NOTE: This Technical Note has been retired. Please see the Technical Notes page for current documentation.

Technical Note TB33

Color, Windows and 7.0

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[Oct 01 1992]

Introduction

System software version 7.0 introduces a new look for the Macintosh desktop. In order to implement those changes, `'wctb'` and `'cctb'` resources have changed in both form and use; it is now up to developers to take the lead and help the new standard work. The task can be divided into two main areas: in most cases all developers have to do is to stick to the system resources in order to provide a homogeneous feel to the user; developers in this group need only make sure the old 'wctb's are disposed of and that all dialogs and windows are based on CGrafPorts. The other case is more restricted and involves developers that need to use their own colors; these applications have to define the resources using the new templates and do a careful selection of the colors in order not to break the color scheme implemented by the system.

The good news is that the mechanics of coloring windows through the use of `'wctb'` resources is amazingly well documented in *Inside Macintosh* Volume V; the bad news is that System 7 uses a new and completely different scheme for colorizing windows. The new method uses `'wctb'` resources that are different than what is described in *Inside Macintosh* Volume V in both their contents and use, and it is no longer recommended that applications provide their own `'wctb'`s or that they change system `'wctb'` resources at all.

This change is not arbitrary. System 7 establishes a new user interface that not only presents a new and better-looking appearance for windows, but also enhances the user perception of function. The new look helps the user find the place to click in order to produce a certain result.

As with most of the rest of the interface, Apple has already done the research and testing for you, so let the system do the work, and you can focus on your application's code. Of course an application **can** replace the `'wctb'` provided by the system, but the results are bound to produce less-than-desirable results.

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Effects on existing applications

> **Note:**
> `'cctb'` resources are now tightly coupled to `'wctb'`s (especially for scroll bars) and therefore the discussion about the effects of the new scheme on old `'wctb'`s also applies to `'cctb'`s; the extent of the effect depends on the type of application.

Applications that directly access `'wctb'` resources to customize color windows using only the old resource format will not work; these resources are different, and the elements that correspond to the old parts perform new functions or are ignored. Directly accessing `'wctb'` resources may cause system crashes and/or produce really ugly results.

Solution: Revise applications and utilities that manipulate `'wctb'`s to take into account the new data structure.

The system will ignore old-style `'wctb'` resources; as a result applications that provide their own pre-System 7 window color table resources will not get the colors they used to see. The system will use the default look for the windows. If new style resources are provided, then the entries will be used according to the new scheme; chances are the results are not going to be as good as those obtained with the system colors.

Solution: Take away the old resources and get used to the new system colors; your users will appreciate that your windows are similar to those across the system. In the few cases where it makes sense, update your resources to the new templates.

Applications that carry their own `'WDEF'` and `'CDEF'` resources will not get the new nice-looking windows provided by the system, and although these applications should not experience problems since they are doing all the work themselves, the result will be a negative one from the good user interface perspective. These applications will have windows with the old look when all others look modern.

Solution: Developers should revise their applications to include `'WDEF'` and `'CDEF'` resources that are compatible with the new color interface. As of this writing, sample code for `'WDEF'` can be found on AppleLink in the following location:

"Developer Support:Developer Services:System Software:
Macintosh US System Software:System 7 Golden Master:Sys7WDEF.PKG"

Certain colors are counted on to produce the correct shades in this new color interface; applications that completely destroy the color environment of the system will cause interface problems for the user. In the few cases when the system can find colors that produce a similar shading effect, the system will use those colors and display windows using the color interface (although not the same as all the other windows since the colors are different). When the system can not come up with a reasonable alternative for the colors it needs, it reverts to displaying black-and-white windows.

Solution: Developers should revise their applications so that they don't take over the color environment and don't leave the colors all screwed up when switching out. Do use the Palette Manager, don't blast color tables, and don't hog all the available colors. The key to happiness is moderation.

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The Facts Ma'am, Just the Facts....

The new data structure for `'wctb'` resources resembles the old format, but more "part" fields are now present. The part codes for the new `'wctb'`s are:

	Part code:	Part it corresponds to:
0	wContentColor	Content area of the window
1	wFrameColor	Frame
2	wTextColor	Window title color and default text color for dialog buttons
3	wHiliteColor	Reserved
4	wTitleBarColor	Reserved
5	wHiliteColorLight	Used to produce colors in title bar stripes and for grayed text
6	wHiliteColorDark	Used to produce colors in title bar stripes and for grayed text
7	wTitleBarLight	Used to produce colors in title bar background
8	wTitleBarDark	Used to produce colors in title bar background
9	wDialogLight	Used to produce the colors in a dialog box's beveled frame
10	wDialogDark	Used to produce the colors in a dialog box's beveled frame
11	wTingeLight	Used to produce tinges in parts of windows
12	wTingeDark	Used to produce tinges in parts of windows

The colors in the windows are generated algorithmically using the colors in the System 7 `'wctb'`. Most of the colors are shades between the light and dark colors. For example, the background color of the title bar is a shade in between `wTitleBarLight` and `wTitleBarDark`. The resulting color is obtained as described later in this document.

`'cctb'` resources are also different; here are the part codes and their corresponding parts for `'cctb'`:

	Part code:	Part it corresponds to:
0	cFrameColor	Frames controls
1	cBodyColor	Background color in buttons
2	cTextColor	Interior text in buttons and legend for radio buttons and check boxes
3	cThumbColor	Reserved
4	cFillPatColor	Reserved
5	cArrowsColorLight	Used to produce colors in arrows and scroll bar background color
6	cArrowsColorDark	Used to produce colors in arrows and scroll bar background color
7	cThumbLight	Used to produce colors in thumb
8	cThumbDark	Used to produce colors in thumb
9	cHiliteLight	(corresponding to wHiliteLight)
10	cHiliteDark	(corresponding to wHiliteDark)
11	cTitleBarLight	(corresponding to wTitleBarLight)
12	cTitleBarDark	(corresponding to wTitleBarDark)
13	cTingeLight	(corresponding to wTingeLight) Affects 5-6 and 7-8 above
14	cTingeDark	(corresponding to wTingeDark)

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But How Does It Work?

In System 7, windows and scroll bars are drawn in color on a color device 8 bits deep or more (4 bits deep or more in gray-scale devices) independent of the type of `GrafPort`. The design gives windows and scroll bars a "gray" look with subtle color tints around the corners; these tinges are intended to give the user hints about the functions of the different parts.

When a window is active it will be drawn with the frame in `wFrameColor`, the title in `wTextColor`, and the drag bar, the scroll bars and all the gadgets (size, zoom, and close boxes) in a gray color with the edges showing the tints; note that in the context of this Technical Note gray color can be different from RGB gray (R=G=B); for example, if the light color is red and the dark color is blue then the "gray" result will be purple. It is also important to note that the exact gray result may not be available in the color table of the target device in which case a close equivalent is used. In the cases when there is no equivalent available, the system resorts to black-and-white (old-style) windows.

When the window is inactive, the frame is drawn in a grayed `wFrameColor` to indicate its disabled state; the drag bar, the gadgets, and the scroll bar of the window are whited out and the title will be grayed out (using gray color to display text, not the dithered gray produced with a 50 percent pattern) based on `wHiliteColorLight` and `wHiliteColorDark`. When the gadgets of a scroll bar (thumb and arrows) are enabled, they are drawn in gray with tinting (coordinated with the color theme used by the window!); when disabled the thumb disappears altogether and the arrows show in gray, but with no tinges.

In keeping the overall scheme of color interface, the background pattern of scroll bars has to be a gray pattern based on `cArrowsColorLight` and `cArrowsColorDark`; when the scroll bar is disabled (when no scrolling is necessary to show all the items in a window) then the scroll bar will be displayed in a solid gray. Don't confuse this grayed out state with unselected windows that present the scroll bars as well as the drag bar and all gadgets completely whited out.

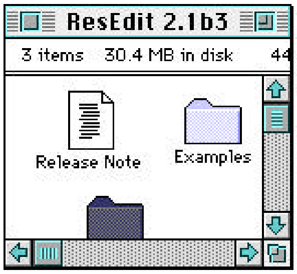

Figure 1 Active Window--Active scroll bars

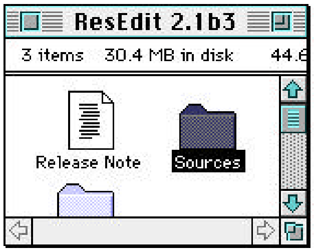

Figure 2 Active Window--Horizontal scroll bar disabled

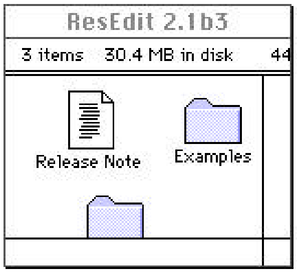

Figure 3 Inactive Window--Notice gray title

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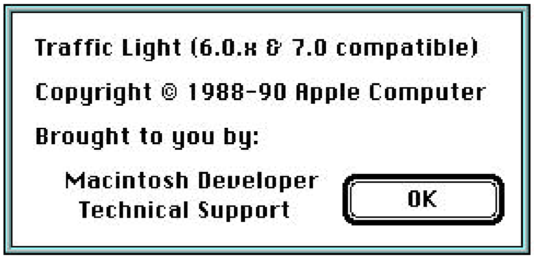
Dialog and Alert Boxes

Dialog and alert boxes have also been colorized following the same theme as in windows, but instead of a tinged border, dialog and alert boxes are displayed with a beveled border outlined with black; the bevel, with its spectrum of colors spreading between `wDialogLight` and `wDialogDark` as indicated by `DialogShades` produce a three-dimensional effect. When a dialog box becomes inactive, the outline reverts to gray.



Traffic Light (6.0.x & 7.0 compatible)

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Regardless of the port (`GrafPort` or `CGrafPort`). dialog and alert boxes are displayed using the shading scheme when the target device is set to 8 bits per pixel or more and colors, or when the target device is gray scale and set to 4 bits per pixel or more.

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Buttons, Radio Buttons, Check Boxes, and Text

Scroll bars are not the only controls affected by `'cctb'` resources. In general the names of the parts give a clear idea of what effect is produced by a given color. One area that is slightly different is text; the text in buttons is drawn using `cTextColor` in a fashion similar to pre-System 7 systems, but when the button is disabled, the new system displays the text using gray color instead of using dithered gray like it did in earlier systems.

A gray color is used to draw the text of disabled buttons whenever the dialog is a `CGrafPort` and the depth of the target device is 2 bits per pixel or more. Dialog boxes based on old-style ports will display disabled text using the old dithered gray.

The text associated with radio buttons and check boxes follows the same principles. Text is the key to indicate the state (enabled or not) of radio buttons and check boxes since the body of radio buttons and check boxes is drawn using `cFrameColor` whether the control is enabled or not.

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And for Those Who Eke Out a Living at the Deep End ...

Although readily available, the `'WDEF'` code has proven to be a little bit difficult a source of information for developers wanting to add System 7 color to their own `'WDEF'`s. The following is an attempt to help those developers see through the mud.

As mentioned before, the color present in the `'wctb'` is used both directly and as shades obtained by mixing light and dark colors. The question is which colors and in what proportions; the answer to how to mix the color is the shade tables found in the `'WDEF'`:

Colors from 'wctb'

Light Color	Dark Color	Rate	Shade
HiliteShades	wHiliteLight, wHiliteDark,	$0	; wHiliteShade0
wHiliteLight	wHiliteDark,	$7	; wHiliteShade7
wHiliteLight	wHiliteDark,	$8	; wHiliteShade8
wHiliteLight	wHiliteDark,	$A	; wHiliteShadeA
wHiliteLight	wHiliteDark,	$D	; wHiliteShadeD
TitleBarShades	wTitleBarLight, wTitleBarDark	$0	; wTitleBarShade0
wTitleBarLight	wTitleBarDark	$1	; wTitleBarShade1
wTitleBarLight	wTitleBarDark	$4	; wTitleBarShade4
DialogShades	wDialogLight, wDialogDark,	$0	; wDialogShade0w
wDialogLight	wDialogDark,	$4	; wDialogShade4w
wDialogLight	wDialogDark,	$6	; wDialogShade6w
wDialogLight	wDialogDark,	$B	; wDialogShadeBb
wDialogLight	wDialogDark,	$F	; wDialogShadeF
TingeShades	wTingeLight, wTitleBarDark,	$0	; wLTinge0
wTingeLight,	wTingeDark,	$4	; wLTinge4
wTitleBarLight	wTingeDark,	$F	; wDTingeF

The shade tables contain the light and dark colors plus the "shady" factor for each case, so `wHiliteShadeA` is a combination of `wHiliteLight` and `wHiliteDark` and modified by a factor of $A. In simple terms this means that the dark color is subtracted from the light color and the result is multiplied by the factor involved. Note that since in this case the colors are expressed in RGB form the higher rates produce lighter colors.

The shades described above are what the `'WDEF'` checks for in each device it has to draw to. If the shades are available then the window is rendered using the fancy colors; if the shades are not available then black and white and, in the case of inactive windows, patterns are used.

Let's use the title bar as an example of how the shades are used. Note that some colors are directly taken from the `'wctb'` and others represent mixtures of colors:

```
Title bar itself:Foreground color  Background color
(title bar frame)(to clear title bar rectangle)

When window activewFrameColorwTitleBarShade1
(wTitleBarLight+wTitleBarDark, $1)

When window inactivewHiliteShadeAwContentColor
(wHiliteLight+wHiliteDark, $1)

================================================================
Foreground color forLeft-Top sidesRight-Bottom sides
rect inside title bar
(present only when wLTinge0wLTinge4
window active)(wTingeLight+wHiliteDark, $0)
(wTingeLight+wTingeDark, $4)

================================================================
*Title stringForeground color
*When window activeWhen window inactive
*
*wTextColorwHiliteShade7
(wHiliteLight+wHiliteDark, $7)

================================================================
Title bar stripesForeground color
only when window active
wHiliteShade8
(wHiliteLight+wHiliteDark, $8)
```

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So what about the Drag Manager?

If you have a window with your own color table and things aren't set up just so, you probably noticed that calls to `ShowDragHilite` result in a gray drag hilite instead of the usual color one. The Drag Manager uses the color table in the window's `AuxWinRec` to determine the color used for the hilite. If the window color table:

- doesn't exist,

- doesn't have a minimum number of entries, or
- doesn't have a wTingeLight and wTingeDark entry,

a default 50% gray is used for the drag highlight color. Often this is desirable, since the window color-based hilites may clash or be invisible with your customized window color table, but in some cases you may want the same color for your hilite regions.

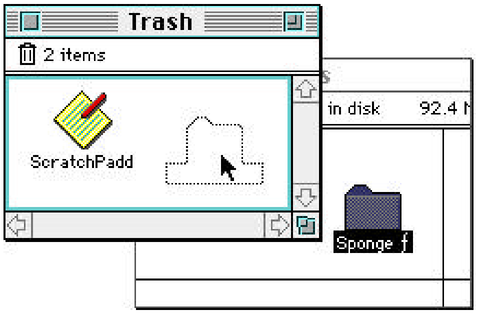

Figure 5. Drag hilite region based on window colors

To stay consistent with what the user chooses in the Colors Control Panel, use the wTingeLight and wTingeDark entries from the default window color table (obtained by calling GetAuxWin) as your window's tinge entries. In order to stay consistent with any changes in the Colors Control Panel, you may want to compare your tinge entries with the default entries when you receive an update event, and reset your color table if the default entries have changed. If a change is made in the Colors Control Panel, every window on the screen will receive an update event, so you'll catch the change as soon as it happens:

```
    case updateEvt:
       whichWindow = (WindowPtr) mainEventRec.message;

       if (TingeColorChanged(whichWindow) == true)
          SyncTingeColors(whichWindow);

       SetPort(whichWindow);
       BeginUpdate(whichWindow);
```

Here's an example showing how to fill in the color table entries after a new window has been created. Note that this calls GetAuxWin in the GetWinCTab routine to obtain the System's default window color table:

```
//------------------------------------------------------------------------------
// SyncTingeColors
//
// Set the tinge colors in this window to the ones found in the default
// window color table.
//------------------------------------------------------------------------------
void SyncTingeColors(WindowPtr theWindow)
{
   WCTabHandle   newWinCTab;
   short         index;

   newWinCTab = (WCTabHandle) GetWinCTab(theWindow);

   if (newWinCTab != nil) {
      // OK, we have our window color table, now set it to have
      // the System's color table entries for light and dark
      // tinges (to match what the user selected in the Colors
      // Control Panel.)

      CTabHandle defaultWCTB;
      RGBColor   defaultTingeDark, defaultTingeLight;
      Boolean    hasEntry;

      // Pass a nil to get the default window color table
      defaultWCTB = GetWinCTab(nil);

      if (defaultWCTB != nil) {
         // OK, we have the default color table, set our
         // window's tinge entries accordingly

         // Get a pointer to the wTingeLight in my window

         for (index = (*newWinCTab)->ctSize; index > 0; index --) {
            if ((*newWinCTab)->ctTable[index].value == wTingeLight)   {
               // Our window's color table has an entry for wTingeLight,
               // so copy the System's light tinge if we can find it.

               hasEntry = GetRGBFromCTable(&defaultTingeLight, defaultWCTB,
                                            wTingeLight);

               if (hasEntry == true)
                  BlockMoveData(&defaultTingeLight,
                       &(*newWinCTab)->ctTable[index].rgb,
                       sizeof(RGBColor));

            }
         }

         // Get a pointer to the wTingeDark in my window

         for (index = (*newWinCTab)->ctSize; index > 0; index --) {
            if ((*newWinCTab)->ctTable[index].value == wTingeDark)   {
               // Our window's color table has an entry for wTingeDark,
               // so copy the System's light tinge if we can find it.

               hasEntry = GetRGBFromCTable(&defaultTingeDark,
                                   defaultWCTB, wTingeDark);

               if (hasEntry == true)
                  BlockMoveData(&defaultTingeDark,
                       &(*newWinCTab)->ctTable[index].rgb,
                       sizeof(RGBColor));

            }
         }

      }

      // Finally, set the color table
      SetWinColor(theWindow, newWinCTab);
   }
}

//----------------------------------------------------------------------------
// GetWinCTab
//
// Given a Window pointer, this will return the color table associated with
// that window.  Note, you can pass nil to this routine to get the default
// window color table.  Check out the documentation on GetAuxWin for details.
//----------------------------------------------------------------------------
CTabHandle GetWinCTab(WindowPtr theWindow)
{
   CTabHandle   returnCTab = nil;
   AuxWinHandle   defaultAuxWin;

   (void) GetAuxWin(theWindow, &defaultAuxWin);
   if (defaultAuxWin != nil)
      returnCTab = (*defaultAuxWin)->awCTable;

   return returnCTab;
}

//----------------------------------------------------------------------------
// GetRGBFromCTable
//
// Fills in a struct with the RGBColor asked for in the whichValue param.
// Returns true if the color is filled in properly, and false if it isn't.
//----------------------------------------------------------------------------
Boolean GetRGBFromCTable(RGBColor *returnColor, CTabHandle colorTable,
                         short whichValue)
{
   Boolean  entryFound = false;
   short    index;

   if (colorTable != nil) {
      for (index = (*colorTable)->ctSize; index > 0; index --)
         if ((*colorTable)->ctTable[index].value == whichValue) {
            *returnColor = (*colorTable)->ctTable[index].rgb;
            entryFound = true;
            break;
         }
   }

   return entryFound;
```

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And You Thought It Would Never End!

As always, all applications should refrain from nonfriendly practices when dealing with the color environment; they should use the Palette Manager, and should never change color tables directly.

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References

Inside Macintosh , Volumes V and VI, Color QuickDraw, Window Manager, Dialog Manager, and Palette Manager

Snippet GrayWindow & Color Hilites

Snippet WDEFColorSample

WDEF code from AppleLink

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Change History

01-January-1991	Originally written.
01-May-1992	In this Note, we have removed mention of `GetGray` and added text describing how colorization of windows really works (kind of).
01-October-1992	Now includes some information on how to obtain and maintain Drag hilite colors for windows with non-default window color tables.

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