T E C H N O T E :
Cross-Platform Communication Using the PC Compatibility Messaging System

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This Technote describes the Messaging System Architecture used in Apple's PC Compatibility and DOS Compatibility products. Specifically, the messaging system allows communication of data between the PC-based machine running on a NuBus or PCI card and the Macintosh OS. This inter-machine communication is facilitated through a driver on the Macintosh which controls the PC card and allows it to run within the Macintosh hardware and software space.

This Technote is directed toward third-party developers who are interested in developing software for the Mac and the PC , which needs to communicate instructions or data between platforms. The applications developed to use the messaging system would be intended to run specifically with Apple's PC Compatibility products.

This document assumes the developer is familiar with application and driver-level software development on the Macintosh platform as well as the PC. For the Mac, an understanding of the Device Manager and implementing 68K and PPC native code is essential. For the PC, an understanding of 16-bit DOS Real mode execution and x86 assembly language is useful. For development in conjunction with Window's based applications, a knowledge of 32-bit Windows programming and virtual device drivers (VxD's) is necessary.

This document also assumes the reader is familiar with Apple's PC Compatibility products and how they function within the Macintosh OS.

Further information on Macintosh programming at the device level can be found in *Inside Macintosh: Devices*. For more information on Windows VxD programming (only necessary for using the message system with Windows 3.x or Windows 95), see *Writing Windows Virtual Device Drivers* by David Thielen and Bryan Woodruff.

About the PC Compatibility Messaging System

The PC Compatibility (or DOS Compatibility) systems currently supported by this messaging architecture are the Centris 610 DOS Compatible, PowerMac 6100/66 DOS Compatible, the Quadra 630 DOS Compatible, and any PCI-based Macintosh which includes the most recent PCI-based 100Mhz Pentium and Cyrix 5x86 PC Compatibility Cards. Currently, the only system bundled with the PCI-based cards is the PowerMac 7200/120. All of these systems must be running version 1.5 of the PC Compatibility Software or later, which includes the driver that allows the messaging system to function.

The messaging system is implemented as a 16-bit DOS real-mode driver and is used extensively in these current products to allow the PC to have access to the shared devices on the Mac (HD, CD, floppy, etc.), networking communications, folder sharing, and clipboard support.

Using the Messaging System

Software programs on the Mac and the PC are capable of exchanging messages containing up to 64K of data by using the Messaging System API. Applications that plan on sharing messages must define and understand the types of messages to be sent and received. More importantly, verification and acknowledgment of sent and received messages must be maintained by the sending and receiving applications.

The driver installed at the Mac OS startup time is called ".Symbiosis" and needs to be opened by your Macintosh application before driver calls can be made.

Your program will then use device manager `_Control` calls to register, send, and receive messages. The PC accesses the messaging system through a software interrupt interface. The application will load x86 registers with appropriate values, a function selector, and then call the messaging system via an INT 5Fh call.

Basic Messaging Concepts

Both the Mac and the PC applications accessing the messaging systems must define a 32-bit selector for their messages and a count value that denotes the number of different types of messages available for this selector. Typically, applications that are to pass messages define one selector type. Selector types can be any unique 32-bit value, so 4-character values work well (32-bit OSType). Both the Mac and the PC applications must know the message selector and they must know the number of message types associated with that selector in order to register themselves with the messaging system (See the *Registering Messages* section for more details on Message Selectors and Types).

The basic process of **single message** communication between an application on the Mac and an application on the PC is as follows:

1) Open the messaging system and verify it is available.
2) Accurately register message selector and number of message types.
3) Install message handlers and completion routines.
4) Begin transceiving messages.
5) Once the message handler is called, the application can provide space to receive the data or ignore the message.
6) After the data has been received, the receiving application should send a response to the sending application, acknowledging the data was properly received.
7) Once the acknowledge has been received, the calling application can then send another message (goto step 4) or both apps can stop sending messages.
8) After all messages have been sent, both applications must remove and deallocate all their message handlers.

Performing **multiple message** communication is also possible (i.e., the ability to send more than one message before receiving an acknowledge), but requires more maintenance. The intent here is to describe the basic communication between applications. Therefore, multiple message communication concepts are discussed in the *Advanced Messaging Techniques* section of this Technote.

Opening the Messaging System

On the Mac, the application must open the .Symbiosis driver and retrieve the refNum for the driver in order to make other message system control calls. Your application can do this using the `OpenDriver` function. If this returns an error, the .Symbiosis driver is not available and the messaging system cannot be used.

On the PC, the application must load the AH register with 0 and call the software interrupt INT 5Fh. If the messaging system is installed, AH = $A5 and AL will equal the highest implemented function code, which is currently 5, when the interrupt returns. The highest implemented function code means there are a total of 5 functions supported for registering and receiving messages. This will be discussed in detail later.

Essential Data Types

The basic data structures for accessing the messaging system on the Mac side are defined as follows:

```
typedef struct {
    QElemPtr    qLink;
    SInt16      qType;
    SInt16      ioTrap;
    Ptr         ioCmdAddr;
    ProcPtr     ioCompletion;          // always NULL
    OSErr       ioResult;              // error result info.
    StringPtr   ioNamePtr;
    SInt16      ioVRefNum;
    SInt16      ioCRefNum;             // refNum of Symbiosis driver.
    SInt16      csCode;                // messaging system function
    void *      csPtr;                 // pointer to procedure or data
    SInt32      csData;                // data
    SInt32      csData2;               // data
} SBParamBlockRec, *SBParamBlockRecPtr;
```

The SBParamBlockRec is virtually the same as a standard paramBlockRec except only the fields used by the messaging system are included for the data area. The only fields needed for messaging are the ioCRefNum and csCode for calling the driver, and then the csPtr and csData fields which are used to point to other structures that are defined below. The different csCode's used for calling the messaging system are defined below:

```
enum {
    eSendMessage           = 800,     // Send a message
    eInstallMsgHandler     = 801,     // Install a message handler
    eRemoveMsgHandler      = 802,     // Remove message handler
    eRegisterMessage       = 803      // Register message type
};
```

The data structures used for sending and receiving messages are below:

```
typedef struct MsgPBlk {
    struct MsgPBlk*msgQLink;  // Pointer to next MsgPBlk
    SInt16            msgQType;      // Queue Flags
    SInt16            msgCmd;        // The message type or command
    SInt32            msgParam1;     // Message parameter 1
    SInt32            msgParam2;     // Message parameter 2
    void*             msgBuffer;     // Ptr to the msg data buffer
    SInt32            msgReqCount;   // Requested data length
    SInt32            msgActCount;   // Actual data length
    MsgCompletionUPP  msgCompletion; // Ptr to comp. rtn. or NULL
    SInt16            msgResult;     // The result of msg operation
    UInt16            msgFlags;      // Message flags
    UInt32            msgUserData;   // refCon (a5, etc…)
} MsgPBlk, *MsgPBlkPtr;


typedef struct MsgRecElem {
    struct MsgRecElem*    recQLink;          // Next queue element
    SInt16                recQType;          // queue flags
    SInt16                recFlags;          // Not used...Set to zero
    MsgReceiveUPP         recProc;           // Ptr to the receive proc.
    SInt16                recCmdBase;// Msg Selector base.
    SInt16                recCmdCount;       // # of msgTypes
    UInt32                recUserData;       // refCon (could be A5...)
} MsgRecElem, *MsgRecElemPtr;
```

The MsgPBlk is used for sending and receiving data and the MsgRecElem is used for notification of incoming messages.

For the PC application using the messaging system, the PC Data structures and function ID constants are defined below:

```
enum {
    eIsAvailable          = 0        // Index for is available
    eSendMessage          = 1        // Index for Send func
    eInstallMsgHandler    = 2        // Index for Install Msg Handler func
    eRemoveMsgHandler     = 3        // Index for Remove Msg Handler func
    eRegisterMessage      = 4        // Index for Register Msg
    eVersionCheck         = 5        // Index to get the version numbers
};

// some basic types used for the MsgPBlk and MsgRecElem structures.

typedef char   SInt8;
typedef short  SInt16;
typedef long   SInt32;
typedef unsigned char  UInt8;
typedef unsigned short UInt16;
typedef unsigned long  UInt32;
typedef char __far* Ptr32;
```

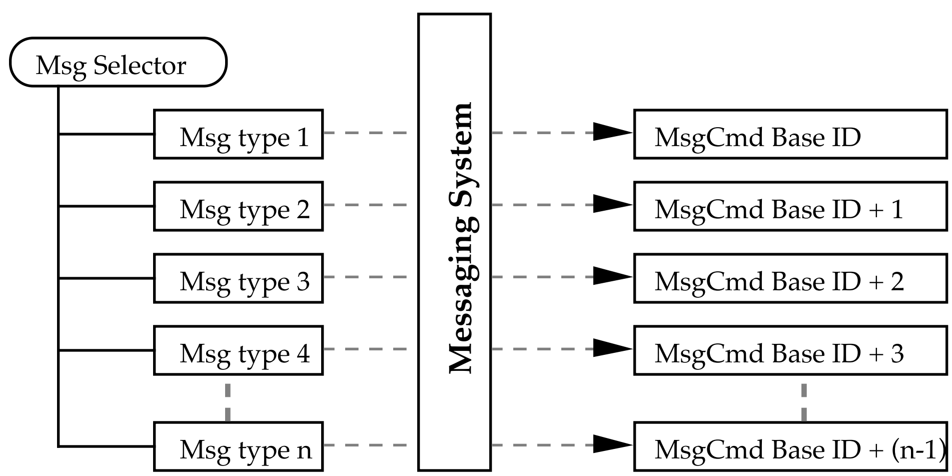
```
typedef struct MsgPBlk {
   struct MsgPBlk*    link;          // Pointer to the next MsgPBlk.
   SInt16             msgCmd;        // The message command or type
   SInt32             msgParam1;     // Param 1
   SInt32             msgParam2;     // Param 2
   UInt32             msgCompletion; // Ptr to the completion routine
   Ptr32              msgBuffer;     // Ptr to the data buffer
   SInt32             msgReqCount;   // Length of the data
   SInt32             msgActCount;   // # of bytes actually transfered
   SInt8              msgResult;     // The err code after complete or 1
   UInt8              msgFlags;      // Not used, init to zero.
   UInt32             msgUserData;   // for caller's use
   UInt32             msgVXD;        // Used by VxD
} MsgPBlk, *MsgPBlkPtr;

typedef struct MsgRecElem {
   struct MsgRecElem* Link;
   SInt32             Code;
   SInt16             cmdBase; // the base message number for this proc
   SInt16             cmdCount;// the # of message numbers for this proc
   UInt32             userData;      // for caller's use
   UInt32             recVXD;        // reserved - Used by VxD
} MsgRecElem, *MsgRecElemPtr;
```

Registering Messages with the Message System

The process of message registration requires both the Mac application and the PC application to be aware of a predefined set of message types that are defined by the application developer. Both applications are aware of the data formats of these messages and know how to decode and use certain parts of the messages based on their distinct message type ID. These message types are grouped together by a message selector (4-byte value of type OSType) known to both the Mac and the PC application.

Both applications send the message selector and the number of message types to the message system and the message system returns a cmdBaseID (See Figure 1).

Figure 1. Registering a message selector and message types.



Once the set of messages for the Mac and PC applications has been registered with the message system, each individual message has a unique value (called a msgCmd) which ranges from the msgCmdBaseID to the total number of messages - 1. When the applications send and receive messages, they will reference particular message types through the msgCmdBaseID plus some value which specifies the message type. The resulting value is the msgCmd.

Registering a Message on the Mac

To register messages on the Mac, your application must fill out a SBParamBlockRec make the appropriate driver call. To do this, fill out the following fields of a SBParamBlockRec:

```
--> ioCRefNum =           <refNum of the .Symbiosis driver>;
--> ioVRefNum =           0;
--> ioCompletion =     0;
<-- ioResult   =          0;
--> csCode =              eRegisterMessage;
<-> csPtr =               <message selector>;
--> csData =              <number of message types>;
```

The message selector entered in the csPtr field should by a 4-byte value of type OSType. The csData field should be the number of message types registered.

Make the driver call using the `PBControlImmed` function. If the registration is successful, the ioResult will equal noErr and the csPtr will contain a message base command (msgCmdBaseID) value which is used in the message send and receive parameter blocks.

Registering a Message on the PC

To register a message on the PC, load the 32-bit message selector into the EBX register and put the number of message types in CX. Then call INT 5Fh with AH equal to the registerMessage function ID (4). On return from the interrupt, BX will contain a message command base ID which must be used in the MsgPBlk's and MsgRecElem's. A sample function called MsgRegister, which passes in a selector and count (number of msg types) and returns the command base ID, is shown below:

```
MsgRegister PROC FAR C  msgSel:DWORD, msgCount:WORD, msgCmmd:WORD

   mov   ebx,msgSel           ; load EBX with the msgSelector.
   mov   cx,msgCount          ; load CX with the msgCount
   mov   ah,registerMessage   ; load AH with the function ID.
   int   05Fh                 ; make the interrupt call.

   mov   dx,bx                ; move BX to DX.
   mov   bx,msgCmmd           ; Put the address of msgCmd in BX.
   mov   [bx],dx              ; Return the msgCmd value.
   ret
MsgRegister ENDP
```

Sending a Message from the Mac

For either machine to send a message to the other, a MsgPBlk must be filled out and passed to the message system. The message system function for sending messages is **always** executed asynchronously, but the actual driver call is still made with PBControlImmed function and the ioCompletion field of the SBParamBlockRec should be set to NULL. The SBParamBlockRec is only used to send the MsgPBlk to the messaging system, so the completion routine function pointer is filled in the ioCompletion field of the MsgPBlk. The csPtr field on the SBParamBlockRec should be a ptr to the completed MsgPBlk.

To send a message, your application should fill out the MsgPBlk as follows:

```
--> msgCmd =           <message cmdBase ID + type ID>;
--> msgParam1 =        <any 32-bit value>;
--> msgParam2 =        <any 32-bit value>;
--> msgBuffer =        <pointer to a data buffer (64K max)>;
--> msgReqCount =      <size (in bytes) of the data buffer)>;
<-- msgActCount =      0;      // init to zero!
--> msgCompletion =    <pointer to completion rtn. or NULL>;
<-- msgResult =        0;      // init to zero.
--> msgFlags =         0;      // always set to zero!
--> msgUserData =      <any 32-bit pointer of value>;
```

The msgCmd field should contain a value equal to the message cmdBase ID returned from the message registration function plus the message type value for this message. If your application registered 15 message types for a particular selector (for which a cmdBase ID was returned), cmdBaseID <= msgCmd < (cmdBaseID + number of message types). The message handler on the PC will receive the msgCmd and can determine the message type ID by subtracting the cmdBaseID from the msgCmd. The format and/or types of these messages are predefined and recognizable by the applications which defined them.

The msgParam1 and msgParam2 fields can contain any 32-bit values the sending application wishes to place in them. The receiving function on the PC will have access to these paramters before the msgBuffer is actually transferred to the PC. So these fields can be used for messages without a data block or they can be used to determine if the receiving application wants to receive the data buffer.

The MsgReqCount field should contain the length (in bytes) of the data that is contained within the msgBuffer block. This does not mean it should be the length of the msgBuffer block, only the length of the data you wish to send that is contained from the start of the msgBuffer (e.g., msgReqCount <= size of buffer). The msgActCount field is filled in by the message system contains the number of bytes that were actually sent to the PC.

The msgUserData is a refCon that can be a 32-bit value or a pointer to data. This field does not get transferred to the PC, but it available for use when the completion routine gets called.

Once the message is sent, the msgResult field will be set to 1 to mark that the message is currently busy. Once the completion routine is called, msgResult will be 0 (noErr) or -3 (msgTimeout).

Note: The completion routine gets called at Deferred Task time and can use registers D0-D2, A0, and A1. All other registers must be saved and restored. A0 will contain a pointer to the MsgPBlk. A5 must be restored and saved if access to globals are necessary and you are coding under 68K. Use the msgUserData field hold onto your A5 world.

If your application is PPC Native, universal proc pointers and mixed-mode function definitions have been provided in the Messaging.h file included in the MessageTest tool source code that accompanies this Technote. Obviously, no save and restore of global space is necessary when running from PPC Native code.

Sending a Message from the PC

The MsgPBlk on the Mac and the MsgPBlk on the PC are virtually identical as far as the fields of the data structure the messaging application must use. The PC application should build the MsgPBlk in the same manner as described in the previous section and then send it through the message system interface on the PC.

To send a message from the PC, ES:BX should contain a far pointer to the MsgPBlk. AH should contain the function ID for sendMessage (1). Then the application should make the INT 5Fh call. The message will be queued and the msgResult field will be set to 1. Once the message has been sent, the completion routine will be called.

Your completion routine can be done in C code as well as assembly, but you must remember to use the __loadds keyword in your function prototype in order to have access to globals within your functions data segment.

Note: The completion routine specified will be called with a far call, so your completion routine must return with a RETF instruction (if you are writing your completion routine in C, this is usually not an issue). Interrupts are also turned off when the completion routine is called and the function **should not** turn interrupts on for any reason. The completion routine can use the AX, BX, CX, DX, DI, SI, ES, and DS registers. When the completion routine is called ES:BX contains a pointer to the MsgPBlk.

See the Test.c and Mesg.asm files for the PC MsgTest tool that accompanies this Technote for sample code.

Receiving a Message

To receive a message, your application must install a message handler function. A message handler function must be unique to every message selector that has been registered with the messaging system, but is the same function for every message type that belongs to a particular selector. In other words, if your application registers a message selector 'abcd' which has 15 message types associated with it, your application only has to install one message handler that will know how to process all 15 types of messages. The receive function can determine the message type by subtracting the cmdBaseID from the msgCmd value in the MsgRecElem.

The purpose of a message handler is to examine the msgCmd, msgParam1 and msgParam2 fields of the message that has been sent to determine if there is any data to be retrieved from the message. If there is data the receiving application wants to get, it must provide a pointer to a MsgPBlk with space allocated for the msgBuffer field for receiving the data. The msgReqCount field of the MsgPBlk should also contain the number of bytes the application expects to receive or the absolute size in bytes of the msgBuffer (i.e., 0 < msgReqCount <= size of msgBuffer). The messaging system will only write a maximum of msgReqCount bytes or less of data to the msgBuffer block.

Once a MsgPBlk has been provided, the messaging system will then retrieve the data into the msgBuffer field and update the msgActCount field of the MsgPBlk with the actual number of bytes transferred. If msgReqCount == msgActCount, msg Result equals noErr (0). If msgReqCount < msgActCount, msgResult will equal -1 (msgOverrun). If msgReqCount > msgActCount, msgResult will equal -2 (msgUnderrun). If msgResult equals -3 (msgTimeout), a time out error occurred and the transferal of data may not be complete. After the data has been received, the completion routine specified in the MsgPBlk will be called.

Note: The msgBuffer pointer will be advanced msgActCount bytes after the data transfer has been made (i.e., the pointer will point the end of the msgBuffer) and needs to be reset back to the start of the buffer after the completion routine is called in order to access the transfered data. This behavior is consistent for the Mac and the PC.

Receiving a Message on the Mac

To establish the ability for the Mac application to receive messages, the MsgRecElem should be built and installed. Typically, this should be done before the application sends a message so it is able to receive an acknowledge from the receiving application. Build a MsgRecElem as follows:

```
--> recFlags =     0;  // not used, init to zero.
--> recProc =      <pointer to msg receive handler function>;
--> recCmdBase =   <cmdBaseID for this app's msg Selector>;
--> recCmdCount =  <Number of msgTypes for this msg selector>;
--> recUserData =  <any 32-bit value or pointer>;
```

To install the msg receive handler, build the MsgRecElem and then build an SBParamBlcokRec as follows:

```
--> ioCRefNum =        <refNum of the .Symbiosis driver>;
--> ioVRefNum =        0;
--> ioCompletion = 0;
<-- ioResult =         0;
--> csCode =           eInstallMsgHandler ;
--> csPtr =            <pointer to MsgRecElem>;
--> csData =           0;
--> csData2 =          0;
```

Then install the msg handler by passing the built SBParamBlock to PBControlImmed.

When the Mac receives a message from the PC, the message handler function pointed to by recProc in the MsgRecElem will be called. Your handler is called at interrupt time with interrupts masked at the slot interrupt level. When the handler is called, D0.w contains the msgCmd, D1 contains msgParam1, and D2 contains msgParam2 from the sending applications MsgPBlk.

Based on these three values passed to the message handler, it must determine whether there is data to be received or whether it wants to receive the data. If the handler decides to receive the message data, it must return a pointer to a MsgPBlk that has an allocated msgBuffer and where the msgReqCount field is set to the number of bytes it expects to or is able to receive (see the previous section). The MsgPBlk should be returned in A0. If the MsgHandler decides not to receive the data, it should return 0 in A0.

The completion routine specified in the MsgPBlk will be called after the data has finished transmitting through the message system. The completion routine is called at deferred task time and can use registers A0, A1, D0, D1, and D2. All other registers must be saved and restored. A0 will contain a pointer to the MsgPBlk. (The universal procedure prototypes automatically handle moving the MsgPBlk into the function for PPC Native C functions.)

Receiving a Message on the PC

The process for receiving a message on the PC is much the same as on the Mac. Build a MsgRecElem just as was shown in the previous section. To install the message handler, place a pointer to MsgRecElem in ES:BX, set AH to installMsgHandler (2) and call INT 5Fh.

The installed message handler routine is called at interrupt time with interrupts turned off. The AX, BX, CX, DX, SI, DI, ES, and DS registers are available for use. When it is called, AX contains the msgCmd from the sending application's MsgPBlk. ECX contains msgParam1 and EDX contains msgParam2 from the sending application's MsgPBlk. DS:DI contains a pointer to the MsgRecElem.

Just the same as in the Mac message handler, the PC message handler must determine whether there is data to be received or whether it wants to receive the data in the message. If it does, it must return a pointer to a MsgPBlk in ES:BX, otherwise it should set ES:BX to NULL.

After the data has been received by the PC, the completion routine specified in the MsgPBlk will be called. ES:BX will contain the pointer the MsgPBlk and the function can use the AX, BX, CX, DX, DI, SI, ES, and DS registers. All other registers must be saved and restored.

Note: Both the message handling routine and the completion routine are called at interrupt time with interrupts turned off. Both functions should adhere to any rules of execution during interrupt time for a PC system and **should not** at any time turn interrupts back on.

Removing the Message Handlers

Message handlers must be removed when applications that installed them are no longer active. If the message handler is not removed, the messaging system could attempt to call the handler again. If the application has been terminated, it's a good bet that both the PC and Mac will crash.

To remove a message handler on the Mac, create a SBParamBlockRec and specify the eRemoveMsgHandler function code for the csCode. The csPtr field would be a pointer to the MsgRecElem that was used to install the message handler. Pass the SBParamBlockRec to the messaging system using a `PBControl` call.

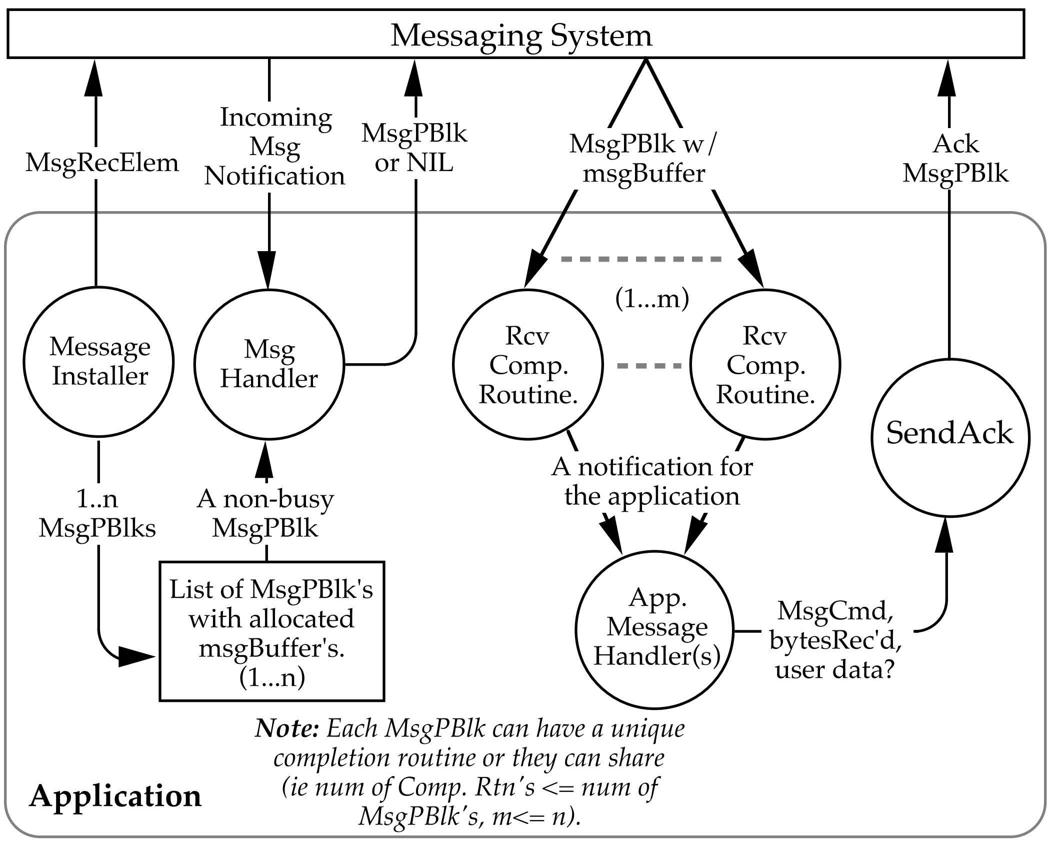
To remove a message handler on the PC, set the AH register to removeMsgHandler (3), set ES:BX to a pointer to the MsgRecElem used to install the handler, and make an INT 5Fh call.

Advanced Messaging System Techniques

As described in the *Basic Messaging Concepts* section of this Technote, the goal here is introduce developers to simple methods of performing Mac <--> PC communication using the PC Compatibility Card's messaging system interface. That basic level of communications means two applications send information to each one message at a time (i.e., the sending application does not send a second message to a receiving application until the receiving application has acknowledged it actually received the data of the sent message). Some applications may have a need to send multiple threads of messages back and forth before awaiting a reply, however. The good news is that this can be done. The bad news is that the developer is responsible for managing all of the message types and basic send/acknowledge protocols the applications should adhere to.

This management of messages is primarily performed in the message handler function which would be required to maintain a list of MsgPBlk's to grab all of the data being sent in. The only limit being how much memory the application can allocate to hold on to this incoming data and how well the message parameters and data are defined so acknowledging messages can be adequately returned to the sending application

Figure 2. Basic data flow for multiple message communication.



As shown in Figure 2, a message installer can install a MsgRecElem and some number of n MsgPBlk's with msgBuffer's allocated. When the MsgHandler is called, it searches the list for an available MsgPBlk (one in which the msgResult field <= 0, and the msgActCount = 0, so it knows the msgBuffer is empty) and returns it to the messaging system. Each MsgPBlk may have its own completion routine (if, for instance, one type of MsgPBlk was to be used for a specific message type) or can use one particular completion routine. So the number of completion routines <= the number of MsgPBlk's in the list.

After a MsgPBlk's completion routine is called, it can handle the data in any method needed, but then needs to notify the application that the data is ready. Either the msgBuffer needs to be detatched from the MsgPBlk (and a new buffer attached) or the application must have some way of marking the MsgPBlk as busy until the application can retrieve and process the data. The MsgPBlk can then be reset and the MsgHandler can use it again for other incoming messages.

The application message handler is then responsible for sending the acknowledge message back to the sending application after it has verified the length and/or quality of the data.

What is described here is one possible methodology for handling multiple message communication. Simpler methods or more complex methods may be needed based on the complexity of data to be exchanged. The level of this complexity is left to the developer, however. As long as the basic criteria are met as to when the messaging system has access to the paramBlock's and when the application has access to them, any system should work.

Similar messaging algorithms should be maintained for both the Mac and the PC applications that communicate information. All transactions between the Mac and the PC are made asynchronously at interrupt time.

Limitations

As stated earlier, the messaging system is capable of sending individual data packets of up to 64K. All data transfers between the Mac and the PC occur at interrupt time. This can sometimes have an effect on other software that may rely on processing data during interrupt time. Therefore, it is highly reccommended that if software designed to use this messaging system requires transmission of large blocks of data, the packet size used for each message sent should be reduced.

There is no absolute rule to follow here and the effect on other interrupt dependent software running at the same time as the data packets being transmitted to and from the PC Compatibility Card also depends on the capability of the hardware being used. As a general rule, however, it is advised that if the software being developed needs to transmit more than 1 MB of data at any particular time, the message packet size should be reduced to 32K or 16K. This will allow interrupts to not be turned off for as long a period of time to process the data transfers and allow other interrupts to execute and catch up.

The MacMsgTest and PCMsgTst Tools

This Technote is accompanied by two tools, one for the Mac and one for the PC, that perform very simple messaging. MacMsgTest is written entirely in C and is designed and compiled to run PPC Native. PCMsgTst is written in C and x86 assembly. Source code, header files, and makefiles are included for each tool. The necessary build environments are not included.

The tools are available on Apple's Developer World website (http://www.devworld.apple.com/) and on the Developer CD.

Please see each tool's individual ReadMe files for further information on executing and building MacMsgTest and PCMsgTst.

Summary of the Messaging System

Note: All of the Macintosh constants, data types, universal procedure pointers, and universal procedure definitions can be found in the "Messaging.h" file in MacMsgTest tool that accompanies this technote.

Constants (Mac)

```
#define kDriverName    "\p.Symbiosis" // The name of the driver

enum {
    eSendMessage           = 800,      // Send a message
    eInstallMsgHandler     = 801,      // Install a message handler
    eRemoveMsgHandler      = 802,      // Remove message handler
    eRegisterMessage       = 803       // Register message type
};


enum {
    msgNoError     = 0,                // No error
    msgOverrun     = -1,               // More data was available
    msgUnderrun    = -2,               // Less data was available
    msgTimeout     = -3                // Timeout error
};
```

Data Types (Mac)

```
typedef struct {
    QElemPtr   qLink;
    SInt16     qType;
    SInt16     ioTrap;
    Ptr        ioCmdAddr;
    ProcPtr    ioCompletion;           // always NULL
    OSErr      ioResult;               // error result info.
    StringPtr  ioNamePtr;
    SInt16     ioVRefNum;
    SInt16     ioCRefNum;              // refNum of Symbiosis driver.
    SInt16     csCode;                 // messaging system function
    void *     csPtr;                  // pointer to procedure or data
    SInt32     csData;                 // data
    SInt32     csData2;                // data
} SBParamBlockRec, *SBParamBlockRecPtr;

typedef struct MsgPBlk {
    struct MsgPBlk*msgQLink;  // Pointer to next MsgPBlk
    SInt16            msgQType;      // Queue Flags
    SInt16            msgCmd;        // The message type or command
    SInt32            msgParam1;     // Message parameter 1
    SInt32            msgParam2;     // Message parameter 2
    void*             msgBuffer;     // Ptr to the msg data buffer
    SInt32            msgReqCount;   // Requested data length
    SInt32            msgActCount;   // Actual data length
    MsgCompletionUPP  msgCompletion; // Ptr to comp. rtn. or NULL
    SInt16            msgResult;     // The result of msg operation
    UInt16            msgFlags;      // Message flags
    UInt32            msgUserData;   // refCon (a5, etc…)
} MsgPBlk, *MsgPBlkPtr;
```

```
typedef struct MsgRecElem {
    struct MsgRecElem* recQLink;      // Next queue element
    SInt16             recQType;      // queue flags
    SInt16             recFlags;      // Not used...Set to zero
    MsgReceiveUPP      recProc;       // Ptr to the receive proc.
    SInt16             recCmdBase;    // Msg Selector base.
    SInt16             recCmdCount;   // # of msgTypes
    UInt32             recUserData;   // refCon (could be A5...)
} MsgRecElem, *MsgRecElemPtr;
```

Universal ProcPtr and Procedure Definitions

```
#if GENERATINGCFM
typedef UniversalProcPtr MsgCompletionUPP;
typedef UniversalProcPtr MsgReceiveUPP;
#else
typedef ProcPtr MsgCompletionUPP;
typedef ProcPtr MsgReceiveUPP;
#endif


enum {
    uppMsgReceiveProcInfo = kRegisterBased
        | REGISTER_ROUTINE_PARAMETER(1, kRegisterA1,
                                        SIZE_CODE(sizeof(MsgRecElemPtr)))
        | REGISTER_ROUTINE_PARAMETER(2, kRegisterD0,
                                        SIZE_CODE(sizeof(short)))
        | REGISTER_ROUTINE_PARAMETER(3, kRegisterD1,
                                        SIZE_CODE(sizeof(long)))
        | REGISTER_ROUTINE_PARAMETER(4, kRegisterD2,
                                        SIZE_CODE(sizeof(long)))
        | REGISTER_RESULT_LOCATION(kRegisterA0)
        | RESULT_SIZE(kFourByteCode),

    uppMsgCompletionProcInfo = kRegisterBased
        | REGISTER_ROUTINE_PARAMETER(1, kRegisterA0,
                                       SIZE_CODE(sizeof(MsgPBlkPtr)))
        | REGISTER_RESULT_LOCATION(kRegisterA0)
        | RESULT_SIZE(kFourByteCode)
};


#if GENERATINGCFM
#define NewMsgReceiveProc(userRoutine) \
        (MsgReceiveUPP) NewRoutineDescriptor((ProcPtr)(userRoutine), \
                                              uppMsgReceiveProcInfo, \
                                              GetCurrentArchitecture())
#else
#define NewMsgReceiveProc(userRoutine) \
        ((MsgReceiveUPP) (userRoutine))
#endif


#if GENERATINGCFM
#define NewMsgCompletionProc(userRoutine) \
        (MsgCompletionUPP) NewRoutineDescriptor((ProcPtr)(userRoutine), \
                                                 uppMsgCompletionProcInfo, \
                                                 GetCurrentArchitecture())
#else
```

```
#define NewMsgCompletionProc(userRoutine) \
       ((MsgCompletionUPP) (userRoutine))
#endif
```

Note: All of the PC constants and data types for assembly language programming can be found in the "PCMesg.inc" file that is part of the PCMsgTst tool that accompanies this Technote. Constants and data types for C programming can be found in the PCMesg.h file that is included

Constants (PC)

```
enum {
    eIsAvailable = 0          // Index for is available
    eSendMessage = 1          // Index for Send func
    eInstallMsgHandler = 2    // Index for Install Msg Handler func
    eRemoveMsgHandler = 3     // Index for Remove Msg Handler func
    eRegisterMessage = 4      // Index for Register Msg
    eVersionCheck = 5         // Index to get the version numbers
};
```

Data Types (PC)

```
// some basic types used for the MsgPBlk and MsgRecElem structures.

typedef char   SInt8;
typedef short  SInt16;
typedef long   SInt32;
typedef unsigned char  UInt8;
typedef unsigned short UInt16;
typedef unsigned long  UInt32;
typedef char __far* Ptr32;


typedef struct MsgPBlk {
   struct MsgPBlk* link;             // Pointer to the next MsgPBlk.
   SInt16          msgCmd;           // The message command or type
   SInt32          msgParam1;        // Param 1
   SInt32          msgParam2;        // Param 2
   UInt32          msgCompletion;    // Ptr to the completion routine
   Ptr32           msgBuffer;        // Ptr to the data buffer
   SInt32          msgReqCount;      // Length of the data
   SInt32          msgActCount;      // # of bytes actually transfered
   SInt8           msgResult;        // The err code after complete or 1
   UInt8           msgFlags;         // Not used, init to zero.
   UInt32          msgUserData;      // for caller's use
   UInt32          msgVXD;           // Used by VxD
} MsgPBlk, *MsgPBlkPtr;
```

```
typedef struct MsgRecElem {
   struct MsgRecElem*  Link;
   SInt32              Code;
   SInt16              cmdBase;   // the base message number for this proc
   SInt16              cmdCount;  // the # of message numbers for this proc
   UInt32              userData;  // for caller's use
   UInt32              recVXD;   // reserved - Used by VxD
} MsgRecElem, *MsgRecElemPtr;
```

Summary

The Messaging System Architecture described in this Technote is compatible with the PC Compatibility Software v1.5 or later which is installable on all DOS Compatible and PC Compatible products shipped by Apple. This includes the Centris 610 DOS Compatible, the Quadra 630 DOS Compatible, the PowerMac 6100 DOS Compatible, the 7200 PC Compatible, and all PCI based Macintosh's which support the 12" 100 MHz Pentium and 7" 100MHz Cyrix 5x86 PC Compatibility Cards.

Future releases of the PC Compatibility Software may have modifications to Messaging System Architectures that will require updates of the software Interface described in this Technote.

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