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Technical Note PT13

Getting through CUSToms

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This technical note provides a way for developers to allow sophisticated users to add code to an off-the-shelf application. Using this scheme, the user can easily install the code module; the application has to know how to call it and, optionally, be able to respond to a set of predefined calls from the custom package.

[Jul 01 1987]

Note

The following code makes heavy use of features of the Macintosh Programmer's Workshop. It also assumes a basic familiarity with the standard Sample program included with MPW. The Pascal code (which is here only as an example implementation of the mechanism) is presented as only those sections which *differ* from Sample.p. The assembly language code also includes MPW-only features, such as record templates. Some of these are explained in [TN.PT.Signals](#).

In addition, since the order in which parameters to various routines are passed is critical, special care will have to be taken in writing interfaces for use with C. It is probably best to declare them as Pascal in the C source.

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Concepts

Basically, we create a code resource of type CUST with an entry point at the beginning which takes several parameters on the stack; this code is reached via a dispatching routine which is written in assembly language.

The data passed on the stack to this dispatcher includes:

- a selector (to specify the operation desired)
- the address of a section of application globals (for communication back and forth between the application and the module when the stack parameters are insufficient)
- a handle which references the custom code resource on the stack.

Other parameters may be added (as long as they are pushed on the stack before the required ones) if desired. Since these extra parameters would **always** have to be included in any calls to a given package, it might be more convenient to use the application global space area which is accessed through the `appaddr` parameter.

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Template

Your application must contain the following global data and procedure declarations to support this model:

```

VAR
    custhandle: Handle;

    {the following globals constitute the data known to the custom code}
    appdispatch: ProcPtr; {address of dispatch routine custom code can call}
    {examples of further application globals for the custom package:}
    (*
    paramptr: Ptr; {general pointer used as param. to appdispatch code}
    paramword1: INTEGER;
    paramword2: INTEGER;
    CUSTerr: INTEGER;
    *)
    {any other globals the module should get at}

    {the two assembly language glue routines which are linked into the
    application}
PROCEDURE CustomInit(resID: INTEGER; VAR custhandle: Handle);
    EXTERNAL; {the routine used to set up the custhandle resource handle}

PROCEDURE CustomCall({application & package-specific paramters}
    selector: INTEGER; appaddr: UNIV Ptr; ourhandle: Handle);
    EXTERNAL; {this is the code dispatcher}

    {this is called by the custom package to perform a service which is more
    easily provided by the application; since we pass a pointer to it to the
    package, CustDispatch must be at the outermost nesting level in the main
    segment }

PROCEDURE CustDispatch(selector: INTEGER);

BEGIN
    CASE selector OF
        {
            .
            .
        }
        .
    END; {CASE}
    END; {CustDispatch}

{your initialization code should contain the following:}

{Custom package initialization stuff}
appdispatch := @CustDispatch; {put pointer where the package can see it}
CustomInit(69,custhandle);    {our CUST resource has ID = 69}

```

You must also assemble CustomInit and CustomCall and link them with into your application. The custom package itself can be written in any language which can produce stand-alone code.

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The example

CustomCall is only referenced once in this example. When a variety of unrelated functions are provided, however, it is more convenient to provide a separate interfacing procedure to invoke each one and have them make their own CustomCall calls.

Note that this example is somewhat contrived; you probably wouldn't "externalize" the code for finding a word or sequence of characters like this. This is an idealized situation. More realistic uses would be: to add-on special routines to a database to perform custom calculations or the like; allow for localization when code is required (and hooks aren't already provided); let documents carry around code which may vary among software versions, etc. so that older documents would be able to work alongside the new ones, etc.

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What it does

We simply add a new menu to the sample program which allows Find bycharacters or word. We just pass the menu item to the package and let it do the finding; it then calls back to the application dispatch routine to highlight text or display the "not found" message.

The Pascal source for the example application appears first:

```

{$R-}
{$D+}
PROGRAM P;

USES
    {$LOAD :: PInterfaces:most.dump}
    Memtypes, Quickdraw, OSIntf, ToolIntf, PackIntf {, MacPrint}
    {$LOAD}
    , {$U ErrSignal.p} ErrSignal;

CONST
    appleID = 128; {resource IDs/menu IDs for Apple, File and Edit menus}
    fileID = 129;
    editID = 130;
    findID = 131;

```

```

appleM = 1; {index for each menu in myMenus (array of menu handles)}
fileM = 2;
editM = 3;
findM = 4;

menuCount = 4; {total number of menus}

windowID = 128; {resource ID for application's window}

undoCommand = 1; {menu item numbers identifying
    commands in Edit menu}
cutCommand = 3;
copyCommand = 4;
pasteCommand = 5;
clearCommand = 6;

findcharsCommand = 1; {menu items for Custom menu}
findwordCommand = 2;

aboutMeCommand = 1; {menu item in apple menu for About sample item}

aboutMeDLOG = 128;
findDLOG = 129;
infoDLOG = 130;

{application dispatching code selectors}
highlightSel = 0;
notifySel = 1;

VAR
*
*
*
errCode: INTEGER;
dlogString: Str255;
cushandle: Handle;

{here is the area known to the custom code}
appdispatch: ProcPtr; {address of dispatch routine custom
    code can call}

{examples of further application globals for the custom package}
paramptr: Ptr; {general pointer used as param. to appdispatch code}
paramword1: INTEGER;
paramword2: INTEGER;
{any other globals the module should get at}

PROCEDURE CustomInit(resID: INTEGER; VAR cushandle: Handle);
EXTERNAL; {the routine used to set up the cushandle resource handle}

PROCEDURE CustomCall(
    text: Ptr;
    count: INTEGER;
    findstr: StringPtr;
    selector: INTEGER;
    appaddr: UNIV Ptr;
    ourhandle: Handle);
EXTERNAL; {this is the code dispatcher}

{this will do the "about" dialog and }
{the info dialog requested by the custom pack.}

PROCEDURE ShowADialog(meDlog: INTEGER);

CONST
    okButton = 1;
    authorItem = 2;
    languageItem = 3;
    infoItem = 2;

VAR
    itemHit, itemType: INTEGER;
    itemHdl: Handle;
    itemRect: Rect;
    theDialog: DialogPtr;

BEGIN
    theDialog := GetNewDialog(meDlog, NIL, WindowPtr( - 1));

    CASE meDlog OF
        aboutMeDLOG: BEGIN
            GetDitem(theDialog, authorItem, itemType, itemHdl, itemRect);
            SetIText(itemHdl, 'Ming The Vaseless');
            GetDitem(theDialog, languageItem, itemType, itemHdl, itemRect);
            SetIText(itemHdl, 'Pascal et al');
        END;

        infoDLOG: BEGIN {display the message requested by the custom
            package}
            GetDitem(theDialog, infoItem, itemType, itemHdl, itemRect);
            SetIText(itemHdl, StringPtr(paramptr)^);
        END;
    END;

```

```

        END;
    END; {CASE}

    REPEAT
        ModalDialog(NIL,itemHit)
    UNTIL (itemHit = okButton);

    CloseDialog(theDialog);
END; {of ShowADialog}

{this will put up the Find dialog to allow the user to type
in the characters to search for}
FUNCTION DoCustomDialog: BOOLEAN;

CONST
    okButton = 1;
    cancelButton = 2;
    fixedItem = 3;
    editItem = 4;

VAR
    itemHit,itemType: INTEGER;
    itemHdl: Handle;
    itemRect: Rect;
    theDialog: DialogPtr;

BEGIN
    theDialog := GetNewDialog(findDLOG,NIL,WindowPtr( - 1));
    GetDitem(theDialog,editItem,itemType,itemHdl,itemRect);
    SetIText(itemHdl,dlogString);
    TSEtSelect(0,MAXINT,DialogPeek(theDialog)^.textH);

    REPEAT
        ModalDialog(NIL,itemHit)
    UNTIL (itemHit IN [okButton,cancelButton]);
    GetIText(itemHdl,dlogString);
    DoCustomDialog := itemHit = okButton;

    CloseDialog(theDialog);
END; {of DoCustomDialog}

PROCEDURE DoCommand(mResult: LONGINT);
*
*
*
(* partial procedure fragment *)

{here is one of the case sections for the DoCommand procedure}

    findID:
    IF DoCustomDialog THEN
        BEGIN
            MoveHHI(Handle(textH)); {stop it from fragmenting heap}
            WITH textH^^ DO BEGIN
                HLock(hText);
                { since we don't know what the }
                { package might be up to }

                {now call the package to find characters or words}
                CustomCall(POINTER(ORD(hText^) + selEnd),
                    teLength - selEnd, @dlogString, theItem, @appdispatch,
                    custhandle);
                HUnlock(textH^^.hText);
            END; {WITH}
        END;

    END; {OF menu CASE} {to indicate completion of command,}
    HiliteMenu(0); {call Menu Manager to unhighlight }
    {menu title (highlighted by }
    {MenuSelect) }
END; {OF DoCommand}

    { this is called by the custom package to set the new selection }
    { or display a message; it must be in CODE 1 at the outermost }
    { lexical level }
PROCEDURE CustDispatch(selector: INTEGER);

BEGIN
    CASE selector OF
        hilightSel: {hilight the characters selected }
                    {by the custom pack.}

        {paramptr=pointer to text to select, }
        { paramword1&paramword2=start,end chars}

        WITH textH^^ DO
            {we'll subtract the start of text from}
        {paramptr to get the base offset...}
        TSEtSelect(ORD(paramptr)
            - StripAddress (ORD(hText^))
            + paramword1, ORD(paramptr)

```

```

        - StripAddress (ORD(hText^))
        + paramword2,textH);

    notifySel: {put up message per request from custom pack.}
    {paramptr points to string to display}
    ShowADialog(infoDLOG);

    END; {CASE}
END; {CustDispatch}

BEGIN {main program}
{ Initialization }
InitGraf(@thePort); {initialize QuickDraw}
InitFonts; {initialize Font Manager}
FlushEvents(everyEvent - diskMask,0); {call OS Event Mgr to discard
                                     non-disk-inserted events}
InitWindows; {initialize Window Manager}
InitMenus; {initialize Menu Manager}
TEInit; {initialize TextEdit}
InitDialogs(NIL); {initialize Dialog Manager}
InitCursor; {call QuickDraw to make cursor (pointer) an arrow}

InitSignals;
errCode := CatchSignal;
IF errCode <> 0 THEN BEGIN
    Debugger;
    Exit(P);
END;

SetUpMenus; {set up menus and menu bar}
UnloadSeg(@SetUpMenus); {remove the once-only code}

{Custom package initialization stuff}
appdispatch := @CustDispatch;
CustomInit(69,custhandle); {should test custhandle for NIL
                           {and alert the user}
    dlogString := '';
...
{etc. with the rest of initialization and the main event loop}
END.

; now for the assembly language code
; first, the dispatching and initializing code that must be linked
; into the application

; CustomCalling
; Custom packages initializing and dispatching
;
; Rick Blair    May, 1987
;
; PRINT OFF
; INCLUDE 'Traps.a'
; INCLUDE 'ToolEqu.a'
; INCLUDE 'QuickeQu.a'
; INCLUDE 'SysEqu.a'
; PRINT ON

        LOAD    'most.dmp'    ; from a dump of the files above

appdata    EQU        12

;Initialize a custom module
; Pascal call format:
; CustomInit(resID:INTEGER;VAR custhandle:Handle);
;
; This will load the CUST module with the given resource ID, install a
; handle to it in custhandle, and set the module's appdata pointer to
; point to the address appaddr.
;
resID      EQU        8
custhandle EQU        4

CustomInit PROC EXPORT
    SUBQ.L    #4,A7    ;make room for handle from GetResource
    MOVE.L    #'CUST',-(A7)
    MOVE.W    resID+8(A7),-(A7);resource ID
    _GetResource
    MOVE.L    (A7)+,A0
    MOVE.L    custhandle(A7),A1
    MOVE.L    A0,(A1)    ;store handle in app's custhandle global
; (return with nil handle if GR failed)
    MOVE.L    (A7),A0    ;get return address
    ADD.L    #10,A7    ;strip everything
    JMP      (A0)    ;adieu

;Call a custom module
;Pascal format:
; CustomCall( {parameters as desired} selector: INTEGER; appaddr: Ptr;
;            module: Handle);
;

```

```

;This will call the code whose handle is passed on the stack. If the
;application was written in assembly language you would just
;dereference the handle and call it directly (you wouldn't need this at
;all).
;
CustomCall    PROC    EXPORT
    IMPORT     Signal
    MOVE.L     4(A7),A0    ;get handle
    MOVE.L     (A0),D0
    BNE.S      @0          ;if hasna' been purged, ga' ahead
    MOVE.L     A0,-(A7)    ;push handle
    _LoadResource
    MOVE.W     ResErr,-(A7)
    JSR        Signal     ;Signal is a NOP if a zero is passed to it
    MOVE.L     4(A7),A0    ;handle again
; we don't lock the handle here (we can't save it so we can unlock it
; later), so it's up to the package to lock/unlock itself
@0            MOVE.L     (A0),A0    ;dereference
            JMP         (A0)        ;call CUST code

            END

; here is the module for the custom package itself

; CustomPack
; Example custom code package
;
; Rick Blair    May, 1987
;
; This demonstrates the recommend structure of a code module which a
; sophisticated user could add to an existing application which supported
; this mechanism. Aside from allowing for multiple routines within the
; module (via a selector), provision is made for calling a routine
; dispatcher within the application itself.

;Finding text
;We support a call to find a string anywhere within a block of text
; (selector=0), and one to find the string only as a separate "word"
; with spaces around it (selector=1).
;PROCEDURE CustomCall(text:Ptr; count:INTEGER; findstr:^STRING;
;                      selector:INTEGER; appaddr: UNIV Ptr; ourhandle:Handle);
;Rather than return a result indicating whether they succeeded or not,
;these routines take whatever action is appropriate (the application
;may not even know what these routines actually do).
;Once a call succeeds or fails, it then takes action by making a call to
;one of the services provided by the application. In this case the two
;functions provided are just what we need; the ability to select text and
;the ability to put up a message saying "Text not found".

            STRING      ASIS

;            PRINT      OFF
;            INCLUDE    'Traps.a'
;            INCLUDE    'ToolEqu.a'
;            INCLUDE    'QuickEqu.a'
;            INCLUDE    'SysEqu.a'
;            PRINT      ON

            LOAD        'most.dmp'    ; from a dump of the files above

CustPack      PROC      EXPORT

            BRA.S       Entry        ;skip header

            DC.W        0            ;flags
            DC.B        'CUST'       ;custom add-on code module
            DC.W        69           ;resource ID (picked by Mr. Peabody &
;                      ; Sherman)
            DC.W        $10          ;version 1.0

StackFrame    RECORD      {A6Link},DECR
paramsize     EQU         *-8
; call-specific parameters... (optional)
text          DS.L        1          ;pointer to text block
count         DS.W        1          ;word count of characters in text
findstr       DS.L        1          ;pointer to p-string to find
; selector(word, optional - you might only have 1 call)
selector      DS.W        1
fcharsCmd     EQU         1          ; selector for "find characters"
fwordCmd      EQU         2          ; selector for "find word"
; pointer to app. globals (long)
appaddr       DS.L        1
; handle to this resource (long)
ourhandle     DS.L        1
; TOS:return address (long)
return        DS.L        1
;the stack link is built off the origin of the saved old A6 on the stack
A6Link        DS.L        1
LocalSize     EQU         *
            ENDR

;offsets into our application globals area

```

```

AppGlobals    RECORD    {appdispatch},DECR
appdispatch   DS.L      1
paramptr      DS.L      1
paramword1    DS.W      1
paramword2    DS.W      1
;CUSTerr      DS.W      1    ;if we had possible errors
                ENDR

Entry
    WITH        StackFrame,AppGlobals
    LINK        A6,#LocalSize
;    MOVEM.L    ...    ;we'd save any non-trashable regs here
;first lock us down...
    MOVE.L      ourhandle(A6),A0
    _HLock

    MOVE.W      selector(A6),D0
    CMP.W       #fcharsCmd,D0
    BEQ.S       charfind    ;go find characters
    CMP.W       #fwordCmd,D0
    BEQ.S       wordfind    ;go find a word
;well, M. App didn't call us with a selector we know, so...

;unlock ourselves, clean up, return
; (if we wanted to return an error code we could stuff it into the app.
;  global area)
duhn          MOVE.L    ourhandle(A6),A0
    _HUnLock
;    MOVEM.L    ...    ;restore any registers here
    UNLK        A6
    MOVE.L      (A7)+,A0    ;return address
    ADD.L       #paramsize,A7;strip parameters
    JMP         (A0)

;selector codes for calls to application
highlight     EQU       0    ;highlight characters, please
notify        EQU       1    ;beep a little

;find the string "findstr" anywhere in the block "text"
charfind
    JSR         findchars    ;see if findstr is anywhere in text
    BEQ.S       nofind      ;if not then skip
    JSR         calcsels     ;compute selstart and selend
didfind       MOVE.L      appaddr(A6),A0    ;get pointer to appl. globals area
    MOVE.L      text(A6),paramptr(A0)    ;setup text pointer and...
    MOVE.W      D0,paramword1(A0)    ;start character position,
    MOVE.W      D1,paramword2(A0)    ;end character position
    MOVE.W      #highlight,-(A7)    ;pass proper selector
goapp         MOVE.L      appdispatch(A0),A0    ;get dispatch address
    JSR         (A0)    ;call the application to select the range
    BRA.S       duhn        ;return to application (dejÀ vu)

nofind        MOVE.L      appaddr(A6),A0    ;get pointer to appl. globals area
    LEA         oopstring,A1    ;get pointer to "Not found" message
    MOVE.L      A1,paramptr(A0)    ;put string pointer in "paramptr"
    MOVE.W      #notify,-(A7)    ;tell app. to display message
    BRA.S       goapp

;figure selstart and selend
calcsels      NEG.W       D0    ;        negate # characters unskipped in text
    SUBQ.W      #1,D0    ;include 1st character
    ADD.W       count(A6),D0    ;compute 1st character position for
                                ; select
    MOVE.L      findstr(A6),A1
    MOVE.B      (A1),D1    ;get length of string
    EXT.W       D1
    ADD.W       D0,D1    ;compute last char. pos. for select
    RTS

;find the characters, but only if surrounded by space (including end or
; beg.)
;we could extend the test to check for other delimiters (";",",",etc.)
wordfind
    JSR         findchars
wloop         BEQ.S       nofind
    MOVE.W      D0,D2    ;save count of text remaining
    JSR         calcsels    ;figure start and end offsets
    MOVE.L      text(A6),A1    ;point to text
    TST.W       D0    ;start=beginning of text?
    BEQ.S       @0    ;yep, so it passes
    CMP.B       #' ',-(A1,D0)    ;preceded by a space?
    BNE.S       @1    ;nope, keep looking
    @0          CMP.W      count(A6),D1    ;D1=length of text?
    BEQ.S       didfind    ;yep, so it passes
    CMP.B       #' ',(A1,D1)    ;followed by a space?
    BEQ.S       didfind    ;yes, so we've found it

;this wasn't paydirt, so keep panning
    @1          MOVE.W      D2,D0    ;restore chars remaining count
    BMI.S       nofind    ;forget it if we ran out of text
    JSR         bigloop    ;keep looking
    BRA.S       wloop

```

```

;this code will find the string if it lies anywhere in the text
findchars    MOVE.L    text(A6),A0        ;point A0 to chars to search
             MOVE.W    count(A6),D0       ;size of text block
bigloop      MOVE.L    findstr(A6),A1;point A1 to chars to find
             MOVE.W    (A1)+,D1           ;get length byte and 1st char. (skip 'em)
             CMP.W     #255,D1
             BGT.S     @1                ;enter loop if length<>0
             ADDQ.L     #4,A7             ;strip findchar's return address
             BRA        duhn             ;return having done nothing

;search for first character
@0           CMP.B     (A0)+,D1           ;this one match 1st character?
@1           DBEQ      D0,@0             ;branch until found or done 'em all
             BNE.S     cnofind          ;skip out if no match on 1st character

             MOVE.B     -2(A1),D1        ;length of findstr
             EXT.W     D1
             SUBQ.W     #1,D1            ;length sans 1st character
             BEQ.S     cfound           ;if Length(findstr)=1, we're done
             CMP.W     D1,D0
             BLT.S     cnofind          ;fail if findstr is longer than text left
             MOVE.L     A0,D2            ;save this character position
             CMP.W     D1,D1            ;force EQuality
             BRA.S     @3              ;enter loop

@2           CMP.B     (A0)+,(A1)+
@3           DBNE      D1,@2            ;check until mismatch or end of findstr

             MOVEA.L     D2,A0           ;restore position (cc's unaffected)
             BNE.S     bigloop          ;if no match then keep looking

cfound       MOVEQ      #1,D1           ;return TRUE
             RTS

cnofind      SUB.W      D1,D1           ;return FALSE
             RTS

STRING       PASCAL
oopstring    DC.B      'Pattern not found.'

END

#additions to the resource file

resource 'DLOG' (129, "Find dialog") {
    {72, 64, 164, 428},
    dBoxProc,
    visible,
    noGoAway,
    0x0,
    129,
    "Find"
};

resource 'DLOG' (130, "Info") {
    {66, 102, 224, 400},
    dboxproc, visible, nogoaway, 0x0, 130, ""
};

resource 'DITL' (130) {
    {
        /* 1 */ {130, 205, 150, 284},
        button {
            enabled,
            "OK already"
        };
        /* 2 */ {8, 32, 120, 296},
        statictext {
            disabled,
            ""
        }
    }
};

resource 'DITL' (129) {
    {
        /* array DITLarray: 4 elements */
        /* [1] */
        {64, 48, 84, 121},
        Button {
            enabled,
            "OK"
        };
        /* [2] */
        {64, 231, 84, 304},
        Button {
            enabled,
            "Cancel"
        };
        /* [3] */
        {8, 8, 24, 352},
        StaticText {

```



```

        disabled,
        "Find what?"
    };
    /* [4] */
    {32, 8, 48, 352},
    EditText {
        disabled,
        ""
    }
}
};

resource 'MENU' (131, "Custom", preload) {
    131, textMenuProc, 0x3, enabled, "Custom",
    {
        "Find Chars...",
        noicon, "F", nomark, plain;
        "Find Word...",
        noicon, "W", nomark, plain
    }
};

type 'CTST' as 'STR ' ;

resource 'CTST' (0) {
    "Custom Application - Version 1.0"
};

include "CustomPack.code";

# This makefile puts the program together incl. the CUST pack.

CustomTest [[florin]][[florin]] CustomCalling.a.o CustomTest.p.o ErrSignal.a.o
# the predefined rule for assembly will build CustomCalling.a.o,
# CustomPack.code
Link CustomTest.p.o CustomCalling.a.o ErrSignal.a.o [[partialdiff]]
    "{Libraries}"Interface.o [[partialdiff]]
    "{Libraries}"Runtime.o [[partialdiff]]
    "{PLibraries}"Paslib.o [[partialdiff]]
-o CustomTest
CustomPack.code [[florin]] CustomPack.a.o
Link CustomPack.a.o -rt CUST=69 -o CustomPack.code
# Put the resource file together (including the custom code resource)
CustomTest [[florin]][[florin]] CustomTest.r CustomPack.code

```

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