Parameter	Description
hwnd	Identifies the window that owns the caret. This parameter can be set to NULL to indirectly specify the window in the current task that owns the caret.

Returns

This function does not return a value.

Comments

The **ShowCaret** function shows the caret only if it has a current shape and has not been hidden two or more times consecutively. If the given window does not own the caret, the caret is not shown. If the *hwnd* parameter is NULL, the **ShowCaret** function shows the caret only if it is owned by a window in the current task.

Hiding the caret is cumulative. If the **HideCaret** function has been called five times consecutively, **ShowCaret** must be called five times to show the caret.

The caret is a shared resource. A window should show the caret only when it has the input focus or is active.

See Also

CreateCaret, **GetActiveWindow**, **GetFocus**, **HideCaret**

ShowCursor (2.x)

int ShowCursor(*fShow***)**

BOOL *fShow;* /* cursor visibility flag */

The **ShowCursor** function shows or hides the cursor.

Parameter	Description
fShow	Specifies whether the display count is incremented or decremented (increased or decreased by one). If this parameter is TRUE, the display count is incremented; otherwise, it is decremented.

Returns

The return value specifies the new display count, if the function is successful.

Comments

A cursor show-level count is kept internally. It is incremented by a show operation and decremented by a hide operation. The cursor is visible only if the count is greater than or equal to zero. If a mouse exists, the initial setting of the cursor show level is zero; otherwise, it is -1.

The cursor is a shared resource. A window that hides the cursor should show it before the cursor leaves its client area or before the window relinquishes control to another window.

See Also

SetCursor

ShowOwnedPopups (2.x)

void ShowOwnedPopups(*hwnd, fShow***)**

HWND *hwnd;* /* handle of window */
BOOL *fShow;* /* window visibility flag */

The **ShowOwnedPopups** function shows or hides all pop-up windows owned by the given window.

Parameter	Description
hwnd	Identifies the window that owns the pop-up windows to be shown or hidden.
fShow	Specifies whether pop-up windows are to be shown or hidden. If this parameter is TRUE, all hidden pop-up windows are shown. If this parameter is FALSE, all visible pop-up windows are hidden.

Returns
This function does not return a value.

See Also
IsWindowVisible, **ShowWindow**

ShowScrollBar (2.x)

void ShowScrollBar(*hwnd, fnBar, fShow***)**

```
HWND hwnd;      /* handle of window with scroll bar */
int fnBar;      /* scroll-bar flag                  */
BOOL fShow;     /* scroll-bar visibility flag       */
```

The **ShowScrollBar** function shows or hides a scroll bar.

Parameter	Description
hwnd	Identifies a scroll bar or a window that contains a scroll bar in its nonclient area, depending on the value of the *fnBar* parameter. If *fnBar* is **SB_CTL**, *hwnd* identifies a scroll bar. If *fnBar* is **SB_HORZ**, **SB_VERT**, or **SB_BOTH**, *hwnd* identifies a window that has a scroll bar in its nonclient area.
fnBar	Specifies whether the scroll bar is a control or part of a window's nonclient area. If the scroll bar is part of the nonclient area, *fnBar* also indicates whether the scroll bar is positioned horizontally, vertically, or both. This parameter can be one of the following values:

Value	Meaning
SB_BOTH	Specifies the window's horizontal and vertical scroll bars.
SB_CTL	Specifies that the *hwnd* parameter identifies a scroll bar control.
SB_HORZ	Specifies the window's horizontal scroll bar.
SB_VERT	Specifies the window's vertical scroll bar.

fShow	Specifies whether the scroll bar is shown or hidden. If this parameter is TRUE, the scroll bar is shown; otherwise, it is hidden.

Returns

This function does not return a value.

Comments

An application should not call this function to hide a scroll bar while processing a scroll-bar notification message.

See Also

GetScrollPos, **GetScrollRange**, **ScrollWindow**, **SetScrollPos**, **SetScrollRange**

ShowWindow (2.x)

BOOL ShowWindow(*hwnd, nCmdShow***)**

HWND *hwnd;* /* handle of window */
int *nCmdShow;* /* window visibility flag */

The **ShowWindow** function sets the given window's visibility state.

Parameter	Description
hwnd	Identifies the window.
nCmdShow	Specifies how the window is to be shown. This parameter can be one of the following values:

Value	Meaning
SW_HIDE	Hides the window and passes activation to another window.
SW_MINIMIZE	Minimizes the specified window and activates the top-level window in the system's list.
SW_RESTORE	Activates and displays a window. If the window is minimized or maximized, Windows restores it to its original size and position (same as SW_SHOWNORMAL).
SW_SHOW	Activates a window and displays it in its current size and position.
SW_SHOWMAXIMIZED	Activates a window and displays it as a maximized window.
SW_SHOWMINIMIZED	Activates a window and displays it as an icon.
SW_SHOWMINNOACTIVE	Displays a window as an icon. The window that is currently active remains active.
SW_SHOWNA	Displays a window in its current state. The window that is currently active remains active.
SW_SHOWNOACTIVATE	Displays a window in its most recent size and position. The window that is currently active remains active.
SW_SHOWNORMAL	Activates and displays a window. If the window is minimized or maximized, Windows restores it to its original size and position (same as SW_RESTORE).

Returns
The return value is nonzero if the window was previously visible. It is zero if the window was previously hidden.

Comments
The **ShowWindow** function must be called only once per application using the *nCmdShow* parameter from the **WinMain** function. Subsequent calls to **ShowWindow** must use one of the values listed in the preceding list, instead of the one specified by the *nCmdShow* parameter from **WinMain**.

See Also
IsWindowVisible, **ShowOwnedPopups**, **WM_SHOWWINDOW**

SubtractRect (3.1)

BOOL SubtractRect(*lprcDest, lprcSource1, lprcSource2***)**

```
RECT FAR* lprcDest;              /* pointer to destination rectangle */
const RECT FAR* lprcSource1;     /* pointer to rect. to subtract from */
const RECT FAR* lprcSource2;     /* pointer to rect. to subtract      */
```

The **SubtractRect** function retrieves the coordinates of a rectangle by subtracting one rectangle from another.

Parameter	Description
lprcDest	Points to the **RECT** structure to receive the dimensions of the new rectangle.
lprcSource1	Points to the **RECT** structure from which a rectangle is to be subtracted.
lprcSource2	Points to the **RECT** structure that is to be subtracted from the rectangle pointed to by the *lprcSource1* parameter.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The rectangle specified by the *lprcSource2* parameter is subtracted from the rectangle specified by *lprcSource1* only when the rectangles intersect completely in either the x- or y-direction. For example, if *lprcSource1* were (10,10, 100,100) and *lprcSource2* were (50,50, 150,150), the rectangle pointed to by *lprcDest* would contain the same coordinates as *lprcSource1* when the function returned. If *lprcSource1* were (10,10, 100,100) and *lprcSource2* were (50,10, 150,150), however, the rectangle pointed to by *lprcDest* would contain the coordinates (10,10, 50,100) when the function returned.

See Also

IntersectRect, **UnionRect**, **RECT**

SwapMouseButton (2.x)

BOOL SwapMouseButton(*fSwap***)**

BOOL *fSwap;* /* reverse or restore buttons */

The **SwapMouseButton** function reverses the meaning of left and right mouse buttons.

Parameter	Description
fSwap	Specifies whether the button meanings are reversed or restored. If this parameter is TRUE, the left button generates right-button mouse messages and the right button generates left-button messages. If this parameter is FALSE, the buttons are restored to their original meanings.

Returns

The return value specifies the meaning of the mouse buttons immediately before the function is called. It is nonzero if the meaning was reversed. Otherwise, it is zero.

Comments

Button swapping is provided as a convenience to people who use the mouse with their left hands. The **SwapMouseButton** function is usually called by Control Panel only. Although an application is free to call the function, the mouse is a shared resource and reversing the meaning of the mouse button affects all applications.

Example

The following example swaps the mouse buttons, depending on the check state of a check box:

```
BOOL fSwap;

fSwap = (BOOL) SendDlgItemMessage(hdlg, IDD_SWAP,
    BM_GETCHECK, 0, 0L);
SwapMouseButton(fSwap);
```

SystemParametersInfo (3.1)

BOOL SystemParametersInfo(*uAction, uParam, lpvParam, fuWinIni***)**

UINT *uAction;* /* system parameter to query or set */
UINT *uParam;* /* depends on system parameter */
void FAR* *lpvParam;* /* depends on system parameter */
UINT *fuWinIni;* /* WIN.INI update flag */

The **SystemParametersInfo** function queries or sets system-wide parameters. This function can also update the WIN.INI file while setting a parameter.

Parameter	Description
uAction	Specifies the system-wide parameter to query or set. This parameter can be one of the following values:

Value	Meaning
SPI_GETBEEP	Retrieves a **BOOL** value that indicates whether the warning beep is on or off.
SPI_GETBORDER	Retrieves the border multiplying factor that determines the width of a window's sizing border.
SPI_GETFASTTASKSWITCH	Determines whether fast task switching is on or off.
SPI_GETGRIDGRANULARITY	Retrieves the current granularity value of the desktop sizing grid.
SPI_GETICONTITLELOGFONT	Retrieves the logical-font information for the current icon-title font.
SPI_GETICONTITLEWRAP	Determines whether icon-title wrapping is on or off.
SPI_GETKEYBOARDDELAY	Retrieves the keyboard repeat-delay setting.
SPI_GETKEYBOARDSPEED	Retrieves the keyboard repeat-speed setting.
SPI_GETMENUDROPALIGNMENT	Determines whether pop-up menus are left-aligned or right-aligned relative to the corresponding menu-bar item.
SPI_GETMOUSE	Retrieves the mouse speed and the mouse threshold values, which Windows uses to calculate mouse acceleration.
SPI_GETSCREENSAVEACTIVE	Retrieves a **BOOL** value that indicates whether screen saving is on or off.
SPI_GETSCREENSAVETIMEOUT	Retrieves the screen-saver time-out value.
SPI_ICONHORIZONTALSPACING	Sets the width, in pixels, of an icon cell.
SPI_ICONVERTICALSPACING	Sets the height, in pixels, of an icon cell.
SPI_LANGDRIVER	Forces the user to load a new language driver.
SPI_SETBEEP	Turns the warning beep on or off.
SPI_SETBORDER	Sets the border multiplying factor that determines the width of a window's sizing border.

SPI_SETDESKPATTERN	Sets the current desktop pattern to the value specified in the Pattern entry in the WIN.INI file or to the pattern specified by the *lpvParam* parameter.
SPI_SETDESKWALLPAPER	Specifies the filename that contains the bitmap to be used as the desktop wallpaper.
SPI_SETDOUBLECLKHEIGHT	Sets the height of the rectangle within which the second click of a double-click must fall for it to be registered as a double-click.
SPI_SETDOUBLECLICKTIME	Sets the double-click time for the mouse. The double-click time is the maximum number of milliseconds that may occur between the first and second clicks of a double-click.
SPI_SETDOUBLECLKWIDTH	Sets the width of the rectangle within which the second click of a double-click must fall for it to be registered as a double-click.
SPI_SETFASTTASKSWITCH	Turns fast task switching on or off.
SPI_SETGRIDGRANULARITY	Sets the granularity of the desktop sizing grid.
SPI_SETICONTITLELOGFONT	Sets the font that is used for icon titles.
SPI_SETICONTITLEWRAP	Turns icon-title wrapping on or off.
SPI_SETKEYBOARDDELAY	Sets the keyboard repeat-delay setting.
SPI_SETKEYBOARDSPEED	Sets the keyboard repeat-speed setting.
SPI_SETMENUDROPALIGNMENT	Sets the alignment value of pop-up menus.
SPI_SETMOUSE	Sets the mouse speed and the x and y mouse-threshold values.
SPI_SETMOUSEBUTTONSWAP	Swaps or restores the meaning of the left and right mouse buttons.
SPI_SETSCREENSAVEACTIVE	Sets the state of the screen saver.
SPI_SETSCREENSAVETIMEOUT	Sets the screen-saver time-out value.

uParam

Depends on the *uAction* parameter. For more information, see the following Comments section.

lpvParam

Depends on the *uAction* parameter. For more information, see the following Comments section.

fuWinIni

If a system parameter is being set, specifies whether the WIN.INI file is updated, and if so, whether the **WM_WININICHANGE** message is broadcast to all top-level windows to notify them of the change. This parameter can be a combination of the following values:

Value	Meaning
SPIF_UPDATEINIFILE	Writes the new system-wide parameter setting to the WIN.INI file.
SPIF_SENDWININICHANGE	Broadcasts the **WM_WININICHANGE** message if the WIN.INI file is updated. This flag has no effect if **SPIF_UPDATEINIFILE** is not specified.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **SystemParameterInfo** function is intended for applications, such as Control Panel, that allow the user to customize the Windows environment.

The following table describes the *uParam* and *lpvParam* parameters for each SPI_ constant:

Constant	uParam	lpvParam
SPI_GETBEEP	0	Points to a **BOOL** variable that receives TRUE if the beep is on, FALSE if it is off.
SPI_GETBORDER	0	Points to an integer variable that receives the border multiplying factor.
SPI_GETFASTTASKSWITCH	0	Points to a **BOOL** variable that receives TRUE if fast task switching is on, FALSE if it is off.
SPI_GETGRIDGRANULARITY	0	Points to an integer variable that receives the grid-granularity value.
SPI_GETICONTITLELOGFONT	Size of **LOGFONT** structure	Points to a **LOGFONT** structure that receives the logical-font information.
SPI_GETICONTITLEWRAP	0	Points to a **BOOL** variable that receives TRUE if wrapping is on, FALSE if wrapping is off.
SPI_GETKEYBOARDDELAY	0	Points to an integer variable that receives the keyboard repeat-delay setting.
SPI_GETKEYBOARDSPEED	0	Points to a **WORD** variable that receives the current keyboard repeat-speed setting.
SPI_GETMENUDROPALIGNMENT	0	Points to a **BOOL** variable that

		receives TRUE if pop-up menus are right-aligned, FALSE if they are left-aligned.
SPI_GETMOUSE	0	Points to an integer array name lpiMouse, where lpiMouse[0] receives the WIN.INI entry **MouseThreshold 1**, lpiMouse[1] receives the entry **MouseThreshold 2**, and lpiMouse[2] receives the entry **MouseSpeed**.
SPI_GETSCREENSAVEACTIVE	0	Points to a **BOOL** variable that receives TRUE if the screen saver is active, FALSE if it is not.
SPI_GETSCREENSAVETIMEOUT	0	Points to an integer variable that receives the screen-saver time-out value, in milliseconds.
SPI_ICONHORIZONTALSPACING	New width, in pixels, for horizontal spacing of icons	Is NULL if the icon cell width, in pixels, is returned in *uParam.* If this value is a pointer to an integer, the current horizontal spacing is returned in that variable and *uParam* is ignored.
SPI_ICONVERTICALSPACING	New height, in pixels, for vertical spacing of icons	Is NULL if the icon cell height, in pixels, is returned in *uParam.* If this value is a pointer to an integer, the current vertical spacing is returned in that variable and *uParam* is

		ignored.
SPI_LANGDRIVER	0	Points to a string containing the new language driver filename. The application should make sure that all other international settings remain consistent when changing the language driver.
SPI_SETBEEP	TRUE = turn the beep on; FALSE = turn the beep off	Is NULL.
SPI_SETBORDER	Border multiplying factor	Is NULL.
SPI_SETDESKPATTERN	0 or -1	Specifies the desktop pattern. If this value is NULL and the *uParam* parameter is -1, the value is reread from the WIN.INI file. This value can also be a null-terminated string (**LPSTR**) containing a sequence of 8 numbers that represent the new desktop pattern; for example, "170 85 170 85 170 85 170 85" represents a 50% gray pattern.
SPI_SETDESKWALLPAPER	0	Points to a string that specifies the name of the bitmap file.
SPI_SETDOUBLECLKHEIGHT	Double-click height, in pixels	Is NULL.
SPI_SETDOUBLECLICKTIME	Double-click time, in milliseconds	Is NULL.
SPI_SETDOUBLECLKWIDTH	Double-click width, in pixels	Is NULL.
SPI_SETFASTTASKSWITCH	TRUE = turn on fast task switching; FALSE = turn it off	Is NULL.
SPI_SETGRIDGRANULARITY	Grid granularity	
SPI_SETICONTITLELOGFONT	Size of the **LOGFONT** structure	Points to a **LOGFONT** structure that defines the font to use for icon titles.

		If *uParam* is set to zero and *lParam* is set to NULL, Windows uses the icon-title font and spacings that were in effect when Windows was started.
SPI_SETICONTITLEWRAP	TRUE = turn wrapping on; FALSE = turn wrapping off	Is NULL.
SPI_SETKEYBOARDDELAY	Keyboard-delay setting	Is NULL.
SPI_SETKEYBOARDSPEED	Repeat-speed setting	Is NULL.
SPI_SETMENUDROPALIGNMENT	TRUE = right-alignment; FALSE = left-alignment	Is NULL.
SPI_SETMOUSE	0	Points to an integer array named lpiMouse, where lpiMouse[0] receives the WIN.INI entry **xMouseThreshold**, lpiMouse[1] receives the entry **yMouseThreshold**, and lpiMouse[2] receives the entry **MouseSpeed**.
SPI_SETMOUSEBUTTONSWAP	TRUE = reverse the meaning of the left and right mouse buttons; FALSE =restore the buttons to their original meanings	Is NULL.
SPI_SETSCREENSAVEACTIVE	TRUE = activate screen saving; FALSE = deactivate screen saving	Is NULL.
SPI_SETSCREENSAVETIMEOUT	Idle time-out duration, in seconds, before screen is saved	Is NULL.

Example

The following example retrieves the value for the DoubleClickSpeed entry from the WIN.INI file and uses the value to initialize an edit control. In this example, while the **WM_COMMAND** message is being processed, the user-specified value is retrieved from the edit control and used to set the double-click time.

```
char szBuf[32];
int iResult;

case WM_INITDIALOG:

    /* Initialize edit control to the current double-click time. */
```

```
    iResult = GetProfileInt("windows",
        "DoubleClickSpeed", 550);
    itoa(iResult, szBuf, 10);
    SendDlgItemMessage(hdlg, IDD_DCLKTIME, WM_SETTEXT, 0,
        (DWORD) (LPSTR) szBuf);

    .
    . /* Initialize any other controls. */
    .

    return 0;

case WM_COMMAND:
    switch(wParam) {

        case IDOK:

            /* Set double-click time to a user-specified value. */

            SendDlgItemMessage(hdlg, IDD_DCLKTIME, WM_GETTEXT,
                sizeof(szBuf), (DWORD) (LPSTR) szBuf);
            SystemParametersInfo(SPI_SETDOUBLECLICKTIME, atoi(szBuf),
                (LPVOID) NULL, SPIF_UPDATEINIFILE |
                SPIF_SENDWININICHANGE);
            .
            . /* Set any other system-wide parameters. */
            .

            EndDialog(hdlg, TRUE);
            return TRUE;
    }
    return 0;
```

See Also

WM_WININICHANGE

SPI_GETBEEP 1

Retrieves a **BOOL** value that indicates whether the warning beep is on or off.

SPI_GETBEEP 1

SPI_GETBORDER 5

Retrieves the border multiplying factor that determines the width of a window's sizing border.

SPI_GETBORDER 5

SPI_GETFASTTASKSWITCH 35

Determines whether fast task switching is on or off.

SPI_GETGRIDGRANULARITY 18

Retrieves the current granularity value of the desktop sizing grid.

SPI_GETICONTITLELOGFONT 31

Retrieves the logical-font information for the current icon-title font.

SPI_GETICONTITLELOGFONT 31

SPI_GETICONTITLEWRAP 25

Determines whether icon-title wrapping is on or off.

SPI_GETKEYBOARDDELAY 22

Retrieves the keyboard repeat-delay setting.

SPI_GETKEYBOARDDELAY 22

SPI_GETKEYBOARDSPEED 10

Retrieves the keyboard repeat-speed setting.

SPI_GETKEYBOARDSPEED 10

SPI_GETMENUDROPALIGNMENT 27

Determines whether pop-up menus are left-aligned or right-aligned relative to the corresponding menu-bar item.

SPI_GETMOUSE 3

Retrieves the mouse speed and the mouse threshold values, which Windows uses to calculate mouse acceleration.

SPI_GETMOUSE 3

SPI_GETSCREENSAVEACTIVE 16

Retrieves a **BOOL** value that indicates whether screen saving is on or off.

SPI_GETSCREENSAVEACTIVE 16

SPI_GETSCREENSAVETIMEOUT 14

Retrieves the screen-saver time-out value.

SPI_GETSCREENSAVETIMEOUT 14

SPI_ICONHORIZONTALSPACING 13

Sets the width, in pixels, of an icon cell.

SPI_ICONVERTICALSPACING 24

Sets the height, in pixels, of an icon cell.

SPI_ICONVERTICALSPACING 24

SPI_LANGDRIVER 12

Forces the user to load a new language driver.

SPI_SETBEEP 2

Turns the warning beep on or off.

SPI_SETBEEP 2

SPI_SETBORDER 6

Sets the border multiplying factor that determines the width of a window's sizing border.

SPI_SETBORDER 6

SPI_SETDESKPATTERN 21

Sets the current desktop pattern to the value specified in the Pattern entry in the WIN.INI file or to the pattern specified by the *lpvParam* parameter.

SPI_SETDESKPATTERN 21

SPI_SETDESKWALLPAPER 20

Specifies the filename that contains the bitmap to be used as the desktop wallpaper.

SPI_SETDESKWALLPAPER 20

SPI_SETDOUBLECLKHEIGHT 30

Sets the height of the rectangle within which the second click of a double-click must fall for it to be registered as a double-click.

SPI_SETDOUBLECLKHEIGHT 30

SPI_SETDOUBLECLICKTIME 32

Sets the double-click time for the mouse. The double-click time is the maximum number of milliseconds that may occur between the first and second clicks of a double-click.

SPI_SETDOUBLECLICKTIME 32

SPI_SETDOUBLECLKWIDTH 29

Sets the width of the rectangle within which the second click of a double-click must fall for it to be registered as a double-click.

SPI_SETDOUBLECLKWIDTH 29

SPI_SETFASTTASKSWITCH 36

Turns fast task switching on or off.

SPI_SETFASTTASKSWITCH 36

SPI_SETGRIDGRANULARITY 19

Sets the granularity of the desktop sizing grid.

SPI_SETICONTITLELOGFONT 34

Sets the font that is used for icon titles.

SPI_SETICONTITLELOGFONT 34

SPI_SETICONTITLEWRAP 26

Turns icon-title wrapping on or off.

SPI_SETICONTITLEWRAP 26

SPI_SETKEYBOARDDELAY 23

Sets the keyboard repeat-delay setting.

SPI_SETKEYBOARDDELAY 23

SPI_SETKEYBOARDSPEED 11

Sets the keyboard repeat-speed setting.

SPI_SETKEYBOARDSPEED 11

SPI_SETMENUDROPALIGNMENT 28

Sets the alignment value of pop-up menus.

SPI_SETMENUDROPALIGNMENT 28

SPI_SETMOUSE 4

Sets the mouse speed and the x and y mouse-threshold values.

SPI_SETMOUSE 4

SPI_SETMOUSEBUTTONSWAP 33

Swaps or restores the meaning of the left and right mouse buttons.

SPI_SETMOUSEBUTTONSWAP 33

SPI_SETSCREENSAVEACTIVE 17

Sets the state of the screen saver.

SPI_SETSCREENSAVEACTIVE 17

SPI_SETSCREENSAVETIMEOUT 15

Sets the screen-saver time-out value.

SPI_SETSCREENSAVETIMEOUT 15

SPIF_UPDATEINIFILE 0x0001

Writes the new system-wide parameter setting to the WIN.INI file.

SPIF_UPDATEINIFILE 0x0001

SPIF_SENDWININICHANGE 0x0002

Broadcasts the **WM_WININICHANGE** message if the WIN.INI file is updated. This flag has no effect if **SPIF_UPDATEINIFILE** is not specified.

SPIF_SENDWININICHANGE 0x0002

TabbedTextOut (3.0)

LONG TabbedTextOut(*hdc, xPosStart, yPosStart, lpszString, cbString, cTabStops, lpnTabPositions, nTabOrigin***)**

```
HDC hdc;                    /* handle of device context              */
int xPosStart;              /* x-coordinate of starting position     */
int yPosStart;              /* y-coordinate of starting position     */
LPCSTR lpszString;          /* address of string                     */
int cbString;               /* number of characters in string        */
int cTabStops;              /* number of tabs in array               */
int FAR* lpnTabPositions;   /* address of array with tab positions   */
int nTabOrigin;             /* x-coordinate for tab expansion        */
```

The **TabbedTextOut** function writes a character string at the specified location, expanding tabs to the values specified in the array of tab-stop positions. The function writes text in the currently selected font.

Parameter	Description
hdc	Identifies the device context.
xPosStart	Specifies the logical x-coordinate of the starting point of the string.
yPosStart	Specifies the logical y-coordinate of the starting point of the string.
lpszString	Points to the character string to be drawn.
cbString	Specifies the number of characters in the string.
cTabStops	Specifies the number of values in the array of tab-stop positions.
lpnTabPositions	Points to an array containing the tab-stop positions, in device units. The tab stops must be sorted in increasing order; the smallest x-value should be the first item in the array.
nTabOrigin	Specifies the logical x-coordinate of the starting position from which tabs are expanded.

Returns

The return value is the dimensions of the string, in logical units, if the function is successful. The low-order word contains the string width; the high-order word contains the string height. Otherwise, the return value is zero.

Comments

If the *cTabStops* parameter is zero and the *lpnTabPositions* parameter is NULL, tabs are expanded to eight times the average character width.

If *cTabStops* is 1, the tab stops are separated by the distance specified by the first value in the *lpnTabPositions* array.

If the *lpnTabPositions* array contains more than one value, a tab stop is set for each value in the array, up to the number specified by *cTabStops.*

The *nTabOrigin* parameter allows an application to call the **TabbedTextOut** function several times for a single line. If the application calls **TabbedTextOut** more than once with the *nTabOrigin* set to the same value each time, the function expands all tabs relative to the position specified by *nTabOrigin.*

By default, the current position is not used or updated by the **TabbedTextOut** function. If an application must update the current position when calling **TabbedTextOut**, it can call the **SetTextAlign** function with the *wFlags* parameter set to TA_UPDATECP. When this flag is set, Windows ignores the *xPosStart* and *yPosStart* parameters on subsequent calls to the **TabbedTextOut** function, using the current position instead.

Example

The following example expands tabs from the same x-coordinate as the string's starting point:

```
LPSTR lpszTabbedText = "Column 1\tColumn 2\tTest of TabbedTextOut";
int aTabs[2] = { 150, 300 };
int iStartXPos = 100;
int iStartYPos = 100;

TabbedTextOut(hdc,               /* handle of device context   */
    iStartXPos, iStartYPos,      /* starting coordinates       */
    lpszTabbedText,              /* address of text            */
    lstrlen(lpszTabbedText),     /* number of characters       */
    sizeof(aTabs) / sizeof(int), /* number of tabs in array    */
    aTabs,                       /* array for tab positions    */
    iStartXPos);                 /* x-coord. for tab expanding */
```

See Also

GetTabbedTextExtent, **SetTextAlign**, **SetTextColor**, **TextOut**

TrackPopupMenu (3.0)

BOOL TrackPopupMenu(*hmenu, fuFlags, x, y, nReserved, hwnd, lprc***)**

```
HMENU hmenu;          /* handle of menu                        */
UINT fuFlags;         /* screen-position and mouse-button flags */
int x;                /* horizontal screen position            */
int y;                /* vertical screen position              */
int nReserved;        /* reserved                              */
HWND hwnd;            /* handle of owner window                */
const RECT FAR* lprc; /* address of structure with rectangle   */
```

The **TrackPopupMenu** function displays the given floating pop-up menu at the specified location and tracks the selection of items on the pop-up menu. A floating pop-up menu can appear anywhere on the screen.

Parameter	Description
hmenu	Identifies the pop-up menu to be displayed. The application retrieves this handle by calling the **CreatePopupMenu** function to create a new pop-up menu or by calling the **GetSubMenu** function to retrieve the handle of a pop-up menu associated with an existing menu item.
fuFlags	Specifies the screen-position and mouse-button flags. The screen-position flag can be one of the following:

Value	Meaning
TPM_CENTERALIGN	Centers the pop-up menu horizontally relative to the coordinate specified by the *x* parameter.
TPM_LEFTALIGN	Positions the pop-up menu so that its left side is aligned with the coordinate specified by the *x* parameter.
TPM_RIGHTALIGN	Positions the pop-up menu so that its right side is aligned with the coordinate specified by the *x* parameter.

The mouse-button flag can be one of the following:

Value	Meaning
TPM_LEFTBUTTON	Causes the pop-up menu to track the left mouse button.
TPM_RIGHTBUTTON	Causes the pop-up menu to track the right mouse button instead of the left.

x	Specifies the horizontal position, in screen coordinates, of the pop-up menu. Depending on the value of the *fuFlags* parameter, the menu can be left-aligned, right-aligned, or centered relative to this position.
y	Specifies the vertical position, in screen coordinates, of the top of the menu on the screen.
nReserved	Reserved; must be zero.
hwnd	Identifies the window that owns the pop-up menu. This window receives all **WM_COMMAND** messages from the menu. The window will not receive WM_COMMAND messages until **TrackPopupMenu** returns.
lprc	Points to a **RECT** structure that contains the screen coordinates of a rectangle in which the user can click without dismissing the pop-up menu. If this parameter is NULL, the pop-up menu is dismissed if the user clicks outside the pop-up menu.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Example

The following example creates and tracks a pop-up menu when the user clicks the left mouse button:

```
POINT ptCurrent;
HMENU hmenu;

ptCurrent = MAKEPOINT(lParam);
hmenu = CreatePopupMenu();
AppendMenu(hmenu, MF_ENABLED, IDM_ELLIPSE, "Ellipse");
AppendMenu(hmenu, MF_ENABLED, IDM_SQUARE, "Square");
AppendMenu(hmenu, MF_ENABLED, IDM_TRIANGLE, "Triangle");
ClientToScreen(hwnd, &ptCurrent);
TrackPopupMenu(hmenu, TPM_LEFTALIGN, ptCurrent.x,
    ptCurrent.y, 0, hwnd, NULL);
```

See Also
CreatePopupMenu, **GetSubMenu**, **RECT**

Windows 3.1 changes

Applications receive **WM_COMMAND** messages from the pop-up menu after the **TrackPopupMenu** function returns. For earlier versions of Windows, applications received WM_COMMAND before **TrackPopupMenu** returned.

The seventh parameter to the **TrackPopupMenu** function is no longer reserved:

Parameter	Description
lprc	Points to a **RECT** structure that contains the screen coordinates of a rectangle within which the user can click without dismissing the pop-up menu. If this parameter is NULL, the pop-up menu is dismissed if the user clicks outside the pop-up menu.

The following constants have been added:

TPM_CENTERALIGN
TPM_LEFTALIGN
TPM_RIGHTALIGN
TPM_RIGHTBUTTON

TPM_CENTERALIGN 0x0004

Centers the pop-up menu horizontally relative to the coordinate specified by the *x* parameter.

TPM_CENTERALIGN 0x0004

TPM_LEFTALIGN 0x0000

Positions the pop-up menu so that its left side is aligned with the coordinate specified by the *x* parameter.

TPM_LEFTALIGN 0x0000

TPM_RIGHTALIGN 0x0008

Positions the pop-up menu so that its right side is aligned with the coordinate specified by the *x* parameter.

TPM_RIGHTALIGN 0x0008

TPM_LEFTBUTTON 0x0000

Causes the pop-up menu to track the left mouse button.

TPM_LEFTBUTTON 0x0000

TPM_RIGHTBUTTON 0x0002

Causes the pop-up menu to track the right mouse button instead of the left.

TPM_RIGHTBUTTON 0x0002

TranslateAccelerator (2.x)

int TranslateAccelerator(*hwnd, haccl, lpmsg***)**

```
HWND hwnd;          /* handle of window                          */
HACCEL haccl;       /* handle of accelerator table               */
MSG FAR* lpmsg;     /* address of structure with message information */
```

The **TranslateAccelerator** function processes accelerator keys for menu commands. The function translates **WM_KEYUP** and **WM_KEYDOWN** messages to **WM_COMMAND** or **WM_SYSCOMMAND** messages if there is an entry for the accelerator key in the application's accelerator table.

Parameter	Description
hwnd	Identifies the window whose messages are to be translated.
haccl	Identifies an accelerator table (loaded by using the **LoadAccelerators** function).
lpmsg	Points to an **MSG** structure retrieved by a call to the **GetMessage** or **PeekMessage** function. The structure contains message information from the application's message queue.

Returns

The return value is nonzero if the message is translated. Otherwise, it is zero.

Comments

The high-order word of the *lParam* parameter of the **WM_COMMAND** or **WM_SYSCOMMAND** message contains the value 1, to differentiate the message from messages sent by menus or controls.

WM_COMMAND or **WM_SYSCOMMAND** messages are sent directly to the window, rather than being posted to the application queue. The **TranslateAccelerator** function does not return until the message is processed.

Accelerator keystrokes that are defined to select items from the System menu are translated into **WM_SYSCOMMAND** messages; all other accelerator keystrokes are translated into **WM_COMMAND** messages.

When **TranslateAccelerator** returns a nonzero value (meaning that the message is translated), the application should *not* process the message again by using the **TranslateMessage** function.

Keystrokes in accelerator tables need not correspond to menu items.

If the accelerator keystroke does correspond to a menu item, the application is sent **WM_INITMENU** and **WM_INITMENUPOPUP** messages, just as if the user were trying to display the menu. However, these messages are not sent if any of the following conditions are present:

- The window is disabled.
- The menu item is disabled.
- The accelerator keystroke does not correspond to an item on the System menu and the window is minimized.
- A mouse capture is in effect (for more information, see the description of the **SetCapture** function).

If the window is the active window and there is no keyboard focus (generally the case if the window is minimized), **WM_SYSKEYUP** and **WM_SYSKEYDOWN** messages are translated instead of **WM_KEYUP** and **WM_KEYDOWN** messages.

If an accelerator keystroke that corresponds to a menu item occurs when the window that owns the menu is minimized, no **WM_COMMAND** message is sent. However, if an accelerator keystroke that does not match any of the items on the window's menu or the System menu occurs, a WM_COMMAND message is sent, even if the window is minimized.

See Also

GetMessage, **LoadAccelerators**, **PeekMessage**, **SetCapture**, **MSG**

TranslateMDISysAccel (3.0)

BOOL TranslateMDISysAccel(*hwndClient, lpmsg***)**

HWND *hwndClient;* /* handle of parent MDI client window */
MSG FAR* *lpmsg;* /* address of structure with message data */

The **TranslateMDISysAccel** function processes accelerator keystrokes for the given multiple document interface (MDI) child window. The function translates **WM_KEYUP** and **WM_KEYDOWN** messages to **WM_SYSCOMMAND** messages.

Parameter	Description
hwndClient	Identifies the parent MDI client window.
lpmsg	Points to an **MSG** structure retrieved by a call to the **GetMessage** or **PeekMessage** function. The structure contains message information from the application's message queue.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The high-order word of the *lParam* parameter of the **WM_SYSCOMMAND** message contains the value 1, to differentiate the message from messages sent by menus or controls.

See Also

GetMessage, **PeekMessage**, **MSG**, **WM_SYSCOMMAND**

TranslateMessage (2.x)

BOOL TranslateMessage(*lpmsg***)**

const MSG FAR* *lpmsg;* /* address of MSG structure */

The **TranslateMessage** function translates virtual-key messages into character messages, as follows:

- **WM_KEYDOWN**/**WM_KEYUP** combinations produce a **WM_CHAR** or **WM_DEADCHAR** message.
- **WM_SYSKEYDOWN**/**WM_SYSKEYUP** combinations produce a **WM_SYSCHAR** or **WM_SYSDEADCHAR** message.

The character messages are posted to the application's message queue, to be read the next time the application calls the **GetMessage** or **PeekMessage** function.

Parameter	Description
lpmsg	Points to an **MSG** structure retrieved by a call to the **GetMessage** or **PeekMessage** function. The structure contains message information from the application's message queue.

Returns

The return value is nonzero if the message is **WM_KEYDOWN**, **WM_KEYUP**, **WM_SYSKEYDOWN**, or **WM_SYSKEYUP**, regardless of whether the key that was pressed or released generates a **WM_CHAR** message. Otherwise, the return value is zero.

Comments

The **TranslateMessage** function does not modify the message pointed to by the *lpmsg* parameter.

TranslateMessage produces **WM_CHAR** messages only for keys that are mapped to ASCII characters by the keyboard driver.

An application should not call **TranslateMessage** if the application processes virtual-key messages for some other purpose. For instance, an application should not call **TranslateMessage** if the **TranslateAccelerator** function returns nonzero.

See Also

GetMessage, **PeekMessage**, **TranslateAccelerator**

TransmitCommChar (2.x)

int TransmitCommChar(*idComDev, chTransmit***)**

int *idComDev;* /* communications device */
char *chTransmit;* /* character to transmit */

The **TransmitCommChar** function places the specified character at the head of the transmission queue for the specified device.

Parameter	Description
idComDev	Specifies the communications device to transmit the character. The **OpenComm** function returns this value.
chTransmit	Specifies the character to be transmitted.

Returns
The return value is zero if the function is successful. It is less than zero if the character cannot be transmitted.

Comments
The **TransmitCommChar** function cannot be called repeatedly if the device is not transmitting. Once **TransmitCommChar** places a character in the transmission queue, the character must be transmitted before the function can be called again. **TransmitCommChar** returns an error if the previous character has not yet been sent.

Example
The following example uses the **TransmitCommChar** function to send characters from the keyboard to the communications port:

```
case WM_CHAR:

    ch = (char)wParam;
    TransmitCommChar(idComDev, ch);

    /* Add a linefeed for every carriage return. */

    if (ch == 0x0d)
        TransmitCommChar(idComDev, 0x0a);

    break;
```

See Also
OpenComm, **WriteComm**

UngetCommChar (2.x)

int UngetCommChar(*idComDev, chUnget***)**

```
int idComDev;      /* communications device      */
char chUnget;      /* character to place in queue */
```

The **UngetCommChar** function places the specified character back in the receiving queue. The next read operation will return this character first.

Parameter	Description
idComDev	Specifies the communications device that will receive the character. The **OpenComm** function returns this value.
chUnget	Specifies the character to be placed in the receiving queue.

Returns

The return value is zero if the function is successful. Otherwise, it is less than zero.

Comments

Consecutive calls to the **UngetCommChar** function are not permitted. The character placed in the queue must be read before this function can be called again.

UnhookWindowsHook (2.x)

BOOL UnhookWindowsHook(*idHook, hkprc***)**

```
int idHook;          /* type of hook function to remove          */
HOOKPROC hkprc;      /* hook function procedure-instance address */
```

The **UnhookWindowsHook** function is obsolete but has been retained for backward compatibility with Windows versions 3.0 and earlier. Applications written for Windows version 3.1 should use the **UnhookWindowsHookEx** function.

The **UnhookWindowsHook** function removes an application-defined hook function from a chain of hook functions. A hook function processes events before they are sent to an application's message loop in the **WinMain** function.

Parameter	Description
idHook	Specifies the type of function to be removed. This parameter can be one of the following values:

Value	Meaning
WH_CALLWNDPROC	Removes a window-procedure filter. For more information, see the description of the **CallWndProc** callback function.
WH_CBT	Removes a computer-based training (CBT) filter. For more information, see the description of the **CBTProc** callback function.
WH_DEBUG	Removes a debugging filter. For more information, see the description of the **DebugProc** callback function.
WH_GETMESSAGE	Removes a message filter. For more information, see the description of the **GetMsgProc** callback function.
WH_HARDWARE	Removes a nonstandard hardware-message filter. For more information, see the description of the **HardwareProc** callback function.
WH_JOURNALPLAYBACK	Removes a journaling playback filter. For more information, see the description of the **JournalPlaybackProc** callback function.
WH_JOURNALRECORD	Removes a journaling record filter. For more information, see the description of the **JournalRecordProc** callback function.
WH_KEYBOARD	Removes a keyboard filter. For more information, see the description of the **KeyboardProc** callback function.
WH_MOUSE	Removes a mouse-message filter. For more information, see the description of the **MouseProc** callback function.
WH_MSGFILTER	Removes a message filter. For more information, see the description of the **MessageProc** callback function.
WH_SYSMSGFILTER	Removes a system-wide message filter. For more information, see the description of the **SysMsgProc** callback function.

hkprc	Specifies the procedure-instance address of the application-defined filter function to remove.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

The **UnhookWindowsHook** function calls the hook chain, causing the hook function to receive a negative value for the *idHook* parameter. The hook function must then call the **DefHookProc** function, which removes the hook function from the chain.

See Also

SetWindowsHook

Windows 3.1 changes

The following new hook types have been added:

Value	Meaning
WH_CBT	Removes a Computer-Based Training (CBT) filter.
WH_DEBUG	Removes a debugging filter.
WH_HARDWARE	Removes a non-standard hardware-message filter.
WH_MOUSE	Removes a mouse-message filter.

UnhookWindowsHookEx (3.1)

BOOL UnhookWindowsHookEx(*hhook***)**

HHOOK *hhook;* /* handle of hook function to remove */

The **UnhookWindowsHookEx** function removes an application-defined hook function from a chain of hook functions. A hook function processes events before they are sent to an application's message loop in the **WinMain** function.

Parameter	Description
hhook	Identifies the hook function to be removed. This is the value returned by the **SetWindowsHookEx** function when the hook was installed.

Returns
The return value is nonzero if the function is successful. It is zero if the hook cannot be found.

Comments
The **UnhookWindowsHookEx** function must be used in combination with the **SetWindowsHookEx** function.

Example
The following example uses the **UnhookWindowsHookEx** function to remove a message filter that was used to provide context-sensitive help for a dialog box:

```
DLGPROC lpfnAboutProc;
HOOKPROC lpfnFilterProc;
HHOOK   hhook;

case IDM_ABOUT:
    lpfnAboutProc = (DLGPROC) MakeProcInstance(About, hinst);
    lpfnFilterProc = (HOOKPROC) MakeProcInstance(FilterFunc, hinst);
    hhook = SetWindowsHookEx(WH_MSGFILTER, lpfnFilterProc,
        hinst, (HTASK) NULL);

    DialogBox(hinst, "AboutBox", hwnd, lpfnAboutProc);

    UnhookWindowsHookEx(hhook);
    FreeProcInstance((FARPROC) lpfnFilterProc);
    FreeProcInstance((FARPROC) lpfnAboutProc);

    break;
```

See Also
CallNextHookEx, **SetWindowsHookEx**

UnionRect (2.x)

BOOL UnionRect(*lprcDst, lprcSrc1, lprcSrc2***)**

```
RECT FAR* lprcDst;          /* address of structure for union      */
const RECT FAR* lprcSrc1;   /* address of structure with 1st rect. */
const RECT FAR* lprcSrc2;   /* address of structure with 2nd rect. */
```

The **UnionRect** function creates the union of two rectangles. The union is the smallest rectangle that contains both source rectangles.

Parameter	Description
lprcDst	Points to a **RECT** structure to receive a rectangle containing the rectangles pointed to by the *lprcSrc1* and *lprcSrc2* parameters.
lprcSrc1	Points to a **RECT** structure that contains the first source rectangle.
lprcSrc2	Points to a **RECT** structure that contains the second source rectangle.

Returns

The return value is nonzero if the function is successful--that is, if the *lprcDst* parameter contains a nonempty rectangle. It is zero if the rectangle is empty or an error occurs.

Comments

Windows ignores the dimensions of an empty rectangle--that is, a rectangle that has no height or no width.

See Also

InflateRect, **IntersectRect**, **OffsetRect**, **SubtractRect**, **RECT**

UnregisterClass (3.0)

BOOL UnregisterClass(*lpszClassName, hinst***)**

LPCSTR *lpszClassName;* /* address of class-name string */
HINSTANCE *hinst;* /* handle of application instance */

The **UnregisterClass** function removes a window class, freeing the storage required for the class.

Parameter	Description
lpszClassName	Points to a null-terminated string containing the class name. This class name must have been registered by a previous call to the **RegisterClass** function with a valid **hInstance** member of the **WNDCLASS** structure. Predefined classes, such as dialog box controls, cannot be unregistered.
hinst	Identifies the instance of the module that created the class.

Returns

The return value is nonzero if the function successful. It is zero if the class could not be found or if a window exists that was created with the class.

Comments

Before calling this function, an application should destroy all windows that were created with the specified class.

See Also

RegisterClass, **WNDCLASS**

UpdateWindow (2.x)

void UpdateWindow(*hwnd***)**

HWND *hwnd;* /* handle of window */

The **UpdateWindow** function updates the client area of the given window by sending a **WM_PAINT** message to the window if the update region for the window is not empty. The function sends a WM_PAINT message directly to the window procedure of the given window, bypassing the application queue. If the update region is empty, no message is sent.

Parameter	Description
hwnd	Identifies the window to be updated.

Returns

This function does not return a value.

See Also

ExcludeUpdateRgn, **GetUpdateRect**, **GetUpdateRgn**, **InvalidateRect**, **InvalidateRgn**, **WM_PAINT**

ValidateRect (2.x)

void ValidateRect(*hwnd, lprc***)**

```
HWND hwnd;              /* handle of window                        */
const RECT FAR* lprc;   /* address of structure with validation rect.*/
```

The **ValidateRect** function validates the client area within the given rectangle by removing the rectangle from the update region of the given window.

Parameter	Description
hwnd	Identifies the window whose update region is to be modified.
lprc	Points to a **RECT** structure that contains the client coordinates of the rectangle to be removed from the update region. If this parameter is NULL, the entire client area is removed.

Returns

This function does not return a value.

Comments

The **BeginPaint** function automatically validates the entire client area. Neither the **ValidateRect** nor the **ValidateRgn** function should be called if a portion of the update region needs to be validated before the next **WM_PAINT** message is generated.

Windows continues to generate **WM_PAINT** messages until the current update region is validated.

See Also

BeginPaint, **InvalidateRect**, **InvalidateRgn**, **ValidateRgn**, **RECT**, **WM_PAINT**

ValidateRgn (2.x)

void ValidateRgn(*hwnd, hrgn***)**

```
HWND hwnd;      /* handle of window       */
HRGN hrgn;      /* handle of valid region */
```

The **ValidateRgn** function validates the client area within the given region by removing the region from the current update region of the specified window.

Parameter	Description
hwnd	Identifies the window whose update region is to be modified.
hrgn	Identifies a region that defines the area to be removed from the update region. If this parameter is NULL, the entire client area is removed.

Returns

This function does not return a value.

Comments

The given region must have been created by a region function. The region coordinates are assumed to be client coordinates.

The **BeginPaint** function automatically validates the entire client area. Neither the **ValidateRect** nor the **ValidateRgn** function should be called if a portion of the update region must be validated before the next **WM_PAINT** message is generated.

See Also

BeginPaint, **InvalidateRect**, **InvalidateRgn**, **ValidateRect**, **WM_PAINT**

WaitMessage (2.x)

void WaitMessage(void)

The **WaitMessage** function yields control to other applications when an application has no other tasks to perform. The **WaitMessage** function suspends the application and does not return until a new message is placed in the application's queue.

Returns
This function does not return a value.

Comments
The **WaitMessage** function normally returns immediately if there is a message in the queue. If an application has used the **PeekMessage** function but not removed the message, however, **WaitMessage** does not return until the message is received. Applications that use the **PeekMessage** function should remove any retrieved messages from the queue before calling **WaitMessage**.

The **GetMessage**, **PeekMessage**, and **WaitMessage** functions yield control to other applications. Using these functions is the only way to allow other applications to run. Applications that do not call any of these functions for long periods prevent other applications from running.

See Also
GetMessage, **PeekMessage**

WindowFromPoint (2.x)

HWND WindowFromPoint(*pt***)**

POINT *pt;* /* structure with point */

The **WindowFromPoint** function retrieves the handle of the window that contains the specified point.

Parameter	Description
pt	Specifies a **POINT** structure that defines the screen coordinates of the point to be checked.

Returns

The return value is the handle of the window in which the point lies, if the function is successful. The return value is NULL if no window exists at the specified point.

Comments

The **WindowFromPoint** function does not retrieve the handle of a hidden, disabled, or transparent window, even if the point is within the window. An application should use the **ChildWindowFromPoint** function for a nonrestrictive search.

See Also

ChildWindowFromPoint

WinHelp (3.0)

BOOL WinHelp(*hwnd, lpszHelpFile, fuCommand, dwData***)**

```
HWND hwnd;          /* handle of window requesting help */
LPCSTR lpszHelpFile; /* address of directory-path string */
UINT fuCommand;     /* type of help                     */
DWORD dwData;       /* additional data                  */
```

The **WinHelp** function starts Windows Help (WINHELP.EXE) and passes optional data indicating the nature of the help requested by the application. The application specifies the name and, where required, the path of the help file that the Help application is to display.

Parameter	Description
hwnd	Identifies the window requesting Help. The **WinHelp** function uses this handle to keep track of which applications have requested Help.
lpszHelpFile	Points to a null-terminated string containing the path, if necessary, and the name of the help file that the Help application is to display. The filename may be followed by an angle bracket (>) and the name of a secondary window if the topic is to be displayed in a secondary window rather than in the primary window. The name of the secondary window must have been defined in the **[WINDOWS]** section of the Help project (.HPJ) file.
fuCommand	Specifies the type of help requested. For a list of possible values and how they affect the value to place in the *dwData* parameter, see the following Comments section.
dwData	Specifies additional data. The value used depends on the value of the *fuCommand* parameter. For a list of possible values, see the following Comments section.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero.

Comments

Before closing the window that requested the help, the application must call **WinHelp** with *fuCommand* set to HELP_QUIT. Until all applications have done this, Windows Help does not terminate.

The following table shows the possible values for the *fuCommand* parameter and the corresponding formats of the *dwData* parameter:

fuCommand	dwData	Action
HELP_CONTEXT	An unsigned long integer containing the context number for the topic.	Displays Help for a particular topic identified by a context number that has been defined in the [MAP] section of the .HPJ file.
HELP_CONTENTS	Ignored; applications should set to 0L.	Displays the Help contents topic as defined by the Contents option in the [OPTIONS] section of the .HPJ file.
HELP_SETCONTENTS	An unsigned long integer containing the context number for the topic theapplication wants to designate as the Contents topic.	Determines which Contents topic Help should display when a user presses the F1 key.
HELP_CONTEXTPOPUP	An unsigned long integer containing the context number for a topic.	Displays in a pop-up window a particular Help topic identified by a context number that has been

		defined in the [MAP] section of the .HPJ file.
HELP_KEY	A long pointer to a string that contains a keyword for the desired topic.	Displays the topic found in the keyword list that matches the keyword passed in the *dwData* parameter if there is one exact match. If there is more than one match, displays the Search dialog box with the topics listed in the Go To list box.
HELP_PARTIALKEY	A long pointer to a string that contains a keyword for the desired topic.	Displays the topic found in the keyword list that matches the keyword passed in the *dwData* parameter if there is one exact match. If there is more than one match, displays the Search dialog box with the topics found listed in the Go To list box. If there is no match, displays the Search dialog box. If you just want to bring up the Search dialog box without passing a keyword (the third result), you should use a long pointer to an empty string.
HELP_MULTIKEY	A long pointer to the **MULTIKEYHELP** structure, as defined inWINDOWS.H. This structure specifies the table footnote character and the keyword.	Displays the Help topic identified by a keyword in an alternate key word table.
HELP_COMMAND	A long pointer to a string that contains a Help macro to be executed.	Executes a Help macro.
HELP_SETWINPOS	A long pointer to the **HELPWININFO** structure, as defined in WINDOWS.H. Thisstructure specifies the size and position of the primary Help window or a secondary window to be displayed.	Displays the Help window if it is minimized or in memory, and positions it according to the data passed.
HELP_FORCEFILE	Ignored; applications should set to 0L.	Ensures that WinHelp is displaying the correct Help file. If the correct Help file is currently displayed, there is no action. If the incorrect Help file is displayed, WinHelp opens the correct file.
HELP_HELPONHELP	Ignored; applications should set to 0L.	Displays the Contents topic of the designated Using Help file.
HELP_QUIT	Ignored; applications should set to 0L.	Informs the Help application that Help is no longer needed. If no other applications have asked for Help, Windows closes the Help

application.

See Also
MULTIKEYHELP, **Creating Help Files**

Windows 3.1 changes

The following constants have been added:

HELP_SETCONTENTS (used to be HELP_SETINDEX)
HELP_FORCEFILE
HELP_PARTIALKEY
HELP_CONTENTS (used to be HELP_INDEX)
HELP_POPUPID

WNetAddConnection (3.1)

UINT WNetAddConnection(*lpszNetPath, lpszPassword, lpszLocalName***)**

```
LPSTR lpszNetPath;      /* address of network device  */
LPSTR lpszPassword;     /* address of password        */
LPSTR lpszLocalName;    /* address of local device    */
```

The **WNetAddConnection** function redirects the specified local device (either a disk drive or a printer port) to the given shared device or remote server.

Parameter	Description
lpszNetPath	Points to a null-terminated string specifying the shared device or remote server.
lpszPassword	Points to a null-terminated string specifying the network password for the given device or server.
lpszLocalName	Points to a null-terminated string specifying the local drive or device to be redirected. All *lpszLocalName* strings (such as LPT1) are case-independent. Only the drive names A through Z and the device names LPT1 through LPT3 are used.

Returns

The return value is one of the following:

Value	Meaning
WN_SUCCESS	The function was successful.
WN_NOT_SUPPORTED	The function was not supported.
WN_OUT_OF_MEMORY	The system was out of memory.
WN_NET_ERROR	An error occurred on the network.
WN_BAD_POINTER	The pointer was invalid.
WN_BAD_NETNAME	The network resource name was invalid.
WN_BAD_LOCALNAME	The local device name was invalid.
WN_BAD_PASSWORD	The password was invalid.
WN_ACCESS_DENIED	A security violation occurred.
WN_ALREADY_CONNECTED	The local device was already connected to a remote resource.

See Also

WNetCancelConnection, **WNetGetConnection**

WN_SUCCESS 0x0000

The function was successful.

WN_SUCCESS 0x0000

WN_NOT_SUPPORTED 0x0001

The function was not supported.

WN_NOT_SUPPORTED 0x0001

WN_OUT_OF_MEMORY 0x000B

The system was out of memory.

WN_OUT_OF_MEMORY 0x000B

WN_NET_ERROR 0x0002

An error occurred on the network.

WN_NET_ERROR 0x0002

WN_BAD_POINTER 0x0004

The pointer was invalid.

WN_BAD_POINTER 0x0004

WN_BAD_NETNAME 0x0032

The network resource name was invalid.

WN_BAD_NETNAME 0x0032

WN_BAD_LOCALNAME 0x0033

The local device name was invalid.

WN_BAD_LOCALNAME 0x0033

WN_BAD_PASSWORD 0x0006

The password was invalid.

WN_BAD_PASSWORD 0x0006

WN_ACCESS_DENIED 0x0007

A security violation occurred.

WN_ACCESS_DENIED 0x0007

WN_ALREADY_CONNECTED 0x0034

The local device was already connected to a remote resource.

WN_ALREADY_CONNECTED 0x0034

WNetCancelConnection (3.1)

UINT WNetCancelConnection(*lpszName, fForce***)**

```
LPSTR lpszName;     /* address of device or resource  */
BOOL fForce;        /* forced closure flag            */
```

The **WNetCancelConnection** function cancels a network connection.

Parameter	Description
lpszName	Points to the name of the redirected local device (such as LPT1 or D:).
fForce	Specifies whether any open files or open print jobs on the device should be closed before the connection is canceled. If this parameter is FALSE and there are open files or jobs, the connection should not be canceled and the function should return the WN_OPEN_FILES error value.

Returns

The return value is one of the following:

Value	Meaning
WN_SUCCESS	The function was successful.
WN_NOT_SUPPORTED	The function was not supported.
WN_OUT_OF_MEMORY	The system was out of memory.
WN_NET_ERROR	An error occurred on the network.
WN_BAD_POINTER	The pointer was invalid.
WN_BAD_VALUE	The *lpszName* parameter was not a valid local device or network name.
WN_NOT_CONNECTED	The *lpszName* parameter was not a redirected local device or currently accessed network resource.
WN_OPEN_FILES	Files were open and the *fForce* parameter was FALSE. The connection was not canceled.

See Also

WNetAddConnection, **WNetGetConnection**

WNetGetConnection (3.1)

UINT WNetGetConnection(*lpszLocalName, lpszRemoteName, cbRemoteName***)**

```
LPSTR lpszLocalName;        /* address of local device name     */
LPSTR lpszRemoteName;       /* address of remote device name    */
UINT FAR* cbRemoteName;     /* max. number of bytes in buffer   */
```

The **WNetGetConnection** function returns the name of the network resource associated with the specified redirected local device.

Parameter	Description
lpszLocalName	Points to a null-terminated string specifying the name of the redirected local device.
lpszRemoteName	Points to the buffer to receive the null-terminated name of the remote network resource.
cbRemoteName	Points to a variable specifying the maximum number of bytes the buffer pointed to by *lpszRemoteName* can hold. The function sets this variable to the number of bytes copied to the buffer.

Returns

The return value is one of the following:

Value	Meaning
WN_SUCCESS	The function was successful.
WN_NOT_SUPPORTED	The function was not supported.
WN_OUT_OF_MEMORY	The system was out of memory.
WN_NET_ERROR	An error occurred on the network.
WN_BAD_POINTER	The pointer was invalid.
WN_BAD_VALUE	The *szLocalName* parameter was not a valid local device.
WN_NOT_CONNECTED	The *szLocalName* parameter was not a redirected local device.
WN_MORE_DATA	The buffer was too small.

See Also

WNetAddConnection, **WNetCancelConnection**

WriteComm (2.x)

int WriteComm(*idComDev, lpvBuf, cbWrite***)**

```
int idComDev;              /* identifier of comm. device */
const void FAR* lpvBuf;    /* address of data buffer     */
int cbWrite;               /* number of bytes to write   */
```

The **WriteComm** function writes to the specified communications device.

Parameter	Description
idComDev	Specifies the device to receive the bytes. The **OpenComm** function returns this value.
lpvBuf	Points to the buffer that contains the bytes to be written.
cbWrite	Specifies the number of bytes to be written.

Returns

The return value specifies the number of bytes written, if the function is successful. The return value is less than zero if an error occurs, making the absolute value of the return value the number of bytes written.

Comments

To determine what caused an error, use the **GetCommError** function to retrieve the error value and status.

For serial ports, the **WriteComm** function deletes data in the transmission queue if there is not enough room in the queue for the additional bytes. Before calling **WriteComm**, applications should check the available space in the transmission queue by using the **GetCommError** function. Also, applications should use the **OpenComm** function to set the size of the transmission queue to an amount no smaller than the size of the largest expected output string.

See Also

GetCommError, **OpenComm**, **TransmitCommChar**

wvsprintf (3.0)

int wvsprintf(*lpszOutput, lpszFormat, lpvArglist***)**

```
LPSTR lpszOutput;          /* address of output destination   */
LPCSTR lpszFormat;         /* address of format string        */
const void FAR* lpvArglist; /* address of array of arguments */
```

The **wvsprintf** function formats and stores a series of characters and values in a buffer. The items pointed to by the argument list are converted according to the corresponding format specification in the format string.

Parameter	Description
lpszOutput	Points to a null-terminated string to receive the string formatted as specified in the *lpszFormat* parameter.
lpszFormat	Points to a null-terminated string that contains the format-control string. In addition to the standard ASCII characters, a format specification for each argument appears in this string. For more information about the format specification, see the description of the **wsprintf** function.
lpvArglist	Points to an array of 16-bit values, each of which specifies an argument for the format-control string. The number, type, and interpretation of the arguments depend on the corresponding format-control character sequences specified in the *lpszFormat* parameter. Each character or 16-bit integer (**%c**, **%d**, **%x**, **%i**) requires one word in *lpvArglist.* Long integers (**%ld**, **%li**, **%lx**) require two words, the low-order word of the integer followed by the high-order word. A string (**%s**) requires two words, the offset followed by the segment (which together make up a far pointer).

Returns

The return value is the number of bytes stored in the *lpszOutput* string, not counting the terminating null character, if the function is successful.

See Also

wsprintf

User functions

AdjustWindowRect	Computes required size of a window rectangle
AdjustWindowRectEx	Computes required size of a window rectangle
AnsiLower	Converts a string to lowercase
AnsiLowerBuff	Converts a string buffer to lowercase
AnsiNext	Moves to the next character in a string
AnsiPrev	Moves to the previous character in a string
AnsiUpper	Converts a string to uppercase
AnsiUpperBuff	Converts a string buffer to uppercase
AnyPopup	Indicates if pop-up or overlapped window exists
AppendMenu	Appends a new item to a menu
ArrangeIconicWindows	Arranges minimized child windows
BeginDeferWindowPos	Creates a window-positioning structure
BeginPaint	Prepares a window for painting
BringWindowToTop	Uncovers an overlapped window
BuildCommDCB	Translates a device-definition string to a **DCB**
CallMsgFilter	Passes a message to a message-filter function
CallNextHookEx	Passes hook information down the hook chain
CallWindowProc	Passes a message to a window procedure
ChangeClipboardChain	Removes a window from the clipboard-viewer chain
ChangeMenu	Not used in Windows 3.1
CheckDlgButton	Changes a check mark by a dialog box button
CheckMenuItem	Changes a check mark by a menu item
CheckRadioButton	Places a check mark by a radio button
ChildWindowFromPoint	Determines the child window containing a point
ClearCommBreak	Restores character transmission
ClientToScreen	Converts a client point to screen coordinates
ClipCursor	Confines the cursor to a specified rectangle
CloseClipboard	Closes the clipboard
CloseComm	Closes a communications device
CloseWindow	Minimizes a window
CloseDriver	Closes an installable driver
CopyCursor	Copies a cursor
CopyIcon	Copies an icon
CopyRect	Copies the dimensions of a rectangle
CountClipboardFormats	Returns the number of clipboard formats
CreateCaret	Creates a new shape for the system caret
CreateCursor	Creates a cursor with the specified dimensions
CreateDialog	Creates a modeless dialog box
CreateDialogIndirect	Creates modeless dialog box from memory template
CreateDialogIndirectParam	Creates modeless dialog box from memory template
CreateDialogParam	Creates a modeless dialog box
CreateIcon	Creates an icon with the specified dimensions
CreateMenu	Creates a menu
CreatePopupMenu	Creates a pop-up menu
CreateWindow	Creates a window
CreateWindowEx	Creates a window
DefDlgProc	Does default window message processing
DefDriverProc	Calls the default installable-driver procedure
DeferWindowPos	Updates a multiple window-positioning structure
DefFrameProc	Does default MDI frame window message processing
DefHookProc	Calls the next function in a hook-function chain
DefMDIChildProc	Does default MDI child window message processing
DefWindowProc	Calls the default window procedure
DeleteMenu	Deletes an item from a menu
DestroyCaret	Destroys the current caret

DestroyCursor	Destroys a cursor
DestroyIcon	Destroys an icon
DestroyMenu	Destroys a menu
DestroyWindow	Destroys a window
DialogBox	Creates a modal dialog box
DialogBoxIndirect	Creates modal dialog box from memory template
DialogBoxIndirectParam	Creates modal dialog box from memory template
DialogBoxParam	Creates a modal dialog box
DispatchMessage	Dispatches a message to a window
DlgDirList	Fills a directory list box
DlgDirListComboBox	Fills a directory list box
DlgDirSelect	Retrieves a selection from a directory list box
DlgDirSelectEx	Retrieves a selection from a directory list box
DlgDirSelectComboBox	Retrieves a selection from a directory list box
DlgDirSelectComboBoxEx	Retrieves a selection from a directory list box
DrawFocusRect	Draws a rectangle in the focus style
DrawIcon	Draws an icon in the specified device context
DrawMenuBar	Redraws the menu bar
DrawText	Draws the formatted text in a rectangle
EmptyClipboard	Empties the clipboard and frees the data handles
EnableCommNotification	Enables or disables **WM_COMMNOTIFY** posting
EnableHardwareInput	Controls mouse and keyboard input queuing
EnableMenuItem	Enables, disables, or grays a menu item
EnableScrollBar	Enables or disables scroll-bar arrows
EnableWindow	Sets the window-enable state
EndDeferWindowPos	Updates position and size of multiple windows
EndDialog	Hides a modal dialog box
EndPaint	Marks the end of painting in specified window
EnumChildWindows	Passes child-window handles to a callback
EnumClipboardFormats	Returns available clipboard formats
EnumProps	Passes property-list entries to a callback
EnumTaskWindows	Passes task's window handles to a callback
EnumWindows	Passes parent-window handles to a callback
EqualRect	Determines whether two rectangles are equal
EscapeCommFunction	Passes an extended function to a device
ExcludeUpdateRgn	Excludes updated region from clipping region
ExitWindows	Restarts or terminates Windows
ExitWindowsExec	Terminates Windows and runs MS-DOS application
FillRect	Fills a rectangle with the specified brush
FindWindow	Returns window handle for class and window name
FlashWindow	Flashes a window once
FlushComm	Flushes a transmit or receiving queue
FrameRect	Draws a window border with a specified brush
GetActiveWindow	Retrieves the handle of the active window
GetAsyncKeyState	Determines the key state
GetCapture	Returns the handle for the mouse-capture window
GetCaretBlinkTime	Returns the caret blink rate
GetCaretPos	Returns the current caret position
GetClassInfo	Returns window-class information
GetClassLong	Returns a window-class long value
GetClassName	Returns a window-class name
GetClassWord	Returns a window-class word value
GetClientRect	Returns client area coordinates of window
GetClipboardData	Returns a handle to the current clipboard data
GetClipboardFormatName	Returns the registered clipboard format name
GetClipboardOwner	Returns the clipboard owner window handle

GetClipboardViewer	Returns first clipboard-viewer window handle
GetClipCursor	Returns cursor-confining rectangle coordinates
GetCommError	Returns the communications-device status
GetCommEventMask	Retrieves the device event mask
GetCommState	Reads the communications-device status
GetCurrentTime	Returns the elapsed time since Windows started
GetCursor	Returns the current cursor handle
GetCursorPos	Returns the current cursor position
GetDC	Returns the window device-context handle
GetDCEx	Retrieves the device-context handle
GetDesktopWindow	Returns desktop window handle
GetDialogBaseUnits	Returns the dialog box base units
GetDlgCtrlID	Returns the handle of a child window
GetDlgItem	Returns dialog box control handle
GetDlgItemInt	Translates dialog box text into an integer
GetDlgItemText	Retrieves dialog box control text
GetDoubleClickTime	Returns mouse double-click time
GetDriverModuleHandle	Retrieves an installable-driver instance handle
GetDriverInfo	Retrieves installable-driver data
GetFocus	Returns the current focus window handle
GetFreeSystemResources	Returns percentage of free system-resource space
GetInputState	Returns mouse and keyboard status
GetKeyboardState	Returns the status of virtual-keyboard keys
GetKeyState	Returns the specified virtual-key state
GetLastActivePopup	Determines most recently active pop-up window
GetMenu	Returns the menu handle for a specified window
GetMenuCheckMarkDimensions	Returns the default check mark bitmap dimensions
GetMenuItemCount	Returns the number of items in a menu
GetMenuItemID	Returns a menu-item identifier
GetMenuState	Returns status flags for the specified menu item
GetMenuString	Copies a menu-item label into a buffer
GetMessage	Retrieves a message from the message queue
GetMessageExtraInfo	Retrieves information about a hardware message
GetMessagePos	Returns the cursor position for the last message
GetMessageTime	Returns the time for the last message
GetNextDlgGroupItem	Returns handle of next or previous group control
GetNextDlgTabItem	Returns next or previous **WS_TABSTOP** control
GetNextDriver	Enumerates installable-driver instances
GetNextWindow	Returns next or previous window manager window
GetOpenClipboardWindow	Returns handle to window that opened clipboard
GetParent	Returns the parent window handle
GetPriorityClipboardFormat	Returns the first clipboard format
GetProp	Returns data handle from window property list
GetQueueStatus	Determines the queued message type
GetScrollPos	Returns the current scroll-bar thumb position
GetScrollRange	Returns minimum and maximum scroll-bar positions
GetSubMenu	Returns the pop-up menu handle
GetSysColor	Returns the display-element color
GetSysModalWindow	Returns the system-modal window handle
GetSystemDebugState	Returns system-state information to a debugger
GetSystemMenu	Provides access to the System menu
GetSystemMetrics	Retrieves the system metrics
GetTabbedTextExtent	Determines the dimensions of a tabbed string
GetTickCount	Returns amount of time Windows has been running
GetTimerResolution	Retrieves the timer resolution
GetTopWindow	Returns handle for top child of given window

GetUpdateRect	Returns the window update region dimensions
GetUpdateRgn	Returns the window update region
GetWindow	Returns the specified window handle
GetWindowDC	Returns the window device context
GetWindowLong	Returns long value from extra window memory
GetWindowPlacement	Returns window show state and min/max position
GetWindowRect	Retrieves window screen coordinates
GetWindowTask	Returns the task associated with a window
GetWindowText	Copies the window title-bar text to a buffer
GetWindowTextLength	Returns the length of window title bar text
GetWindowWord	Returns a word value from extra window memory
GlobalAddAtom	Adds a string to the system atom table
GlobalDeleteAtom	Decrements the reference count of a global atom
GlobalFindAtom	Retrieves string atom from global atom table
GlobalGetAtomName	Retrieves a global atom string
GrayString	Draws gray text at the specified location
hardware_event	Places a hardware message in the system queue
HideCaret	Removes the caret from the screen
HiliteMenuItem	Changes the highlight of a top-level menu item
InflateRect	Changes the rectangle dimensions
InSendMessage	Determines if a window is processing SendMessage
InsertMenu	Inserts a new item in a menu
IntersectRect	Calculates a rectangle intersection
InvalidateRect	Adds a rectangle to the update region
InvalidateRgn	Adds a region to the update region
InvertRect	Inverts a rectangular region
IsCharAlpha	Determines if a character is alphabetic
IsCharAlphaNumeric	Determines is a character is alphanumeric
IsCharLower	Determines if a character is lowercase
IsCharUpper	Determines if a character is uppercase
IsChild	Determines if a window is a child window
IsClipboardFormatAvailable	Determines availability of data in given fromat
IsDialogMessage	Determines if a message is for a dialog box
IsDlgButtonChecked	Determines the state of a button control
IsIconic	Determines if a window is minimized
IsMenu	Determines if a menu handle is valid
IsRectEmpty	Determines whether a rectangle is empty
IsWindow	Determines if a window handle is valid
IsWindowEnabled	Determines if a window accepts user input
IsWindowVisible	Determines the visibility state of a window
IsZoomed	Determines if a window is maximized
KillTimer	Removes a timer
LoadAccelerators	Loads an accelerator table
LoadBitmap	Loads a bitmap resource
LoadCursor	Loads a cursor resource
LoadIcon	Loads an icon resource
LoadMenu	Loads a menu resource
LoadMenuIndirect	Obtains a menu handle for a menu template
LoadString	Loads a string resource
LockInput	Locks input to all tasks except the current one
LockWindowUpdate	Disables or reenables drawing in a window
lstrcmp	Compares two character strings
lstrcmpi	Compares two character strings
MapDialogRect	Maps dialog box units to pixels
MessageBeep	Generates a beep
MessageBox	Creates a message box window

MapWindowPoints	Converts points to another coordinate system
ModifyMenu	Changes an existing menu item
MoveWindow	Changes the position and dimensions of a window
OffsetRect	Moves a rectangle by an offset
OpenClipboard	Opens the clipboard
OpenComm	Opens a communications device
OpenDriver	Opens an installable driver
OpenIcon	Activates a minimized window
PeekMessage	Checks the message queue
PostAppMessage	Posts a message to an application
PostMessage	Places a message in a window message queue
PostQuitMessage	Tells Windows that an application is terminating
PtInRect	Determines if a point is in a rectangle
QuerySendMessage	Determines if a message originated within a task
ReadComm	Reads from a communications device
RealizePalette	Maps entries from logical to system palette
RedrawWindow	Updates a client rectangle or region
RegisterClass	Registers a window class
RegisterClipboardFormat	Registers a new clipboard format
RegisterWindowMessage	Defines a new and unique window message
ReleaseCapture	Releases mouse capture
ReleaseDC	Frees a device context
RemoveMenu	Deletes a menu item and pop-up menu
RemoveProp	Removes a property-list entry
ReplyMessage	Replies to SendMessage
ScreenToClient	Converts a screen point to client coordinates
ScrollDC	Scrolls a rectangle horizontally and vertically
ScrollWindow	Scrolls a window client area
ScrollWindowEx	Scrolls a window client area
SelectPalette	Selects a palette into a device context
SendDlgItemMessage	Sends a message to a dialog box control
SendDriverMessage	Sends a message to an installable driver
SendMessage	Sends a message to a window
SetActiveWindow	Makes a top-level window active
SetCapture	Sets the mouse capture to a window
SetCaretBlinkTime	Sets the caret blink rate
SetCaretPos	Sets the caret position
SetClassLong	Sets a long value in extra class memory
SetClassWord	Sets a word value in extra class memory
SetClipboardData	Sets the data in the clipboard
SetClipboardViewer	Adds a window to the clipboard-viewer chain
SetCommBreak	Suspends character transmission
SetCommEventMask	Enables events in a device event mask
SetCommState	Sets the communications-device state
SetCursor	Changes the mouse cursor
SetCursorPos	Sets mouse-cursor position in screen coordinates
SetDlgItemInt	Converts an integer to a dialog box text string
SetDlgItemText	Sets dialog box title or item text
SetDoubleClickTime	Sets the mouse double-click time
SetFocus	Sets the input focus to a window
SetKeyboardState	Sets the keyboard state table
SetMenu	Sets the menu for a window
SetMenuItemBitmaps	Associates bitmaps with a menu item
SetMessageQueue	Creates a new message queue
SetParent	Changes a child's parent window
SetProp	Adds or changes a property-list entry

SetRect	Sets rectangle dimensions
SetRectEmpty	Creates an empty rectangle
SetScrollPos	Sets scroll-bar thumb position
SetScrollRange	Sets minimum and maximum scroll-bar positions
SetSysColors	Sets one or more system colors
SetSysModalWindow	Makes a window the system-modal window
SetTimer	Installs a system timer
SetWindowLong	Sets a long value in extra window memory
SetWindowPlacement	Sets window show state and min/max position
SetWindowPos	Sets window size, position, and order
SetWindowsHook	Installs a hook function
SetWindowsHookEx	Installs a hook function
SetWindowText	Sets text in a caption title or control window
SetWindowWord	Sets a word value in extra window memory
ShowCaret	Shows (unhides) the caret
ShowCursor	Shows or hides the mouse cursor
ShowOwnedPopups	Shows or hides pop-up windows
ShowScrollBar	Shows or hides a scroll bar
ShowWindow	Sets the window visibility state
SubtractRect	Creates rect from difference of two rects
SwapMouseButton	Reverses the meaning of the mouse buttons
SystemParametersInfo	Queries or sets system-wide parameters
TabbedTextOut	Writes a tabbed character string
TrackPopupMenu	Displays and tracks a pop-up menu
TranslateAccelerator	Processes menu command keyboard accelerators
TranslateMDISysAccel	Processes MDI keyboard accelerators
TranslateMessage	Translates virtual-key messages
TransmitCommChar	Places a character in the transmission queue
UngetCommChar	Puts character back in receiving queue
UnhookWindowsHook	Removes a filter function
UnhookWindowsHookEx	Removes a function from the hook chain
UnionRect	Creates the union of two rectangles
UnregisterClass	Removes a window class
UpdateWindow	Updates a window client area
ValidateRect	Removes a rectangle from the update region
ValidateRgn	Removes a region from the update region
WaitMessage	Suspends an application and yields control
WindowFromPoint	Returns handle of window containing point
WinHelp	Invokes Windows Help
WNetAddConnection	Adds network connections
WNetCancelConnection	Removes network connections
WNetGetConnection	Lists network connections
WriteComm	Writes to a communications device
wvsprintf	Formats a string

GetFileResource (3.1)

#include ver.h

BOOL GetFileResource(*lpszFileName, lpszResType, lpszResID, dwFileOffset, dwResLen, lpvData***)**

```
LPCSTR lpszFileName;      /* address of buffer for filename          */
LPCSTR lpszResType;       /* address of buffer for resource type     */
LPCSTR lpszResID;         /* address of buffer for resource ID       */
DWORD dwFileOffset;       /* resource offset in file                 */
DWORD dwResLen;           /* size of resource buffer                 */
void FAR* lpvData;        /* address of buffer for resource copy     */
```

The **GetFileResource** function copies the specified resource from the specified file into the specified buffer. To obtain the appropriate buffer size, the application can call the **GetFileResourceSize** function before calling **GetFileResource**.

Parameter	Description
lpszFileName	Points to the buffer that contains the name of the file containing the resource.
lpszResType	Points to a value that is created by using the **MAKEINTRESOURCE** macro with the numbered resource type. This value is typically VS_FILE_INFO.
lpszResID	Points to a value that is created by using the **MAKEINTRESOURCE** macro with the numbered resource identifier. This value is typically VS_VERSION_INFO.
dwFileOffset	Specifies the offset of the resource within the file. The **GetFileResourceSize** function returns this value. If this parameter is NULL, the **GetFileResource** function searches the file for the resource.
dwResLen	Specifies the buffer size, in bytes, identified by the *lpvData* parameter. The **GetFileResourceSize** function returns the buffer size required to hold the resource. If the buffer is not large enough, the resource data is truncated to the size of the buffer.
lpvData	Points to the buffer that will receive a copy of the resource. If the buffer is not large enough, the resource data is truncated.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero, indicating the function could not find the file, could not find the resource, or produced an MS-DOS error. The **GetFileResource** function returns no information about the type of error that occurred.

Comments

If the *dwFileOffset* parameter is zero, the **GetFileResource** function determines the location of the resource by using the *lpszResType* and *lpszResID* parameters.

If *dwFileOffset* is not zero, **GetFileResource** assumes that *dwFileOffset* is the return value of **GetFileResourceSize** and, therefore, ignores *lpszResType* and *lpszResID.*

See Also

GetFileResourceSize

GetFileResourceSize (3.1)

#include ver.h

DWORD GetFileResourceSize(*lpszFileName, lpszResType, lpszResID, lpdwFileOffset***)**

```
LPCSTR lpszFileName;          /* address of buffer for filename       */
LPCSTR lpszResType;           /* address of buffer for resource type */
LPCSTR lpszResID;             /* address of buffer for resource ID    */
DWORD FAR *lpdwFileOffset;    /* address of resource offset in file   */
```

The **GetFileResourceSize** function searches the specified file for the resource of the specified type and identifier.

Parameter	Description
lpszFileName	Points to the buffer that contains the name of the file in which to search for the resource.
lpszResType	Points to a value that is created by using the **MAKEINTRESOURCE** macro with the numbered resource type. This value is typically VS_FILE_INFO.
lpszResID	Points to a value that is created by using the **MAKEINTRESOURCE** macro with the numbered resource identifier. This value is typically VS_VERSION_INFO.
lpdwFileOffset	Points to a 16-bit value that the **GetFileResourceSize** function fills with the offset to the resource within the file.

Returns

The return value is the size of the resource, in bytes. The return value is NULL if the function could not find the file, the file does not have any resources attached, or the function produced an MS-DOS error. The **GetFileResourceSize** function returns no information about the type of error that occurred.

See Also

GetFileResource

GetFileVersionInfo (3.1)

#include ver.h

BOOL GetFileVersionInfo(*lpszFileName, handle, cbBuf, lpvData***)**

```
LPCSTR lpszFileName;      /* address of buffer for filename          */
DWORD handle;             /* file-version information                */
DWORD cbBuf;              /* size of buffer                          */
void FAR* lpvData;        /* address of buffer for file-version info */
```

The **GetFileVersionInfo** function returns version information about the specified file. The application must call the **GetFileVersionInfoSize** function before calling **GetFileVersionInfo** to obtain the appropriate handle if the handle is not NULL.

Parameter	Description
lpszFileName	Points to the buffer that contains the name of the file.
handle	Identifies the file-version information. The **GetFileVersionInfoSize** function returns this handle, or it may be NULL. If the *handle* parameter is NULL, the **GetFileVersionInfo** function searches the file for the version information.
cbBuf	Specifies the buffer size, in bytes, identified by the *lpvData* parameter. The **GetFileVersionInfoSize** function returns the buffer size required to hold the file-version information. If the buffer is not large enough, the file-version information is truncated to the size of the buffer.
lpvData	Points to the buffer that will receive the file-version information. This parameter is used by a subsequent call to the **VerQueryValue** function.

Returns

The return value is nonzero if the function is successful. Otherwise, it is zero, indicating the file does not exist or the *handle* parameter is invalid. The **GetFileVersionInfo** function returns no information about the type of error that occurred.

Comments

The file version information is organized in a **VERSIONINFO** statement.

Currently, the **GetFileVersionInfo** function recognizes only version-information created by Microsoft Resource Compiler (RC).

See Also

GetFileVersionInfoSize, **VerQueryValue**, **VERSIONINFO**

GetFileVersionInfoSize (3.1)

#include ver.h

DWORD GetFileVersionInfoSize(*lpszFileName, lpdwHandle***)**

LPCSTR *lpszFileName;* /* address of buffer for filename */
DWORD FAR **lpdwHandle;* /* address of handle for info */

The **GetFileVersionInfoSize** function determines whether it can obtain version information from the specified file. If version information is available, **GetFileVersionInfoSize** returns the size of the buffer required to hold the version information. It also returns a handle that can be used in a subsequent call to the **GetFileVersionInfo** function.

Parameter	Description
lpszFileName	Points to the buffer that contains the name of the file.
lpdwHandle	Points to a 32-bit value that the **GetFileVersionInfoSize** function fills with the handle to the file-version information. The **GetFileVersionInfo** function can use this handle.

Returns

The return value is the buffer size, in bytes, required to hold the version information if the function is successful. The return value is NULL if the function could not find the file, could not find the version information, or produced an MS-DOS error. The **GetFileVersionInfoSize** function returns no information about the type of error that occurred.

Comments

The file version information is organized in a **VERSIONINFO** statement.

See Also

GetFileVersionInfo, **VERSIONINFO**

GetSystemDir (3.1)

#include ver.h

UINT GetSystemDir(*lpszWinDir, lpszBuf, cbBuf***)**

```
LPCSTR lpszWinDir;      /* address of Windows directory */
LPSTR lpszBuf;          /* address of buffer for path   */
int cbBuf;              /* size of buffer               */
```

The **GetSystemDir** function retrieves the path of the Windows system directory. This directory contains such files as Windows libraries, drivers, and fonts.

GetSystemDir is used by MS-DOS applications that set up Windows applications; it exists only in the static-link version of the File Installation library. Windows applications should use the **GetSystemDirectory** function to determine the Windows directory.

Parameter	Description
lpszWinDir	Points to the Windows directory retrieved by a previous call to the **GetWindowsDir** function.
lpszBuf	Points to the buffer that is to receive the null-terminated string containing the path.
cbBuf	Specifies the size, in bytes, of the buffer pointed to by the *lpszBuf* parameter.

Returns

The return value is the length of the string copied to the buffer, in bytes, including the terminating null character, if the function is sucessful. If the return value is greater than the *cbBuf* parameter, the return value is the size of the buffer required to hold the path. The return value is zero if the function fails.

Comments

An application must call the **GetWindowsDir** function before calling the **GetSystemDir** function to obtain the correct *lpszWinDir* value.

The path that this function retrieves does not end with a backslash unless the Windows system directory is the root directory. For example, if the system directory is named WINDOWS\SYSTEM on drive C, the path of the system directory retrieved by this function is C:\WINDOWS\SYSTEM.

See Also

GetSystemDirectory, **GetWindowsDir**

GetWindowsDir (3.1)

#include ver.h

UINT GetWindowsDir(*lpszAppDir, lpszPath, cbPath***)**

```
LPCSTR lpszAppDir;      /* address of Windows directory */
LPSTR lpszPath;         /* address of buffer for path   */
int cbPath;             /* size of buffer for path      */
```

The **GetWindowsDir** function retrieves the path of the Windows directory. This directory contains such files as Windows applications, initialization files, and help files.

GetWindowsDir is used by MS-DOS applications that set up Windows applications; it exists only in the static-link version of the File Installation library. Windows applications should use the **GetWindowsDirectory** function to determine the Windows directory.

Parameter	Description
lpszAppDir	Specifies the current directory in a search for Windows files. If the Windows directory is not on the path, the application must prompt the user for its location and pass that string to the **GetWindowsDir** function in the *lpszAppDir* parameter.
lpszPath	Points to the buffer that will receive the null-terminated string containing the path.
cbPath	Specifies the size, in bytes, of the buffer pointed to by the *lpszPath* parameter.

Returns

The return value is the length of the string copied to the *lpszPath* parameter, including the terminating null character, if the function is successful. If the return value is greater than the *cbPath* parameter, it is the size of the buffer required to hold the path. The return value is zero if the function fails.

Comments

The path that this function retrieves does not end with a backslash unless the Windows directory is the root directory. For example, if the Windows directory is named WINDOWS on drive C, the path retrieved by this function is C:\WINDOWS. If Windows is installed in the root directory of drive C, the path retrieved is C:\.

After the **GetWindowsDir** function locates the Windows directory, it caches the location for use by subsequent calls to the function.

See Also

GetSystemDir, **GetWindowsDirectory**

VerFindFile (3.1)

#include ver.h

UINT VerFindFile(*flags, lpszFilename, lpszWinDir, lpszAppDir, lpszCurDir, lpuCurDirLen, lpszDestDir, lpuDestDirLen***)**

```
UINT flags;              /* source-file flags                    */
LPCSTR lpszFilename;     /* address of buffer for file           */
LPCSTR lpszWinDir;       /* address of Windows directory         */
LPCSTR lpszAppDir;       /* address of application directory     */
LPSTR lpszCurDir;        /* address of buffer for current directory */
UINT FAR* lpuCurDirLen;  /* address of buffer size for directory */
LPSTR lpszDestDir;       /* address of buffer for dest. directory */
UINT FAR* lpuDestDirLen; /* address of size for dest. directory  */
```

The **VerFindFile** function determines where to install a file based on whether it locates another version of the file in the system. The values **VerFindFile** returns are used in a subsequent call to the **VerInstallFile** function.

Parameter	Description
flags	Contains a bitmask of flags. This parameter can be VFFF_ISSHAREDFILE, which indicates that the source file may be shared by multiple applications. **VerFindFile** uses this information to determine where the file should be copied. All other values are reserved for future use.
lpszFilename	Points to a null-terminated string specifying the name of the file to be installed. This name should include only the filename and extension, not a path.
lpszWinDir	Points to a null-terminated string specifying the Windows directory. This string is returned by the **GetWindowsDir** function. The dynamic-link library (DLL) version of **VerFindFile** ignores this parameter.
lpszAppDir	Points to a null-terminated string specifying the drive letter and directory where the installation program is installing a set of related files. If the installation program is installing an application, this is the directory where the application will reside. This directory will also be the application's working directory unless you specify otherwise.
lpszCurDir	Points to a buffer that receives the path to a current version of the file being installed. The path is a null-terminated string. If a current version is not installed, the buffer will contain the source directory of the file being installed. The buffer must be at least _MAX_PATH bytes long.
lpuCurDirLen	Points to a null-terminated string specifying the length, in bytes, of the buffer pointed to by *lpszCurDir.* On return, *lpuCurDirLen* contains the size, in bytes, of the data returned in *lpszCurDir,* including the terminating null character. If the buffer is too small to contain all the data, *lpuCurDirLen* will be greater than the actual size of the buffer.
lpszDestDir	Points to a buffer that receives the path to the installation directory recommended by **VerFindFile**. The path is a null-terminated string. The buffer must be at least _MAX_PATH bytes long.
lpuDestDirLen	Points to the length, in bytes, of the buffer pointed to by *lpszDestDir.* On return, *lpuDestDirLen* contains the size, in bytes, of the data returned in *lpszDestDir,* including the terminating null character. If the buffer is too small to contain all the data, *lpuDestDirLen* will be greater than the actual size of the buffer.

Returns

The return value is a bitmask that indicates the status of the file, if the function is successful. This value may be one or more of the following:

Error	Meaning

VFF_CURNEDEST	Indicates that the currently installed version of the file is not in the recommended destination.
VFF_FILEINUSE	Indicates that Windows is using the currently installed version of the file; therefore, the file cannot be overwritten or deleted.
VFF_BUFFTOOSMALL	Indicates that at least one of the buffers was too small to contain the corresponding string. An application should check the *lpuCurDirLen* and *lpuDestDirLen* parameters to determine which buffer was too small.

All other values are reserved for future use.

Comments

The dynamic-link library (DLL) version of **VerFindFile** searches for a copy of the specified file by using the **OpenFile** function. In the LIB version, the function searches for the file in the Windows directory, the system directory, and then the directories specified by the PATH environment variable.

VerFindFile determines the system directory from the specified Windows directory, or it searches the path.

If the *flags* parameter indicates that the file is private to this application (not VFFF_ISSHAREDFILE), **VerFindFile** recommends installing the file in the application's directory. Otherwise, if the system is running a shared copy of Windows, the function recommends installing the file in the Windows directory. If the system is running a private copy of Windows, the function recommends installing the file in the system directory.

See Also

VerInstallFile

VerInstallFile (3.1)

#include ver.h

DWORD VerInstallFile(*flags, lpszSrcFilename, lpszDestFilename, lpszSrcDir, lpszDestDir, lpszCurDir, lpszTmpFile, lpwTmpFileLen***)**

```
UINT flags;                 /* source-file flags                    */
LPCSTR lpszSrcFilename;     /* address of source filename           */
LPCSTR lpszDestFilename;    /* address of destination filename      */
LPCSTR lpszSrcDir;          /* address of buffer for source dir. name */
LPCSTR lpszDestDir;         /* address of buffer for dest. dir. name */
LPCSTR lpszCurDir;          /* address of buffer for preexisting dir. */
LPSTR lpszTmpFile;          /* address of buffer for temp. filename */
UINT FAR* lpwTmpFileLen;    /* address of buffer for temp. file size */
```

The **VerInstallFile** function attempts to install a file based on information returned from the **VerFindFile** function. **VerInstallFile** decompresses the file with the **LZCopy** function and checks for errors, such as outdated files.

Parameter	Description
flags	Contains a bitmask of flags. This parameter can be a combination of the following values: **Value** — **Meaning** VIFF_FORCEINSTALL — Installs the file regardless of mismatched version numbers. The function will check only for physical errors during installation. If *flags* includes VIFF_FORCEINSTALL and *lpszTmpFileLen* is not a pointer to zero, **VerInstallFile** will skip all version checks of the temporary file and the destination file and rename the temporary file to the name specified by *lpszSrcFilename,* as long as the temporary file exists in the destination directory, the destination file is not in use, and the user has privileges to delete the destination file and rename the temporary file. The return value from **VerInstallFile** should be checked for any errors. VIFF_DONTDELETEOLD — Installs the file without deleting the previously installed file, if the previously installed file is not in the destination directory. If the previously installed file is in the destination directory, **VerInstallFile** replaces it with the new file upon successful installation. All other values are reserved for future use.
lpszSrcFilename	Points to the name of the file to be installed. This is the filename in the directory pointed to by *lpszSrcDir;* the filename should include only the filename and extension, not a path. **VerInstallFile** opens the source file by using the **LZOpenFile** function. This means it can handle both files as specified and files that have been compressed and renamed by using the **/r** option with COMPRESS.EXE.
lpszDestFilename	Points to the name **VerInstallFile** will give the new file upon installation. This filename may be different than the filename in the directory pointed to by *lpszSrcFilename.* The new name should include only the filename and extension, not a path.

lpszSrcDir	Points to a buffer that contains the directory name where the new file is found.
lpszDestDir	Points to a buffer that contains the directory name where the new file should be installed. The **VerFindFile** function returns this value in the *lpszDestDir* parameter.
lpszCurDir	Points to a buffer that contains the directory name where the preexisting version of this file is found. **VerFindFile** returns this value in the *lpszCurDir* parameter. If the filename specified in *lpszDestFilename* already exists in the *lpszCurDir* directory and *flags* does not include VIFF_DONTDELETEOLD, the existing file will be deleted. If *lpszCurDir* is a pointer to NULL, a previous version of the file does not exist on the system.
lpszTmpFile	Points to a buffer that should be empty upon the initial call to **VerInstallFile**. The function fills the buffer with the name of a temporary copy of the source file. The buffer must be at least _MAX_PATH bytes long.
lpwTmpFileLen	Points to the length of the buffer pointed to by *lpszTmpFile.* On return, *lpwTmpFileLen* contains the size, in bytes, of the data returned in *lpszTmpFile,* including the terminating null character. If the buffer is too small to contain all the data, *lpwTmpFileLen* will be greater than the actual size of the buffer. If *flags* includes VIFF_FORCEINSTALL and *lpwTmpFileLen* is not a pointer to zero, **VerInstallFile** will rename the temporary file to the name specified by *lpszSrcFilename.*

Returns

The return value is a bitmask that indicates exceptions, if the function is successful. This value may be one or more of the following:

Value	Meaning
VIF_TEMPFILE	Indicates that the temporary copy of the new file is in the destination directory. The cause of failure is reflected in other flags. Applications should always check whether this bit is set and delete the temporary file, if required.
VIF_MISMATCH	Indicates that the new and preexisting files differ in one or more attributes. This error can be overridden by calling **VerInstallFile** again with the VIFF_FORCEINSTALL flag.
VIF_SRCOLD	Indicates that the file to install is older than the preexisting file. This error can be overridden by calling **VerInstallFile** again with the VIFF_FORCEINSTALL flag.
VIF_DIFFLANG	Indicates that the new and preexisting files have different language or code-page values. This error can be overridden by calling **VerInstallFile** again with the VIFF_FORCEINSTALL flag.
VIF_DIFFCODEPG	Indicates that the new file requires a code page that cannot be displayed by the currently running version of Windows. This error can be overridden by calling **VerInstallFile** with the VIFF_FORCEINSTALL flag.
VIF_DIFFTYPE	Indicates that the new file has a different type, subtype, or operating system than the preexisting file. This error can be overridden by calling **VerInstallFile** again with the VIFF_FORCEINSTALL flag.
VIF_WRITEPROT	Indicates that the preexisting file is write-protected. The installation program should reset the read-only bit in the destination file before proceeding with the installation.
VIF_FILEINUSE	Indicates that the preexisting file is in use by Windows and cannot be deleted.
VIF_OUTOFSPACE	Indicates that the function cannot create the temporary file due to

	insufficient disk space on the destination drive.
VIF_ACCESSVIOLATION	Indicates that a create, delete, or rename operation failed due to an access violation.
VIF_SHARINGVIOLATION	Indicates that a create, delete, or rename operation failed due to a sharing violation.
VIF_CANNOTCREATE	Indicates that the function cannot create the temporary file. The specific error may be described by another flag.
VIF_CANNOTDELETE	Indicates that the function cannot delete the destination file or cannot delete the existing version of the file located in another directory. If the VIF_TEMPFILE bit is set, the installation failed and the destination file probably cannot be deleted.
VIF_CANNOTRENAME	Indicates that the function cannot rename the temporary file but already deleted the destination file.
VIF_OUTOFMEMORY	Indicates that the function cannot complete the requested operation due to insufficient memory. Generally, this means the application ran out of memory attempting to expand a compressed file.
VIF_CANNOTREADSRC	Indicates that the function cannot read the source file. This could mean that the path was not specified properly, that the file does not exist, or that the file is a compressed file that has been corrupted. To distinguish these conditions, use **LZOpenFile** to determine whether the file exists. (Do not use the **OpenFile** function, because it does not correctly translate filenames of compressed files.) Note that VIF_CANNOTREADSRC does not cause either the VIF_ACCESSVIOLATION or VIF_SHARINGVIOLATION bit to be set.
VIF_CANNOTREADDST	Indicates that the function cannot read the destination (existing) files. This prevents the function from examining the file's attributes.
VIF_BUFFTOOSMALL	Indicates that the *lpszTmpFile* buffer was too small to contain the name of the temporary source file. On return, *lpwTmpFileLen* contains the size of the buffer required to hold the filename.

All other values are reserved for future use.

Comments

VerInstallFile is designed for use in an installation program. This function copies a file (specified by *lpszSrcFilename*) from the installation disk to a temporary file in the destination directory. If necessary, **VerInstallFile** expands the file by using the functions in LZEXPAND.DLL.

If a preexisting copy of the file exists in the destination directory, **VerInstallFile** compares the version information of the temporary file to that of the preexisting file. If the preexisting file is more recent than the new version, or if the files' attributes are significantly different, **VerInstallFile** returns one or more error values. For example, files with different languages would cause **VerInstallFile** to return VIF_DIFFLANG.

VerInstallFile leaves the temporary file in the destination directory. If all of the errors are recoverable, the installation program can override them by calling **VerInstallFile** again with the VIFF_FORCEINSTALL flag. In this case, *lpszSrcFilename* should point to the name of the temporary file. Then, **VerInstallFile** deletes the preexisting file and renames the temporary file to the name specified by *lpszSrcFilename.* If the VIF_TEMPFILE bit indicates that a temporary file exists and the application does not force the installation by using the VIFF_FORCEINSTALL flag, the application must delete the temporary file.

If an installation program attempts to force installation after a nonrecoverable error, such as VIF_CANNOTREADSRC, **VerInstallFile** will not install the file.

See Also
VerFindFile

VerLanguageName (3.1)

#include ver.h

UINT VerLanguageName(*uLang, lpszLang, cbLang***)**

```
UINT uLang;        /* Microsoft language identifier          */
LPSTR lpszLang;    /* address of buffer for language string */
UINT cbLang;       /* size of buffer                         */
```

The **VerLanguageName** function converts the specified binary Microsoft language identifier into a text representation of the language.

Parameter	Description
uLang	Specifies the binary Microsoft language identifier. For example, **VerLanguageName** translates 0x040A into Castilian Spanish. If **VerLanguageName** does not recognize the identifier, the *lpszLang* parameter will point to a default string, such as "Unknown language". For a complete list of the language identifiers supported by Windows, see the following Comments section.
lpszLang	Points to the buffer to receive the null-terminated string representing the language specified by the *uLang* parameter.
cbLang	Indicates the size of the buffer, in bytes, pointed to by *lpszLang.*

Returns

The return value is the length of the string that represents the language identifier, if the function is successful. This value does not include the null character at the end of the string. If this value is greater than *cbLang,* the string was truncated to *cbLang.* The return value is zero if an error occurs. Unknown *uLang* values do not produce errors.

Comments

Typically, an installation application uses this function to translate a language identifier returned by the **VerQueryValue** function. The text string may be used in a dialog box that asks the user how to proceed in the event of a language conflict.

Windows supports the following language identifiers:

Value	Language
0x0401	Arabic
0x0402	Bulgarian
0x0403	Catalan
0x0404	Traditional Chinese
0x0405	Czech
0x0406	Danish
0x0407	German
0x0408	Greek
0x0409	U.S. English
0x040A	Castilian Spanish
0x040B	Finnish
0x040C	French
0x040D	Hebrew
0x040E	Hungarian
0x040F	Icelandic
0x0410	Italian
0x0411	Japanese

0x0412	Korean
0x0413	Dutch
0x0414	Norwegian - Bokmål
0x0415	Polish
0x0416	Brazilian Portuguese
0x0417	Rhaeto-Romanic
0x0418	Romanian
0x0419	Russian
0x041A	Croato-Serbian (Latin)
0x041B	Slovak
0x041C	Albanian
0x041D	Swedish
0x041E	Thai
0x041F	Turkish
0x0420	Urdu
0x0421	Bahasa
0x0804	Simplified Chinese
0x0807	Swiss German
0x0809	U.K. English
0x080A	Mexican Spanish
0x080C	Belgian French
0x0810	Swiss Italian
0x0813	Belgian Dutch
0x0814	Norwegian - Nynorsk
0x0816	Portuguese
0x081A	Serbo-Croatian (Cyrillic)
0x0C0C	Canadian French
0x100C	Swiss French

VerQueryValue (3.1)

#include ver.h

BOOL VerQueryValue(*lpvBlock, lpszSubBlock, lplpBuffer, lpcb***)**

```
const void FAR* lpvBlock;       /* address of buffer for version resource */
LPCSTR lpszSubBlock;            /* address of value to retrieve           */
VOID FAR* FAR* lplpBuffer;      /* address of buffer for version pointer  */
UINT FAR* lpcb;                 /* address of version-value length buffer */
```

The **VerQueryValue** function returns selected version information from the specified version-information resource. To obtain the appropriate resource, the **GetFileVersionInfo** function must be called before **VerQueryValue**.

Parameter	Description
lpvBlock	Points to the buffer containing the version-information resource returned by the **GetFileVersionInfo** function.
lpszSubBlock	Points to a zero-terminated string specifying which version-information value to retrieve. The string consists of names separated by backslashes (\) and can have one of the following forms:

Form	Description
****	Specifies the root block. The function retrieves a pointer to the **VS_FIXEDFILEINFO** structure for the version-information resource.
\VarFileInfo\Translation	Specifies the translation table in the variable information block. The function retrieves a pointer to an array of language and character-set identifiers. An application uses these identifiers to create the name of an language-specific block in the version-information resource.
\StringFileInfo*lang-charset******string-name*	Specifies a value in a language-specific block. The *lang-charset* name is a concatenation of a language and character-set identifier pair found in the translation table for the resource. The *lang-charset* name must be specified as a hexadecimal string. The *string-name* name is one of the predefined strings described in the following Comments section.

lplpBuffer	Points to a buffer that receives a pointer to the version-information value.
lpcb	Points to a buffer that receives the length, in bytes, of the version-information value.

Returns

The return value is nonzero if the specified block exists and version information is available. If *lpcb* is zero, no value is available for the specified version-information name. The return value is zero if the specified name does not exist or the resource pointed to by *lpvBlock* is not valid.

Comments

The *string-name* in the *lpszSubBlock* parameter can be one of the following predefined names:

Name	Value
Comments	Specifies additional information that should be displayed for diagnostic purposes.
CompanyName	Specifies the company that produced the file--for example, "Microsoft Corporation" or "Standard Microsystems Corporation, Inc.". This string is required.
FileDescription	Specifies a file description to be presented to users. This string may be displayed in a list box when the user is choosing files to install--for example, "Keyboard Driver for AT-Style Keyboards" or "Microsoft Word for Windows". This string is required.
FileVersion	Specifies the version number of the file--for example, "3.10" or "5.00.RC2". This string is required.
InternalName	Specifies the internal name of the file, if one exists--for example, a module name if the file is a dynamic-link library. If the file has no internal name, this string should be the original filename, without extension. This string is required.
LegalCopyright	Specifies all copyright notices that apply to the file. This should include the full text of all notices, legal symbols, copyright dates, and so on--for example, "Copyright Microsoft Corporation 1990-1991". This string is optional.
LegalTrademarks	Specifies all trademarks and registered trademarks that apply to the file. This should include the full text of all notices, legal symbols, trademark numbers, and so on--for example, "Windows(TM) is a trademark of Microsoft Corporation". This string is optional.
OriginalFilename	Specifies the original name of the file, not including a path. This information enables an application to determine whether a file has been renamed by a user. The format of the name depends on the file system for which the file was created. This string is required.
PrivateBuild	Specifies information about a private version of the file--for example, "Built by TESTER1 on \TESTBED". This string should be present only if the VS_FF_PRIVATEBUILD flag is set in the **dwFileFlags** member of the **VS_FIXEDFILEINFO** structure of the root block.
ProductName	Specifies the name of the product with which the file is distributed--for example, "Microsoft Windows". This string is required.
ProductVersion	Specifies the version of the product with which the file is distributed--for example, "3.10" or "5.00.RC2". This string is required.
SpecialBuild	Specifies how this version of the file differs from the standard version--for example, "Private build for TESTER1 solving mouse problems on M250 and M250E computers". This string should be present only if the VS_FF_SPECIALBUILD flag is set in the **dwFileFlags** member of the **VS_FIXEDFILEINFO** structure in the root block.

Example

The following example loads the version information for a dynamic-link library and retrieves the company name:

```
BYTE   abData[512];
DWORD  handle;
DWORD  dwSize;
LPBYTE lpBuffer;
char   szName[512];

dwSize = GetFileVersionInfoSize("c:\\dll\\sample.dll", &handle));

GetFileVersionInfo("c:\\dll\\sample.dll", handle, dwSize, abData));
```

```
VerQueryValue(abData, "\\VarFileInfo\\Translation", &lpBuffer, &dwSize));

if (dwSize!=0) {
    wsprintf(szName, "\\StringFileInfo\\%8lx\\CompanyName", &lpBuffer);
    VerQueryValue(abData, szName, &lpBuffer, &dwSize);
}
```

See Also
GetFileVersionInfo, **VS_FIXEDFILEINFO**

Version Functions (3.1)

GetFileResource	Copies a resource into a buffer
GetFileResourceSize	Returns the size of a resource
GetFileVersionInfo	Returns version information about a specified file
GetFileVersionInfoSize	Returns the size of version information for a file
GetSystemDir	Returns the path of the Windows system subdirectory
GetWindowsDir	Returns the path of the Windows directory
VerFindFile	Determines where to install a file
VerInstallFile	Installs a file and checks for errors
VerLanguageName	Converts a binary language identifier into a string
VerQueryValue	Returns version information about a block