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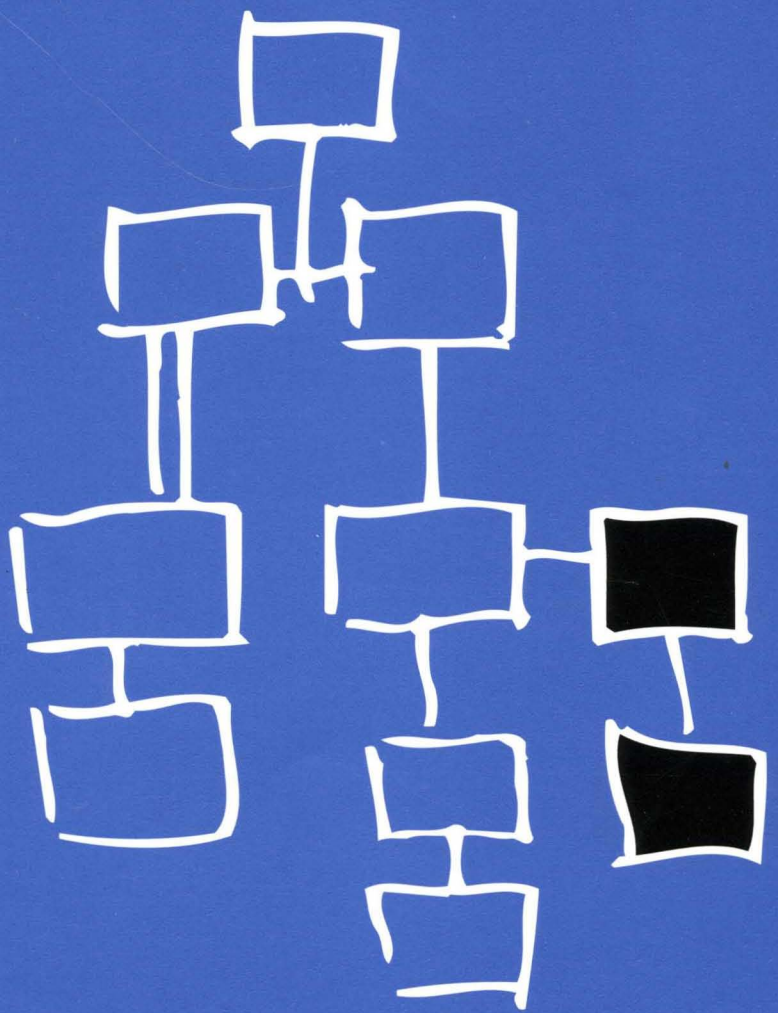
PenPoint™ Architectural Reference

Volume II



PenPoint

PenPoint™

PenPoint™ Architectural Reference

VOLUME II

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PenPoint Application Writing Guide provides a tutorial on writing PenPoint applications, including many coding samples. This is the first book you should read as a beginning PenPoint applications developer.

PenPoint Architectural Reference Volume I presents the concepts of the fundamental PenPoint classes. Read this book when you need to understand the fundamental PenPoint subsystems, such as the class manager, application framework, windows and graphics, and so on.

PenPoint Architectural Reference Volume II presents the concepts of the supplemental PenPoint classes. You should read this book when you need to understand the supplemental PenPoint subsystems, such as the text subsystem, the file system, connectivity, and so on.

PenPoint API Reference Volume I provides a complete reference to the fundamental PenPoint classes, messages, and data structures.

PenPoint API Reference Volume II provides a complete reference to the supplemental PenPoint classes, messages, and data structures.

PenPoint User Interface Design Reference describes the elements of the PenPoint Notebook User Interface, sets standards for using those elements, and describes how PenPoint uses the elements. Read this book before designing your application's user interface.

PenPoint Development Tools describes the environment for developing, debugging, and testing PenPoint applications. You need this book when you start to implement and test your first PenPoint application.

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PenPoint™ Architectural Reference

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Preface

The *PenPoint Architectural Reference* provides detailed information on the various subsystems of the PenPoint™ operating system. Volume I describes the functions and messages that you use to manipulate classes and describes the fundamental classes used by almost all PenPoint applications. Volume II describes the supplemental classes and functions that provide many different capabilities to PenPoint applications.

Intended Audience

The *PenPoint Architectural Reference* is written for people who are designing and developing applications and services for the PenPoint operating system. We assume that you are familiar with the C language, understand the basic concepts of object-oriented programming, and have read the *PenPoint Application Writing Guide.*

What's Here

The *PenPoint Architectural Reference* is divided into several parts, which are split across two volumes. Volume I contains these parts:

- *Part 1: Class Manager* describes the PenPoint class manager, which supports object-oriented programming in PenPoint.
- *Part 2: PenPoint Application Framework* describes the PenPoint Application Framework, which provides you the tools you use to allow your application to run under the notebook metaphor.
- *Part 3: Windows and Graphics* describes ImagePoint, the imaging system for the PenPoint operating system, and how applications can control the screen (or other output devices).
- *Part 4: UI Toolkit* describes the PenPoint classes that implement many of the common features required by the PenPoint user interface.
- *Part 5: Input and Handwriting Translation* describes the PenPoint input system and programmatic access to the handwriting translation subsystems.

Volume II contains these parts:

- *Part 6: Text Component* describes the PenPoint facilities that allow any application to provide text editing and formatting capabilities to its users.
- *Part 7: File System* describes the PenPoint file system.
- *Part 8: System Services* describes the function calls that applications can use to access kernel functions, such as memory allocation, timer services, process control, and so on.

- *Part 9: Utility Classes* describes a wide variety of classes that save application writers from implementing fundamental things such as list manipulation, data transfer, and so on.
- *Part 10: Connectivity* describes the classes that applications can use to access remote devices.
- *Part 11: Resources* describes how to read, write, and create PenPoint resource files.
- *Part 12: Installation API* describes PenPoint support for installing applications, services, fonts, dictionaries, handwriting prototypes, and so on.
- *Part 13: Writing PenPoint Services*, describes how to write an installable service.

You can quickly navigate between these sections using their margin tabs. Each volume has its own index. The *PenPoint Development Tools* has a master index for all the manuals in the Software Development Kit.

Other Sources of Information

As mentioned above, the *PenPoint Application Writing Guide* provides a tutorial on writing PenPoint applications. The tutorial is illustrated with several sample applications.

The *PenPoint Development Tools* describes how to run PenPoint on a PC, how to debug programs, and how to use a number of tools to enhance or debug your applications. This volume also contains a master index to the five volumes included in the PenPoint SDK.

The *PenPoint API Reference* is a set of "datasheets" that were generated from the PenPoint SDK header files. These datasheets contain information about all the messages defined by the public PenPoint classes. If you own the PenPoint SDK, you can also find the header files in the directory \PENPOINT\SDK\INC.

To learn how to use PenPoint, you should refer to the PenPoint user documentation. The user documentation is included with the PenPoint SDK, and is usually packaged with a PenPoint computer. The user documentation consists of these books:

- *Getting Started with PenPoint*, a primer on how to use PenPoint.
- *Using PenPoint*, a detailed book on how to use PenPoint to perform tasks and procedures.

Type Styles in This Book

To emphasize or distinguish particular words or text, we use different fonts.

Computerese

We use fonts to distinguish two different forms of "computerese":

- C language keywords and preprocessor directives, such as `switch`, `case`, `#define`, `#ifdef`, and so on.
- Functions, macros, class names, message names, constants, variables, and structures defined by PenPoint, such as **msgListAddItem**, **clsList**, **stsBadParam**, P_LIST_NEW, and so on.

Although all these PenPoint terms use the same font, you should note that PenPoint has some fixed rules on the capitalization and spelling of messages, functions, constants, and types. By the spelling and capitalization, you can quickly identify the use of a PenPoint term.

- Classes begin with the letters "**cls**"; for example, **clsList**.
- Messages begin with the letters "**msg**"; for example, **msgNew**.
- Status values begin with the letters "**sts**"; for example, **stsOK**.
- Functions are mixed case with an initial upper case letter and trailing parentheses; for example, **OSMemAvailable**().
- Constants are mixed case with an initial lower case letter; for example, **wsClipChildren**.
- Structures and types are all upper case (with underscores, when needed, to increase comprehension); for example, U32 or LIST_NEW_ONLY.

Code Listings

Code listings and user-PC dialogs appear in a fixed-width font.

```
//
// Allocate, initialize, and record instance data.
//
StsJmp(OSHeapBlockAlloc(osProcessHeapId, SizeOf(*pInst), &pInst), \
        s, Error);
pInst->>placeHolder = -1L;
ObjectWrite(self, ctx, &pInst);
```

Less significant parts of code listings are grayed out to de-emphasize them. You needn't pay so much attention to these lines, although they are part of the listing.

```
ObjCallJmp(msgNewDefaults, clsAppMgr, &new, s, Error);
new.object.uid                  = clsTttApp;
new.object.key                  = 0;
new.cls.pMsg                    = clsTttAppTable;
new.cls.ancestor                = clsApp;
new.cls.size                    = SizeOf(P_TTT_APP_INST);
new.cls.newArgsSize             = SizeOf(APP_NEW);
new.appMgr.flags.stationery     = true;
new.appMgr.flags.accessory      = false;
strcpy(new.appMgr.company, "GO Corporation");
new.appMgr.copyright = "\213 1992 GO Corporation, All Rights Reserved.";
ObjCallJmp(msgNew, clsAppMgr, &new, s, Error);
```

Placeholders

Anything you do *not* have to type in exactly as printed is generally formatted in italics. This includes C variables, suggested filenames in dialogs, and pseudocode in file listings.

Other Text

The documentation uses *italics* for emphasis. When a Part uses a significant term, it is usually emphasized the first time. If you aren't familiar with the term, you can look it up in the glossary in the *PenPoint Application Writing Guide* or the index of the book.

DOS filenames such as \\BOOT\PENPOINT\APP are in small capitals. PenPoint file names can be upper and lower case, such as \My Disk\\Package Design Letter.

Book names such as *PenPoint Application Writing Guide* are in italics.

PENPOINT ARCHITECTURAL REFERENCE / VOL II
CONTENTS

Part 6 / Text

Chapter 62 / Introduction

The Text subsystem presents text to the user for viewing and editing. It also provides an API to clients to allow programmatic modification of the text and its presentation attributes.

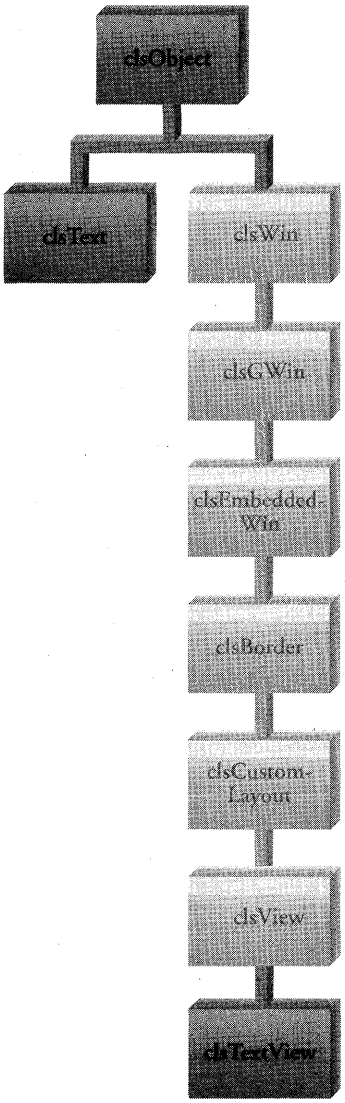
Overview

62.1

clsText implements the data object subclass of the Text subsystem. **clsTextView** implements the viewing subclass of the Text subsystem; it is the user's view onto the data managed by **clsText.** TXTDATA.H defines the messages used for text data objects; TXTVIEW.H defines the messages used for text view objects.

clsText is a descendent of **clsObject. clsTextView** is a subclass of **clsView.** Figure 62-1 shows the class hierarchy for **clsText** and **clsTextView.**

Figure 62-1
Text Class Hierarchies



Features

62.2

The Text subsystem is implemented as a group of related classes. The Text subsystem uses the PenPoint™ operating system class system. The classes allow:

- Your code to display both plain and fancy text to the user in one or more text data objects.
- The user to interact with the text to modify both the characters and their appearance.
- The user to transfer all or part of the text from one text data object to another (possibly non-text) object, and vice versa.
- Your code to file text data objects.
- Your code to observe and direct the user's interactions with the text.

- Embedded objects, which are used to implement insertion pads and signature pads, and can include graphics, spread sheets and other applications in documents.

There is a difference between displaying text through the graphics subsystem and using the Text subsystem. You can use the graphics subsystem to display characters on the screen, but users can't dynamically manipulate the text. Furthermore, the text subsystem includes paragraph and document attributes that define things such as margins and tabs.

Developer's Quickstart

62.3

This section presents a quick summary of the essential things that application writers will need to know about the Text subsystem.

If you want to display text on the screen, you can use the windows and graphics subsystem to quickly display text in a window. If you want to make text available for editing and be able to file text as separate objects, you need to use the Text subsystem.

The simplest way to access the Text subsystem is to create a text view object by sending **msgNewDefaults** and **msgNew** to **clsTextView** (thus specifying no object to view). Like all views, the text view will create an empty text data object automatically. When you insert the text view into a window, the empty text view appears on screen. The user can now make an insertion gesture to bring up an insertion pad.

If you want to open a view to an existing text data object, you specify the object when you send **msgNew** to **clsTextView**. You can create a text data object separately and map it to a view later.

Most of the time the user will modify the text attributes through an option sheet for the application that uses text. You can programmatically change attributes (both default attributes and local attributes).

Organization of This Part

62.4

This part consists of six chapters. This, the first chapter, presents a brief overview of the Text subsystem.

Chapter 63, Text Subsystem Concepts, describes the organization and structure of the Text subsystem and presents the terminology used in the Text subsystem.

Chapter 64, Using Text Data Objects, describes how to access the text subsystem. It describes the messages defined for text data objects and how you use the messages.

Chapter 65, Using Text Views, describes how to access text views. It describes the messages defined for text view objects and how you use the messages.

Chapter 66, Using Text Insertion Pads, describes the messages used to handle text insertion pads.

Chapter 67, Sample Code, lists the code that is used in the examples to demonstrate features of the Text subsystem. These files are also available on disk in the \PENPOINT\SDK\SAMPLE directory.

Chapter 68, Advanced Information, describes advanced features of the Text subsystem. Although very powerful, these features are also rather complex.

Chapter 63 / Text Subsystem Concepts

This section describes the concepts related to the Text subsystem.

Topics covered in this chapter:

- The Text subsystem classes and objects.
- The types of attributes that text objects can have.
- Units of measurement used by the Text subsystem.

The Text Subsystem Classes 63.1

Messages for the Text subsystem are described by two separate files. TXTDATA.H provides an interface to **clsText**, which allows you to manipulate text data objects (adding, modifying, formatting, and so on). TXTVIEW.H provides an interface to **clsTextView**, a subclass of **clsView**, which allows you to display text data objects so that users can modify them.

Text Data Objects 63.2

The fundamental component of the Text subsystem is the **text data object**. You create a text data object by sending **msgNewDefaults** and **msgNew** to **clsText**. There is no limit to the size of text data objects.

A text data object has default attributes for characters, paragraphs, and the entire document. Additionally, a text data object supports local attributes for characters and paragraphs. **Default attributes** apply to an entire object; **local attributes** apply to contiguous ranges of characters or paragraphs. A text data object has a single set of default attributes, but it can have any number of local attributes. You can use the **clsText** messages to change both the default attributes and the local attributes.

In this description, a **block** is synonymous with a text data object. Your application might choose to implement documents that have a larger scale than a single text data object.

Text data objects are observable. Any object can add itself to a text data object's observer list, so that the object will receive notification of changes in the text data object. The changes include text affected and text replaced messages.

Organization of Text Data Objects 63.2.1

A text data object is a stream of characters with no embedded formatting information. The formatting information is managed internally by **clsText**, and is available to advanced users.

The characters within a text data object are indexed with a value of type TEXT_INDEX (which is a U32 value). The text index is zero based; the index 0 indicates the first character in the text data object.

You must always use TEXT_INDEX type variables when indexing text.

The character encodings are similar to those used by the IBM-PC Code Page 850. However, the GO text data objects use some controls that replace codes used by Code Page 850. These codes and their meanings are defined in the file TENCODE.H; the codes are listed in Table 63-1.

Table 63-1
Text Character Encoding

Symbol	Represents
teEmbeddedObject	An object is embedded at this location.
teSpace	A space.
teTab	A tab.
teNewLine	A new line.
teNewPage	A new page.
teNewParagraph	A new paragraph.
teUnrecognized	A character that was not recognized by the handwriting recognition system.

Attributes 63.2.2

As mentioned above, attributes exist for characters, paragraphs, and documents. Default attributes are established when the text data object is created. You can change the default attributes programmatically, or the user can use the option sheet to change the attributes.

Your application can programmatically change local or default attributes (for example, the type family or point size). However, most applications don't intervene in formatting, they allow the user to change attributes by way of the option sheet.

Character Attributes 63.2.2.1

Character attributes apply to any range of characters, regardless of paragraph boundaries. The default character attributes apply to the entire text data object.

Characters have two types of attributes, display attributes and font attributes. The display attributes include size, underlining, small caps, capital letters, and so on. Font attributes include type face and weight.

Defined but not used are:

- Display attributes (superscript and subscript).
- Font attribute (aspect).

When you create a new text data object, **clsText** usually reads the current default character attributes from the system resource file. However, an application can override these defaults by redefining the resource in its own APP.RES file. If you define your own character attribute resource, the resource ID must be **textResDefaultCharAttrs**. These values are defined in TXTDATA.H.

Paragraph Attributes 63.3

Paragraph attributes include: alignment, leading, space before and after, margins, and tabs. Each tab has its own position; alignment and leader characters are in the design but are not implemented.

Text Views 63.4

You usually use text data objects because you want users to create, and modify text on screen. To display the text data objects, you use a **text view**, which is an instance of **clsTextView**. **clsTextView** is a subclass of **clsView**, the view class.

While **clsText** provides facilities for storing the text's characters and attributes, **clsTextView** provides a user interface that allows the user to view and modify those characters and attributes.

When you create a text view, it displays the initial portion of the data object (that is, the characters beginning at index 0 and their associated attributes). The exact formatting of the view depends both on the data object and on the view's style. You set the view's style in the **tv.style** field of the TV_NEW structure (which you send with the **msgNew** that creates the view). If there is more data than can be completely displayed in the view, it is the client's responsibility to place the text view within a scrolling window (**clsScrollWin**) so that it will have scroll bars.

You can use the **TextCreateTextScrollWin** function to create a text view and a scrolling window, and then insert the text view into a scrolling window.

Because views file their own data, the text view will send filing messages to its data object when it receives **msgSave**.

Text Insertion Pads 63.5

When you create a text view, **clsTextView** creates an insertion pad in the text view by default. (You can turn off this behavior by clearing the **tvFillWithIP** flag in the **tv.flags** field of TV_NEW.)

This insertion pad is an object of **clsTextIP**, the text insertion pad class. **clsTextIP** inherits from **clsIP**. Most behavior of text insertion pads is identical to that of other insertion pads. For a complete description of insertion pads, see *Part 5: Input and Handwriting Translation.*

Units of Measurement

63.6

Many text data attributes can be expressed as dimensions (such as character size, margin position, tab position, and so on).

In general, paragraph units (including tabs) and font sizes are expressed in twips. Twips are described in *Part 3: Windows and Graphics.*

Internally, some attributes are converted from Twips to units that have a lower resolution (and are stored that way). If you change one of these attributes and then get the attribute again, you might notice some round off.

Chapter 64 / Using Text Data Objects

This section describes the messages that create and modify text data objects.

Topics covered in this chapter include:

- Creating and destroying text data objects.
- Getting characters from text data objects.
- Scanning for characters in text data objects.
- Modifying text data objects.
- Setting character, paragraph, and block attributes in text data objects.
- Embedding and extracting objects in text data objects.
- The observer messages for text data objects.

Text Data Functions 64.1

The following functions are defined in TXTDATA.H. These functions implement common actions that you might perform on text data. The functions are listed in Table 64-1.

Table 64-1
Text Data Functions

Function	Description
TextDeleteMany	Deletes one or more bytes from a text data object.
TextInsertOne	Inserts a single byte in a text data object.

Deleting Many Characters 64.1.1

You use **TextDeleteMany** to delete a number of characters from a text data object. The function prototype is:

```
STATUS EXPORTED TextDeleteMany(
    const OBJECT        dataObj,
    const TEXT_INDEX    pos,
    const TEXT_INDEX    length);
```

The function deletes **length** number of characters, starting at **pos**, in the text data object **dataObj**. If there are any characters in **dataObj** beyond **pos** + **length**, they are moved to **pos**.

This function uses an **ObjectCall** to **msgTextModify** to do its work.

Inserting a Character

64.1.2

You use **TextInsertOne**() to insert a single character into a text data object. The function prototype is:

```
STATUS EXPORTED TextInsertOne(
    const OBJECT        dataObj,
    const TEXT_INDEX    pos,
    const CHAR          toInsert);
```

The function inserts the character **toInsert** at the location **pos** in the text data object **dataObj**. Characters in the data object after **pos** have their indices incremented by one.

If you insert a character between characters with different formatting (such as between a plain text character and a bold text character), the character takes on the attributes of the character to the right (that is, the character with the higher TEXT_INDEX value).

This function uses an **ObjectCall**() to **msgTextModify** to do its work.

Text Data Messages

64.2

As described above, the messages for **clsText** are defined in TXTDATA.H. Most of those messages are described here. In order to better organize the topics, some messages defined by **clsText** are described later in Chapter 67, Advanced Information.

Table 64-2
clsText Messages

Message	Takes	Description
		Class Messages
msgNewDefaults	P_TD_NEW	Initializes the msgNew arguments.
msgNew	P_TD_NEW	Creates a new text data object.
		Object Messages
msgTextGetMetrics	P_TD_METRICS	Passes back the textData's metrics.
msgTextSetMetrics	P_TD_METRICS	Sets a textData's metrics.
msgTextChangeCount	S32	Passes back (and optionally sets) the textData's changeCount.
msgTextGet	TEXT_INDEX	Returns the character in a textData at the specified position.
msgTextGetBuffer	P_TEXT_BUFFER	Passes back a contiguous range of characters from a textData.
msgTextLength	nothing	Returns the number of characters stored in the textData.
msgTextModify	P_TEXT_BUFFER	Modifies the characters stored in the textData.
msgTextSpan	P_TEXT_SPAN	Determines the range corresponding to the requested span.

continued

Table 64-2 (continued)

Message	Takes	Description
msgTextSpanType	P_TEXT_SPAN	Determines the span type of the specified range.
msgTextEmbedObject	P_TEXT_EMBED_OBJECT	Embeds an object at a specified position.
cmsgTextExtractObject	OBJECT	Extracts the specified embedded object.
msgTextGetAttrs	P_TEXT_GET_ATTRS	Gets the attributes of the specified type.
msgTextInitAttrs	P_TEXT_CHANGE_ATTRS	Initializes the attributes and mask before a msgTextChangeAttrs.
msgTextChangeAttrs	P_TEXT_CHANGE_ATTRS	Changes the attributes of the specified range.
msgTextClearAttrs	ATOM	Clears all attributes of the specified type to the default values.
msgTextPrintAttrs	P_TEXT_CHANGE_ATTRS	Prints the values of an attribute set and a mask (DEBUG DLLs only).
msgTextRead	P_TEXT_READ	Inserts Ascii, RTF, etc. at the specified location.
msgTextWrite	P_TEXT_WRITE	Outputs the specified span as one of Ascii, RTF, etc.
msgTextEnumEmbeddedObjects	P_TEXT_ENUM_EMBEDDED	Enumerates the textData's embedded objects.
		Observer Notification Messages
msgTextAffected	P_TEXT_AFFECTED	Notifies observers that a range of text has been affected.
msgTextReplaced	P_TEXT_REPLACED	Notifies observers that a range of text has been replaced via msgTextModify.
msgTextCounterChanged	P_TEXT_COUNTER_CHANGED	Notifies observers that textData's changeCount has been modified.

Creating a New Text Data Object

64.3

To create a new text data object, send **msgNewDefaults** and **msgNew** to **clsText**. These messages take a TD_NEW structure that contains:

metrics A set of metrics for the text object. The metrics include a **flags** value that specifies whether the text object is read only (**tdmReadOnly**) and whether operations on text can be undone (**tdmCanUndo**).

expectedSize The expected number of characters held by the text object.

expectedTagCount The expected number of tags. This field is reserved for future extensions; just use the default value.

The TD_NEW structure returns the UID of the newly created text object.

If you create a text data object this way, you are responsible for making it visible to the user. You can do this either by creating a window and displaying the text by hand or, preferably, creating a text view and specifying the text data object to the view. Like all views, **clsTextView** can create a text data object automatically. For more information see Chapter 65, Using Text Views.

Getting and Setting Text Metrics 64.4

You specify metrics for a text data object when you create it. You can later get and set the text data object's metrics with **msgTextGetMetrics** and **msgTextSetMetrics**. Both messages take a pointer to a TD_METRICS structure, which contains a **flags** field that indicates:

tdmReadOnly Whether the text object is read only.

tdmCanUndo Whether operations on text can be undone.

Reading Characters in Text Data Objects 64.5

You can get a character or characters from a text data object by sending **msgTextGet** or **msgTextGetBuffer** to the text data object.

Getting a Single Character 64.5.1

To get a character from the text data object, send **msgTextGet** to the object, specifying a text index. The message returns either the character at the specified index or a status value. (Status values have the sign bit set.) If the sign bit is clear, use a cast operator to convert the character from STATUS to CHAR. For example:

```
status = ObjectCall(textData, msgTextGet, (P_ARGS)10);
if (status < stsOK)
{
    // Some kind of error
}
else
    character = (CHAR)status;
```

If the text index is beyond the end of data, the message returns **stsEndOfData**.

Getting a Range of Characters 64.5.2

To get a series of characters from a text data object, send **msgTextGetBuffer** to the object. The message takes a pointer to a TEXT_BUFFER structure that contains:

first The index of the starting character.

length The number of characters to read.

bufLen The length of the buffer that will receive the characters.

buf The pointer to the buffer that receives the characters.

When **msgTextGetBuffer** returns, it passes back the number of characters read in the **bufUsed** field. If the starting position was beyond the end of the text data object, it returns **stsEndOfData**; otherwise it returns **stsOK**.

Text Length 64.6

You can request the length, in characters, of a particular text data object by sending **msgTextLength** to the object. The message does not have any arguments, and returns the length of the text data object.

Altering Text Data Objects 64.7

You can alter the contents of a text data object by sending **msgTextModify** to the object. The message takes a TEXT_BUFFER structure that contains:

first The offset of the first character to replace.

length The number of characters to replace. If this value is 0, **msgTextModify** inserts the characters in **buf** (rather than replacing any characters).

bufLen The length of the replacement characters.

buf A pointer to the buffer containing the replacement characters. If this pointer is **null**, **msgTextModify** deletes the characters identified by **first** and **length**.

When **msgTextModify** returns, the message passes back the number of characters from **buf** that it used in **bufUsed**.

Scanning Ranges of Characters 64.8

The Text subsystem allows you to scan the characters in a text data object for groups of characters. That is, you can search a text data object for characters that belong to, or don't belong to, a certain class of characters.

You indicate the type of data you are searching for by an identifier, called an **atom**. PenPoint predefines a number of atoms in TXTDATA.H; the two atoms used most commonly in text are **atomChar** and **atomPara**. For further information, see Chapter 68.

To search for a range of characters, send **msgTextSpan** to the object. The message takes a TEXT_SPAN structure that contains:

first The starting character index.

length The length of the initial span.

type An atom that identifies the group to be matched. Usually the type is **atomWord** or **atomPara**.

direction A direction indicator. If the direction indicator is **tdForward**, the search range includes the starting character (**first**+**length**-1) through to the last character in the text data object. If the direction indicator is **tdBackward**, the search range includes the first character in the text data object (index 0) to the starting character (**first**). To search the entire string, you can OR the values.

needPrefix A BOOLEAN value that specifies whether the message should return the prefix of the span.

needSuffix A BOOLEAN value that specifies whether the message should return the suffix of the span.

When the message returns, the TEXT_SPAN structure contains:

first The index of the matched character.

length The number of characters that were matched.

prefixLength A U16 that will receive the length of the prefix. This field is updated only if **needPrefix** is **true**.

suffixLength A U16 that will receive the length of the suffix. This field is updated only if **needSuffix** is **true**.

Getting and Setting Attributes 64.9

The messages that affect attributes (**msgTextInitAttrs**, **msgTextGetAttrs**, **msgTextChangeAttrs**, and **msgTextClearAttrs**) require similar arguments. We will describe the messages after describing the arguments that they use.

Text Attribute Arguments 64.9.1

All text attribute messages include a **tag** argument that specifies the type of attribute that is to change (character or paragraph). The **tag** argument uses an atom to specify the different types of attributes. The atoms that apply to text attributes are **atomChar**, **atomPara**, **atomParaTab**, and **atomEmbedded**.

Most attribute messages require a **first** argument that indicates the position, or beginning of the position affected by the message. If **first** contains the symbol **textDefaultAttrs**, the message pertains to current defaults for that text data object.

Most attribute messages also require arguments that specify new attributes and a mask. The mask specifies the attributes to change.

The mask is most useful when changing attributes on a range of characters or paragraphs. Any range of characters can contain many different formats. Without the mask, it would be necessary to enumerate all of the existing formats within the range, and carefully update each one with a separate call. With the mask, rather than worry about what attributes are set already, you identify the range of characters you want to modify and let **clsText** do the work. Similarly, the mask allows modification of a subset of the default attributes without having to first fetch the current values.

Character Attributes 64.9.1.1

When changing character attributes, applications use the **tag atomChar**. The mask for character attributes is defined in TA_CHAR_MASK and the attributes are defined in TA_CHAR_ATTRS. The symbols for the attributes and their corresponding mask bits are almost identical, the difference is that the mask defines additional symbols for the font (SYSDC_FONT_SPEC) structure.

Table 64-3 describes the symbols for the character attributes defined in TA_CHAR_ATTRS.

Table 64-3
Character Attributes

Attribute	Usage
size	Specifies the character size in Twips.
smallCaps	If true, characters are displayed in small capital letters.
upperCase	If true, characters are displayed in all uppercase.
strikeout	If true, characters have a line through them.
underlines	Specifies the underline style. The three possible styles are none (0), single underline (1), or double underline (2).
font	Specifies the font characteristics structure. The font characteristics are defined by SYSDC_FONT_SPEC. These characteristics are described in Part 4: Windows and Graphics and in SYSFONT.H.

As mentioned above, the symbols for the mask defined in TA_CHAR_MASK are similar to the symbols in TA_CHAR_ATTR, with the exception of the font attributes, which are defined by SYSDC_FONT_SPEC. Table 64-4 describes the mask symbols defined by TA_CHAR_MASK for the font attributes.

Table 64-4
Character Font Masks

Mask	Meaning
id	Enables use of font.id in the TA_CHAR_ATTRS structure.
group	Enables use of font.group in the TA_CHAR_ATTRS structure.
weight	Enables use of font.weight in the TA_CHAR_ATTRS structure.
aspect	Enables use of font.aspect in the TA_CHAR_ATTRS structure.
italic	Enables use of font.italic in the TA_CHAR_ATTRS structure.
monospaced	Enables use of font.monospaced in the TA_CHAR_ATTRS structure.
encoding	Enables use of font.encoding in the TA_CHAR_ATTRS structure.

Paragraph Attributes

64.9.1.2

When changing paragraph attributes, set **tag** to **atomPara**. The mask for paragraph attributes is defined in TA_PARA_MASK and the attributes are defined in TA_PARA_ATTRS. The symbols for the attributes and their corresponding mask bits are identical. Table 64-5 describes the symbols for the paragraph attributes and masks defined in TA_PARA_ATTRS and TA_PARA_MASK.

Table 64-5
Paragraph Attributes

Attribute	Usage
alignment	Specifies the alignment of the paragraph. The possible values are taParaLeft, taParaCenter, or taParaRight to indicate left, center and right alignment respectively.
justify	If true, text should be justified. If false, text is ragged right.
lineHeight	Specifies the line height in Twips. This is usually the same as the character height. The constant useMaxHeightOnLine indicates the the line height should be big enough to accomodate the tallest character in the line. If a line contains any character or embedded object larger than the specified lineHeight, the larger value is used. Thus lineHeight is a minimum, not a maximum.
interLineHeight	Specifies additional space between lines in Twips.
beforeSpacing	Specifies the amount of space before the paragraph in Twips. This space is considered to belong to the first line of the paragraph above the ink of the characters in the first line.
afterSpacing	Specifies the amount of space after the paragraph in Twips. The before and after spacing are additive. This space is considered to belong to the last line of the paragraph below the ink of the characters in the last line.
firstLineOffset	Specifies the horizontal offset for the first line in Twips. This is a signed value; a negative value will result in a hanging indent.
leftMargin	Specifies the position of the left margin, relative to the left edge of the view, in Twips.
rightMargin	The position of the right margin, relative to the right edge, in Twips.

Paragraph Tabs

64.9.1.3

The tab stops for a paragraph are set independently of the other paragraph attributes. The **tag** for tab stops is **atomParaTabs**; the mask is **pNull**, and the value is specified by a TA_MANY_TABS structure, which contains:

count The number of tab stops in the paragraph.

repeatAtEnd Whether the last explicit stop acts as a prototype for an infinity of implicit stops.

tabs A fixed-length array of TA_TAB_STOP descriptors. Only the first **count** number of descriptors are valid. Each TA_TAB_STOP descriptor contains:

x The position of the tab stop, relative to the left edge of the paragraph.

type The alignment for the tab. The only valid alignment is **taTabLeft**.

lead The leader characters for the tab. The only valid leader character is space (**taLeadSpace**).

Getting Attributes

64.9.2

To get the character or paragraph attributes, send **msgTextGetAttrs** to the text object. **msgTextGetAttrs** can retrieve either local or default attributes. The message takes a pointer to a TEXT_GET_ATTRS structure, which specifies:

tag An atom that indicates the type of attribute to get.

first A text index to a location in the text data object. If you specify **textDefaultAttrs** rather than a text index, the message returns the default

attributes for the type of data specified in **tag**. If you specify a text index, the attributes are initialized to the **tag** attributes at that location (which allows you to copy attributes from one location in text to another).

length Reserved for future use. Must be zero.

pValues The address of the buffer to receive the attributes. Because **pValues** is of type P_UNKNOWN, you must use a cast to render the attributes in their correct type (P_TA_CHAR_ATTRS for character attributes, P_TA_PARA_ATTRS for paragraph attributes, P_TA_MANY_TABS for tabs).

When the message returns, **pValues** contains the specified attributes.

Modifying Attributes 64.9.3

When you change attributes, you can change either local or default attribute sets. The first step in changing attributes is to initialize an attributes structure by sending **msgTextInitAttrs** to a text data object. After initializing the structure, you can use it in the arguments to **msgTextChangeAttrs**.

To change all attributes to their defaults, you can send **msgTextClearAttrs** to the text data object.

Initializing Attributes 64.9.3.1

To initialize an attributes structure and mask, send **msgTextInitAttrs** to the text data object. The message takes a pointer to a TEXT_CHANGE_ATTRS structure. The interesting fields in the structure are:

tag An atom that indicates the type of attribute to initialize.

pNewMask The address of the buffer that will receive the initialized mask.

When the message returns, all bits in the mask are disabled (that is, the structure won't affect any attributes if used in **msgTextChangeAttrs**).

If you want to avoid the time required to send another message, you can skip sending **msgTextInitAttrs**, but you must use `memset` to zero the mask. If you do not zero the mask, unpredictable results can occur in **msgTextChangeAttrs**.

Changing Attributes 64.9.3.2

When you have initialized the attributes structure, you can send **msgTextChangeAttrs** to the text data object.

msgTextChangeAttrs message takes a pointer to the initialized TEXT_CHANGE_ATTRS structure, which contains:

tag An atom that indicates the type of attribute to change.

first A text index for a location in the text data object that specifies the beginning of the range to change. If you specify **textDefaultAttrs** for **first**, the message changes the default attributes.

length A text index that indicates the range of text over which the attribues should be changed. If **first** is **textDefaultAttrs**, **length** is ignored.

pNewMask The address of the mask. The mask's initialized state is all attributes disabled. Therefore, you must enable at least one bit in the mask before you send the change message.

pNewValues The address of the attributes buffer.

If you are changing paragraph or tab attributes for a range of paragraphs, the **first** and **length** values identify the affected paragraphs to begin with the paragraph containing first through to the paragraph containing **first** + **length** – 1.

Clearing Attributes 64.9.3.3

To change all attributes of a specific type to their defaults, send **msgTextClearAttrs** to a text data object. The only argument for the message is an atom that indicates the type of attributes to clear.

Embedding Objects 64.10

An embedded object is represented in a text data object by the character **teEmbeddedObject** and associated attributes. However, you can't embed an object by simply inserting **teEmbeddedObject** into the text data object. You must send **msgTextEmbedObject** to the text data object. The message takes a pointer to a TEXT_EMBED_OBJECT structure that contains:

first A text index that indicates where the object should be embedded.

toEmbed The UID of the object to embed.

clientFlags A set of client flags.

action A set of flags that specifies the type of embedding. The possible values are: **textEmbedInsert**, **textEmbedCopy**, and **textEmbedMove**. Most clients should only use **textEmbedInsert**, which specifies that a new object is to be embedded.

Copy and move are used with the transfer protocol and can cause unpredictable results if used incorrectly.

Again, to remove an embedded object, you can't simply delete the embedded object character. To extract an object, send **msgTextExtractObject** to the text data object. The only argument required by the message is the UID of the object to extract. **clsText** observes embedded objects; if you free an embedded object, **clsText** will clean up the embedded object character. To enumerate all the embedded objects, use **msgTextEnumEmbeddedObjects** (see TXTDATA.H).

Observer Messages 64.11

An observer of a text data object will receive the following four messages. The most important fact to observers is that the text has changed.

Table 64-6
clsText Observer Messages

Message	Description
msgTextReplaced	A client replaced text in the observed object, using msgTextModify. Descendants must pass this message to superclass.
msgTextAffected	A client changed attributes for the observed object.
	Clients should ignore the following two messages:
msgTextMarkAllocated	Informs that a msgTextMarkAlloc has happened.
msgTextFreed	Informs that a msgTextMarkFree has happened.

msgTextReplaced Observer Message 64.11.1

msgTextReplaced indicates that text in the observed object has been replaced. The message takes a TEXT_REPLACED structure that consists of two elements: a TEXT_SPAN_AFFECTED structure (**span**) and a TEXT_INDEX that indicates the number of bytes that replaced the span (**bytesTakenFromBuf**).

The TEXT_SPAN_AFFECTED structure contains:

span.object The object that was altered.

span.changeCount The number of changes that the object has experienced since the counter was last reset to zero, including this change.

span.first The first character that changed.

span.length The number of characters that changed.

msgTextAffected Observer Message 64.11.2

msgTextAffected indicates that attributes in the observed object have been changed. The message takes a TEXT_AFFECTED structure that consists of two elements: a TEXT_SPAN_AFFECTED structure (**span**) and a U16 value that indicates whether the change affects the size of the characters in a view (**remeasure**).

The TEXT_SPAN_AFFECTED structure is described above in the **msgTextModified** observer message.

remeasure is important to views. If it is **true**, it means that the change affected the size of the characters in the view and that the view must be remeasured before it can be redrawn.

Chapter 65 / Using Text Views

This section describes the messages that display text data objects. When displayed in a text view, users can use the pen to modify the text data. Topics covered include:

- Creating and destroying text views.
- Embedding objects in views.
- Interacting with the input subsystem.
- Scrolling a text view.
- Getting the current selection.

Text View Messages 65.1

clsTextView is a subclass of **clsView**, which inherits indirectly from **clsEmbeddedWin**. Messages for **clsTextView** are defined in TXTVIEW.H. The text view object messages are:

Table 65-1
clsTextView Messages

Message	Takes	Description
		Class Messages
msgNew	P_TV_NEW	Creates a new instance of clsTextView.
msgNewDefaults	P_TV_NEW	Initializes the NEW structure.
		Superclass Override Messages
msgGWinXList	P_XLIST	Defined in GWIN.H.
msgGWinGesture	P_GWIN_GESTURE	Defined in GWIN.H.
		Protocol Messages
msgXferGet	lots of things	Sent by a Receiver to get "one-shot" data transfer information.
msgXferList	OBJECT	Ask Sender for its list of data transfer types.
msgXferStreamWrite	STREAM	Asks the Sender to write more data to the stream.
msgXferStreamConnect	XFER_CONNECT	Sent to the Sender to ask it to link the Sender's and Receiver's pipe.
msgXferStreamFreed	STREAM	Sent to the Sender when the Receiver's side of the stream has been freed.
msgSelYield	BOOLEAN	theSelectionManager requires the release of selection.
msgSelDelete	U32	The selection owner should delete the selection.
msgTextViewAddIP	P_TV_EMBED_METRICS	Adds an insertion pad to the textView.

continued

Table 65-1 (continued)

Message	Takes	Description
		Object Messages
msgTextViewEmbed	P_TV_EMBED_METRICS	Embeds an object in the textView. Makes associated changes in text data.
msgTextViewGetEmbedMetrics	P_TV_EMBED_METRICS	Passes back the textView-specific metrics for an embedded object.
msgTextViewResolveXY	P_TV_RESOLVE	Given an point in LWC space, passes back the character at (or near) the point.
TextCreateTextScrollWin		Utility function that creates a textView (with a data object) placed inside a scroll window. (See swin.h.)
msgNewDefaults	P_TEXTIP_NEW	Initializes the NEW struct.
msgTextViewScroll	P_TV_SCROLL	Repositions displayed text within the textView.
msgTextViewGetStyle	P_TV_STYLE	Passes back a textView's style.
msgTextViewSetSelection	P_TV_SELECT	Selects one or more characters displayed by the textView.
msgTextViewSetStyle	P_TV_STYLE	Sets a textView's style.
msgTextViewCheck	P_UNKNOWN	A textView performs a self-consistency check (DEBUG DLLs only).
msgTextViewRepair	pNull	Forces a delayed paint operation to take place immediately.

Creating a Text View

65.2

To create a new text view object, send **msgNewDefaults** and **msgNew** to **clsTextView**. Both messages take a TV_NEW structure.

Because text views behave differently from many other views, **msgNewDefaults** in **clsTextView** changes many of the default values returned from **clsView** (its ancestor). Table 65-2 lists the defaults provided by **clsTextView**.

Table 65-2
msgNewDefaults for clsTextView

Class	Field	New Default
clsWin	flags.style	wsSendLayout = false
clsWin	flags.style	wsCaptureLayout = false
clsWin	flags.style	wsGrowBottom = true
clsWin	flags.style	wsSendFile = true
clsWin	flags.style	wsSendGeometry = true
clsWin	flags.style	wsCaptureGeometry = true
clsWin	flags.input	inputMoveDown = true
clsWin	flags.input	inputMoveDelta= true
clsWin	flags.input	inputHoldTimeout = true
clsWin	flags.input	inputOutProx = true
clsWin	flags.input	inputTip = true

continued

Table 65-2 (continued)

Class	Field	New Default
clsWin	flags.input	inputEnter = true
clsWin	flags.input	inputExit = true
clsgWin	helpId	tagTextView
clsView	createDataObject	true
clsTextView	style.flags	tvsWordWrap
clsTextView	flags	tvFillWithIP

If **view.CreateDataObject** is **true**, **clsTextView** automatically creates a **clsText** data object. To explicitly pass a data object, set **view.dataObject** to the desired data object and set **view.createDataObject** to **false**.

The TV_NEW structure also contains:

flags A set of flags that specify properties of a new text view. The only flag currently defined is **fillWithIP**, which specifies that the text view should have a **clsTextIP** insertion pad added to the end of the text. **fillWithIP** is the default; if you don't want an insertion pad, you must turn off this flag. Subclasses of **clsTextView** can change this behavior by intercepting **msgTextAddIP**.

dc A text data object to view. In PenPoint 1.0, you must leave **dc** set to its default.

style Styles for the view. Styles are defined in TV_STYLE and include:

style.flags Indicate the behavior of the text view. These flags are described in the next paragraph. The flags are saved in the text view's instance data.

style.magnification A character size adjustment.

style.showSpecial Show special characters. The special characters that are affected by this field are the tab, line break, paragraph break, and page break characters. The possible values are 0 to show none and 3 to show all.

style.printer Reserved for future expansion. Leave this value set to its default (**null**).

The TV_STYLE flags are:

tvsEmbedOnlyComponents Don't embed applications.

tvsEmbedOnlyIPs Only embed insertion pads.

tvsFormatForPrinter Format text for a printer.

tvsQuietWarning Don't display warning notes.

tvsQuietError Don't display error notes.

tvsQuiet Don't display either warning notes or error notes.

tvsReadOnlyChars Characters are read only.

tvsReadOnlyAttrs Attributes are read only.

tvsReadOnly Both characters and attributes are read only.

tvsWordWrap Wrap lines at word breaks.

Getting the Viewed Object's UID 65.3

To get the object being viewed, send the message **msgViewGetDataObject** to the view. You can read about using **msgViewGetDataObject** in *Part 2: The Application Framework.* You can change the view's object to a new object by sending **msgViewSetDataObject** to the view object.

Embedding Objects in Views 65.4

There are two messages used to embed objects in a text view **msgTextViewAddIP** and **msgTextViewEmbed.**

When the user makes a gesture to create an insertion pad, **clsTextView** sends **msgTextViewAddIP** to itself. This allows its subclasses (such as the Writing Paper application) to intercept the message and thereby learn that the user requested an insertion pad.

You use **msgTextViewEmbed** to actually embed objects, such as insertion pads. The message adds the embedded object character and associated attribute to the text data object and inserts the object into the tree of views.

Both messages take a TV_EMBED_METRICS structure that contains:

pos A text data object index, that specifies where the object should be embedded. The special value **infTEXT_INDEX** means at the end of the document.

flags A flags word that specifies how the view should present the object. The flags indicate that the embedded object:

tvEmbedReplace Will replace some text.

tvEmbedFloat Is floating.

tvEmbedOneChar Will insert a single character.

tvEmbedAddMargin Has a margin to leave space for gestures.

tvEmbedPreload Is preloaded with some text.

tvEmbedPara Will insert or replace a paragraph.

embedded The UID of the object to be embedded.

If you subclass **clsTextView** and override **msgTextViewAddIP**, you must remember that **tvEmbedPreload** directs **clsTextView** to preload the insertion pad with the text under a circle gesture. However, if you intercept a **msgTextViewAddIP** that was caused by a a circle-line gesture, you must ensure that **tvEmbedPreload** is clear. This ensures that the insertion pad is not preloaded with the text under the gesture.

Also if you override the behavior of **msgTextViewAddIP**, you must free the object specified in the **embedded** field before adding your own embedded object.

To determine the metrics of an embedded object, send **msgTextViewGetEmbedMetrics** to the text view object. The message takes a TV_EMBED_METRICS structure. On input, **embedded** must specify an embedded object; the message returns the index of the object in text and the flags that pertain to the object.

Interacting with the Input Subsystem 65.5

The Text subsystem provides three messages that interact with the Input subsystem: **msgGWinGesture**, **msgTextViewResolveXY**, and **msgGWinRunXList**.

Obtaining the Text Index from a Tap Position 65.5.1

msgTextViewResolveXY determines a character index (and a number of other values) from the x and y coordinates for a pen event. The message takes a TV_RESOLVE structure that specifies:

xy The x-y coordinates of the pen tap.

flags Flags that specify whether to select the next character beyond the tap (**tvrSelLPO**) and whether to select relative to the midpoint of a character (**tvrBalance**).

pos An index location to receive the position of the character directly under **xy**. If no character is selected by the pen tap, **pos** receives the value **maxTEXT_INDEX**.

lineStart An index location to receive the position of the first character on the line that contains **xy**.

xRegion An S8 value to receive the x region of **xy**. See Figure 65-1.

yRegion An S8 value to receive the y region of **xy**. See Figure 65-2.

selects An index location to receive the position of the character closest to **xy**, when the tap lies outside the text in the view. When the user taps above or to the left of the text area, **selects** receives the first character in the view; when the user taps below or to the left of the text area, **selects** receives the last character in the view.

offset The offset to the previous or next character's ink. When using **tvrBalance**, **offset** helps to determine which half of a character was tapped.

If the message returns **stsOK**, the location was resolved. If the message returns **stsNoMatch**, no text was found in the view to resolve the x and y position.

Figure 65-1 illustrates the **xRegion** of a block of text.

Figure 65-1
Text View X-Regions

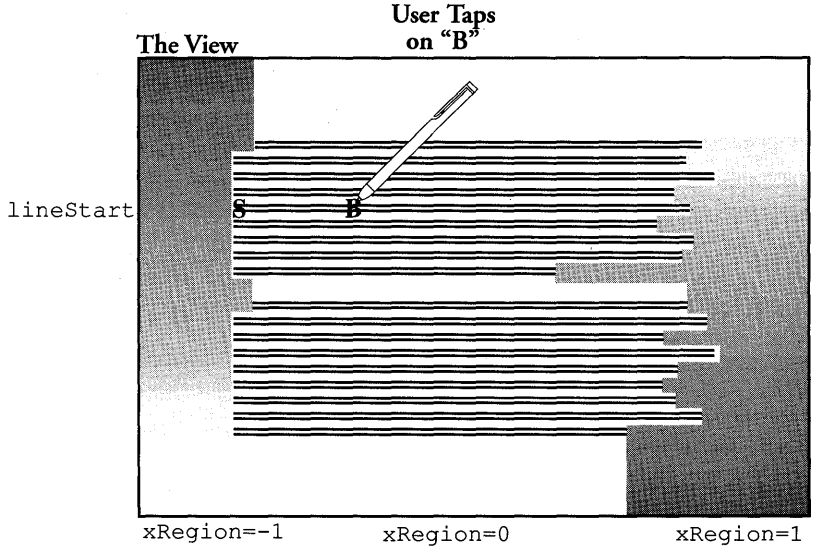
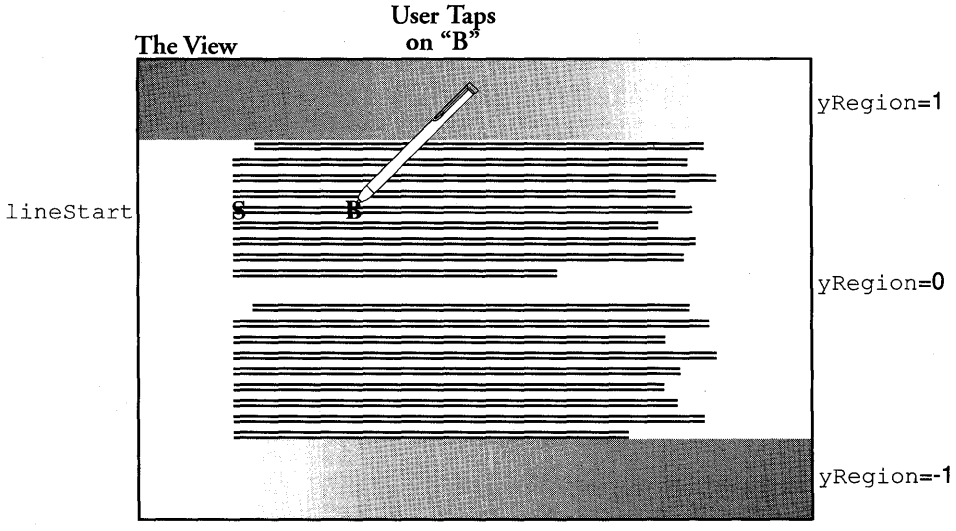


Figure 65-2 illustrates the **yRegion** of a block of text.

Figure 65-2
Text View Y-Regions



Most views contain margins, where the user can tap without touching any text. When **msgTextViewResolveXY** evaluates the position of a tap, it first resolves the y (vertical) region. If the tap was above the text, **yRegion** contains a 1; if the tap was in the text area, **yRegion** contains a 0; if the tap was below the text area, **yRegion** contains a –1. If the tap was in the text area, the messages also evaluates which line of text contains the tap and calculates the index for **lineStart**.

The message then uses that text line to evaluate the x (horizontal) region of the tap. If the tap was to the left of the text line, **xRegion** contains a –1; if the tap was within the text line, **xRegion** contains a 0; if the tap was to the right of the text line, **xRegion** contains a 1.

Processing an Input Xlist or Gesture 65.5.2

To process an input xlist and act on the commands in the xlist, send **msgGViewXList** to the text view. The only argument to the message is a pointer to an xlist. For further information on xlists and the Input subsystem, see *Part 5: Input and Handwriting Translation.*

To process just a gesture, send **msgGWinGesture** to the text view.

Scrolling a Text View 65.6

If your text view window doesn't display all the text in its text object, you might want to scroll the text programmatically, either by one line, or to the top of the page. To scroll text, send **msgTextViewScroll** to the text view object. The message takes a TV_SCROLL structure that specifies:

pos The text index of the location in text to display.

flags A set of flags that specifies where the text at **pos** should be positioned in the view. The flags are:

tsAlignAtTop Position text at the top of the view.

tsAlignAtBottom Position text at the bottom of the view.

tsAlignAtCenter Position the text at the center of the view.

tsAlignEdge Force the text to the edge of the view. Currently this happens whether or not you specify this flag.

tsIffInvisble Scroll only if the text is not currently visible.

textNoScrollNotify Do not notify the scroll bars to update after scrolling. By default, **clsTextView** notifies the scroll bars that they should update after **msgTextViewScroll**.

In the future, **msgTextViewScroll** might scroll so that it leaves some space between **pos** and the edge of the view, thereby giving the user some context. If you want the text to scroll to the edge specified by **flags**, OR **tsAlignEdge** with the position flag. For example:

By using **tsAlignEdge** now, you can be sure that its behavior will be consistent in future versions of PenPoint.

```
flags = tsAlignAtTop | tsAlignEdge
```

If you want the user to be able to scroll the text with the pen, you should insert the text view in a scrolling window (see "Inserting a Text View in a Scrolling Window" below).

Inserting a Text View in a Scrolling Window 65.7

To enable the user to scroll a text view, you must insert the text view in a scrolling window. Because this set of actions is performed so many times, **clsTextView** defines a function, **TextCreateTextScrollWin**, which creates a text view and inserts it in a scrolling window.

The prototype for the function is:

```
STATUS TextCreateTextScrollWin(
    P_TV_NEW  pNew,
    P_OBJECT  scrollWin);
```

The function takes a pointer to a new arguments structure (**pNew**) and a pointer to an OBJECT (**scrollWin**). **pNew** must point to a TV_NEW structure or the new arguments structure for a subclass of **clsTextView**. If **pNew** is **null**, the function uses a TV_NEW structure by default.

The function uses the new argument structure to create a new text view and then creates a scrolling window with the text view as its client window. The function configures the scrolling window for text scrolling. The function determines whether to format for printer or format for screen depending on the style flag in the TV_NEW structure.

If the function completes successfully, it returns **stsOK** and passes back the UID of the scrolling window in **scrollWin**.

The following code fragment illustrates the use of the function:

```
TV_NEW  tvn;
STATUS  status;
OBJECT  sw;     // scrolling window

// Initialize the text view new structure.
status = ObjectCall(msgNewDefaults, clsTextView, &tvn);

// Modify initialized structure
tvn.flags = FlagClr (tvFillWithIP, tvn.flags           // Turn off insertion pad flag
tvn.showSpecial = 3;                  // Show all special characters

// Create the text view and scroll window.
status = TextCreateTextScrollWin(&tvn, &sw);
if (status  stsOK)
    ...
```

Getting the Current Selection 65.8

Like other views, **clsTextView** interacts with the selection owner. Using the Xfer mechanism, you can query the text view for the span of the text contained in the current selection.

For more information on the selection mechanism and the Application Framework, see *Part 2: PenPoint Application Framework.* For more information on the Xfer mechanism, see *Part 9: Utility Classes.*

The Xfer mechanism requires two steps: first your application must negotiate with the selection owner for the protocols available for data transfer, then you must send the message requesting the transfer using the best available protocol.

Actually, we know that the text view supports the ASCII Metrics protocol (where we pass a pointer to a metrics structure), so the negotiation is not necessary.

To get the current selection for a text view, you must:

- Make sure that your view owns the selection by sending **msgSelOwner** to **theSelectionManager**.
- Declare an XFER_ASCII_METRICS structure and set the **id** field to **XferASCIIMetrics**.
- Send **msgXferGet** to the text view.

When **msgXferGet** completes sucessfully, the **first** field of the XFER_ASCII_METRICS structure contains the text index of the first character in the selection; the **length** field contains the length of the selection, in characters. The **level** field indicates the units that make up the selection. The possible units and their values are:

Value	Unit
0	ignore
1	characters
2	words
3	sentences
4	paragraphs

The following example illustrates how the Writing Paper application gets the current selection.

```
XFER_ASCII_METRICS  xaMetrics;
OBJECT              view;
...
/*
* If the view is null, this app can't be holding the selection.
*/
if (! view)
    return(stsFailed);

/*
* Get the selection from theSelectionManager.
*/
StsJmp(ObjCallWarn(msgSelOwner, theSelectionManager, &sel), s, \
        ErrorExit);
if (sel == view) {

    /*
    * If this view is holding the selection, then get the selection
    * metrics and return them to the client.
    */
    xaMetrics.id = XferASCIIMetrics;
    ObjCallRet(ObjCallWarn(msgXferGet, view, &xaMetrics), s);
    *pSelMetrics = xaMetrics;
```

Getting and Setting the Text Style

65.9

You can control several aspects about the the way that text views display their contents. You can control whether the view responds to editing gestures, how the text is formatted on screen, and whether to display special characters.

To get the style for a text view, send **msgTextViewGetStyle** to the text view. To set the style, send **msgTextViewSetStyle** to the text view. Both messages take a TV_STYLE structure that contains:

flags Flags that indicate the behavior of the text view. Flags include:

- **tvsEmbedOnlyComponents** Don't embed applications.
- **tvsEmbedOnlyIPs** Only embed insertion pads.
- **tvsFormatForPrinter** Format text for a printer rather than the screen.
- **tvsReadOnlyChars** Characters are read only.
- **tvsReadOnlyAttrs** Attributes are read only.
- **tvsReadOnly** Both characters and attributes are read only.
- **tvsWordWrap** Wrap lines at word breaks.

magnification A magnification value for fonts. The magnification value specifies the number of points to add to the fonts when they are displayed on screen.

showSpecial A value that specifies whether the view shows special characters, such as tab, paragraph, line break, and page break characters. The special characters that are affected by this field are the line break and paragraph break characters. The possible values are 0 to show none and 3 to show all.

printer In PenPoint 1.0 this should be **null**.

Checking Consistency of Text Views

65.10

When debugging a text view application, you can check the consistency of a text view by sending **msgTextViewCheck** to the text view object. This message performs work only when you use the DEBUG version of the TEXT.DLL file (in \PENPOINT\BOOT\DLL). **msgTextViewCheck** takes a 32-bit value that specifies the type of consistency checks to make.

If **HighU16(pArgs)** is 0, **LowU16(pArgs)** contains flags that indicate what type of simple consistency checks should be made. Currently, the only check is made on the line table when the **LowU16(pArgs)** is 0.

If **HighU16(pArgs)** is not 0, **pArgs** is a pointer to a structure whose first 32 bits specify more complicated consistency checks.

If the internal check does not detect a problem, the message returns **stsOK**.

If you do not use the DEBUG version of the TEXT.DLL, **msgTextViewCheck** does not perform a consistency check and always returns **stsOK**.

Chapter 66 / Using Text Insertion Pads

This section describes the messages associated with text insertion pads. The text insertion pads incorporate many gestures that are useful for adding text to a text view.

Topics covered in this chapter:

- Creating and destroying text insertion pads.

Text Insertion Pad Messages 66.1

clsTextIP is a subclass of **clsIP**. Messages for **clsTextIP** are defined in TXTVIEW.H. Table 66-1 lists the text insertion pad messages.

Table 66-1
clsTextIP Messages

Message	Takes	Description
		Class Messages
msgNewDefaults	P_TEXTIP_NEW	Initializes text insertion pad arguments.
msgNew	P_TEXTIP_NEW	Creates a new instance of clsTextIP.
		Object Messages
msgTextIPGetMetrics	P_TEXTIP_METRICS	Passes back a textIP's metrics.
msgTextIPSetMetrics	P_TEXTIP_METRICS	Sets a textIP's metrics.

Creating Text Insertion Pads 66.2

Usually **clsTextView** creates a text insertion pad by default (provided that **tvFillWithIP** is not clear). To create a text insertion pad, send **msgNewDefaults** and **msgNew** to **clsTextIP**. Both messages take a TEXTIP_NEW structure that contains a **flags** field. The flags field is reserved for future expansion; leave it at its default value.

After creating the insertion pad, you can insert it in a text view by sending **msgTextViewAddIP** to the text view, specifying the UID of the text insertion pad in the TV_EMBED_METRICS structure.

Destroying Text Insertion Pads 66.3

To destroy a text insertion pad, send **msgDestroy** to the text insertion pad object.

Chapter 67 / Sample Code

The most trivial use of the Text subsystem is to simply create an object of **clsTextView** and display it on **theRootWindow**. This can be achieved with the following code fragment.

```
#include <txtview.h>
TV_NEW  new;
STATUS  s;

s = ObjectCall(msgNewDefaults, clsTextView, &new);
new.win.bounds.size.h = ...;
new.win.bounds.size.w = ...;
new.win.bounds.origin.y = ...;
new.win.bounds.origin.x = ...;
s = ObjectCall(msgNew, clsTextView, &new);

if (s < stsOK) {...}

// insert the text view in the root window
new.win.parent = theRootWindow;
new.win.options = wsPosTop;
s = ObjectCall(msgWinInsert, new.object.id, &new.win);
```

The resulting view is connected to an empty data object (automatically created by the view because the **view.dataObject** field of the **msgNew** argument was not filled in). Such a view is far from useless, because the user can now use pen gestures to create an insertion pad inside the view and enter text through the insertion pad.

The client can also pre-load the data object with text by making a call such as the following before inserting the view into the window tree.

```
TEXT_BUFFER tBuf;

tBuf.first = 0;
tBuf.length = 0;
tBuf.buf = "Hello World";
tBuf.bufLen = strlen(tBuf.buf);
s = ObjectCall(msgTextModify, new.view.dataObject,&tBuf);
```

The view displays the text using the data object's default character, paragraph, and document attributes. The user can change these attributes by selecting the desired characters within the view and making a check mark ✓ to bring up the view's option sheet. Alternatively, client code can obtain these attributes by sending **msgTextGetAttrs** to the text object, and then modify them with **msgTextChangeAttrs**.

As an example, suppose that the client wanted to change the default font size to 20 points, and then to make the characters in "Hello" be in 12 points.

```
#include <txtdata.h>
#include <txtview.h>

#define MakeTwips(i)     (i*20)

TEXT_CHANGE_ATTRS   tca;
TA_CHAR_ATTRS       charAttrs;
TA_CHAR_MASK        charMask;

tca.tag = atomChar
tca.first = txtDefaultAttrs;
tca.pNewMask = &charMask;
tca.pNewValues = &charAttrs;
s = ObjectCall(msgTextInitAttrs, new.view.dataObject, &tca);

charAttrs.size = MakeTwips(20); // points
charMask.size = true;
s = ObjectCall(msgTextChangeAttrs, new.view.dataObject, &tca);

tca.tag = atomChar;
tca.first = 0;
tca.length = 5;
charMask.size = true;
charAttr.size = MakeTwips(12);      // points
s = ObjectCall(msgTextChangeAttrs,new.view.dataObject, &tca);
```

Chapter 68 / Advanced Information

This chapter covers topics that might be useful for sophisticated applications, but which most clients will not need.

Topics covered in this chapter include:

- Counting changes
- Atoms.

Counting the Changes 68.1

The text class keeps a count of the number of times **msgTextModify** has changed the text. You can get and set the change counter by sending **msgTextChangeCount** to the text data object. The argument is an S32 value. If the value is **maxS32**, the message increments the counter and returns the new value. If the argument value is greater than zero, the value becomes the new change count. If the value is **minS32**, the message returns the current counter.

Atoms 68.2

The Text subsystem provides a database of unique identifiers through a globally valid, compact, unique identifier, called **atoms**.

The strings stored in the database have the following properties:

- They are terminated by a zero byte.
- They have at least one character, other than the terminator.
- They do not contain characters in the ASCII ranges 1 through 31 and 127 through 159.
- Case is preserved when the strings are stored, but it is ignored when searching for a string in the database.

The atom for a nil string is Nil(ATOM).

Predefined Atoms

68.2.1

The following nine atoms are predefined:

Table 68-2
Predefined Atoms

Name	Definition
atomChar	Any character
atomWord	A word, delimited by a space or the characters: "!"&()*+.,:;<=>?@[\]^‘{|}~"
atomWSDelimit	A span of characters delimited by white space.
atomLine	A line, terminated by a paragraph, newline, or newpage mark.
atomSentence	A sentence, terminated by the characters: .?!
atomPara	A paragraph, terminated by a paragraph mark.
atomParaTabs	The tab stops for a paragraph.
atomDoc	A document, which is the whole text data object.
atomEmbedded	An embedded object.

Part 7 / File System

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Chapter 69 / Introduction

The PenPoint™ file system enables you to control and access all aspects of files and file organization. This part describes the file system and how you use it.

Overview

69.1

The organization of the file system is similar to most hierarchical file systems. The file system has a hierarchical structure of **directories** and **files** (similar to those of MS-DOS and UNIX). Each directory or file is called a **node**.

The file system is divided into **volumes**. Each volume represents an installable portion of the file system. PenPoint has a **boot volume**, which is always present, and supports the dynamic connection and disconnection of additional volumes.

Each volume has a **root directory**, which is the starting point for the hierarchical organization on that volume. The file system maintains a list of all currently known volumes, connected and disconnected.

You can use **file system handle** objects to access nodes. There are two types of file system handles: **directory handles** and **file handles**. To create a directory or file handle, you send **msgNew** to either **clsDirHandle** or **clsFileHandle**.

To perform file system operations, you send messages to file or directory handles. Messages sent to file handles affect the file directly. Messages sent to directory handles usually include other information indicating the specific node that the message affects. Much confusion can result if you don't remember that a handle is not a node, but a means to access a node. You send messages to the handles; the handles in turn indicate which node to modify.

The file system allows you to:

- Create, open, close, and delete files.
- Read and write file data.
- Copy, rename, and move files and directories.
- Seek to a new position within a file or find out the current byte position within a file.
- Modify file and directory attributes.
- Create user-defined attributes for files and directories.

You can also access nodes with the **stdio** run-time package. The **stdio** run-time package provides a conventional C-language interface to the file system. **stdio** is faster than the object-based file system when performing many small reads or writes to a file. On the other hand, **stdio** calls are no faster at operations such as opening files, and **stdio** can't provide all the features of the PenPoint file system.

You use the file system to create data files for your applications, to read and write data in those files, and to manipulate file and directory organization. You can also use the file system to get information about volumes and to get and set nodes' attributes. PenPoint itself uses the file system for storing objects and application data. The organization of the Notebook, which is a specialized PenPoint application, is mapped onto the file system. Each section in the Notebook is a directory in the file system. Each page in a section is a directory within that directory. The In box and Out box sections of the Notebook use the file system to store the contents of their queues.

Developer's Quick Start

69.2

As an application writer, you'll most commonly use the file system to:

- Save your instance data when you receive **msgSave**.
- Restore your instance data when you receive **msgRestore**.
- Open and close files that contain data from other operating systems.

Writing Objects and Data

69.2.1

When the user closes your application (turns away from or deletes your application), you'll receive **msgSave**. Upon receiving **msgSave**, you must:

- Tell your objects to save themselves by sending **msgResPutObject** to each object. *Part 11: Resources* describes how to use **msgResPutObject**.
- Write your instance data to the resource file by sending **msgStreamWrite** to the resource file handle passed to you in the **pArgs** for **msgSave**. You can use **msgStreamWrite** more than once.

There are several approaches to writing your instance data. If you have fixed-length data, it is a good idea to copy the data to a single struct and write that struct to the file. However, if you have variable-length instance data, you'll need to use one **msgStreamWrite** message to write the length of the data and another to write the data itself. That way you will know how many bytes to specify in **msgStreamRead** when you read the data back in.

If you do write several small pieces of data, you might consider using **stdio** functions rather than **msgStreamWrite**. "Accessing the Files System with **stdio**," in Chapter 72, Using the File System, describes some of the criteria for determining when this is appropriate and how to access **stdio** using file handles.

The following example shows a typical message handler that responds to **msgSave**:

```
MSGPROC ...
    case Msg(msgSave):
        return MyAppWrite(self, (P_OBJ_SAVE)pArgs, ctx, pInst);

...
METHOD MyAppWrite(
    OBJECT                  class,
    P_OBJ_SAVE              pObjSave,
    CONTEXT                 ctx,
    P_MY_INSTANCE_DATA      pInst)
{
```

```
    STATUS              s;
    STREAM_READ_WRITE   srw;
    MY_FILED_DATA           filedData;
    ObjectCallAncestor(msgSave, class, (P_ARGS)pObjSave, ctx);
    /* Copy instance data to structure */
    filedData.foo       = pInst->foo;
    filedData.bar       = pInst->bar;
    /* Fill in the stream read write structure */
    srw.numBytes        = SizeOf(MY_FILED_DATA);
    srw.pBuf            = &filedData;
    /* call msgStreamWrite */
    s = ObjectCall(msgStreamWrite, pObjSave->file, &srw);
    return stsOK;
}
```

Reading Objects and Data

69.2.2

When the user opens or reopens your application, you'll receive **msgRestore**. Upon receiving **msgSave**, you must:

- Re-create your objects by sending **msgResGetObject** to the resource file handle passed to you by **msgRestore**. *Part 11: Resources* describes how to use **msgResGetObject**.
- Read your instance data by sending **msgStreamRead** to the resource file handle.

Be sure to read the same number of bytes that you wrote when you received **msgSave**.

The following example shows a typical message handler that responds to **msgRestore**:

```
MSGPROC ...
    case Msg(msgRestore):
        return MyAppRead(self, (P_OBJ_RESTORE)pArgs, ctx, pInst);
...
METHOD MyAppRead(
    OBJECT              class,
    P_OBJ_RESTORE       pObjRest,
    CONTEXT             ctx,
    P_MY_INSTANCE_DATA  pInst)
{
    STATUS              s;
    STREAM_READ_WRITE   srw;
    OF_GET              get;
    MY_FILED_DATA           filedData;
    ObjectCallAncestor(msgRestore, class, (P_ARGS)pObjRest, ctx);
    /* Read in the filed instance data */
    srw.pBuf        = &filedData;
    srw.numBytes    = SizeOf(MY_FILED_DATA);
    s = ObjectCall(msgStreamRead, pObjRest->file, &srw);
    pInst->foo = filedData.foo;
    pInst->bar = filedData.bar;
    return stsOK;
}
```

Opening and Closing Files 69.2.3

The other common reason for using the file system is for reading or writing files that belong to other operating systems. For example, you might want to read a database file created on an MS-DOS machine so that you could import the data to your PenPoint application.

To open a file:

1. Declare an FS_NEW structure.
2. Fill in the defaults by sending **msgNewDefaults** to **clsFileHandle**.
3. Modify the FS_NEW structure to specify the volume, directory, and file that you want to open.
4. Send **msgNew** to **clsFileHandle**.

msgNew returns a file handle on the open file. You can read and write data by sending **msgStreamRead** and **msgStreamWrite** to the file handle.

To close the file, send **msgFree** to the file handle.

The following code excerpt shows how to open and close a file:

```
STATUS      s;
FS_NEW      fsNew;
FILE_HANDLE myFileHandle;

...

s = ObjectCall(msgNewDefaults, clsFileHandle, &fsNew);
/*
    The following filled in by msgNewDefaults
        fsNew.object.key = objWKNKey;
        fsNew.object.cap = objCapCall;
        fsNew.object.uid = null;
        fsNew.fs.locator.uid = theWorkingDir;
        fsNew.fs.mode = fsFileNewDefaultMode;
        fsNew.fs.exist = fsExistDefault;
*/
fsNew.fs.locator.pPath = "MyDir\\MyFile";
status = ObjectCall(msgNew, clsFileHandle, &fsNew);
myFileHandle = fsNew.object.uid;

...

/* time to free the handle */
    s = ObjectCall(msgFree, myFileHandle, (P_ARGS) objWKNKey);
```

Comparison with Other File Systems 69.3

The PenPoint file system is similar to most other file systems in the following ways:

- It has a hierarchical directory structure.
- You locate nodes in the file system hierarchy by using paths.
- Files and directories have attributes, which you can get and set.
- You access files through handles.

The PenPoint file system is different from other file systems in these ways:

- File system handles are instances of file system classes; you can subclass the file system classes to add special capabilities.
- Clients can define their own file and directory attributes. Many file systems have file and directory attributes, but very few allow clients to add their own attributes.
- In some operating systems (including UNIX), nodes can be subordinate to more than one directory; in PenPoint nodes can have only one parent.
- The PenPoint file system is designed to smoothly handle events when volumes are disconnected and reconnected.

Table 69-1 describes how PenPoint implements many common file operations.

Table 69-1
Common File System Operations

Operation	File System Method
Get a list of installed volumes	Send msgFSGetInstalledVolumes to theFileSystem.
Get information on a volume	Send msgFSGetVolMetrics to a handle for a file or directory on that volume.
Get a node's attributes	Send msgFSGetAttr to a file or directory handle.
Change a node's attributes	Send msgFSSetAttr to a file or directory handle.
Open a file, create if necessary	Send msgNew to clsFileHandle. (Create is the default.)
Open a file, return error if it doesn't exist	Send msgNew to clsFileHandle specifying fsNoExistGenError in exist.
Read from a file	Send msgStreamRead to a file handle.
Write to a file	Send msgStreamWrite to a file handle.
Move file pointer within a file	Send msgFSSeek to a file handle.
Copy a file or directory	Send msgFSCopy to a directory handle, specifying the path to the file and the location for the new file.
Move a file or directory	Send msgFSMove to a directory handle, specifying the path to the file and the location for the new file.
Rename a file or directory	Send msgFSSetAttr to a directory handle, specifying a path to a file or directory node and a new name for that node.
Change a directory handle's target directory	Send msgFSSetTarget to a directory handle.
Delete a file or directory	Send msgFSDelete to a directory handle, specifying a path to the node to delete.
Close a file	Send msgFSFree to the directory handle.

Organization of This Part 69.4

This part is organized into four chapters.

Chapter 69, Introduction, presents a brief overview of the file system.

Chapter 70, File System Principles and Organization, describes how the file system is organized and presents the terminology used with the file system.

Chapter 71, Accessing the File System, describes how you access the file system. It describes how the notebook and other applications use the file system. This chapter also describes how to subclass file system classes and presents considerations for dealing with remote file systems.

Chapter 72, Using the File System, describes in detail how you use the file system to perform most file system operations.

Chapter 70 / File System Principles and Organization

This chapter discusses general concepts about the file system organization and defines file system terms. Topics covered in this chapter include:

- Volumes supported by the PenPoint™ operating system, including local disk volumes, remote volumes, memory-resident volumes, memory mapped files.
- File and directory nodes.
- Directories and directory entries.
- File and directory attributes.
- Files.
- Locators.

Volumes 70.1

Directories and files are grouped together in a volume. When a volume is removed, the files and directories on that volume are no longer accessible to the file system.

Volume Concepts 70.1.1

The file system maintains a list of volume objects. You can get a copy of this list by sending **msgGetInstalledVolumes** to the well-known object **theFileSystem**. When a new volume is connected to the PenPoint computer, the UID of the volume's root directory handle is added to the list of volumes.

You can make yourself an observer of the volume list by sending **msgAddObserver** to **theFileSystem**. When a volume is added, removed, or changes state, you will receive notification.

Volume Metrics 70.1.1.1

Each volume has information associated with it. You can retrieve volume information by sending **msgFSGetVolMetrics** to a volume object. Volume information includes:

- The volume's type.
- The volume's name.
- The volume's root directory.
- The volume's serial number.
- The total number of bytes on the volume.
- The number of free bytes on the volume.

There are three types of volumes: local disk volumes, remote volumes, and memory-resident volumes. These types are explained in detail below.

The possible characters in the volume name, depend on the volume type.

Duplicate Volume Names 70.1.1.2

The file system allows duplicate volume names. When you write application programs, be aware that duplicate volume names might exist. This is especially critical when you use the list of volumes to find a particular volume. You can use **msgFSGetVolMetrics** and examine the **volType**, **serialNum**, and **creationDate** values to distinguish between volumes with the same name.

Connecting and Disconnecting Volumes 70.1.1.3

PenPoint supports the dynamic connection and disconnection of volumes. For example, when the user connects the PenPoint computer to a network, the network volumes become available. The user installs and removes a volume as a single unit; either the file system can access the entire volume or it cannot access it at all.

The user can physically disconnect a volume from the PenPoint computer. For example, the user can disconnect the computer from a network, or remove a floppy disk from its drive. Your application must be prepared to handle this situation.

If any task has active references to nodes on the disconnected volume, the volume remains in the volume list, but is no longer marked **connected**. Any attempts by your application to read or modify data on a disconnected volume pops up a dialog box asking the user to connect the volume. (You can suppress this behavior when you first access the file; see "Creating a File Handle" in Chapter 72.)

If the user connects the volume and taps the OK button on the dialog, the file system operation completes and the volume can be used normally once again. Optionally, the user can tap the Cancel button, which causes the file system to send the status message **stsFSVolDisconnected** to your application.

If no tasks have active references to nodes on the disconnected volume, that volume is removed from the volume list, effectively removing all traces of the volume from the PenPoint computer.

Volume Types 70.1.2

As mentioned above, the file system defines three types of volumes:

- Local disk volumes
- Remote volumes
- Memory-resident volumes.

Local disk volumes are volumes directly attached to the PenPoint computer. Remote volumes are those that are connected through a network or channel controller. Memory resident volumes reside in PenPoint computer RAM.

Local Disk Volumes 70.1.2.1

Local disk volumes exist on hard or floppy disk drives internal to or attached to the PenPoint computer. The user can connect and disconnect external disks at any time.

PenPoint has no native disk format. Rather, the file system makes use of a volume's normal organization to store additional information. Currently PenPoint uses the MS-DOS FAT disk format.

An MS-DOS volume name is a string containing between 1 and 11 characters. The volume name cannot use the following characters:

/ \ ; : = < > [ ]

The name can use spaces, but not tabs.

Here are some examples of MS-DOS volume names:

- A
- MYDISK
- RAM
- MY VOLUME
- BACKUP 3
- ACCNTS RCVL.

The MS-DOS disk format consists of files and directories. In MS-DOS, file names are limited to 8 characters with a 3-character file extension, there are only a few file attributes, and there is only one type of file (data). PenPoint uses MS-DOS format files and directories whenever possible to store its own files and directories. However, when a file or directory has one or more of these characteristics:

- A node name that uses any control characters, lowercase characters, or any of these special characters: * ? / \ | . , ; : + = < > [ ] " (space).
- A name longer than eight characters, plus a three-character extension.
- A name that uses lower case characters.
- Has client-defined attributes.

PenPoint creates a special file, named PENPOINT.DIR, in that file or directory's parent directory, which contains the additional information. The PENPOINT.DIR file is described in further detail in Chapter 71, Accessing the File System.

In the future, PenPoint may support disk formats other than the MS-DOS FAT format. The file system architecture makes it easy for GO or third parties to develop support for other disk formats.

Remote Volumes 70.1.2.2

Remote volumes are available over a network or a communication channel. The name for a remote volume is limited only by the network's volume naming conventions.

A computer that responds to a remote file access protocol is called a **remote file server**. A remote file server can be any sort of computer, ranging from a personal computer to a dedicated file server with gigabytes of storage. The administrator of the remote file server decides how much of the file system to make available to the PenPoint computer and what sort of security to enforce.

As with local disk volumes, the file system provides features that might exceed the remote file system's capabilities. PenPoint supports these extended features in a fashion similar to that for local disk volumes.

To access a remote volume, file system operations must use the **remote file access protocol** that is appropriate to the server. For example, a TOPS remote volume requires a TOPS remote file access protocol. Like file system support for local disk volumes, the file system architecture makes it easy for GO or third parties to develop support for other protocols.

Memory-Resident Volumes

70.1.2.3

Memory-resident volumes reside in the PenPoint computer's RAM. The memory-resident RAM volume is named RAM. This volume is only available with the SDK version of PenPoint 1.0, and only when the ENVIRON.INI file includes the `Config=DebugRAM` directive. There is only one RAM volume, and PenPoint dynamically allocates RAM memory to the RAM volume as needed.

Nodes

70.2

Within each volume, the file system maintains a tree of file system **nodes**. There are two types of nodes:

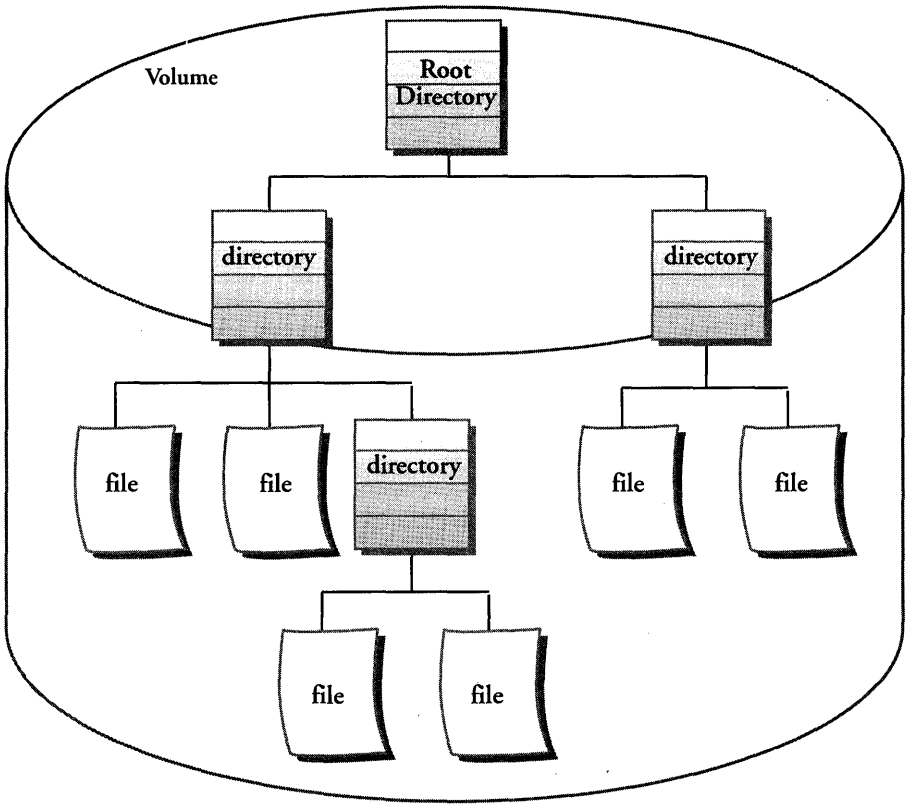
- Directory nodes
- File nodes.

Directories are catalogs of files and directories. Directories can contain both files and other directories. As in MS-DOS, a volume is organized into a strictly hierarchical structure of files and directories. Strictly hierarchical means that each node appears in only one directory; there are no multiple references to nodes.

The top-most node in a volume's directory structure is the **root directory**. All other nodes in the volume are descendants of the root directory. Because a volume is self-contained, the directories within a given volume contain nodes only in that volume.

Figure 70-1 illustrates an example of the file system on a volume.

Figure 70-1
Directory Structure on a Volume



The name of a node is a string containing 1 to 31 characters. Any character is valid except backslash (\) and null (character code 0), and a node name is not valid if it begins or ends with a space character. Here are some examples of valid node names:

- Red
- GO Corporation
- A Very, Very, Lengthy Node Name
- Patient X: Cardiac Status
- FILENAME.DOS.

Note that the characters can be uppercase or lowercase. The file system stores the node names in upper and lower case, but ignores the case when it performs comparisons.

Your application can use the **FSNameValid** function to determine if a user-supplied file name is a valid node name.

All of the node names within a single directory are unique; the file system will reject any request to create a duplicate node name. You can use the **fsExistGenUnique** or **fsNoExistCreateUnique** flags, discussed in Chapter 72,

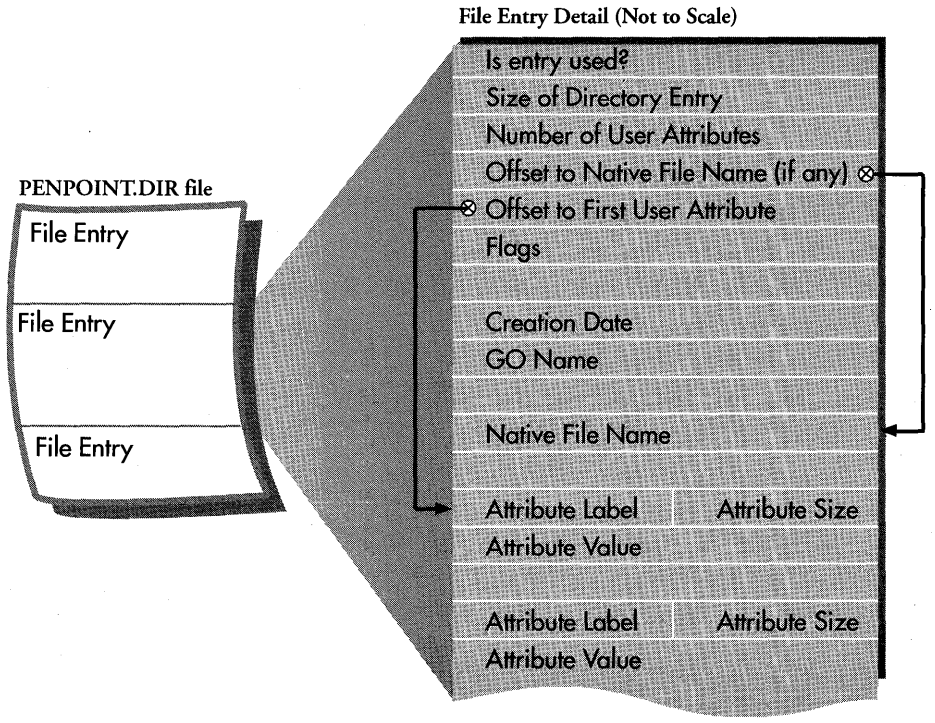
Using the File System, to direct the file system to generate a unique node name when it creates a new node.

Directories and Directory Entries 70.3

A **directory** is a container for file system nodes; it contains a **directory entry** for each node directly subordinate to it. Each directory entry contains the file-system and client-defined attributes for the node it describes.

Figure 70-2 shows the contents of one of the directory entries shown in Figure 70-1.

Figure 70-2
Contents of a PENPOINT.DIR Directory Entry



Attributes 70.4

Each node in the file system has a set of attributes. The file system stores a node's attributes in its parent directory (with the directory entry) or in the PENPOINT.DIR file if the attributes are beyond the native file system's capabilities. There are two kinds of attributes:

- Client-defined attributes
- File-system attributes.

Nodes can have any number of **client-defined attributes**. Client-defined attributes can contain any sort of data. Clients can explicitly create and destroy client-defined attributes.

Every node has a fixed set of **file system attributes**. Clients can alter some of these attributes, but cannot remove any of them. Among the file system attributes are:

- The node name.
- Flags (such as access flags).
- Modification date.
- For files, the size of the file.

Files 70.5

A **file** is a repository for data. The maximum size of a PenPoint file is limited only by the available disk or memory space.

When an application opens a data file, it must read information from the file into main memory. An alternative to traditional **stdio**-style file access is to memory map the file.

PenPoint support **memory mapped files**, which allow you to address data in a file as if it were in main memory. PenPoint makes use of several memory mapped files, including:

- Font files.
- Handwriting prototypes.
- The dictionary, which is used to proof handwriting translations.
- The indexes for the Table Server (**clsTable**).

Memory mapped files will work for all volume types.

Locators 70.6

To find a particular node, a client must be able to specify the location of the node in the file system. The location is specified by a **locator**, which consists of:

- A starting point.
- A path to a node.

The **starting point** is a handle on either a directory or file node.

A **path** is a null-terminated string that defines a traversal of the file system hierarchy. There are five types of paths:

- If the path is null, the location is the starting point node.
- If the path begins with ".\" or contains a node name, the traversal begins at the starting point directory node.
- If the path begins with "..\", the traversal begins at the parent directory of the starting point. If the path contains ".." the target of the path is the directory that contains the starting point node.

- If the path begins with a backslash (\), the traversal begins at the root directory of the starting point's volume.
- If the path begins with two backslashes (\\), what follows is a volume name. The traversal begins at the root directory of that volume. If the volume name is not recognized as an installed volume, the file system prompts the user to attach the correct volume.

Locators in the file system messages take on two forms. **Explicit locators** use the FS_LOCATOR structure, which contains both a starting point and a path. **Implicit locators** use the file or directory handle to which the message was sent as the starting point and require only a path argument.

Because PenPoint is a multi-tasking operating system, it is possible for another task to change (move, rename, or delete) nodes in the file system tree. A path that successfully located a node at one time might not locate the same node at a later time. Remember that a path is not a direct handle on the node, but more like a road map to it; the location of a node might change.

Another way to locate a directory is to use a directory index. A **directory index** is a unique identifier for a directory. You create a directory index the same way you create an attribute. Directory indexes work only for nodes in the \PENPOINT directory tree.

Chapter 71 / Accessing the File System

This chapter discusses the mechanism by which you access the file system.

Topics covered in this chapter include:

- Directory and file handles.
- Volume root directory handle.
- Working directory handle.
- File access control.
- Summary of file system messages.
- Temporary files.
- Using **stdio** function calls.
- Concurrency considerations.
- Subclassing the file system classes.
- The PENPOINT.DIR file.

File System Handles

71.1

The programmatic interface to the file system provides:

- Access to information in files.
- Inspection and modification of node attributes.
- Alteration of the directory hierarchy.

This is all accomplished through **file system handles**. Handles provide a uniform method of accessing file system nodes for every type of volume and shield your application from the low-level file system implementation.

You access files and directories on a volume by sending messages to file system handles.

There can only be one file system operation taking place at any one time on a given volume. Each operation on a volume is run to completion before another operation is permitted to start. However, operations taking place on different volumes can take place concurrently. For example, when copying a text file from one volume to another, the file system can read text from one volume while it writes text to another.

Handle objects guarantee consistent and atomic results if simultaneously used by different tasks. If two tasks send messages to the same handle object at the same time, or if two tasks use two handles to access the same file at the same time, the

PenPoint™ operating system will suspend one task until it finishes processing the operation specified by the other task.

PenPoint defines two file system classes:

- **clsDirHandle** (directory handles), descended from **clsObject**.
- **clsFileHandle** (file handles), descended from **clsStream**.

Although these classes descend from different classes, they are designed to handle a common set of **clsFileSystem** messages. **clsFileSystem** messages perform functions such as creating new handles and nodes, destroying handles, and manipulating node attributes. Generally, do not send messages directly to an instance of **clsFileSystem**. Instead, you send messages to directory and file handles, both of which are written to handle most **clsFileSystem** messages. A few messages are specific to one of **clsFileHandle** or **clsDirHandle**.

To create a directory handle, you send **msgNew** to **clsDirHandle**; to create a file handle, send **msgNew** to **clsFileHandle**. A directory handle has a target directory node; a file handle points to a file node. In the arguments to **msgNew**, you specify the location of the node. You can also include a request in the message to create the node if it does not exist already. If the message succeeds, the file system returns a handle.

A process can create any number of handle objects (up to the memory limit of the PenPoint computer). PenPoint may also allocate disk or communication system buffers as a side effect of handle creation. Therefore, you should free handle objects when they are no longer needed.

If a task terminates while it has active handles, the file system frees the handles.

You can create subclasses of the file system handles to implement specialized file access behavior. Creating descendant classes does not change the actual disk or memory layout of files and directories; it only changes the manner in which clients access them.

Handles and Locators

71.1.1

When you use handles, it is important to remember that the handle is not the node itself.

The idea of a completely object-oriented programming environment encounters some obstacles when it is applied to a file system. In a completely object-oriented file system, each node would be an object. To perform any operation in such a file system, you would send a message directly to the node. This approach has these disadvantages:

- Each time you send a message to an object, the file system has to locate that object.
- As the number of files and directories grows, it becomes slow and unwieldy.
- Objects are usually short-lived. Files, being a means of permanent storage, are much longer-lived than objects.

Rather than make each node an object, PenPoint uses handles, which add a level of indirection between the object-based messages and the file system.

A handle is all you need in operations that manipulate information within files and handles. For example, you need a handle on a file for **msgStreamWrite** (which alters data in the file) and **msgFSSeek** (which alters the current file position in the handle).

A file handle has a one-to-one relationship with its file. On the other hand, directory handles have a target directory, which you can change to point to other directories (with **msgFSSetTarget**). Some operations (**msgFSGetAttr** and **msgFSGetPath**) allow you to indicate a file in two ways: either by sending the message to a directory handle and specifying a path or by sending the message directly to a file handle.

There are file operations that do not manipulate information within files. These operations, such as move or copy, do not need to open nodes. In these operations you use locators to indicate the source and destination nodes.

A locator makes directory handles even more flexible. A locator consists of a file handle or a directory handle and a path. A file handle indicates the node; a directory handle is merged with the path to give the location of a node. Thus, you can use a locator to indicate a specific directory or file, without having a handle on it. Also you can use one directory handle with any number of paths (one at a time) to indicate many nodes.

Under the system of handles and locators, you can still write an application that has a handle for each node (provided the memory will allow it). In a limited way, this might be a desirable thing to do; however, handles do consume memory. If you are concerned about memory limitations (and most PenPoint programmers should be concerned), this is a high amount of overhead.

At the other extreme, you can use current directory or volume root handle and use paths to specify all of the nodes. This scheme has to be balanced against the memory that you use storing all of the path name strings, and the overhead of always checking to be sure that the path still indicates a valid node.

Directory Handles 71.1.2

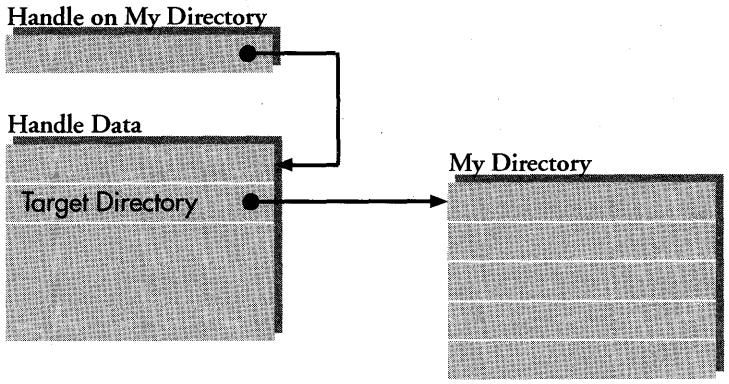
Directory handles support operations that query and manipulate nodes in the file system.

A directory handle is associated with a directory node. You can use a directory handle to designate the location of a directory, to create, copy, move, and delete nodes, and to access the contents of directories.

Each directory handle has a target directory. The target directory is set when you create the directory handle; you can change it at any time thereafter. This allows you to use one directory handle to roam through the file system tree, and is similar to the working directory concept in MS-DOS or UNIX.

You can also create a directory handle with the **fsUnchangeable** flag set, which disallows changing the target directory. Figure 71-1 shows how directory handles are used in the file system.

Figure 71-1
Using Directory Handles



When you rename or move a node, the file system modifies any other directory handles that reference it, so that they follow the node to its new location.

You can make yourself an observer of directory handles. If you observe a directory handle, you receive notifications of any changes to nodes in the directory (but not to the directory node itself).

Note that unlike files, there is no access control for directories, other than making a directory node hidden.

Applications can pass directory handles between processes. However, the file system destroys directory handles when the process that owns them is destroyed.

PenPoint has several well-known directory handles. Some are defined by the file system, others are defined by the application framework.

- The boot volume's root directory handle.
- The "selected" volume, PenPoint's primary operating volume (this is usually, but not always, the same as the boot volume).
- The current working directory handle.
- For the SDK version of PenPoint 1.0, the RAM volume's root directory handle.

Volume Root Directory Handle

71.1.2.1

Each volume has a root directory. A **root directory handle** is an unchangeable directory handle that points to a volume's root directory. There are two ways to get a volume's root directory handle:

- Send **msgFSGetInstalledVolumes** to **theFileSystem** to get a list of available volumes, then send **msgFSGetVolMetrics** to each volume object in the list, until you find the needed volume.

- Specify a locator that has a null UID and a path that contains only the volume name.

A volume's root directory handle is stored in the FS_VOL_METRICS structure.

The Working Directory Handle 71.1.2.2

theWorkingDir is a local, well-known directory handle object created by the file system for each task at creation time. **theWorkingDir** is similar to the DOS or UNIX concept of a default directory.

Both **msgNewDefaults** and the **stdio** run-time package uses **theWorkingDir** for its default volume and directory.

The RAM Volume Handle 71.1.2.3

With the SDK version of PenPoint 1.0, it is possible to configure the file system so that there is a volume in RAM. When configured, the RAM volume has a root directory and a handle on that directory.

File Handles 71.1.3

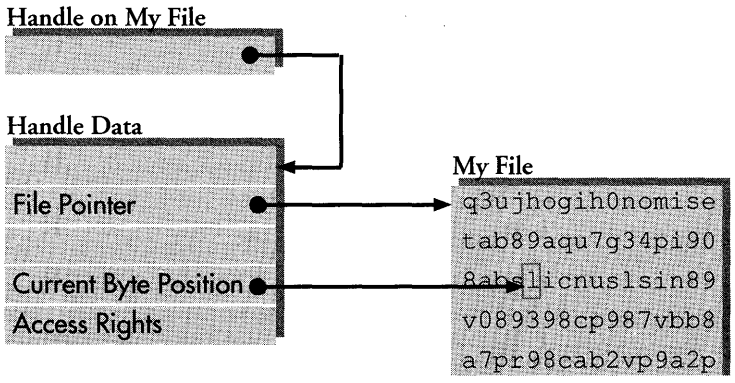
You use **file handles** to access data in a file node. Creating a file handle is analogous to opening a file in MS-DOS or UNIX. Destroying a file handle is like closing a file (however, destroying a handle should not be equated with deleting the file to which the handle refers).

Each file handle has a **current byte position**, which represents the handle's current position in the file. The current byte position points to the next byte to be read or written. It is updated by read, write, and seek messages.

When the current byte position is at the end of a file, it is set one byte beyond the last byte in the file. Writing past end-of-file automatically enlarges the file and sets the current byte position to the new end-of-file. Reading past the end-of-file returns less data than was requested and sets the current byte position to the end-of-file.

Figure 71-2 illustrates the use of file handles.

Figure 71-2
File Handles and Byte Position



Applications can pass file handles between processes. However, file handles are destroyed when the process that owns them is destroyed. When a client renames or moves a file node, all handles that referenced that node continue to reference the node.

File Access Control 71.1.3.1

The file system supports limited access control for files. When you create a file handle, you specify a set of access intentions (that is, what you plan to do with the file) and a set of exclusivity requirements (the limits you want to place on other applications that might attempt to access the same file). The access intentions are:

- Read-only access
- Read/write access.

Exclusivity requirements are:

- Exclusive access
- Deny other writers
- Public access.

Exclusivity requirements apply when the file system is asked to create a file handle on the same file.

Note that access intentions and exclusivity requirements pertain to handles. Each file has its own read-only attribute flag, which you set with **msgFSSetAttr**. When a file is marked read-only, you must specify read-only access when you create a handle for that file.

When you create a file handle, the file system compares your handle access intentions and exclusivity requirements to the current state of the file (file's attributes and any existing handles on the file). If your request is compatible with the file's state, the file system allows you access to the file and returns you a file handle.

The access intentions, exclusivity requirements, and the file access flags are only compared when you attempt to create a file handle. Once you have a file handle, a change to the access intentions, exclusivity requirements, or file's access flags will have no effect on you or anyone else currently accessing the file.

File System Messages 71.2

This section summarizes the file system messages for each of the three classes (**clsFileSystem**, **clsFileHandle**, and **clsDirHandle**). **theFileSystem**, a global well-known, is the only instance of **clsFileSystem**. Although neither **clsFileHandle** nor **clsDirHandle** descend from **clsFileSystem**, they are designed to handle most of the **clsFileSystem** messages. A few **clsFileSystem** messages apply only to **clsFileHandle** or to **clsDirHandle**.

clsFileSystem Messages 71.2.1

clsFileSystem defines the operations that are common to directory handles and file handles.

Table 71-1 lists the **clsFileSystem** messages. The class messages are those that you send to **clsDirHandle** and **clsFileHandle** to create new instances of these classes; the instance messages are those that you send to **clsDirHandle** and **clsFileHandle** to operate on individual instances of these classes.

Table 71-1
clsFileSystem Messages

Message	Takes	Description
		Class Messages
msgNew	P_FS_NEW	Creates a directory or file handle object on a new or existing dir/file.
msgNewDefaults	P_FS_NEW	Initializes the FS_NEW structure to default values.
		Instance Messages
msgFSNull	void	Does nothing.
msgFSGetVolMetrics	P_FS_GET_VOL_METRICS	Returns metrics of the volume.
msgFSSetVolName	P_STRING	Changes the name of a volume.
msgFSNodeExists	P_FS_NODE_EXISTS	Tests the existence of a file or directory node.
msgFSGetHandleMode	P_U16	Returns the "new" mode for the object's fs handle.
msgFSSetHandleMode	P_FS_SET_HANDLE_MODE	Changes the "new" mode for the object's fs handle.
msgFSSame	OBJECT	Tests if another directory or file handle references the same node.
msgFSGetPath	P_FS_GET_PATH	Gets the path to (or name of) a directory or file handle node.
msgFSGetAttr	P_FS_GET_SET_ATTR	Gets an attribute or attributes of a file or directory node.
msgFSSetAttr	P_FS_GET_SET_ATTR	Sets the attribute or attributes of a file or directory node.
msgFSMove	P_FS_MOVE_COPY	Moves a node (and any children) to a new destination.
msgFSCopy	P_FS_MOVE_COPY	Copies a node (and any children) to a new destination.
msgFSMoveNotify	P_FS_MOVE_COPY_NOTIFY	Same as msgFSMove with notification routine extensions.
msgFSCopyNotify	P_FS_MOVE_COPY_NOTIFY	Same as msgFSCopy with notification routine extensions.
msgFSDelete	P_STRING	Deletes a node (and all of its children).
msgFSFlush	void	Flushes any buffers and attributes associated with the file or directory.
msgFSMakeNative	P_FS_MAKE_NATIVE	Removes anything not supported by the native file system.
msgFSEjectMedia	void	Ejects media from an ejectable, removable volume.
msgFSForceDelete	P_STRING	Forcibly deletes a node (and all of its childen).
msgFSVolSpecific	P_FS_VOL_SPECIFIC	Sends a volume specific message via a dir or file handle.
		Sent to Observers
msgFSChanged	P_FS_CHANGE_INFO	Notifies observers of directory changes.
msgFSVolChanged	P_FS_VOL_CHANGE_INFO	Notifies observer of volume changes.
		Sent Only to theFileSystem
msgFSGetInstalledVolumes	P_LIST	Returns list of all installed volumes.

clsDirHandle Messages

71.2.2

Directory handle objects support certain operations unique to directories. For example, to open or create a file, you first need a directory handle, to which you send a message. You can always use the root directory handle for a volume, or your own **theWorkingDir** handle.

In addition to the instance messages listed in Table 71-1 above, a directory handle responds to the instance messages listed in Table 71-2.

Table 71-2
Directory Handle Instance Messages

Message	Takes	Description
msgFSSetTarget	P_FS_LOCATOR	Changes the target directory to directory specified by locator.
msgFSReadDir	P_FS_READ_DIR	Reads the next entry (its attributes) from a directory.
msgFSReadDirReset	void	Resets the ReadDir position to the beginning.
msgFSReadDirFull	P_FS_READ_DIR_FULL	Reads all the entries in a directory into a local buffer.
msgFSTraverse	P_FS_TRAVERSE	Traverse through the nodes of a tree starting with the target of this msg.

Most of these messages take a path argument. The file system uses the directory handle's target directory and the path to determine the location of the node to act upon. You can reference the target directory alone by supplying an empty path. Some messages do not take a path. These messages always operate on the target directory node.

clsFileHandle Messages

71.2.3

In addition to the instance messages listed in Table 71-1 above, a file handle responds to the instance messages listed in Table 71-3.

Table 71-3
File Handle Instance Messages

Message	Takes	Description
msgStreamRead	P_STREAM_READ_WRITE	Reads data from the file.
msgStreamWrite	P_STREAM_READ_WRITE	Writes data to the file.
msgStreamFlush	void	Flushes any buffers associated with the file.
msgStreamSeek	P_STREAM_SEEK	Seeks to new position within the file.
msgFSSeek	P_FS_SEEK	Seeks to new position within the file.
msgFSGetSize	P_FS_FILE_SIZE	Gets the size of the file.
msgFSSetSize	P_FS_SET_SIZE	Sets the size of the file.
msgFSMemoryMap	PP_MEM	Associates the file with a directly accessible memory pointer.
msgFSMemoryMapFree	void	Frees the memory map pointer currently associated with the file.
msgFSMemoryMapSetSize	SIZEOF	Sets the size of the file's memory map.
msgFSMemoryMapGetSize	P_SIZEOF	Gets the size of the file's memory map.
FSNameValid()	P_STRING	Function to check a file or directory name for validity.

Using Handles with Temporary Files 71.3

Sometimes you only need a file for a short time during the life of a task. You might need a file that behaves like an object, which you bring into existence, use it, and when you don't need it, you free it. To create a temporary file, specify the **fsTempFile** flag in your call to **msgNew**.

When you specify **fsTempFile** for a non-existent file (and the exist flags specify **fsNoExistCreate**), the file system creates the handle and the file at the same time. When you free the handle, the file system deletes the file.

If you specify **fsTempFile** for a file that exists already (and the exist flags specify **fsExistGenUnique**), the file system deletes the file when you free the handle.

If you don't know whether you will want to keep the file or not when you create it, do not use **fsTempFile**. If you decide you want to delete the file, you can always use **msgFSSetHandleMode** to make the handle an **fsTempFile** handle, or use **msgFSDelete** to delete the file before you free the handle.

Accessing the File System with stdio 71.4

Your applications will usually open and close files and do most directory management with file system handles. However, to facilitate porting an existing code base, PenPoint supports the use of **stdio** calls to perform file handle. **stdio** calls are not class-based, and therefore can't be subclassed.

Because **stdio** calls are buffered, consecutive, small reads and writes are much faster than using **msgStreamRead** or **msgStreamWrite**. However, if the block of information is equal to or larger than the **stdio** buffer size (usually 512 bytes), the speed is roughly equal to that of the class-based operations. You can change the buffer size with the **setvbuf**() system service.

You must include the PenPoint SDK header files STREAM.H to use the stdio functions (this is in addition to the usual STDIO.H). You can't use **stdio** operations to change **theWorkingDir**.

Translating Between Handles and FILE Pointers 71.4.1

If you open a file by creating a handle, but want to use **stdio** calls to perform reads and writes, you will need to translate the file handle into a file pointer. To do this, use the **StdioStreamBind**() system service, supplying the handle. The routine returns a file pointer.

This following code excerpt illustrates the conversion:

```
FS_NEW  fsNew;
FILE    *fp;
s = ObjectCall(msgNewDefaults, clsFileHandle, &fsNew);
s = ObjectCall(msgNew, clsFileHandle, &fsNew);
if (s < stsOK) ...
/* Build a FILE structure based on the handle. */
fp = StdioStreamBind(fsNew.object.uid);
```

You might also need to translate a file pointer into a handle. This operation is a little easier, because the handle is stored in the **uid** field of the FILE struct. This following code excerpt illustrates how to translate a file pointer into a file handle.

```
#include <stdio>
#include <stream.h>
    OBJECT  newHandle;
    FILE    *fp;
    fp = fopen("MyFile","r");
    if (fp == NULL) ...
    newHandle = StdioStreamToObject(fp);
```

Paths and stdio 71.4.2

When you use **stdio** functions that require a path to a file (such as **fopen**()), you specify the path to the file as you would for any file system message. The **stdio** functions use your task's current directory handle, **theWorkingDir**, for the volume and directory defaults.

Thus, if the path begins with a volume name, indicated by two backslashes (\\), the function uses the path to locate the file. If the path begins with a backslash (\), the function uses the root directory of the volume identified by **theWorkingDir**. If the path doesn't begin with a backslash, the function starts its traversal at **theWorkingDir**.

Using stdio 71.4.3

You can close files using **stdio**. However, don't open files by creating a handle, then close them with **stdio**. Because **stdio** doesn't know about the handle object, this will result in unreclaimed resources.

If you open a file with **stdio**, close it with **stdio**. If you create a handle on a file, destroy the handle.

Concurrency Considerations 71.5

PenPoint is a multitasking operating system. While your application is performing some action, it might yield the processor to another task. The other task might attempt to alter (or even delete) the file you are working on. This means that you have to program more defensively than you would for an ordinary single-tasking operating system. While you program, assume that another task might attempt to access your files or change the file's location.

Protecting Your File Data 71.5.1

While you are not accessing a file, you can use **msgSetAttr** to make the file read-only.

While you have a handle on a file, the file system will not allow anyone to delete the file, unless they use **msgFSForceDelete**.

When you create a file handle with **msgNew**, you can specify an exclusion mode so that you can limit access to the file while your handle is attached to it.

File Location Considerations 71.5.2

Be aware that another task might change your file's location as well as its contents. All tasks can change (move, rename, or delete) nodes in the file system tree. A path that successfully located a node at one time might not locate the same node later. Remember that a path is not a direct handle on the node, but more like a road map to the node.

You can programmatically search for files with the message **msgFSTraverse**. Note also that you can use directory indexes to find directories, no matter what their path is.

Directory indexes work only for nodes under the \PENPOINT directory tree.

A handle, on the other hand, will follow its node wherever the node is moved. If a task has a handle on a node, the node can't be deleted by any other task (unless it uses **msgFSForceDelete**).

Volume Protection Considerations 71.5.3

Remember also that other computers might have access to volumes you are using. Another user can delete a target node by modifying a remote or local disk volume outside of the PenPoint computer's control.

When a handle's target node is deleted or destroyed, the file system marks the handle invalid. If you use an invalid handle, the file system returns **stsFSHandleInvalid**.

The only things you can do with an invalid directory handle are to free it with **msgFree** or change its target directory to a valid directory with **msgFSSetTarget**.

The only valid thing you can do with an invalid file handle is to free it with **msgFree**.

Subclassing File System Classes 71.6

In coding your application, you might find that you perform a particular set of file operations many times or you need to supplement the file system messages with your own. At this point you might consider subclassing **clsFileHandle**.

A good example of a subclass of **clsFileHandle** is **clsResFile**, the resource file class. **clsResFile** defines a number of new messages that, when sent by the user or the class manager, handle all the details of tracking all resources in the resource file. **clsResFile** maintains tables that index resources within the file. Another example is **clsAppDir**, which support the application directories used by the PenPoint Application Framework.

Most of the details about creating a subclass are described in the *Part 1: The Class Manager*. In short, you must define the class and make it known to the class manager.

The PENPOINT.DIR File

71.7

As mentioned before, the PenPoint file system attempts to use a volume's native file system whenever possible. When a file or directory has additional information that the native file system cannot contain, the PenPoint file system creates a PENPOINT.DIR entry for that information. The file system still relies on the native file format to carry most of the information. PENPOINT.DIR contains only the information that the native file system cannot support.

On the standard MS-DOS FAT file system, the following characteristics will cause the file system to create a PENPOINT.DIR entry:

- A node name that uses any control characters, lowercase characters, or any of these special characters: * ? / \ | . , ; : + = < > [ ] " (space).
- A name longer than eight characters, plus a three-character extension.
- A name that uses lower case characters.
- A node that has client-defined attributes or other file attrbutes not supported by the MS-DOS file system.

The structure of the PENPOINT.DIR file is quite simple. It consists of a series of variable-length directory entries that contain:

- Entry information, including whether the file is in use, the total size of the entry, the number of user-defined attributes, and offsets within the directory entry.
- The node flags (both PenPoint-specific flags and those duplicated from the native file system).
- The date the node was created.
- The PenPoint file name.
- The native file system file name.
- The user attributes (if any).

For further information on the PENPOINT.DIR file, see the file VOLGODIR.H.

How the Notebook Uses the File System

71.8

The organization of sections and pages in the Notebook is a direct map of the file system. Each section in the Notebook is a directory in the file system; each page in the Notebook is a directory within that directory. The names of the sections are the actual names of the directories that contain the page nodes.

Chapter 72 / Using the File System

This chapter describes how to use the file system to perform most file system operations. The section is organized in a rough "life cycle" order, that is, we present the operations in an order that approximates how you will want to use the file system to create, modify, and delete a file.

Most of the structures and typedefs described in this chapter are defined in FS.H.

Topics covered in this chapter include:

- Creating a handle and creating a new node.
- Creating a handle for an existing node.
- Deleting a node.
- Freeing a handle.
- Freeing a handle and deleting a node.
- Getting and setting file and directory attributes.

Creating Directories and Files 72.1

Before you can create or access a node, you need to create a handle object that you use to access the node. You create the handle by sending **msgNewDefaults** and **msgNew** to **clsDirHandle** or **clsFileHandle**. In the call to **msgNew**, you direct the file system to create the node (file or directory) if it doesn't exist already. This is the first step in a file's life cycle.

Creating a file handle is equivalent to opening a file in other file systems. As with most other file systems, you can specify certain open actions, such as what to do if the file or directory does or does not exist.

Creating a directory handle has no equivalent operation in other file systems.

Creating Handles 72.1.1

To create a handle, send **msgNewDefaults** and **msgNew** to **clsDirHandle** or **clsFileHandle**. Both messages take a FS_NEW structure that contains:

object.key A key value. If you specify this, you (and any other users of the handle) must provide an equivalent key value in order to destroy the handle. (Locks are further explained in *Part 1: Class Manager*). If you don't want to use the lock, specify **objWKNKey**.

fs.locator A LOCATOR structure that indicates a directory handle and a path to the node. If you do not specify the directory handle, the default is **theWorkingDir**; if you do not specify a path, the default is nil.

volType The type of volume. The file system uses this argument when **locator.path** contains a full path. If this argument is anything other than **fsAnyVolType**, it is used for "filtering" if a volume is not found. The available volume types are:

fsAnyVolType Any volume type.

fsVolTypeMemory A RAM volume (available only on the SDK version of PenPoint).

fsVolTypeDisk A local disk volume.

fsVolTypeRemote A remote (network) disk volume.

fs.dirIndex An optional directory index. The directory index is for directory handles only. If you use a directory index, the locator must indicate the volume to use.

fs.mode Flags that indicate handle characteristics. There are different options for directory and file handles.

fs.exist What to do if the node does or doesn't exist.

Use **msgNewDefaults** to initialize the fields to their default values, then modify any of the fields.

Use the constants defined in FS_EXIST to specify the action to take if the node does or does not exist.

Two of the existence flags **fsExistGenUnique** and **fsNoExistCreateUnique** work slightly differently from each other. Ostensibly, **fsExistGenUnique** takes effect if the requested node exists already; whereas **fsNoExistCreateUnique** takes effect when the requested node does not exist.

At a more detailed level, **fsExistGenUnique** will only generate a new unique name if that name exists already. For example, if a node named BLUE exists already, **fsNew** will create a new node named BLUE 1. **fsNoExistCreateUnique** uses the input node name to create a unique name, whether or not the file exists already. The Notebook uses **fsNoExistCreateUnique** to create unique page numbers for pages.

Checking Valid File and Directory Names

72.1.2

If you get a file or directory name from the user, you probably will want to check the validity of the name before creating a file or directory handle. You can use the file system function **FSNameValid**() to test whether a name is valid. The prototype for **FSNameValid**() is:

```
STATUS EXPORTED FSNameValid (
    P_STRING            pName
);
```

The **pName** argument is a string pointer to the file or directory name to be validated.

If the name is valid, the function returns **stsOK**; if the name is not valid, the function returns **stsFailed**.

Creating a Directory Handle

72.1.3

The next code fragment shows how to create a directory handle and a directory. First the program declares an FS_NEW structure, and uses **msgNewDefaults** to set the default values. The program then sets the values that it needs to specify and sends **msgNew** to **clsDirHandle**.

```
FS_NEW      fsNew;

status = ObjectCall(msgNewDefaults, clsDirHandle, &fsNew);
/* The following filled in by msgNewDefaults
    fsNew.object.key = objWKNKey;
    fsNew.object.cap = objCapCall;
    fsNew.fs.mode = fsDirNewDefaultMode;
    fsNew.fs.exist = fsExistDefault;
    fsNew.fs.locator.uid = theWorkingDir;
*/
fsNew.fs.locator.pPath = "MyDir";
status = ObjectCall (msgNew, clsDirHandle, &fsNew);
if (status < stsOK) {
    Debugf ("Error creating dir = %lx", status);
}
```

When the file system creates the directory handle, it sends back the UID for the handle in **object.uid** of the FS_NEW structure. When you need to send other messages to the handle (such as **msgFSGetAttr** or **msgFree**), you can use this UID.

Use the constants defined in the FS_DIR_NEW_MODE typedef to specify the **mode** flags for directories. The mode flags indicate the directory characteristics. Table 72-1 describes the **mode** flags for directories.

Table 72-1
Directory Mode Flags

Flag	Meaning If Set
fsTempDir	The file system should delete the directory when the handle is destroyed.
fsUnchangeable	Disallow changing the target directory.
fsUseDirIndex	Find the directory using the directory index specified in the dirIndex field. Use the locator's UID and path to determine which volume to use.
fsSystemDir	Directory handle is owned by the system (ring 0).

You can use the constant **fsDirNewDefaultMode**, which is the same as specifying a permanent and changeable directory (all flags clear).

To get or set the directory mode flags, use **msgFSGetHandleMode** and **msgFSSetHandleMode**.

Creating a File Handle

72.1.4

The next code fragment shows how to create a file handle and a new file. First the program declares an FS_NEW structure and initializes it with **msgNewDefaults**.

The program then specifies the value that it needs to change and sends **msgNew** to **clsFileHandle**.

```
STATUS      s;
FS_NEW      fsNew;
FILE_HANDLE myFileHandle;

...

s = ObjectCall(msgNewDefaults, clsFileHandle, &fsNew);
/*
    The following filled in by msgNewDefaults
        fsNew.object.key = objWKNKey;
        fsNew.object.cap = objCapCall;
        fsNew.object.uid = null;
        fsNew.fs.locator.uid = theWorkingDir;
        fsNew.fs.mode = fsFileNewDefaultMode;
        fsNew.fs.exist = fsExistDefault;
*/
fsNew.fs.locator.pPath = "MyDir\\MyFile";
status = ObjectCall(msgNew, clsFileHandle, &fsNew);
myFileHandle = fsNew.object.uid;
```

Again, when the file system creates the file handle, it sends back the UID for the handle in **object.uid** of the FS_NEW structure. In this example, the program saves the handle in the variable **myFileHandle**. Now when the program needs to send other messages to the handle (such as **msgStreamRead** or **msgFree**), it can use **myFileHandle**.

Use the constants defined in FS_FILE_NEW_MODE to specify the **mode** flags for files. The **mode** flags indicate how the file system is to open the file. The mode includes your access intentions, your exclusivity requirements, and whether memory mapped regions should be in shared memory. Access intentions describe how you intend to access the file (reading only, or writing and reading). Exclusivity requirements describe what you will let other clients do to the file while you have a handle on it (allow other readers and writers, allow readers only, or deny access to all). If a memory mapped file region is shared, more than one client can access the memory mapped file.

Table 72-2 describes the mode flags for files.

Table 72-2
File Mode Flags

Flag	Meaning If Set
fsTempFile	Delete the file when the handle is destroyed.
fsReadOnly	Open the file with read-only access.
fsSystemFile	Directory handle is owned by the system (ring 0).
fsSharedMemoryMap	Shared memory used for memory mapped files.
fsDisablePrompts	Do not prompt the user if the volume containing the file is disconnected. Always return stsFSVolDisconnected.
Enumerator	**Meaning if Set**
fsNoExclusivity	No exclusive access.
fsDenyWriters	Deny access to readers.
fsExclusiveOnly	Handle owner has exclusive access to the file.

You can use the constant **fsFileNewDefaultMode** to use the file open defaults. The constant is the same as specifying **fsNoExclusivity** (the file is permanent with read/write access).

To get or set the file mode flags, use **msgFSGetHandleMode** and **msgFSSetHandleMode**.

Mapping a File to Memory 72.1.5

Memory mapped files allow you to address information in a file as if its contents were in main memory. In PenPoint 1.0, you map files to memory by establishing a block of virtual memory to which the file system can swap the file contents.

The message **msgFSMemoryMapSetSize** specifies the amount of virtual memory available to a memory mapped file. You cannot specify a size of zero, less than the file size, or less than the size set by any other client. The memory map size can be larger than its previous size. The memory map size must be set before memory mapping the file.

The memory map size should be set to a reasonable expected maximum. If your file is static, then set the memory map size to the file size. If your file will grow then set the limit to its anticipated size. Setting a file's memory map size to 1MB does not take 1MB of RAM, but does require approximately 1KB of data structures to support in the memory manager and uses 1MB of the virtual memory address space. The minimum memory required is 4KB per file, so memory mapping very small files is not efficient.

If a file is memory mapped, then the memory map size can't change (use **msgFSMemoryMapSetSize** before **msgFSMemoryMap**) and the file size can't grow (via either **msgStreamWrite** or **msgFSSetSize**). All of these error cases return **stsFSNodeBusy**. The single pointer returned by **msgFSMemoryMap** can be used to address the entire memory map. A zero length file can be memory mapped.

Sharing Memory Mapped Files 72.1.5.1

By default the memory mapped region is in local memory. If you want to share a memory mapped file with other clients, you must specify **fsSharedMemoryMap** in the **mode** argument of the FS_FILE_NEW_MODE structure when you create the file handle.

Memory Mapped File Life Cycle 72.1.5.2

This section presents the life cycle of a memory mapped file. Clients need to be particularly aware of the second step.

1 Open the file.

Some memory map related options are specified in **pNew->fs.mode** when a file handle is created. Setting **fsReadOnly** will result in a read only memory map. Setting **fsSharedMemoryMap** will result in a memory map allocated from shared memory. Setting **fsSystemFile** will result in a memory map owned by the system (this flag is only accessible to supervisor code).

2 Set the maximum size of the memory mapped file.

You specify the memory map size using **msgFSMemoryMapSetSize**. This message takes a single argument, the memory map size. Decide on the maximum size that your memory map will grow to and set that size. The memory map size must be as large or larger than the actual file size. You may want to set the memory map size based on the maximum of **msgFSGetSize** and the desired memory map size. Setting unnecessarily large sizes will quickly use up all of virtual memory space.

Also be aware that each 4KB of virtual memory map space still requires approximately 16 bytes of real memory in the memory manager. If your memory mapped file is read-only or static (for example fonts or a dictionary) set the memory map size to the file size. The message **msgFSMemoryMapGetSize** can be used to query the current memory map size.

3 Memory map the file.

msgFSMemoryMap to the file handle will return a pointer to the memory map. The pointer will always point to the base of the memory mapped region. Sending **msgFSMemoryMap** to a memory mapped file handle will return the same pointer, not another one. There is only one memory map per file handle.

4 Flush the memory map (optional).

msgFSFlush to the file handle of the memory mapped file will cause all dirty portions of the memory mapped file to be written to disk.

5 Free the memory map.

msgFSMemoryMapFree frees the memory map.

6 Set the file size (optional).

If you want your file to be the size of the memory mapped data structures that you have mapped onto the file, then you need to explicitly set the file size before freeing the file handle. If you do not, then the file will be a multiple of the system page size, and the undefined bytes past the end of the memory mapped file will become part of the file on disk.

7 Close the file.

msgDestroy to the file handle will close the file handle. All dirty pages in the memory map will be written to disk. The memory map will be freed if you did not free it in step 5.

Closing Files

72.2

When you have finished with a file or directory, you should free the handle to deallocate the memory required by the handle. This is equivalent to closing a file.

To free a handle, send the message **msgDestroy** to the handle that you want to free. The only argument to **msgDestroy** is the key that was used to create the handle, if any. The following fragment illustrates the use of **msgDestroy**:

```
...
myFileHandle = fsNew.object.uid;
...
status = ObjectCall(msgDestroy, myFileHandle, (P_ARGS) objWKNKey);
```

When the file system created the handle, it returned the UID in **fsNew.object.uid**. Here the program calls **msgDestroy** to free that handle. The key value specified here uses **objWKNKey**, the well-known key, which has a value of 0. Use **objWKNKey** when you didn't specify a key value in **msgNew**. For more information about the keys, see the *Part 1: The Class Manager.*

Sending **msgDestroy** to a directory or file handle does not delete the node (unless the file is marked temporary); it merely has the effect of closing the file and freeing the resources used by the handle object. The handle is not the node.

Deleting Files and Directories 72.3

Delete a file or directory by sending **msgFSDelete** to a file or directory handle. The only argument to the message is a path that specifies the node to delete. If the path is empty, the file system deletes the file or directory handle's target node. Deleting a directory hierarchically deletes all of the nodes in that directory.

This example illustrates **msgFSDelete**:

```
status = ObjectCall(msgFSDelete, theWorkingDir, "MyDir\\MyFile")
```

If you use the temporary file flag with **msgNew**, the file system deletes the file or directory when you free the file or directory handle.

You can't delete a file that is marked read-only; you must change the file's attribute to read/write before you can delete it. If you attempt to delete a node that is the target of another directory handle, the deletion will fail with **stsFSNodeBusy**.

Forcing Deletion of a File or Directory 72.4

To force the deletion of a node (file or directory) that is marked read-only, or that is the target of another directory handle, send **msgFSForceDelete** to a directory handle.

msgFSForceDelete is a powerful message. It will delete any file or directory without question. *Careless use of* **msgFSForceDelete** *could result in damage to your installed software, including PenPoint.*

msgFSForceDelete takes a pointer to a FS_FORCE_DELETE structure that contains a pointer to a path that indicates the node to delete (**pPath**).

When the message completes successfully, it returns **stsOK**.

When a handle's target node is deleted or destroyed, the file system marks the handle invalid. If you use an invalid handle, the file system returns **stsFSHandleInvalid**.

The only valid thing that you can do with an invalid file handle is to free it with **msgFree**.

The only valid things that you can do with an invalid directory handle are to free it with **msgFree** or change its target directory with **msgFSSetTarget**.

Getting and Setting Attributes 72.5

You can use the **msgFSGetAttr** and **msgFSSetAttr** messages to manipulate file and directory attributes.

When you send an attribute message to a file handle, the message affects that file directly. When you send an attribute message to a directory handle, you can specify a path to any node. There are three types of attribute values:

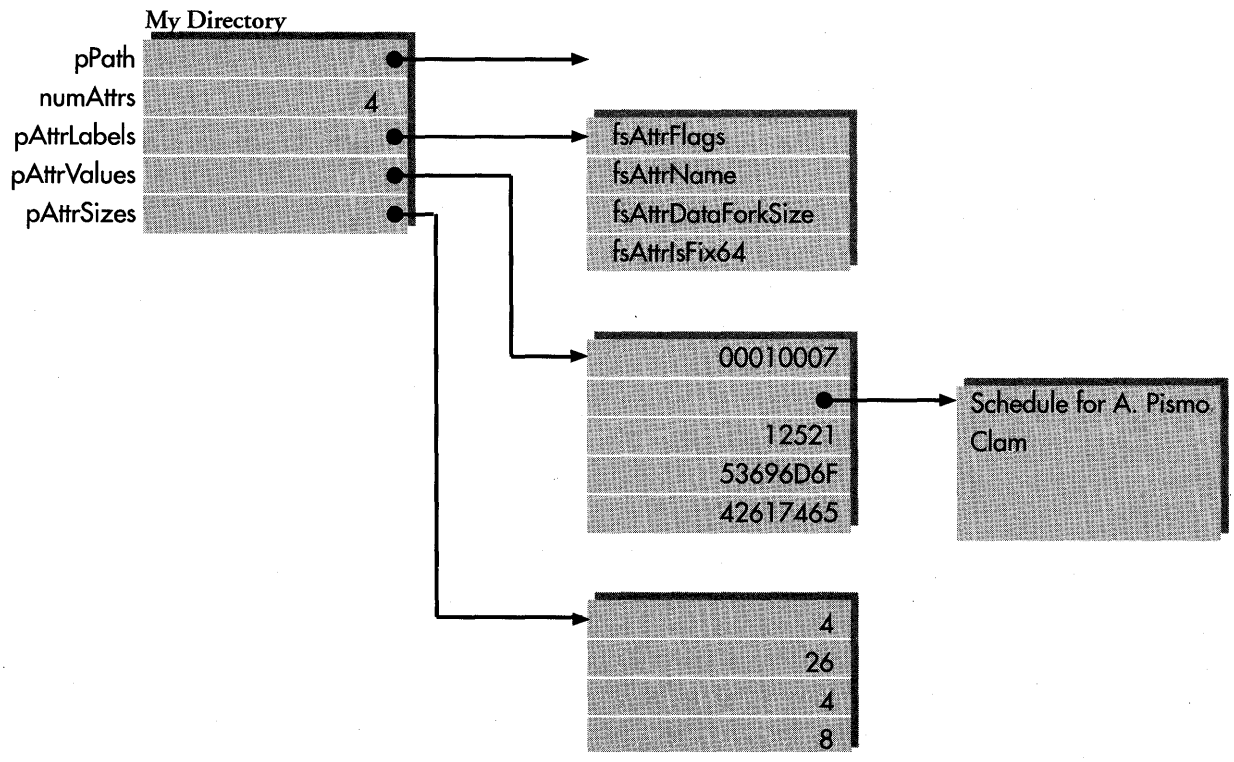
- Fixed-size values (32 or 64 bits).
- Variable-sized values (up to a little less than 64K).
- Null-terminated strings (up to a little less than 64K characters).

Lists of Attributes 72.5.1

msgFSGetAttr and **msgFSSetAttr** both take a FS_GET_SET_ATTR structure that contains pointers to three parallel arrays:

- An array of 32-bit attribute labels (identifiers for particular attributes).
- An array of 32-bit (4-byte) or 64-bit (8-byte) attribute values or pointers to variable-length or string attributes.
- An optional array of attribute sizes (in bytes).

Figure 72-1
File Attribute Arguments



The arrays must contain the same number of elements.

If an attribute is fixed-length, its value is stored in the attribute array; however, if the attribute is variable length, the attribute array contains a pointer to the attribute's buffer. Figure 72-1 shows the FS_GET_SET_ATTR structure for four attributes. The first, third and fourth attributes are fixed-length values. The second attribute is a string. The fourth value is a fixed-length 64-bit value, so its entry in the **pAttrValues** array uses eight, rather than four, bytes.

Zero Value Attributes 72.5.2

When an attribute's value is 0, the attribute is deleted from the node's attribute list. You can still get the attribute value, because the file system always passes back the value 0 for an "undefined" attribute.

This saves memory in attribute lists and in the PENPOINT.DIR files, but at the expense of some confusion. You cannot determine if an attribute with a zero value is defined just by asking for its value. What you can do is request all attributes for a file system node, and then examine the attribute label array for presence or absence of the attribute that you want.

File System Attributes 72.5.3

The file system defines the following attributes:

Table 72-3
File System Attributes

Attribute	Meaning
fsAttrName	Node name.
fsAttrFlags	Node attribute flags. For more information, see the discussion below.
fsAttrDateCreated	Node creation date/time
fsAttrDateModified	Last modified date/time.
fsAttrFileSize	Number of bytes in the file.
fsAttrDirIndex	A directory index value (directories only).
fsAttrFileType	A file type TAG, as defined in FILETYPE.H.

The PenPoint file system does not maintain an "archive" attribute that records whether the file has been modified.

Client-Defined Attributes 72.5.4

The set of attributes the file system defines is fixed, but you can create any number of client-defined attributes.

The file system header file (FS.H) defines three macros to create attribute labels. The macros are:

```
FSMakeFixAttr(class, tag)
FSMakeVarAttr(class, tag)
FSMakeStrAttr(class, tag)
```

where *class* is the class to which the attribute belongs (for example, file system attributes are defined by **clsFileSystem**) and *tag* is a unique value for the attribute.

In many ways client-defined attributes are no different from file system attributes. You can perform the same operations on client-defined attributes (get size, get value, set value). However, when you send **msgFSSetAttr** and indicate a previously undefined attribute, the file system creates a client-defined attribute.

When you specify the value 0 (or a null pointer) for a client-defined attribute, the file system deletes the attribute. Note that you can still get the attribute value; the file system will return 0 (which is both the value of the attribute and the indication that the attribute does not exist).

Getting Attribute Values

72.5.5

To get attribute values, send the message **msgFSGetAttr** to a file or directory handle. The message takes a pointer to a FS_GET_SET_ATTR structure that contains:

pPath A pointer to a path. This path, combined with the handle to which the message is sent, forms an implicit locator.

numAttrs The number of attributes you are requesting.

pAttrLabels A pointer to the array of attribute labels.

pAttrValues A pointer to the array of 32-bit values that either receive the fixed length attributes or point to the buffers that receive the variable-length attributes. You must specify the pointers in the array when you call **msgFSGetAttr**, the message will not return the pointers for you.

pAttrSizes A pointer to the array that receives attribute sizes. If you don't want to receive attribute sizes, use **Nil**(P_FS_ATTR_SIZE) for this pointer. When you call **msgFSGetAttr**, you can use this array to specify the maximum sizes of the variable-length attribute buffers; on return, the array contains the actual sizes returned.

If the attribute does not exist, the value for that attribute is 0.

If you don't want to allocate the variable-length attribute value and size buffers ahead of time, you can direct **msgFSGetAttr** to allocate the buffers for you. To automatically allocate the value buffer, specify **fsAllocAttrValuesBuffer** in **pAttrValues**; to allocate the sizes buffer, specify **fsAllocAttrSizesBuffer** in **pAttrSizes**.

You can direct **msgFSGetAttr** to return all attributes by specifying the constant **fsAllocAttrLabelsBuffer** in **pAttrLabels**. If you specify this value, specify **maxU16** for **numAttrs**, and use **fsAllocAttrValuesBuffer** and **fsAllocAttrSizesBuffer** in **pAttrValues** and **pAttrSizes**. The actual number of attributes is returned in **numAttrs**.

When you are done with the attributes, you must free the returned memory regions with **OSHeapBlockFree**(); PenPoint cannot do it for you. **OSHeapBlockFree**() is documented in the *Part 8: System Services.*

Setting Attribute Values 72.5.6

Setting attribute values is similar to getting attribute values. Send the message **msgFSSetAttr** to a file or directory handle. The message takes a pointer to a FS_GET_SET_ATTR structure that contains:

pPath A pointer to a path, if sending the message to a directory handle.

numAttrs The number of attributes you are setting.

pAttrLabels A pointer to the array of attribute labels.

pAttrValues A pointer to the array of 32-bit values or pointers to variable-length attributes.

pAttrSizes A pointer to the array that specifies the attribute sizes. This is required for variable-length attributes; it is optional for fixed-length and string attributes.

The list of attribute labels and the list of pointers must contain the same number of elements.

Getting the Length of Attribute Values 72.5.7

If you need to get a fixed-length attribute, you usually don't have to worry about allocating space for it, whether you allocate space at compilation or dynamically. However, when you are dealing with variable-length attributes and need to be cautious about memory consumption. You can use **msgFSGetAttr** to obtain only the length of an attribute.

The message attributes are similar to those for **msgFSGetAttr**, but you specify null in the arrays indicated by **pAttrValues**.

Node Attribute Flags 72.5.8

The node attribute flags define information that is common to all file system nodes (such as read-only, hidden, and whether it is a directory or file node). To get the node attribute flags, you must create a FS_NODE_FLAGS_ATTR structure, which contains a FS_NODE_FLAGS structure and a mask.

To get attribute flags, you use the FS_NODE_FLAGS structure to indicate the node attribute flags that you want. The file system ignores the mask on input. When **msgFSGetAttr** sends back the structure, the node flags contains 0xFFFF.

To set attribute flags, you use both the FS_NODE_FLAGS structure and the mask. The mask specifies which node attribute flags you want to change. The mask enables you to alter selected node attribute flags without having to get all the node attribute flags first.

Table 72-4 summarizes the attribute flags defined by FS_NODE_FLAGS.

Table 72-4
Node Attribute Flags

Flag	Meaning
fsNodeReadOnly	The node is read-only (applies to files only).
fsNodeHidden	The node is hidden.
fsNodeDir	The node is a directory. Clients cannot change this attribute.
fsNodeGoFormat	The node has additional GO information (such as a long name or client-defined attributes). Clients cannot change this attribute.
fsNodePenPointHidden	Node is hidden from user in disk browsers.

Creating and Using Directory Indexes 72.5.9

A directory index is a fast way of specifying a directory, that is independent of paths. The Notebook uses directory indexes to implement GoTo buttons and to jump to section tabs.

To create a directory index, send **msgFSSetAttr** to a directory handle. Specify **fsAttrDirIndex** as the label. The attribute is a variable-length attribute that contains a 64-bit unique identifier (UUID). You must create the UUID by calling the function **MakeDynUUID()**. **MakeDynUUID()** is described in *Part 2: Application Framework.*

You can use the directory index in a **msgNew** rather than a locator. When you send **msgNew** to **clsDirHandle**, specify the **mode** flag **fsUserDirIndex** and put the directory index in **dirIndex**. The **locator.uid** *must* specify the volume root.

Copying and Moving Nodes 72.6

You copy nodes by sending **msgFSCopy** to a file or directory handle; you move nodes by sending **msgFSMove** to a file or directory handle. Both messages take a FS_MOVE_COPY structure that contains:

pSourcePath A path to the source node.

destLocator A locator that indicates the destination for the new node.

mode A set of flags that specify the type of move or copy operation. Currently there are three flags defined for **mode**:

msMoveCopyIntoDest Used when copying or moving directories. If you specify this flag, the directory node is moved or copied into the location specified by the locator. If you do not specify this flag, the directory node becomes the location specified by the locator.

fsMoveCopyVerifyOnly Verifies that the move or copy would succeed if performed, but does not do the actual move or copy.

exist What to do if the destination node exists already.

pNewDestName Passes back the name of the new node. If you specify NULL for this address, the buffer is not written. This parameter is necessary only if you specify **fsExistGenUnique**, so that you can receive the new name.

The following example copies the file MYDIR\MYFILE to MYDIR\MYCOPY on the same volume. If the destination file already exists, the **exist** flag specifies that the file system should overwrite it.

```
FS_MOVE_COPY                dhCopy;
dhCopy.pSourcePath = "MyDir\\MyFile";
dhCopy.destLocator.uid = theWorkingDir;
dhCopy.destLocator.pPath = "MyDir\\MyCopy";
dhCopy.intoDest = FALSE;
dhCopy.pNewDestName = Nil(P_STRING);
dhCopy.exist = fsCopyExistOverwrite;
status = ObjectCall (msgFSCopy, theWorkingDir, &dhCopy);
```

If you move a node that has other handles it, those handles are updated to reflect the new location of the node.

Traversing Nodes 72.7

At times, you might need to examine attributes for all nodes that are subordinate to a particular node. For example, you might want to sum the sizes of all nodes subordinate to a directory. To traverse the nodes of a tree, send **msgFSTraverse** to a directory handle, specifying an attribute list (similar to **msgFSGetAttr** or **msgFSReadDir**).

msgFSTraverse will traverse all directory entries subordinate to the directory that received the message. For each directory entry that it encounters, the message retrieves the specified attributes and can invoke a call-back routine, wherein you can examine the attributes. A quicksort comparison routine allows you to sort the directory entries for each directory before invoking the call-back routine.

msgFSTraverse takes a pointer to an FS_TRAVERSE structure that contains:

mode The call-back mode, defined in FS_TRAVERSE_MODE. The mode is explained in "The Traverse Call-Back Routine," below.

numAttrs The number of attributes you are requesting.

pAttrLabels An array of **numAttrs** attribute labels. The array must include **fsAttrFlags** and **fsAttrName** at a minimum.

pCallBackRtn The name of a call-back routine. For more information on the call-back routine, see "The Traverse Call-Back Routine," below.

pClientData A pointer to an area of data that can be read and written by the call-back routine.

pQuickSortRtn The name of an optional **quicksort** routine. If you don't want the directory sorted, specify **Nil**(P_UNKNOWN). For more information on the **quicksort** routine, see "The Traverse Quicksort Routine," below.

When traversing a directory handle, **msgFSTraverse** modifies the target of the handle as it visits each subdirectory. This causes a problem when you want to traverse an entire volume, because root directory handles cannot be modified. This means that **msgFSTraverse** will return **stsFSUnchangeable** if you send it to a root directory handle.

To traverse a volume starting at the root directory node, you must create a directory handle whose target node is a copy of the volume's root directory. Send **msgFSTraverse** to the new handle and it will traverse the entire volume. Be sure to destroy the new handle when you no longer need it.

The Traverse Call-Back Routine 72.7.1

Along with your arguments to **msgFSTraverse**, you name a call-back routine. The call-back routine is a user-written routine that acts on attributes found by **msgFSTraverse**.

When **msgFSTraverse** encounters a file node, enters a directory node, or exits a directory node, it can invoke your call-back routine. The **mode** argument to **msgFSTraverse** specifies when it should invoke the call-back routine.

The call-back routine receives these arguments, which are defined in P_FS_TRAVERSE_CALL_BACK:

dir If the node is a directory, the directory handle to the node. If the node is a file, the directory handle to the file's parent directory. The call-back routine can use this directory handle along with the file name attribute (**fsAttrName**) to open a file.

level The current level in the directory hierarchy, relative to starting directory for traversal.

pNextEntry A pointer to a FS_READ_DIR structure that contains the requested attributes. See the discussion of **msgFSReadDir** for more information on FS_READ_DIR.

pClientData A pointer to the client data.

You can use this area to send data to the call-back routine and to receive information gathered by the call-back routine.

The Traverse Quicksort Routine 72.7.2

If you specify the name of a **quicksort** comparison routine, the message sorts each directory according to the quicksort comparison routine before invoking the callback routine. The comparison routine must compare two values, and return -1, 0, or 1, depending on the result of the comparison.

Order of Traversal 72.7.3

When searching the directories, the traversal starts with the directory that received the message. The traversal examines each directory entry in order.

When it encounters an entry for another directory node, the traversal moves to that directory. The traversal continues recursively until it finishes with the directory entries in a node. It then returns to the previous directory in the traversal and continues.

Renaming Nodes 72.8

You rename nodes by using **msgFSSetAttr** to change the node name.

Determining the Existence of a Node 72.9

To test whether a file or directory node exists, send **msgFSNodeExists** to a directory or file handle. The message takes a pointer to an FS_NODE_EXISTS structure that contains a path that specifies the node that might exist (**pPath**). The path can be null, but that would imply that you are sending the message to a handle on a node whose existence you aren't sure. If you can send messages to the handle, the node probably exists.

When the message completes, it returns **stsOK** if the file or directory exits, or **stsFSNodeNotFound** if it doesn't exist. The message sends back the FS_NODE_EXISTS structure with a BOOLEAN value that contains **true** if the node is a directory and **false** if the node is a file (**isDir**).

Reading and Writing Files 72.10

This section discusses how to read and write files using file handles.

When you have a file handle, you can use **msgStreamRead** and **msgStreamWrite** to read and write data. For both messages take a STREAM_READ_WRITE structure that contains:

numBytes Number of bytes to read or write. This number can be as large as **fsMaxReadWrite** (defined in FS.H as 0x40000000).

pBuf A pointer to a buffer of data to read or write.

When **msgStreamRead** or **msgStreamWrite** complete successfully, they send back the actual number of bytes read or written in **count**.

This example illustrates the use of **msgStreamRead** and **msgStreamWrite**.

```
    STREAM_READ_WRITE   srw;
    char            outbuf[80];
    status = ObjectCall(msgNewDefaults, clsFileHandle, &fsNew);
    fsNew.fs.locator.pPath = "MyDir\\RWFile";
    if ((status = ObjectCall(msgNew, clsFileHandle, &fsNew)) < stsOK)
        FSErr("****FileHandle msgNew 1. Object Open failed", status);
    fh = fsNew.object.uid;
    /* Everyone's typical data... */
    srw.pBuf =
        "This is the text to write to the file.\r\n";
    srw.numBytes = strlen(srw.pBuf);
if ((status = ObjectCall(msgStreamWrite, fh, &srw)) < stsOK)
    FSErr("****FileHandle msgNew 1. Write failed", status);
srw.numBytes = 80;
srw.pBuf = (P_U8) outbuf;
if ((status = ObjectCall(msgStreamRead, fh, &srw)) < stsOK)
    FSErr("****FileHandle msgNew 1. Readfailed", status);
```

File Position and Size

72.11

As with other file systems, you can ask the file system for the current position within a file or you can set it to a new location. You can also find or change the size of a file.

Getting and Setting File Position

72.11.1

To get and set the current file position, use the message **msgFSSeek**. The message takes a pointer to a FS_SEEK structure that contains:

mode The starting position for the seek. You can start a seek at the beginning of a file, the end of a file, or at the current byte position. The starting position symbols are defined in FS_SEEK_MODE (shown in Table 72-5, below).

offset The offset in bytes. This offset is a signed value. Positive offsets move the current byte position closer to the end of file; negative offsets move it closer to the beginning of the file.

Table 72-5
FS_SEEK Flags

Flag	Meaning if Set
fsSeekBeginning	Seek is relative to the beginning of the file.
fsSeekEnd	Seek is relative to the end of the file.
fsSeekCurrent	Seek is relative to the current position of the file.
fsSeekDefaultMode	The default mode is fsSeekBeginning.

msgFSSeek sends back the current byte position, the old position, and indicates whether you are at the end-of-file marker.

To find out the current byte position, specify 0 as the **offset** value, relative to the current position. The following example shows a **msgFSSeek** call that sends back the current position.

```
FS_SEEK fhSeek;
fhSeek.offset = 0;
fhSeek.mode = fsSeekCurrent;
status = ObjectCall(msgFSSeek, fh, &fhSeek);
Debugf("Seek: Old Position: %ld, New Position: %ld %s",
    fhSeek.oldPos, fsSeek.curPos, fsSeek.eof ? "(EOF)" : "");
```

The following example shows a call to **msgFSSeek** that sets the current byte position 80 bytes after the beginning of the file.

```
FS_SEEK fhSeek;
fhSeek.offset = 80;
fhSeek.mode = fsSeekBeginning;
status = ObjectCall(msgFSSeek, fh, &fhSeek);
Debugf("Seek: Old Position: %ld, New Position: %ld %s",
    fhSeek.oldPos, fsSeek.curPos, fsSeek.eof ? "(EOF)" : "");
```

You can't set the current byte position before the beginning of the file or beyond the end-of-file. If you seek from the current position and specify a byte offset that

is before the beginning of the file, the new position is the beginning of the file; if the offset is after the end, the new position will be end-of-file. However, if you specify seek relative to the beginning of the file and pass a negative byte offset, or you specify seek relative to the end-of-file end and pass a positive byte offset, **msgFSSeek** returns **stsBadParam**.

Getting and Setting File Size 72.11.2

Use **msgFSGetSize** to get the file size and **msgFSSetSize** to set it. **msgFSGetSize** takes a pointer to a FS_FILE_SIZE value; when the message completes successfully, it stores the size in that location. **msgFSSetSize** takes a pointer to a FS_SET_SIZE structure that contains the new size of the file (**newSize**); when the message completes successfully, it sends back the previous size of the file (**oldSize**).

This example shows calls to **msgFSGetSize** and **msgFSSetSize**.

```
#define MIN_SIZE    2048
FS_FILE_SIZE        gs;
FS_SET_SIZE ss;
status = ObjectCall(msgFSGetSize, fh, &gs);
if (gs < MIN_SIZE)
{
    ss.newSize = MIN_SIZE;
    status = ObjectCall(msgFSSetSize, fh, &ss);
}
```

If you set the file size to 0, you can delete information in the file without deleting the file itself.

Flushing Buffers 72.12

You flush buffered data and node attributes with **msgFSFlush**. You send **msgFSFlush** to the handle of the file you want to flush. This message does not take any arguments.

You might want to use **msgFSFlush** to be sure that buffered data is written to a file system buffer before another process writes to the same file system buffer. This example shows a call to **msgFSFlush**:

```
status = ObjectCall(msgFSFlush, fh, (P_ARGS) null);
```

Sending **msgFSFlush** to the root directory of a volume flushes data and attributes for every file on the volume that has buffered information.

Getting the Path of a Handle 72.13

If you need to know the path currently used by a file or directory handle, use **msgFSGetPath**. The message takes a pointer to a FS_GET_PATH structure that contains:

mode What the returned path is relative to. The possible values are:

fsGetPathAbsolute Relative to the volume (the returned path begins with two backslashes (\\)).

fsGetPathRoot Relative to the root directory (the returned path begins with a backslash (\)).

fsGetPathRelative Relative to a specified directory (see dir, below).

fsGetPathName The node name only.

dir If you specified **fsGetPathRelative** for **mode**, you must specify a directory handle.

bufLength The length of your return buffer.

pPathBuf A pointer to the buffer that receives the path.

This example shows an example of **msgFSGetPath**:

```
FS_GET_PATH fsGetPath;
char    pPath[fsMaxPathLength];
fsGetPath.mode = fsGetPathRoot;
fsGetPath.dir = objNull;
fsGetPath.pPathBuf = pPath;
fsGetPath.bufLength = fsMaxPathLength;
status = ObjectCall(msgFSGetPath, dh, &fsGetPath);
```

Changing the Target Directory

72.14

You can change the target directory for a directory handle by sending the message **msgFSSetTarget** to any directory handle. This message takes a pointer to a FS_LOCATOR structure that specifies:

uid A directory handle.

pPath The path to the new target directory.

This example illustrates a call to **msgFSSetTarget**.

```
FS_LOCATOR  loc;
loc.uid = theWorkingDir;
loc.pPath = "MyDir\\SubDir";

status = ObjectCall(msgFSSetTarget, dh, &loc);
```

You can also use **msgFSSetTarget** to change the target of the well-known handle, **theWorkingDir**.

Remember that the **unchangeable** attribute might prevent you from changing the target on other well-known or global handles. If you attempt to change a target to a file node, rather than a directory node, **msgFSSetTarget** returns **stsFSNotDir**.

Comparing Handles

72.15

Use **msgFSSame** to find out whether two handles reference the same node. You call **msgFSSame** by sending it to a handle; the only message argument is another handle. If the two handles reference the same node, **msgFSSame** returns **stsOK**; if different, it returns **stsFSDifferent**.

This example illustrates the use of **msgFSSame**.

```
FS_LOCATOR  loc;
DIR_HANDLE  dh1;
...
loc.uid = theWorkingDir;
loc.pPath = "MyDir\\MyFile 1";
status = ObjectCall(msgFSSetTarget, dh1, &loc);
...
status = ObjectCall(msgFSSame, theWorkingDir, dh1);
```

Getting and Setting Handle Mode Flags 72.16

When you create a directory or file handle, you specify mode flags that indicate options for the different handles. If, at a later time, you want to get or re-set the options for a handle, you can use **msgFSGetHandleMode** and **msgFSSetHandleMode**.

msgFSGetHandleMode takes a pointer to a U16 value that will receive the mode flags. When you send the message to a file handle, it interprets the pointer as a pointer to a FS_FILE_NEW_MODE value; when you send the message to a directory handle, it interprets the pointer as a pointer to a FS_DIR_NEW_MODE value.

The mode flags for directory handles are described in Table 72-1; the mode flags for file handles are described in Table 72-2.

msgFSSetHandleMode takes a pointer to a FS_SET_HANDLE_MODE structure, which contains:

mode A FS_FILE_NEW_MODE or FS_DIR_NEW_MODE value. The type of value depends on whether you send the message to a file or directory handle (both types are actually U16s).

mask A mask value.

The mask specifies which mode flags you want to change. The mask enables you to alter selected mode flags without having to get all the mode flags first.

msgFSSetHandleMode can change only a few of the handle mode fields (**fsTempDir** or **fsTempFile** and **fsSharedMemoryMap**, for example). Very few, if any, network file systems allow you to change the read-write access or exclusivity of a file once you have opened it.

Reading Directory Entries 72.17

Use **msgFSReadDir** to sequentially read selected attributes from all entries in a directory. Each time you send **msgFSReadDir**, the file system sends back the specified attributes, then updates the directory's **current directory position**. The current directory position is initially set to the beginning of the directory entries, and is advanced each time you send **msgFSReadDir**.

The arguments to **msgFSReadDir** are similar to **msgFSGetAttr**. You define three parallel arrays that contain attribute labels, locations or pointers, and sizes.

msgFSReadDir takes a pointer to a FS_READ_DIR structure that contains:

numAttrs The number of attributes that you want.

pAttrLabels An array of attribute labels, **numAttrs** long.

pAttrValues An array of P_UNKNOWN, used to store both 32-bit values and pointers to buffers that receive variable-length attributes. You must specify the pointer values when you send **msgFSReadDir**.

pAttrSizes An array of FS_ATTR_SIZE, used to store the length of the variable-length attributes. If you don't want the message to return the sizes, specify Nil(P_FS_ATTR_SIZE) for the pointer.

After you read the last entry, any subsequent **msgFSReadDir** messages return **stsEndOfData**. You can move the current directory pointer back to the beginning of the directory with **msgFSReadDirReset**.

When you change a target node (with **msgFSSetTarget**), the current directory position is set to 0.

Reading All Directory Entries 72.17.1

You use **msgFSReadDirFull** to get a copy all directory entries. You tell PenPoint which directory you want and the attributes you are interested in. PenPoint allocates a heap block, creates a linked list of blocks containing the attributes you requested, and sends back a pointer to the first block (in **pNext**) and the number of blocks in the list (**numEntries**).

Each block contains a pointer to next block (NULL for the last block) and a series of pointers to the requested attribute values. The values are part of the returned heap block.

When you are done with the attributes, you must free the memory block with **OSHeapBlockFree**(); PenPoint cannot do it for you. **OSHeapBlockFree**() is documented in the *Part 8: System Services.*

The current directory position used by **msgFSReadDir** is not affected by **msgFSReadDirFull**.

Sorting Directory Entries 72.17.2

One reason to use **msgFSReadDirFull** is to sort a series of directory entries on a particular attribute. To sort the returned directory entries, use the PenPoint **quicksort** routine.

quicksort sorts a linked list of variable length blocks (which is the format of attributes returned by **msgFSReadDirFull**). **quicksort** takes a pointer to the list and a user-supplied routine for comparing two blocks. It rearranges the sequence by readdressing the links. **quicksort** is described in detail in the *API Reference Manual, Part Eight: System Services.*

This example uses **quicksort** to sort directory entries. It was drawn from the PenPoint application framework.

```
/*****************************************************************
    AppDirCompSeq

    Comparison routine for sorting directory entries by sequence
    number.
*****************************************************************/
int cdecl AppDirCompSeq (
    P_FS_READ_DIR p,
    P_FS_READ_DIR q)
{
    U32 a;
    U32 b;
    a = ((P_APP_DIR_NEXT)(p->attrValue.pValues))->attrs.sequence;
    b = ((P_APP_DIR_NEXT)(q->attrValue.pValues))->attrs.sequence;
    if (a < b) return -1;
    else if (a > b) return 1;
    else return 0;
}
...
{
    /* Read entire directory.   */
    readDirFull.numAttrs            = appDirNumReadDirFullAttrs;
    readDirFull.attrLabel.pLabels   = appDirAttrLabels;
    ObjCallRet(msgFSReadDirFull, dir, &readDirFull, status);
    pReadDir = pArgs->handle = readDirFull.pDirBuf;
    /* Sort directory snapshot by sequence. */
    pReadDir = quicksort(pReadDir, AppDirCompSeq);
...
    /* Deallocate attributes' segment. */
    status = OSHeapBlockFree(pReadDir);
}
```

Observing Changes 72.18

The file system allows you to make yourself an observer of **theFileSystem** or a directory. When a volume is added or removed from **theFileSystem** or when nodes are added or removed from a directory, observers receive **msgFSChanged**. The message carries an FS_CHANGE_INFO structure that contains:

observed The UID of the observed object that changed.

reason The message that caused the change.

Making a Node Native 72.19

At some point you might need ensure that a node will be fully compatible in a non-PenPoint environment. This means removing all PenPoint-specific information from a file, such as the long file names, PenPoint-specific attributes, and client-specified attributes. To remove the PenPoint-related information, use **msgFSMakeNative**.

msgFSMakeNative takes a pointer to an FS_MAKE_NATIVE structure that contains:

pPath A path to the node.

newName A pointer to the buffer that will hold the new node name.

This example shows a call to **msgFSMakeNative.**

```
FS_MAKE_NATIVE  make_native;
char    nameArray[13];
make_native.pPath = "File with a long name";
make_native.newName = nameArray;
status = ObjectCall(msgFSMakeNative, theWorkingDir, &make_native);
```

Getting Volume Information

72.20

You can get information about a specific volume by sending **msgFSGetVolMetrics** to a volume object. To get a list of volume objects send **msgFSGetInstalledVolumes** to **theFileSystem.**

The message takes a pointer to an FS_GET_VOL_METRICS structure that contains:

updateInfo A BOOLEAN value that indicates that all volume information should be refreshed before it is returned.

pVolMetrics An FS_VOL_METRICS structure that defines the variables that contain the returned information. Table 72-6 lists the members in FS_VOL_METRICS and their meanings.

Table 72-6
Volume Metrics Information

Metric	Meaning
type	Indicates the volume type. The type constants are defined in FS_VOL_TYPE.
flags	Indicates a number of volume attributes. The flags are defined in FS_VOL_FLAGS and are:
fsVolReadOnly	The volume is read-only.
fsVolConnected	The volume is currently connected (must set update=true to keep this current).
fsVolRemovableMedia	The volume is located on removable media.
fsVolEjectableMedia	The volume media can be ejected.
fsVolDirsIndexable	The volume supports directory indexes. Some volumes cannot support directory indexes.
fsVolFormattable	The volume can be formatted.
fsVolDuplicatable	The volume can be duplicated by a track-by-track physical duplicator. A common way to duplicate entire volumes is to physically copy each track to the identical track on a volume of the exact same type, without interpreting the data or attempting to un-fragment the files. Some volumes cannot be duplicated this way (such as hard disks).
rootDir	A handle on the volume's root directory.
volObj	The volume object UID.
serialNum	The volume's serial number.
optimalSize	The optimal block size for I/O.
totalBytes	Total number of bytes on the volume.
freeBytes	The number of free bytes on the volume (must set update=true to keep this current).
commSpeed	The communication speed (for remote volumes).
iconResId	The resource ID for the volume's icon.
pName	A buffer to receive the volume name.

The following example illustrates a call to **msgFSGetVolMetrics** that gets volume information for the current directory.

```
FS_GET_VOL_METRICS  volMetrics;
volMetrics.updateInfo = TRUE;  // This ensures an update to all fields.
status = ObjectCall(msgFSGetVolMetrics, theWorkingDir, &volMetrics);
```

Setting or Changing a Volume Name 72.21

To set or change the name of a volume, send **msgFSSetVolName** to a file or directory handle on the volume that you want to rename. The message takes a single argument, a pointer to a string that contains the new volume name.

Currently the volume name must conform to MS-DOS volume naming conventions (up to 11 characters; cannot contain / \ ; : = < > [or]). If the volume name does not conform, the message returns **stsBadParam**.

Ejecting Floppies 72.22

For floppy disk drives that support programmatic control of disk ejection, there is normally no eject button on the drive. Usually the user ejects such a floppy disk volume by making an E, e, or X gesture on the disk icon in the disk browser.

If you need to eject the floppy disk volume under programmatic control, send **msgFSEjectMedia** to a directory handle or file handle. The file system ejects the volume associated with that handle. The message takes no arguments.

Volume Specific Messages 72.23

You can send messages that are specific to a particular device with **msgFSVolSpecific**. You can send this message to either a directory or file handle. Among the reasons for using this message are:

- Getting or setting the Macintosh icon on a TOPS file that resides on a Macintosh.
- Getting a volume-specific error code.
- Low-level device access to device drivers.

The message takes a pointer to a VOL_SPECIFIC structure that contains:

pPath A path to a node. This is only meaningful when you send the message to a directory handle; it must be null if you send the message to a file handle.

msg A message. You must define the messages yourself.

pArgs A pointer to the arguments for the message.

Part 8 / System Services

Chapter 73 / Introduction

The PenPoint™ system services allow you to enhance memory utilization and performance in your programs by providing access to the PenPoint kernel at the lowest level, and by providing optimized run-time routines.

Simple applications may not need to use system services at all. Instead they rely on the PenPoint Application Framework to install their code, create their processes, and communicate with them. They use the class manager to communicate with other objects.

The most common use of system services is to allocate and free memory using **OSHeapBlockAlloc**() and **OSHeapBlockFree**().

Organization of This Part 73.1

This part explains the PenPoint system services concisely. The chapters of *Part 8: System Services* cover the following information:

- Chapter 73, Introduction, is this chapter.
- Chapter 74, PenPoint Kernel Overview, describes the kernel, and the functional elements such as processes, tasks, and task communications that comprise the low-level operation of a PenPoint computer. At its end are tables summarizing the kernel-level APIs.
- Chapter 75, C Run-Time Library, introduces GO's run-time support for the C programming language.
- Chapter 76, Math Run-Time Library, introduces GO's fixed-point math libraries.

Other Sources of Information 73.2

"Datasheets" for each function are in the *PenPoint API Reference*, so that you can quickly locate the syntax for an individual kernel or run-time function.

Most datasheets in the *PenPoint API Reference* are formatted versions of the information in the corresponding header file. However, because the run-time library and other parts of system services are based on WATCOM's standard header files, the information in the header files is not the same as the information in the datasheets.

The *PenPoint Application Writing Guide* explains common `typedefs`, status values, and macros used in PenPoint.

Chapter 74 / PenPoint Kernel Overview

The kernel is the lowest-level application-accessible component of the PenPoint™ operating system. Applications and other programs access the kernel through function calls; in turn, the kernel accesses the computer hardware:

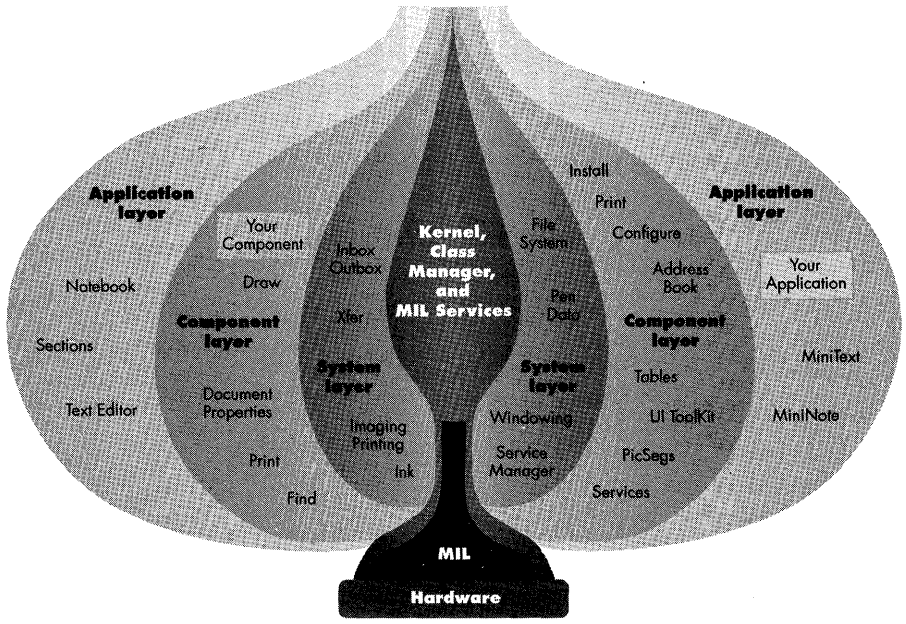
- Directly when performing process management, scheduling, synchronization, and memory management.
- Indirectly through the PenPoint MIL (Machine Interface Layer), when communicating with devices.

These calls are invisible to the application programmer. The kernel provides the following services for PenPoint operations:

- Multitasking, message-passing executive.
- Threads (lightweight tasks sharing the same address space).
- Protected memory management and code execution.
- Semaphores for process synchronization.
- Procedural interface.

Figure 74-1 shows the position of the kernel in the PenPoint software architecture.

Figure 74-1
PenPoint System Architecture



The Machine Interface Layer 74.1

The PenPoint operating system is designed so that it is not dependent on the hardware on which it runs.

The most obvious hardware dependency is on the central processor. However, even hardware that uses a common central processor can have different peripheral devices, such as screens, stylus and digitizers, storage devices, clock chips, and ports.

To support different types of devices, the PenPoint operating system defines a protocol for communicating with devices, called the Machine Interface Layer (MIL). Only the PenPoint kernel and PenPoint device drivers (called MIL services) make calls to the MIL; applications and non-MIL services never communicate directly with MIL.

The Kernel Layer 74.2

The kernel is the portion of the operating system that interacts directly with the processor to manage tasks, memory, and communication between tasks. It allocates memory dynamically as applications run. It manages the sending and receiving of synchronization messages between concurrent processes, and it schedules the resources that these processes need as they execute (access to common data, execution rights for shared code, and so on).

The kernel layer is different in several ways from the portions of the PenPoint operating system that are above the kernel layer:

- The kernel layer is not object-oriented, rather it provides support for the PenPoint object-oriented architecture.
- The kernel layer does not send or receive messages, it uses function calls.

Task Management 74.3

In PenPoint, a **task** is the basic executing entity and refers to any executing thread of control. There are two kinds of tasks: **processes** and **subtasks**. Processes and subtasks are scheduled and run by a software scheduler based on a priority scheme that determines which task should run at any given time.

Processes 74.3.1

A **process** is the first task that runs when an application is instantiated (typically when the user turns to a document of that application). Processes own the resources used by the instance including memory, subtasks, and semaphores (used in locking and interrupts). When a process is terminated, all resources owned by it are returned to the system.

Subtasks 74.3.2

A **subtask** is a thread of execution started by either a process or a subtask. It uses the same context as its parent process. Subtasks created by other subtasks are called

sibling subtasks; all siblings are considered to be at the same level regardless of the creator. The process that creates a subtask **owns** that subtask and any sibling subtasks created by it in a child-parent relationship. A process and all its subtasks make up a **task family**. When a process dies, all its subtasks are cleaned up so that PenPoint can reuse the task family's local memory.

A subtask has the following characteristics:

- It shares all memory with its parent process and any siblings.
- It owns no resources itself.
- It has its own general registers and stack.
- It can lock semaphores, receive and send messages.

Software Task Scheduler 74.3.3

PenPoint allows tasks to dynamically create and delete other tasks in the system. Kernel functions are provided to start processes and subtasks. In addition, The kernel allows for the termination of a given task by any other software task.

In order to start another process, the executable file that contains the code for that process must have already been loaded into the loader database (see the **OSProgramInstall**() function for more details). To start a process, the kernel creates a new execution context (that is new local memory context).

Unlike subtasks, which are hierarchically below their parent process, processes started by other processes (or subtasks) are not hierarchically linked. Since there is no process hierarchy, the following is true:

- The process creator has no special impact on the process being created (and *vice versa*). Thus, if the creator terminates, the newly created process is not notified or terminated. Likewise, the creator is not notified if the newly created process terminates.
- A copy of the process creator's file handles are not passed on to the new process.
- A process is free to associate itself with other processes in whichever way it wants. This more closely resembles the metaphor used by the notebook software (where an application can move from one page to another and applications can be arbitrarily embedded into other applications).

Priority Level 74.3.4

Software tasks have set **priority levels** to control their order of execution. Task scheduling is by priority only. Processes and subtasks with higher priorities execute before lower priority tasks. Priorities may be altered by the task itself or by any other task in the system. Priorities are defined by their priority class (high, medium high, medium low, and low) and a priority within that class (0-50). The PenPoint operating system arranges task priorities within bands.

Intertask Communication 74.4

Intertask communication in PenPoint takes place through **messages** and **semaphores**.

Messages and Queues 74.4.1

An **intertask message** is a pre-defined PenPoint element that contains miscellaneous information for a task along with an optional, variable-length message buffer.

Intertask messages should not be confused with class manager messages. Intertask messages are sent to tasks and begin with the prefix **OSITMsg** where **OS** stands for operating system and **ITMsg** stands for intertask message. Class manager messages are sent to objects and begin with the prefix **msg**.

Important Intertask messages are not the same as class manager messages.

For communications between tasks, the kernel relies on intertask messages. Intertask messages are transferred between tasks, using the task identifier to target the message. Messages contain miscellaneous information along with an optional message buffer. Message buffers are variable length and are not interpreted by the kernel. There is only one message queue per task (subtask or process). The message queue is organized using a first in-first out algorithm.

Messages can be transferred in two modes: **copy** or **noCopy**. **Copy** is the normal mode with all of the data associated with the message copied into the workspace of the target task. **NoCopy** is used for high speed data exchange at the expense of some protection. In **noCopy** mode, the sender passes a pointer to a shared heap, which contains the message buffer.

The message facility also allows the client to pass a 32-bit token as part of the message. In small transfers of data, this token could contain the entire message data.

ObjectSend() uses intertask messages to send a message to an object in a different task. Application developers should use **ObjectSend**() instead of the kernel call **OSITMsgSend**().

Normally messages are sent to just one task. However, the kernel will allow messages to be sent to multiple tasks by the use of broadcast messages. When broadcasting, the kernel sends the message to all tasks that are allowed to receive messages. The broadcast message can be sent to all tasks in the system, or to a single task and its task family. Note that the sending task does not receive its own broadcast message.

As described above, messages are normally processed in FIFO order. However, messages can be processed out of order by the use of filters. A task receiving messages can choose to get a message from the queue using two types of filters:

- The task can have a filter that specifies the types of messages that can be placed in its queue.
- The dispatch loop for the task can use a filter when receiving messages from the task's message queue.

The kernel uses messages to inform tasks of certain important events. As mentioned before, upon task termination, the kernel broadcasts a message to the entire system on a special filter. Those applications that have enabled that filter in their filter mask will be notified.

Semaphores 74.4.2

For synchronization (which really is a form of communication), the kernel provides **semaphores**. A semaphore, as in most operating systems, is a lock that allows only one process or subtask access to a resource at one time. Semaphores have two major purposes:

- To lock tasks in order to prevent collisions between contending tasks seeking access.
- To accept interrupts in event handling, usually from device drivers.

The kernel implements a counting semaphore, so that if a particular task calls for a particular number of lock operations, the task must issue an equal number of unlock operations before the semaphore is free. If a task requests access to a semaphore and is forced to wait because another task has already locked it, the requesting task will be put to sleep until the semaphore is cleared. At that time the highest priority task waiting on that semaphore will be given ownership of the semaphore lock and will be put into the ready list.

If a task with a locked semaphore dies, the kernel will unlock that semaphore and notify the next task attempting to lock that semaphore of the forced unlock by the system. It is up to that next task to determine if there is a problem (for example, an inconsistent data structure). If the semaphore is protecting a critical data structure, any task accessing that data structure (and semaphore) should know how to clean up from accidental task termination. The best way to do this is to centralize access to the semaphore. If all tasks access the semaphore using the same code, then handling the exception case need only be done in that one location.

Memory Management 74.5

In the PenPoint operating system, memory has attributes, such as shared or local, locked or unlocked, access rights, privilege level, length, and so on. Tasks must request the amount of local and shared memory required for execution.

The PenPoint operating system provides a 32-bit flat memory model. Memory is allocated in **heaps**. Allocation of heaps is referred to as **heap management**. The heap manager uses a portion of address space that has already been allocated.

Heaps 74.5.1

A **heap** is a region or list of regions of virtual memory. The heap manager handles the allocation and freeing of smaller blocks within those regions. The heap manager code runs at the privilege level of the code that calls it, so the memory it allocates has the privilege of the code calling it.

The size and characteristics of a heap is defined by the task that creates it. By default, heap regions are 16K bytes long; heaps larger than 16K bytes are allocated in multiples of 4K bytes. Each heap uses a minimum of 4K bytes; its elements can be fixed or variable length. Heaps can be shared (accessible to multiple processes) or local. See OSHEAP.H for more information on heaps.

The system automatically creates two heaps for each process: a local heap and a shared heap. **osProcessHeapId** is the handle (well-known UID) on the local heap for each process; **osProcessSharedHeapId** is the handle for the shared heap.

Most applications should be able to use these predefined heaps and should not need to create additional heaps. When necessary, an application can minimize fragmentation within a heap by using different heaps for different functions. This is only efficient when the data in each heap is greater than than 4K bytes.

Because the heap manager allocates memory within a region, no hardware protection is provided.

The PenPoint operating system does not support either heap compaction or garbage collection.

The heap manager provides a number of utility routines to simplify the management of heaps.

80386 Protected Mode

74.5.2

The PenPoint 1.0 runs in the protected mode of the 80386. This means that the kernel utilizes the hardware facilities for task management and memory protection. The hardware will provide a completely separate address space (through virtual memory) for different programs.

A task family shares local memory. Each process has its own local memory, which is accessible by all the subtasks in its task family, but not by other processes. This means that if a task passes the address of some object in local memory to a task in another task family, the pointer will be invalid or point to some random data for the second task. You should be careful to use shared memory for data which needs to be accessed by tasks using different process contexts.

Shared memory is accessible to all processes. When the CPU switches to a task in a different process, it switches to the new process's local memory.

A task can allocate memory that is either local to its task family or shareable among many different tasks. Different tasks can share ownership of shared memory. The memory manager maintains a reference count of the memory. The memory will be freed only when all tasks sharing the memory have freed their pointers to that memory.

The memory model does support memory movement. The memory manager guarantees that the selector pointing to the memory block will always be valid until that block is freed. In addition, the memory manager exports a number of low level memory routines to support externally developed system code such as device drivers.

Rings 74.5.3

In addition to memory protection among processes, PenPoint utilizes the ring structure of the 386 to protect system data structures from mischievous applications. The kernel runs in supervisor mode (ring 0). Applications run in user mode (ring 3). Data structures that are allocated in supervisor mode by the kernel are not be accessible to application code. Application code can use the function **OSSupervisorCall()** to access the kernel. Applications cannot access system buffers (even those in shared memory).

Shared memory is used for anything that is required across many different processes. Examples include system data structures, application code, and shared objects.

Privilege Levels 74.5.4

A task always executes at some **privilege level**. Memory is accessed through regions. Each region has a privilege level and access permissions (read-only, read-write). All of a task's accesses to memory are checked against the privilege level and access rights of the region. The PenPoint kernel and device drivers have a higher privilege than application tasks.

A task cannot access more privileged data, nor can it execute code at other privilege levels unless that code has made special arrangements. For example, application code can only call PenPoint kernel routines through routines in PENPOINT.LIB.

Date and Time Services 74.6

Timer Routines 74.6.1

Timer notification comes in two flavors: notification by semaphore and notification by message. In the first case, the client calls a function. In the latter case, the client sends a message to a special well-known object, **theTimer**.

If notification is done by semaphore, the client must provide the semaphore; the system will reset that semaphore at the appropriate notification time.

Because the kernel counts time by the system tick interrupt, no timeout values in the range of the system tick interval time will be very accurate. When a timer request occurs and is placed on the transaction queue, the timer subsystem has no way of knowing how much time elapses between the request and the next system tick. As a result, the timer allots the entire **systick** interval time (roughly 30 milliseconds) to the transaction.

Alarm Services 74.6.2

The alarm subsystem uses the clock chip to keep track of the next alarm. A queue of alarms transactions is maintained so that more than one alarm can be set in the system. The alarm code calls the MIL clock device to handle the details of setting an alarm.

Current Time 74.6.3

The kernel provides routines to set and get the date and time from the clock chip. The clock chip is updated through the MIL.

Other Routines 74.6.4

Chapter 75, C Run-Time Library, describes the run-time routines to manipulate the time and date, and some system preferences that determine the user's desired time and date formats.

Object-Oriented Timer Interface 74.6.5

You can access timer and alarm services in an object-oriented manner. There is a well-known object, **theTimer**, which responds to messages. You can ask it to **notify** an object when a timer period expires, or repeatedly, or at a particular alarm time. At the appropriate time, **theTimer** sends **msgTimerNotify** or **msgTimerAlarmNotify** to that object.

theTimer is a well-known instance of **clsTimer**; it's the only instance. (They share the same UID, in fact.)

The messages which **clsTimer** defines are in \PENPOINT\SDK\INC\TIMER.H. They are:

Table 74-1
theTimer Messages

Message	Takes	Description
msgTimerRegister	P_TIMER_REGISTER_INFO	Registers a request for notification with ObjectPost().
msgTimerRegisterAsync	P_TIMER_REGISTER_INFO	Registers a request for notification with ObjectPostAsync().
msgTimerRegisterDirect	P_TIMER_REGISTER_INFO	Registers a request for notification with ObjectPostDirect().
msgTimerRegisterInterval	P_TIMER_INTERVAL_INFO	Registers a request for interval notification.
msgTimerAlarmRegister	P_TIMER_ALARM_INFO	Registers a request for alarm notification.
msgTimerAlarmStop	OS_HANDLE	Stops a pending alarm request.
msgTimerTransactionValid	OS_HANDLE	Determines if a timer transaction is valid.
msgTimerStop	OS_HANDLE	Stops a timer transaction.
		Advisory Messages
msgTimerNotify	P_TIMER_NOTIFY	Notifies the client that the timer request has elapsed.
msgTimerAlarmNotify	P_ALARM_NOTIFY	Notifies the client that the alarm request has elapsed.

A timer request can continue to count down *after* a PenPoint computer is powered-on. An alarm can go off *while* a PenPoint computer is off, and it will turn the PenPoint computer back on in order to deliver the alarm message.

Note This is a hardware feature that may or may not be present on any particular PenPoint computer.

The Clock application uses **theTimer** extensively. Its code is in \PENPOINT\SDK\SAMPLE\CLOCK, and is briefly discussed in the *PenPoint Application Writing Guide.*

Sound Routine 74.7

The kernel provides two basic routines to sound the speaker on a PenPoint computer: **OSErrorBeep**() and **OSTone**(). In **OSErrorBeep**() you specify the type of error (warning or fatal), and the computer beeps the appropriate tone. **OSTone**() is more general; it allows you to sound the speaker, specifying a tone, duration, and volume.

PenPoint Kernel Summary 74.8

The PenPoint operating system kernel functions are defined in two header files:

OS.H Defines functions for tasking, memory information, inter-task communication, and timer services.

OSHEAP.H Defines functions for memory management.

The corresponding Part 8 in the *PenPoint API Reference* describes the details of PenPoint Kernel API. Every function is described along with its associated parameters. The functions defined in OS.H are summarized in Table 74-2; the functions defined in OSHEAP.H are summarized in Table 74-3. For more information on each of these functions, see the header files.

Table 74-2
Kernel Functions

Function	Description
	Task Manager Routines
OSProgramInstall()	Installs a program into the loader database.
OSProgramDeinstall()	Deinstalls a program already loaded into the loader database.
OSProgramInstantiate()	Creates an instance of a program.
OSProgramInfo()	Returns information on the program from the loader.
OSSubTaskCreate()	Creates a new execution thread in this context.
OSTaskTerminate()	Terminates a task.
OSThisTask()	Passes back the task identifier of the current running task.
OSTaskPrioritySet()	Sets the priority of a task or a set of tasks.
OSTaskPriorityGet()	Passes back the priority of a task.
OSTaskNameSet()	Sets a 4 character name for the given task.
OSTaskDelay()	Delays the current task for a specified period of time.
OSNextTerminatedTaskId()	Notifies the caller of the tasks that have terminated.
OSModuleLoad()	Loads a module into the loader's database.
OSEntrypointFind()	Finds an entrypoint in a loaded module either by name or by ordinal.
OSProcessProgHandle()	Passes back the program handle for the process.
OSThisApp()	Passes back the application object stored with the current process.
OSTaskApp()	Passes back the application object for a given process.
OSTaskProcess()	Returns the process id for the task specified.

continued

Table 74-2 (continued)

Function	Description
OSTaskInstallTerminate()	Notifies tasks waiting on OSProgramInstall that the instance is finished.
OSEnvSearch()	Searches the environment for the specified variable and returns its value.
OSAppObjectPoke()	Stores the application object for the current process.
	Intertask Communications Routines
OSITMsgSend()	Sends an inter-task message to a task or set of tasks.
OSITMsgReceive()	Receives a message from the task's message queue.
OSITMsgPeek()	Gets the next message from the message queue without removing it.
OSITMsgFilterMask()	Sets the filter mask for this task.
OSITMsgFromId()	Passes back the message associated with the message identifier.
OSITMsgQFlush()	Flushes the message queue of all messages matching the message filter.
OSSemaCreate()	Creates a semaphore.
OSSemaOpen()	Opens (accesses) an already existing semaphore.
OSSemaDelete()	Deletes a semaphore.
OSSemaRequest()	Locks the counting semaphore (increments the count).
OSSemaClear()	Unlocks the counting semaphore (decrements the count).
OSSemaReset()	Resets event semaphore (no matter what count).
OSSemaSet()	Sets the event semaphore to 1.
OSSemaWait()	Waits for the event semaphore to be reset.
OSFastSemaInit()	Initialize fast sema.
OSFastSemaRequest()	Fast version of sema request.
OSFastSemaClear()	Fast version of sema clear.
	Memory Information Routines
OSMemInfo()	Returns information on memory usage for a specified task.
OSMemUseInfo()	Returns information on memory usage for a specified task.
OSMemAvailable()	Return amount of swappable memory available (to caution zone).
	Date and Timer Routines
OSTimerAsyncSema()	Reset a semaphore after time milliseconds.
OSTimerIntervalSema()	Resets a semaphore after each time interval has elapsed.
OSTimerStop()	Stops a timer request given its transaction handle.
OSGetTime()	Returns local time.
OSSetTime()	Sets the time or time zone.
OSPowerUpTime()	Passes back the number of milliseconds since the last reset.
OSSetInterrupt()	Sets up an interrupt handler.
OSTimerTransactionValid()	Checks to see if the timer transaction is valid.
	Debugger Entry Routines
Debugger()	Enters the debugger.
OSDebugger()	Enters the debugger, should only be called in special situations.

continued

Table 74-2 (continued)

Function	Description
	Keyboard Routines
KeyPressed()	Determines if a key is available.
KeyIn()	Passes back the next key and the scan code from the keyboard.
	Tone Routines
OSErrorBeep()	Outputs a tone based on the type of error encountered.
OSTone()	Sends a tone for a given duration at the specified volume level.
	Display or Screen Device Routines
ScreenOnlyStringPrint()	Prints a string onto the console.
OSDisplay()	Changes the display to the console or the graphics screen.
OSThisWinDev()	Passes back the windowing device for this application.
OSWinDevPoke()	Stores the windowing device for the specified process.
osPrintBufferRoutine()	Function variable print routine.
	Miscellaneous Routines
OSPowerDown()	Powers down the machine.
OSSystemInfo()	Passes back information on the system configuration.

Table 74-3
Heap Routines

Function	Description
OSHeapCreate()	Creates a heap.
OSHeapDelete()	Deletes a heap. Frees all memory allocated by clients and by the heap manager.
OSHeapBlockAlloc()	Allocates a block within the heap.
OSHeapBlockFree()	Frees a heap block.
OSHeapBlockResize()	Resizes a heap block.
OSHeapInfo()	Passes back information on a heap.
OSHeapId()	Passes back the heap id from which a heap block has been allocated.
OSHeapBlockSize()	Passes back the size of the heap block.
OSHeapPoke()	Stores 32 bits of client info in the heap header.
OSHeapPeek()	Passes back the client info previously set via OSHeapPoke().
OSHeapAllowError()	Changes the "out of memory" behavior of heap block allocation.
OSHeapClear()	Clears a heap. Deletes all the allocated heap blocks but not the heap.
OSHeapOpen()	Adds the specified task as an owner of the specified heap.
OSHeapClose()	Remove the specifed task as an owner of the specified heap.
OSHeapEnumerate()	Enumerates all the heaps in the given process.
OSHeapWalk()	Traverses the given heap.
OSHeapMark()	Marks all the allocated blocks in given heap.
OSHeapPrint()	Prints debugging info about the given heap.

Chapter 75 / C Run-Time Library

This chapter lists the C run-time library available to developers of PenPoint applications and services. Many of the C run-time functions are provided by the WATCOM C run-time library. Other functions provided in PenPoint include:

- Time and date preferences.
- 16-bit character support.

ANSI Standard C Routines 75.1

For information on the WATCOM C run-time library, see the *WATCOM C Library Reference for PenPoint.*

Table 75-1 lists the files in the WATCOM C run-time library.

Table 75-1
WATCOM C Run-Time Library

File	Contents
ASSERT.H	Assertion macros.
CONIO.H	Port I/O functions.
CTYPE.H	Character manipulation functions.
DIRENT.H	Directory functions and declarations.
ENV.H	Prototypes of environment string functions.
FCNTL.H	Flags used by open and sopen.
FLOAT.H	Declarations and constants used with floating point numbers.
I86.H	Low-level CPU functions.
LIMITS.H	Constants for limits and boundaries.
MALLOC.H	Memory allocation and deallocation functions.
MATH.H	Mathematical functions.
SEARCH.H	Searching functions (lfind and lsearch).
SETJMP.H	Declarations for setjmp and longjmp functions.
SIGNAL.H	Declarations for signal and raise functions.
STDARG.H	Variable-length argument list functions.
STDDEF.H	A number of standard constants.
STDIO.H	Standard input and output functions.
STDLIB.H	Declarations for standard functions.
STRING.H	String and memory functions.
TIME.H	Time and date functions.
UNISTD.H	System level I/O functions.
UTIME.H	Declarations for utime function.

Time and Date Preferences 75.2

The user (or a program) can specify the desired format for certain system parameters called preferences. These are maintained by **theSystemPreferences** in a resource file. You can get and set preferences by sending resource messages such as **msgResReadData** to **theSystemPreferences**. Resources are explained in *Part 11: Resources.*

System Time 75.2.1

One of the preferences is the current system date and time, with the well-known resource ID **prTime**. The time is in an OS_DATE_TIME structure.

Getting this resource is an alternative to calling the **OSGetTime**() routine.

Time Formats 75.2.2

Other user preferences indicate:

- Whether the user prefers time in military (24-hour) format or regular format (resource ID **prTimeFormat**).
- Whether the user wants to see seconds in time displays (ID **prTimeSeconds**).
- How the user prefers to see dates displayed (ID **prDateFormat**).

Date and Time Strings 75.2.3

Instead of retrieving all these resources, then formatting a string accordingly, you can call functions that create formatted strings for a specified time based on the current user preferences:

- **PrefsDateToString**() fills in a string you supply with the date. The string should be at least **prefsMaxDate** long (this may change if additional formats are added).
- **PrefsTimeToString**() fills in a string you supply with the time. The string should be at least **prefsMaxTime** long (this may change if additional formats are added).

16-Bit Character Support 75.3

PenPoint 2.0 will contain support for applications that are written for more than one language or region. To support languages that have large numbers of characters (such as Japanese), PenPoint 2.0 will support 16-bit characters.

PenPoint 1.0 already includes many features that will be used to support 16-bit character sets. These features include:

- New character types and macro support.
- New run-time library string functions.
- New string composition functions.

16-Bit Character Types 75.3.1

PenPoint provides three character types: CHAR8, CHAR16, and CHAR. The first two provide eight and sixteen bit characters, respectively. In PenPoint 1.0, the plain CHAR type is 8 bits long; in PenPoint 2.0, CHAR is 16 bits long.

When you use CHAR8, you can use standard C conventions for forming character and string constants. That is:

```
CHAR8 *s = "string";
CHAR8 c = 'c';
```

When you use the CHAR16 type, you must preceed the character or string constant with the letter L, which tells the compiler you are using a 16-bit (or long) character, as in:

```
CHAR16 *s = L"string"
CHAR16 c = L'c'
```

When you use the CHAR type, you must preceed the character or string constant with the identifier "U_L", which means UNICODE, long. In PenPoint 1.0, this tells the compiler to use 8-bit characters; in PenPoint 2.0, this tells the compiler to use 16-bit characters.

```
CHAR *s = U_L"string";
CHAR c = U_L'c';
```

16-Bit String Function 75.3.2

The file INTL.H defines a new set of run-time library string functions that operate on 16-bit characters. The names of the 16-bit functions are similar to the existing 8-bit functions, but the 16-bit function names are preceeded with the letter "U". For example, `strcmp()` becomes `Ustrcmp()`.

In PenPoint 1.0, the U... functions are identical to their 8-bit namesakes. In PenPoint 2.0, the U... functions will be true 16-bit functions. In other words, the old functions only work on CHAR8 strings, the U... functions in 1.0 work on CHAR8 strings, in 2.0 the U... functions will work on CHAR16 strings.

Table 75-2 lists the 16-bit string functions and the corresponding 8-bit functions.

Table 75-2
16-Bit String Functions

16-Bit Function	8-Bit Function
	STRING.H
Ustrcat()	strcat()
Ustrncat()	strncat()
Ustrcmp()	strcmp()
Ustrncmp()	strncmp()
Ustrcpy()	strcpy()

continued

Table 75-2 (continued)

16-Bit Function	8-Bit Function
Ustrncpy()	strncpy()
Ustrlen()	strlen()
Ustrdup()	strdup()
Ustrrev()	strrev()
Ustrset()	strset()
Ustrnset()	strnset()
Ustrchr()	strchr()
Ustrrchr()	strrchr()
Ustrspn()	strspn()
Ustrcspn()	strcspn()
Ustrpbrk()	strpbrk()
Ustrstr()	strstr()
Ustrtok()	strtok()
Ustricmp()	stricmp()
Ustrnicmp()	strnicmp()
Ustrlwr()	strlwr()
Ustrupr()	strupr()
Umemcpy()	memcpy()
Umemccpy()	memccpy()
Umemchr()	memchr()
Umemcmp()	memcmp()
Umemicmp()	memicmp()
Umemmove()	memmove()
Umemset()	memset()
Ustrerror()	strerror()

CTYPE.H

Uisalpha()	isalpha()
Uisalnum()	isalnum()
Uisascii()	isascii()
Uiscntrl()	iscntrl()
Uisprint()	isprint()
Uisgraph()	isgraph()
Uisdigit()	isdigit()
Uisxdigit()	isxdigit()
Uislower()	islower()
Uisupper()	isupper()
Uisspace()	isspace()
Uispunct()	ispunct()
Utolower()	tolower()
Utoupper()	toupper()

continued

Table 75-2 (continued)

16-Bit Function	8-Bit Function
	STDLIB.H
Uatoi()	atoi()
Uatol()	atol()
Uitoa()	itoa()
Ultoa()	ltoa()
Uutoa()	utoa()
Ustrtol()	strtol()
Uatof()	atof()
Ustrtod()	strtod()
Ustrtoul()	strtoul()
	STDIO.H
Ufopen()	fopen()
Usprintf()	sprintf()
Uvsprintf()	vsprintf()
Usscanf()	sscanf()
Uputc()	putc()
Ufputc()	fputc()
Ugetc()	getc()
Ufgetc()	fgetc()
Uungetc()	ungetc()
Ufdopen()	fdopen()
Ufreopen()	freopen()
Uprintf()	printf()
Ufprintf()	fprintf()
Uvprintf()	vprintf()
Uvfprintf()	vfprintf()
Uscanf()	scanf()
Ufscanf()	fscanf()
Uvscanf()	vscanf()
Uvfscanf()	vfscanf()
Uvsscanf()	vsscanf()
Ugetchar()	getchar()
Ufgetchar()	fgetchar()
Ugets()	gets()
Ufgets()	fgets()
Uputchar()	putchar()
Ufputchar()	fputchar()
Uputs()	puts()
Ufputs()	fputs()
Uremove()	remove()
Urename()	rename()
Utmpnam()	tmpnam()

continued

Table 75-2 (continued)

16-Bit Function	8-Bit Function
	FCNTL.H
Uopen()	open()
Usopen()	sopen()
Ucreat()	creat()
	TIME.H
Uasctime()	asctime()
Uctime()	ctime()
	UNISTD.H
Urmdir()	rmdir()
Uchdir()	chdir()
Ugetcwd()	getcwd()
	DIRENT.H
Uopendir()	opendir()
Ureaddir()	readdir()

String Composition Functions

75.3.3

The file CMPSTEXT.H contains **ComposeText** functions for assembling a composite string out of other pieces. Use these routines to create strings in your UI—*don't use* `sprintf()`!

The **ComposeText** routines will also save you effort because you can specify the **resId** of a format string and the code will read it from the resfile for you. You can, of course, give the format string directly to the routines.

Table 75-3 lists the string composition functions.

Table 75-3
String Composition Functions

Function	Definition
SComposeText()	Composes a string from a format and arguments.
VSComposeText()	Composes a string from a format and a pointer to the argument list.

Chapter 76 / Math Run-Time Library

Introduction 76.1

- PenPoint provides a fixed-point math facility as a part of its run-time support for ANSI C compilers. This math package resides permanently in the memory of the computer and is shared among computational applications.

  The mathematics library supports **fixed-point** calculations. Fixed-point arithmetic is ideal for situations in which a fixed-point number with 16 bits of precision for the integer part and 16 bits of precision for the fractional part is acceptable.

  Floating point support is provided directly by the C language and a shared library called directly from the compiler.

Programmatic Interface 76.2

Application programs invoke the fixed-point functions through procedure calls. For example:

```
FIXED   a, b, c;
STATUS  s;
s = FxAdd(b, c, a);
```

not:

```
a = b + c;
```

We have choosen the simplest procedure names possible in order to enhance readability of programs. The details of the routines are in the *PenPoint API Reference.*

Fixed-Point Numbers 76.2.1

The FIXED type is an S32. To create a fixed-point number, you use the routine **FxMakeFixed()**, specifying an S16 whole part and a U16 fractional part. For convenience, \PENPOINT\SDK\INC\GOMATH.H defines **GoFx0**, **GoFx1**, and **GoFxMinus1**.

ImagePoint uses FIXED numbers to specify scale factors. To save including GOMATH.H just to specify a scale factor, the definitions of FIXED and **FxMakeFixed()** are in \PENPOINT\SDK\INC\GO.H.

Performance Notes 76.2.2

FxAdd(), **FxSub()**, **FxMul()**, and **FxDiv()**, which include rounding and error checking, perform about 5% slower than **FxAddSC()**, **FxSubSC()**, **FxMulSC()**, and **FxDivSC()**, the truncating, trusting alternatives (which are macros instead of function calls).

PenPoint Fixed-Point Summary

76.2.3

Table 76-1
Fixed-Point Functions

Function	Description
	Addition and Subtraction
FxAdd()	Adds two FIXED numbers, producing a FIXED.
FxAddSC()	Macro form of FxAdd() with no overflow detection.
FxSub()	Subtracts two FIXED numbers, producing a FIXED.
FxSubSC()	Macro form of FxSub() with no overflow detection.
	Multiplication
FxMul()	Multiplies two FIXED numbers, producing a FIXED.
FxMulSC()	Multiplies two FIXED numbers returning the product. No overflow detection.
FxMulInt()	Multiplies a FIXED number by an S32, producing a FIXED.
FxMulIntSC()	Multiplies a FIXED number by an S32, returning the FIXED product. No overflow detection.
FxMulIntToInt()	Multiplies a FIXED number by an S32, producing an rounded S32 product.
FxMulIntToIntSC()	Multiplies a FIXED number by an S32, returning a rounded S32 product. No overflow detection.
	Division
FxDiv()	Divides two FIXED numbers, producing a FIXED quotient.
FxDivSC()	Divides two FIXED numbers, returning a FIXED quotient. No overflow detection.
FxDivInts()	Divides two 32-bit signed integers, producing a FIXED quotient.
FxDivIntsSC()	Divides two FIXED numbers, returning a FIXED quotient. No overflow detection.
FxDivIntToInt()	Divides an S32 by a FIXED, producing a rounded S32 quotient.
FxDivIntToIntSC()	Divides an S32 by a FIXED, producing a rounded S32 quotient. No overflow detection.
	Trigonometric Functions
FxSin()	Returns the sine of an angle specified as an integer degree.
FxCos()	Returns the cosine of an angle specified as an integer degree.
FxTan()	Returns the tangent of an angle specified in as integer degree.
FxSinFx()	Returns the sine of an angle specified as a FIXED degree.
FxCosFx()	Returns the cosine of an angle specified as a FIXED degree.
FxTanFx()	Returns the tangent of an angle specified as a FIXED degree.
FxArcTanInt()	Returns an arctangent value as a FIXED angle.
FxArcTanFx()	Returns an arctangent value as a FIXED angle.

continued

Table 76-1 (continued)

Function	Description
	Miscellaneous Functions
FxCmp()	Compares two FIXED.
FxRoundToInt()	Rounds a FIXED number to a 32-bit signed integer.
FxRoundToIntSC()	Rounds a FIXED number to a 16-bit signed integer without overflow detection.
FxNegate()	Negate a FIXED.
FxAbs()	Takes the absolute value of a FIXED.
FxChop()	Returns the 16-bit signed integer part of a FIXED.
FxChopSC	Returns the 16-bit signed integer part of a FIXED. No overflow detection.
FxFraction()	Returns the 16-bit fractional part of the absolute value a FIXED.
FxMakeFixed()	Make a FIXED with an S16 (integer) and a U116 (fraction).
FxIntToFx()	Convert a 16-bit signed integer into a FIXED.
FxBinToStr()	Converts a FIXED format value into an ASCII string in decimal.
FxStrToBin()	Converts a null-terminated ASCII string to a FIXED.

Part 9 / Utility Classes

Chapter 77 / Introduction

The utility classes provide services to applications and other classes. Many of the classes documented here are subclassed to implement special features. The following classes are included in this part:

- The list class.
- The stream class.
- The file system browser.
- The import and export classes.
- The selection manager.
- The transfer class and protocol.
- The Quick Help class.
- The busy manager.
- The search and replace class and protocol.
- The undo manager.
- The byte buffer and string storage classes.
- The table component.
- The system component.
- The NotePaper component.

Overview

77.1

There are various funtions which many objects in object-oriented systems have a use for, such as:

- Maintaining a list of items or table of data.
- Accessing a stream device.
- Browsing a directory or table of contents.

The PenPoint™ operating system supplies basic classes for each of these toolkit functions. They are each like a function library in ordinary procedural programming. The difference is that not only can your objects employ these utility objects, they can actually *be* a list, stream, or browser, by inheriting from them. If you look at the GO class diagram you will notice many sophisticated classes which inherit from these utility classes.

Features

77.2

- **clsList** provides a fundamental set of tools for creating and managing a list of 32-bit values. It is no coincidence that UIDs and pointers are also 32-bits long. You can use these objects to store lists of UIDs or pointers to larger structures and you can pass these list objects to other objects.
- **clsStream** provides the basic messages used to communicate with a stream device. Many other classes descend from **clsStream**, such as **clsFileSystem** (the File System) and **clsSio** (the Serial Port class).
- The browser allows you to create a browser window or a table of contents on screen so that the user can manipulate the files and directories or documents and sections.
- File import and export uses messages from the browser to import files as PenPoint documents and to export PenPoint documents as files.
- The selection manager provides a central manager that keeps track of the selection owner. The selection manager notifies observers when the selection changes.
- The transfer class provides the messages and functions that implement the PenPoint operating system transfer protocol, which objects can use to exchange data.
- The Quick Help API provides a simple way to provide help to users. When the user makes a question mark gesture on a window, the Quick Help manager locates the Quick Help resources associated with that window and displays the resources on screen.
- The busy manager allows applications to inform the user when a time-consuming operation is taking place, thereby reassuring the user that the machine is still running.
- The search and replace API provides the protocol and traversal driver to search and replace text strings in embedded objects.
- The undo manager enables applications to respond to the Undo command to undo user interface actions.
- **clsByteBuf** and **clsString** implement simple data objects which file byte arrays and null-terminated strings.
- **clsTable** provides a general-purpose table component using a row and column metaphor to implement random and sequential access to data in a file.
- **clsNotePaper**, **clsNPData**, and **clsNPItem** together provide most of the function necessary for a small note-taking application, including a generic data item protocol that allows arbitrary items in the notes.

Organization of This Part 77.3

This part is organized into 15 chapters:

- Chapter 77, this chapter, provides an introduction to the utility classes.

Each of the following chapters describes one utility class:

- Chapter 78, The List Class, describes the list class and how you use it to maintain lists.
- Chapter 79, Class Stream, describes the stream I/O subsystem.
- Chapter 80, The Browser Class, describes the API for the file browser.
- Chapter 81, File Import and Export, describes the classes that you use to import files as PenPoint documents and to export PenPoint documents as files.
- Chapter 82, The Selection Manager, describes the API to the manager that controls selection ownership.
- Chapter 83, Transfer Class, describes the generalized data transfer mechanism.
- Chapter 84, Help, describes the Help notebook and the Quick Help API.
- Chapter 85, The Busy Manager, describes the interface that you use to indicate to the user that the machine is busy.
- Chapter 86, Search and Replace, describes the messages used to search and replace text in applications.
- Chapter 87, Undo, describes how to use the undo manager so that your application can respond to Undo commands.
- Chapter 88, Byte Buffer Objects, describes the byte buffer data object class.
- Chapter 89, String Objects, describes the string data object class.
- Chapter 90, Table Class, describes the concepts of the table component, how to use a table, sharing tables, and table messages.
- Chapter 91, The NotePaper Component, describes the classes that make up the NotePaper component, a very capable data/view system for note taking applications.

Other Sources of Information 77.4

There are hundreds of classes in the PenPoint operating system, many of which will also be of great use to you in developing your application. Other classes are described throughout the *PenPoint Architectural Reference.*

Not everything in PenPoint is object-oriented. Utility functions in the PenPoint C run-time library are documented in *Part Eight: System Services,* of this volume of the *PenPoint Architectural Reference.*

Datasheets for all utility class messages of the utility classes are in the *PenPoint API Reference.*

Chapter 78 / The List Class

clsList provides fundamental functions for maintaining lists of 4-byte values. Typically, a list contains either the UIDs of related objects or pointers. This chapter covers the following topics:

- The concepts of lists.
- How to use the list messages.

List Concepts 78.1

A **list** is an object that holds a collection of items. Many components in the PenPoint™ operating system use lists for keeping track of objects and exchanging information. Each item in the list is 32 bits in length; often this is a handle on (or a pointer to) a larger item. Lists have no semaphores or other forms of access control mechanisms.

The messages defined by **clsList** allow you to:

- Create and destroy lists.
- Add items to and remove items from a list.
- Replace items in a list.
- Find an item in a list.
- Count the items in a list.
- Remove all items from a list.
- Copy a part or all of the list to an array.

A simple picture of a list is a series of 4-byte cells that hold data. The list object maintains an index to the current item (**position**). This index is used by most messages that alter data in the list. To point to the beginning of the list, set **position** to the value 0; to point to the end of the list, set **position** to the number of members in the list (which you obtain through **msgListNumItems**).

Using List Messages 78.2

Table 78-1 summarizes the **clsList** messages. **clsList** is a descendent of **clsObject**.

Table 78-1
clsList Messages

Message	Takes	Description
		Class Messages
msgNew	P_LIST_NEW	Creates a new empty list.
msgNewDefaults	P_LIST_NEW	Initializes the LIST_NEW structure to default values.
		List Management Messages
msgListFree	P_LIST_FREE	Frees a list according to mode.
msgListAddItem	LIST_ITEM	Adds an item to the end of a list.
msgListAddItemAt	P_LIST_ENTRY	Adds an item to a list at pArgs->position.
msgListRemoveItem	LIST_ITEM	The list searches for pArgs in the list and removes the item if found.
msgListRemoveItemAt	P_LIST_ENTRY	Removes the item in the list at pArgs->position.
msgListReplaceItem	P_LIST_ENTRY	Replaces the item in the list at pArgs->position.
msgListGetItem	P_LIST_ENTRY	Gets the item in the list at pArgs->position.
msgListFindItem	P_LIST_ENTRY	Searches for pArgs->item in the list.
msgListNumItems	P_U16	Passes back the number of items in a list.
msgListRemoveItems	no arguments	Removes all of the items in a list.
msgListGetHeap	P_OS_HEAP_ID	Passes back the heap used by the list.
		Enumeration Messages
msgListEnumItems	P_LIST_ENUM	Enumerates the items in a list.
msgListCall	P_LIST_NOTIFY	Sends a message to each object in the list using ObjectCall().
msgListSend	P_LIST_NOTIFY	Sends a message to each object in the list using ObjectSend().
msgListPost	P_LIST_NOTIFY	Sends a message to each object in the list using ObjectPost().
		Observer Notification Messages
msgListNotifyAddition	P_LIST_NOTIFY_ADDITION	Notifies observers that an item has been added to the list.
msgListNotifyDeletion	P_LIST_NOTIFY_DELETION	Notifies observers that an item has been deleted from the list.
msgListNotifyReplacement	P_LIST_NOTIFY_REPLACEMENT	Notifies observers that an item in the list has been replaced.
msgListNotifyEmpty	P_LIST_NOTIFY_EMPTY	Notifies observers that a list is now empty.

Creating Lists 78.3

To create a new list, send **msgNew** to **clsList**. **msgNew** takes a LIST_NEW structure that specifies:

fileMode A filing mode indicator, which specifies how the list object should file items if it receives **msgFile**. There are three filing modes:

listFileItemsAsData File items as U32 data.

listFileItemsAsObjects Send filing messages to items.

listDoNotFileItems Don't file list items. Upon restore, the list will be empty.

Positioning Within a List 78.4

Each list object maintains a current position indicator. You can change the position by sending **msgListFindItem** to the list object. You must declare a LIST_ENTRY structure and specify:

position The place to start the search.

item The item you are searching for.

msgListFindItem returns the first position where it found the item. If the item was not found, **msgListFindItem** returns **stsNoMatch**.

Adding, Removing, Getting, and Replacing Items 78.5

When you have the position of an item, you can do any of the following:

- Add a new item at that position with **msgListAddItemAt**.
- Get the item at that position with **msgListGetItem**.
- Remove the item at that position with **msgListRemoveItemAt**.
- Replace the item at that position with **msgListReplaceItem**.

The four messages related with these tasks are similar. All messages require you to declare a LIST_ENTRY structure, which contains:

position A position within the list.

item A 32-bit list item.

To add an item to the list, send **msgListAddItemAt** to the list. You specify the item to add to the list and its position. The list manager adds the item at the specified position (placing it before the item that is currently at that position). The message returns the new item and its position.

To get an item from the list, send **msgListGetItem** to the list. You specify only a position. The message returns the item and its position.

To remove an item from the list, send **msgListRemoveItemAt** to the list. You specify only the position. The message returns the removed item and its position. The heap memory where the item was stored is freed.

To replace an item in the list, send **msgListReplaceItem** to the list. You specify the item to add to the list and its position. The message returns the old item and its position.

You can read through a list by starting with the first item (give **position** the value 0), and increment **position** for each item.

If you specify a position that is beyond the end of the list, the message uses the last item in the list; if you use a position beyond the end of the list in an add operation, the item is added to the end of the list. A good way to access the end of the list is to use the constant **maxU16** for the **position** value.

Counting Items

78.6

To get the number of items in a list, send **msgListNumItems** to the list. The message takes only a pointer to a U16 value that will receive the count.

Removing All Items

78.7

Before you destroy a list, it is a good idea to remove all items from the list, thereby removing them from the heap so that you don't have to clear the items from the heap by hand. To remove all items from the list, send **msgListRemoveItems** to the list. The message does not require any arguments.

Enumerating Items

78.8

To copy the list, or a portion of the list, to an array, send **msgListEnumItems** to the list. When the message copies the items to the array, you can perform any operation on the items, such as sorting the list or sending messages to UIDs. You must declare a LIST_ENUM structure and specify:

max The size of the array, if you have allocated one.

count The number of items you are requesting.

pItems A pointer to an array, if you have allocated one.

pNext A pointer to a value that contains the current position in the list. Use the value 0 to start at the beginning of the list.

You can either create the array yourself or you can specify a null pointer for **pItems**, in which case **msgListEnumItems** will allocate an array for you. If you create an array that is smaller than **count**, **msgListEnumItems** will allocate a new array that can contain **count** items.

msgListEnumItems uses **count** to indicate the number of items that it returned.

If **msgListEnumItems** allocated an array, it returns the size of the array in **max** and the pointer to the new array in **pItems**. After each call to **msgListEnumItems**, it is a good idea to make sure that the pointer sent to the message is the same as

the pointer returned. If the two are different, a new array was allocated. It is important that you note this, because it is up to you to de-allocate the array.

If the list is long, or you can't allocate a large amount of storage for your array, you can read the list in chunks (by specifying a small **count** value). When the message returns, **pNext** contains the index to the next item in the list. Usually **pNext** points to the end of the list, but if **count** was less than the size of the list, **pNext** points to **count** + 1.

Destroying Lists

78.9

To free a list, send **msgDestroy** to the list object as usual. This frees the list data structures but does not affect the items in the list.

If the items in the list are objects that you want to destroy along with the list object, then use **msgListFree**. The message arguments are in a LIST_FREE structure that contains:

key The object key for the list object.

mode A mode that specifies whether to free the items in the list or not. There are two possible values for **mode**:

listFreeItemsAsData The items in the list should be treated like U32 data that doesn't need freeing.

listFreeItemsAsObjects The items in the list should be freed as objects. **clsList** sends the items **msgDestroy** (with a nil key). All items in the list must be object UIDs.

Chapter 79 / Class Stream

clsStream is an abstract superclass that defines messages for common stream operations. A **stream** operation is one in which files or data items are treated as a series of individual bytes.

clsStream inherits from **clsObject**. Many classes descend from **clsStream**. Structures and \PENPOINT\SDK\INC\STREAM.H defines the structures and macros **clsStream** uses.

Overview 79.1

clsStream is an abstract class; it does not implement the methods for its messages. It is up to the individual subclasses to implement the methods.

Any class that subclasses **clsStream** must implement the "descendant responsibility" messages listed in Table 79-1.

Table 79-1
clsStream Messages

Message	Takes	Description
		Class Messages
msgNewDefaults	P_STREAM_NEW	Initializes defaults for new stream object.
msgNew	P_STREAM_NEW	Creates a new stream object.
		Descendant Responsibility Messages
msgStreamRead	P_STREAM_READ_WRITE	Reads data from stream.
msgStreamWrite	P_STREAM_READ_WRITE	Writes data to stream.
msgStreamReadTimeOut	P_STREAM_READ_WRITE_TIMEOUT	Reads data from stream with timeout.
msgStreamWriteTimeOut	P_STREAM_READ_WRITE_TIMEOUT	Writes to the stream with timeout.
msgStreamFlush	pNull	The stream flushes any buffered data.
msgStreamSeek	P_STREAM_SEEK	Sets the stream's current byte position.
msgStreamBlockSize	P_STREAM_BLOCK_SIZE	Passes back the most efficient write block size for this stream.
		Functions
StdioStreamBind()	OBJECT	Returns a stdio file pointer bound to a stream object.
StdioStreamUnbind()	P_UNKNOWN (FILE *)	Frees the stdio file handle bound to a stream object.
StdioStreamToObject()	P_UNKNOWN (FILE *)	Returns the stream object bound to a stdio file pointer.

You can send these messages to any object whose class has implemented methods for them. The most common stream object is a file handle; **clsFileHandle** is a subclass of **clsStream**. For further discussion of the file system, see *Part 7: File System.*

Other stream objects are selection transfers, serial I/O, and the many kinds of services (printers, Out boxes, etc.).

Creating a Stream Object 79.2

Before you can write or read a stream, you must create a stream object. To create a stream object, send **msgNewDefaults** and **msgNew** to a **clsStream** subclass (because **clsStream** is an abstract class, you should not create instances of **clsStream** itself).

Reading and Writing Streams 79.3

To read or write stream data, send **msgStreamRead** or **msgStreamWrite** to a stream object. Both messages require you to declare a STREAM_READ_WRITE structure that specifies:

numBytes The number of bytes to read or write.

pReadBuffer A pointer to a buffer to receive the data, or containing data to be written. On **msgStreamRead**, the buffer must hold at least **numBytes** of data.

The STREAM_READ_WRITE structure passes back in count the number of bytes read or written.

If the number of bytes read or written (**count**) equals the number of bytes specified (**numBytes**), the messages return **stsOK**.

If you read the end of the stream and the number of bytes read is greater than zero, **msgStreamRead** returns **stsOK**. If you read the end of the stream and the number of bytes read is zero, **msgStreamRead** returns **stsEndOfData**. If you specify zero for **numBytes** after you receive **stsEndOfData**, **msgStreamRead** returns **stsOK**.

Reading and Writing with a Timeout 79.4

The stream messages with timeouts are similar to the non-timeout messages. **msgStreamRead** and **msgStreamWrite** return when a certain number of bytes have been read or written (or when the end of the stream is reached). The timeout stream messages (**msgStreamReadTimeOut** and **msgStreamWriteTimeOut**) return when either of two conditions is met:

- A certain number of bytes have been read or written (or when the end of stream is reached).
- A specified amount of time elapses.

To read or write stream with a timeout, send **msgStreamReadTimeOut** or **msgStreamWriteTimeOut** to a stream object. Both messages take a pointer to a STREAM_READ_WRITE_TIMEOUT structure that contains:

numBytes The number of bytes to read or write.

pBuf A pointer to a buffer to receive the data, or containing data to be written. On **msgStreamReadTimeOut**, the buffer must hold at least **numBytes** of data.

timeOut A timeout value in milliseconds.

If the message completes successfully, it returns **stsOK** and passes back the number of bytes read or written in the **count** field of the STREAM_READ_WRITE_TIMEOUT structure.

If you read to the end of the stream and the number of bytes read is less than the number of bytes requested, **msgStreamRead** returns the warning status **stsTimeOutWithData.**

If the timeout expires before **numBytes** bytes were read or written, the messages return the warning status **stsTimeOutWithData.**

If the timeout expired and no data was read or written, the messages return the error status **stsEndOfData.**

Setting the Current Byte Position 79.5

Some subclasses of **clsStream** can seek to a specific byte position in the stream. This is true for file operations and some buffered operations, but is obviously not possible when the stream originates from a serial port or a keyboard.

To get and set the current stream position, use the message **msgStreamSeek.** The message takes a STREAM_SEEK structure that contains:

mode The starting position for the seek. This can be any one of the following:

streamSeekBeginning Seek is relative to the beginning of the stream.

streamSeekEnd Seek is relative to the end of data.

streamSeekCurrent Seek is relative to the current position of the stream.

offset The offset in bytes. This offset is a signed value. Positive offsets move the current byte position closer to the end of stream; negative offsets move it closer to the beginning of the stream.

If you just want to find out the current byte position, specify 0 as the **offset** value, relative to the current position.

If the subclass of **clsStream** does not support seeks, it should return **stsMessageIgnored.** There is no way for a client to find out ahead of time whether the stream supports seeks or not.

If **msgStreamSeek** completes successfully, it passes back a STREAM_SEEK structure including the following fields:

curPos The current position in the stream, relative to the beginning.

oldPos The old position, relative to the beginning.

eof A BOOLEAN value that indicates whether the new position is at the end of data.

The following example code fragment shows **msgStreamSeek** passing back the current position:

```
STREAM_SEEK ss;
OBJECT      stream;

ss.offset   = 0;
ss.mode = streamSeekCurrent;
status = ObjectCall(msgStreamSeek, stream, &ss);
Debugf("Seek: Old Position: %ld, New Position: %ld %s",
    ss.oldPos, ss.curPos, ss.eof ? "(EOF)" : "");
```

The following example code fragment shows **msgStreamSeek** setting the current byte position to 80 bytes after the beginning of the stream:

```
STREAM_SEEK ss;
OBJECT      stream;     // stream handle

ss.offset   = 80;
ss.mode = streamSeekBeginning;
status = ObjectCall(msgStreamSeek, stream, &ss);
Debugf("Seek: Old Position: %ld, New Position: %ld %s",
    ss.oldPos, ss.curPos, ss.eof ? "(EOF)" : "");
```

You can't set the current byte position before the beginning of the stream or beyond the end of data. If you seek from the current position and specify a byte offset that is before the beginning of the stream, the new position is the beginning of the stream; if the offset is after the end, the new position will be the end of stream. However, if you specify seek relative to the beginning of the stream and pass a negative byte offset, or you specify seek relative to the end of data and pass a positive byte offset, **msgStreamSeek** returns **stsBadParam**.

Flushing the Stream

79.6

Occasionally you need to wait for a buffer to be written out before you can continue processing (or shut down an application). To flush the stream buffer, send **msgStreamFlush** to the stream object. The message doesn't take any arguments.

If the message succeeds in emptying the buffer, it returns **stsOK**. If the buffers do not empty after a timeout period, the message returns **stsFailed**. When you subclass **clsStream**, you must establish a timeout period.

Examples

79.7

All the sample programs which file use **msgStreamWrite** in response to **msgSave** to save state, and use **msgStreamRead** in response to **msgRestore** to restore state. See the source code under \PENPOINT\SDK\SAMPLE for simple examples of using these.

Chapter 80 / The Browser Class

The browser class, **clsBrowser**, allows you to create a browser window in your application. By making your application a client of a browser, the application receives messages when the user taps on items in the browser. A browser is very useful for file selection dialogs. Since the application hierarchy is part of the file system hierarchy, a browser can also display the state of a notebook or section. The Table of Contents of the Notebook and the Disks page of the Connections notebook are examples of the use of browsers.

Browser Concepts 80.1

A **browser** is a window that contains a list of files and directories on a particular volume. As with the Disks page of the Connections notebook, which is documented in the manual *Using PenPoint*, the user can scroll the browser window. If the user double taps on a directory, the directory expands to display its files and directories; another double tap on the directory collapses it down to its name.

The user can select the criterion for sorting files and directories. The user can also choose what information to show about files and directories.

clsBrowser allows your application to display and control a browser window, just like the Connections notebook. You can send commands to the browser to change the sort order, to display certain information, to go to or bring to the selection, to set the selection to a particular file system node, and so on.

Additionally, if you application is a client of a browser window, it receives notification messages when the user makes a selection, turns off the selection, or taps on a bookmark check box.

clsBrowser inherits from **clsScrollWin**, a UI Toolkit class that supports scrolling. You insert a browser window object into your application just like you would insert a scrollwin. The object that displays the browser contents is actually the client window inside the scrollwin. Usually you don't have to do anything to this "hidden" object; however if you need to modify it, you can get its UID by sending **msgBrowserGetBrowWin** to the browser object.

Browsers and Tables of Contents 80.1.1

A table of contents is a specialized form of a browser window. While a browser shows you the files and directories in a particular volume, a table of contents displays the sections and documents in a notebook.

When you create an instance of **clsBrowser**, you can specify whether you want to create a browser or a table of contents (in the **tocView** field of the BROWSER_NEW structure).

If you create a table of contents, the window displays a list of sections and documents, their page number, and the bookmark checkbox. You can choose whether to sort by name or by page number, and whether or not to display the bookmark check box or the icon for the application.

If you create a browser, whether a standard browser or a table of contents, the window displays a list of files and directories (the table of contents variation of **clsBrowser** interprets them as PenPoint documents). You can choose to sort the list by name, size, or date and whether or not to display the size, date, type, or icon.

Integrating a Browser into Your Application 80.1.2

If you incorporate a browser into your application, you should consider the user interface guidelines for dialog boxes.

You can give your browser a menu bar similar to the menu on the Disks page of the Connections notebook by creating a menu bar (an instance of **clsMenu**) with commands such as **Expand** and **Collapse**, and adding the menu bar to your frame. If the browser is a floating frame, to follow the user interface guidelines you should create a command bar (an instance of **clsCommandBar**), to provide **Apply** and **Apply & Close** buttons, and a close corner for your browser dialog.

For more information about **clsMenu** and **clsCommandBar**, see *Part 4: UI Toolkit*. For more information about user interface guidelines, see the *PenPoint User Interface Design Reference* manual.

Using clsBrowser 80.2

Table 80-1 lists the messages **clsBrowser** handles.

Table 80-1
clsBrowser Messages

Message	Takes	Description
		Class Messages
msgNewDefaults	P_BROWSER_NEW	Initializes the BROWSER_NEW structure to default values.
msgNew	P_BROWSER_NEW	Creates a new browser object.
		Instance Messages
msgBrowserCreateDir	nothing	Creates a directory at the selection.
msgBrowserByName	nothing	Sorts by name order.
msgBrowserByType	nothing	Sorts by type order.
msgBrowserBySize	nothing	Sorts by size order.
msgBrowserByDate	nothing	Sorts by date order.
msgBrowserExpand	nothing or P_FS_FLAT_LOCATOR	Expands the section or directory that the argument identifies. If the argument is pNull, expands all sections or directories.
msgBrowserCollapse	nothing or P_FS_FLAT_LOCATOR	Collapses the section or directory that the argument identifies. If the argument is pNull, collapses all sections or directories.

continued

Table 80-1 (continued)

Message	Takes	Description
msgBrowserRefresh	nothing	Refreshes the disk image the browser is displaying.
msgBrowserDelete	nothing or P_FS_FLAT_LOCATOR	Deletes selection if arg is pNull, otherwise deletes the file that the argument identifies.
msgBrowserRename	nothing or P_FS_FLAT_LOCATOR	Renames the selection if argument is pNull. Otherwise, renames the file that the argument identifies.
msgBrowserConfirmDelete	BOOLEAN	Sets a flag whether to confirm deletions within a browser (OBSOLETE).
msgBrowserExport	nothing	Puts the selection into export mode (OBSOLETE).
msgBrowserByPage	nothing	Sorts by page number.
msgBrowserWriteState	nothing	Writes the current browser expanded/collapsed state to a file.
msgBrowserReadState	nothing	Reads the browser expanded/collapsed state from a disk file.
msgBrowserSetSaveFile	P_FS_LOCATOR	Sets the file that the browser will save open/close state to.
msgBrowserGetMetrics	P_BROWSER_METRICS	Gets browser metrics.
msgBrowserSetMetrics	P_BROWSER_METRICS	Sets browser metrics.
msgBrowserUserColumnGetState	P_BROWSER_USER_COLUMN	Does nothing.
msgBrowserUserColumnSetState	P_BROWSER_USER_COLUMN	Sets the user column states in the browser for columns that are marked changed.
msgBrowserUserColumnStateChanged	P_BROWSER_USER_COLUMN	Notifies subclass when user checks a user column checkbox.
msgBrowserUserColumnQueryState	P_BROWSER_USER_COLUMN	Gets the user column state from subclass.
msgBrowserShowIcon	BOOLEAN	Controls icon field display.
msgBrowserShowButton	BOOLEAN	Controls button field display.
msgBrowserShowSize	BOOLEAN	Controls size field display.
msgBrowserShowDate	BOOLEAN	Controls date field display.
msgBrowserShowType	BOOLEAN	Controls type field display.
msgBrowserShowBookmark	BOOLEAN	Controls bookmark field display.
msgBrowserShowHeader	BOOLEAN	Controls column header display.
msgBrowserGoto	BOOLEAN	Takes true to goto, false to bring to the selection.
msgBrowserGotoBringto	P_BROWSER_GOTO	Takes P_BROWSER_GOTO. If pFlat is pNull, applies to selection.
msgBrowserUndo	nothing	Does nothing yet.
msgBrowserSetSelection	P_FS_FLAT_LOCATOR	Causes browser/TOC to select and display the given file system item.
msgBrowserSetClient	OBJECT	Sets the target of the browser client messages.
msgBrowserGetClient	P_OBJECT	Passes back the target of the browser client messages.
msgBrowserGetBaseFlatLocator	P_FS_FLAT_LOCATOR	Passes back the directory the browser is looking at.
msgBrowserSelectionPath	P_BROWSER_PATH	Passes back the full path of the selection.
msgBrowserSelection	P_FS_FLAT_LOCATOR	Passes back the flat locator of the selection.

continued

Table 80-1 (continued)

Message	Takes	Description
msgBrowserSelectionUUID	P_UUID	Passes back the UUID of the selection.
msgBrowserSelectionDir	P_FS_FLAT_LOCATOR	Passes back the flat locator of the directory the selection is in.
msgBrowserSelectionName	P_CHAR	Returns the name of the selection.
msgBrowserSelectionOn	nothing	Notifies client when a selection is made inside the browser.
msgBrowserSelectionOff	nothing	Notifies client when selection is yielded by the browser.
msgBrowserBookmark	P_BROWSER_BOOKMARK	Notifies client that the bookmark specified by locator has toggled.
msgBrowserCreateDoc	P_BROWSER_CREATE_DOC	Creates a directory.
msgBrowserGetBrowWin	P_OBJECT	Passes back the browser's internal display window.
msgBrowserGesture	P_BROWSER_GESTURE	Sends to self gesture and which file it landed on.
msgBrowserGetThisApp	P_OBJECT	Returns the application associated with this instance of clsBrowser.
msgBrowserSetThisApp	OBJECT	Sets the application associated with this instance of clsBrowser.

Creating a Browser Object

80.2.1

To create a browser window, send **msgNewDefaults** and **msgNew** to **clsBrowser**. The messages take a BROWSER_NEW structure that contains:

base A locator that indicates the starting point in the file system to browse.

client The name of the client that is to receive the browser messages. Usually **client** contains **self**.

tocView A BOOLEAN value that indicates whether the browser should take the appearance of a browser or a table of contents. If **tocView** is **true**, the browser object is a table of contents.

Getting the Current Selection

80.2.2

You can use browser messages to get a file system path to the current browser selection.

- To get a flat locator for the current selection, send **msgBrowserSelection** to the browser object.
- To get the full path of the directory that contains the current selection, send **msgBrowserSelectionDir** to the browser object.

The following three messages all take a pointer to a FS_FLAT_LOCATOR structure, which they use to return the path or name of current selection. Flat locators are explained in *Part 7: File System.*

- To get the full path of the selection, send **msgBrowserSelectionPath** to the browser object. This takes a pointer to a BROWSER_PATH structure.

- To get the name of the selection, send **msgBrowserSelectionName** to the browser object. This takes a pointer to a string.
- To get the UUID of the selection, send **msgBrowserSelectionUUID** to the browser object. This takes a pointer to a UUID.

Setting the Current Selection 80.2.3

To specify which file system object should be displayed by the browser, send **msgBrowserSetSelection** to the browser object. The message takes a pointer to a FS_FLAT_LOCATOR structure that contains the path to the file system object.

When the message completes, the browser display scrolls and displays the specified file system object.

Making File System Changes 80.2.4

You can use browser messages to create, rename, and delete directories or files.

- To create a new directory, send **msgBrowserCreateDir** to the browser object. **msgBrowserCreateDir** creates a directory in the directory that contains the current selection. The location of the new directory is unimportant, because it will be positioned according to the current sort order.
- To create a new document, send **msgBrowserCreateDoc** to the browser object.
- To rename a directory or file, send **msgBrowserRename** to the browser object. **msgBrowserRename** brings up a dialog box to rename the current selection or a file system node specified by a flat locator.
- To delete a directory or file, send **msgBrowserDelete** to the browser object. **msgBrowserDelete** deletes the current selection or a file system node specified by a flat locator.

msgBrowserCreateDir takes no arguments. **msgBrowserRename**, **msgBrowserExport**, and **msgBrowserDelete** take one argument; if that argument is null, the message affects the current selection; if the argument contains a pointer to a FS_FLAT_LOCATOR structure, the message affects the file system node indicated by the flat locator.

msgBrowserCreateDoc takes a pointer to a BROWSER_CREATE_DOC structure that contains:

docClass The class of the document to create.

pName A pointer to a string that contains the name of the new document.

xy An XY32 value that specifies where to place the new document. This value is meaningful only when **atSelection** is **false**. **clsBrowser** will create the new document as close to the **xy** position as possible.

atSelection A BOOLEAN value that specifies whether to create the new document immediately after the current selection or at the location

specified by **xy**. If **atSelection** is **true**, **clsBrowser** creates the new document at the current selection. If **false**, uses the value in **xy**.

Refreshing the Browser Data 80.2.5

The browser doesn't monitor the file system for changes. Occasionally you might need to tell the browser to update its information about the state of the file system. To do this, send **msgBrowserRefresh** to the browser object.

The message doesn't take any arguments. When the message completes successfully, the browser reflects the new file system state.

Changing Information Displayed 80.2.6

clsBrowser defines messages that allow you to select the information displayed by the browser. You can elect to show or not show information by sending these messages to the browser object:

- Send **msgBrowserShowIcon** to display the icon for the file or section.
- Send **msgBrowserShowSize** to display the size of the file or section.
- Send **msgBrowserShowDate** to display the date that the file or section was last modified.
- Send **msgBrowserShowBookmark** to display the bookmark check box for the file or section. This message applys only to table of contents windows.
- Send **msgBrowserShowType** to display the type of file.
- Send **msgBrowserShowHeader** to display the column heads at the top of the browser display.

All of these messages take a BOOLEAN value. If the value is **true**, the browser displays the information; if the value is **false**, the browser doesn't display the information.

Changing the Sort Order 80.2.7

You can change the sort order of the information displayed by the browser by sending these messages to the browser object:

- Send **msgBrowserByName** to sort the information by name.
- Send **msgBrowserBySize** to sort the information by size.
- Send **msgBrowserByDate** to sort the information by date.
- Send **msgBrowserByType** to sort the information by type.
- Send **msgBrowserByPage** to sort a table of contents by page number. (If the browser window displays a table of contents.)

These messages take no arguments.

Expanding and Collapsing Sections 80.2.8

When the user double taps on the name of an unexpanded section, the section expands to reveal the documents and sections contained in that section. If the user double taps on the name of an expanded section, the section collapses down to just its name.

You can programmatically expand and collapse the current selection or a specific file system node by sending **msgBrowserExpand** and **msgBrowserCollapse** to the browser object.

Both messages take a single argument. If the argument is **null**, these messages expand and collapse the current selection. If the argument contains a pointer to a FS_FLAT_LOCATOR structure, the message expands or collapses the file system node specified by the path.

By specifying a path, you can expand or collapse a file system node, whether or not that object is currently displayed. To scroll to that path, you must use **msgBrowserSetSelection**.

Reading and Writing the Browser State 80.2.9

The browser state specifies which directories or sections are expanded in the browser window. When the user turns to another page, you can save the browser state. Then, when the user turns back to the browser, you can display it in the same state as when the user turned away.

For example, the user might expand a section (to see its documents) and can turn to one of those documents. When the user turns back to the table of contents, the notebook restores the browser state so that the same section is expanded.

To save the browser state, send **msgBrowserWriteState** to the browser object. To restore the browser state, send **msgBrowserReadState** to the browser object. Neither message takes any arguments.

Usually the read and write state messages save the state in a file named BROWSTAT (in the process directory). However, you can change the file by sending **msgBrowserSetSaveFile** to the browser object. The message takes a pointer to a file system locator that contains the path to the new browser state file.

Getting and Setting Browser Metrics 80.2.10

The browser metrics save the type of information being displayed by a browser window. That is, whether the browser window includes the icon, size, date, type, or bookmark check box in its display.

You can set these values by sending **msgBrowserSetMetrics** or one of the **msgBrowserShow...** messages to the browser object.

To get the metrics, send **msgBrowserGetMetrics** to the browser object. Both **msgBrowserGetMetrics** and **msgBrowserSetMetrics** take a BROWSER_METRICS structure that specifies or returns:

showIcon Whether to display the icon.

showType Whether to display the item type.

showSize Whether to display the size.

showDate Whether to display the date.

showBookmark Whether to display the bookmark check box.

showHeader Whether to display the browser column heads.

computeRecursive Whether to compute recursive size for directories.

showIconButton Whether to display page turn buttons instead of icons (for TOC only).

sortBy A SORT_BY structure determining the field by which to sort items.

userColumn A subclass-definable array of BROWSER_COLUMN structures.

defaultColumn The default columns for the class.

The difference between sending **msgBrowserShow...** messages and setting the metrics is that the messages are usually sent by an external UI, such as a browser menu. If you subclass **clsBrowser**, you might want to intercept these messages.

Changing the Browser Client 80.2.11

You can change the client of the browser by sending **msgBrowserSetClient** to the browser object. The only argument to the message is the UID of the new client.

When the message completes successfully, the browser window is left unchanged, only the new client receives the browser messages.

Navigating with the Browser 80.2.12

Using a browser in TOC mode, the user can go to a particular document by tapping on its page number or icon, or can float a particular document by double tapping on its page number or icon.

You can do the same thing programmatically by sending **msgBrowserGoto** to the browser object for a table of contents. The message only takes one argument, a BOOLEAN value, which specifies whether the operation is a go-to or a bring-to. If value is **true**, the notebook turns to the document currently selected. If the value is false, the document currently selected is floated.

If there is no current selection when **msgBrowserGoto** is sent, the message is ignored.

Getting the Internal Display Window 80.2.13

Usually you don't have to do anything to a browser's internal display window; **clsBrowser** creates the window and controls it. However if you need to access the browser window, you can request its UID by sending **msgBrowserGetBrowWin** to the browser object. The only argument to the message is a pointer to an OBJECT.

When the message completes successfully it returns **stsOK** and passes back the UID of the browser window.

Browser Notification Messages 80.3

The client of a browser object receives notification messages when the user performs certain actions within the browser window. If you are a client of the browser, you might need to respond to these messages.

The Selection Changed 80.3.1

When the user makes a selection in the browser, it sends **msgBrowserSelectionOn** to its client. The message doesn't have any arguments, but you can always send **msgBrowserSelectionPath** (or a related message) to the browser to find out what was selected.

When the user selects something outside the browser (the browser no longer owns the selection), the browser sends **msgBrowserSelectionOff** to its client. This message has no arguments.

Bookmark Check Box Changed 80.3.2

When the user taps the bookmark check box in the table of contents, the browser sends **msgBrowserBookmark** to its client. The message takes a BROWSER_BOOKMARK structure that contains a locator (**loc**). The locator indicates the file for which the bookmark check box was set.

Menu Messages 80.4

You can add a menu bar to your browser object. Table 80-2 lists the **clsBrowser** messages that you are likely to associate with items on a menu or other user interface.

Table 80-2
Browser Menu Messages

Message	Description
msgBrowserExpand	Expands selection.
msgBrowserCollapse	Collapses selection.
msgBrowserGoTo	Go to the selection.
msgBrowserCreateDir	Pops up create dir dialog box.
msgBrowserRename	Pops up rename dialog.
msgBrowserDelete	Deletes selection.
msgBrowserRefresh	Renews file system data.

User Columns 80.5

clsBrowser supports a column of text or checkboxes in addition to its usual display contents. Subclasses of **clsBrowser** can control the appearance of the column, the header above the column, and whether or not the checkboxes appear next to sections or documents or both.

This optional **user column** is enabled by specifying metrics for it in the **userColumn** field in BROWSER_METRICS. The subclass must respond to **msgBrowserUserColumnQueryState** messages self-sent by the browser so that **clsBrowser** can know whether to check the box or what text to display.

Chapter 81 / File Import and Export

File import and export are closely related to the browser. When the user selects a file other than a PenPoint document (for example, a text file on a connected disk) and copies or moves the file to the PenPoint computer, the PenPoint™ operating system prompts the user for the type of document to create from the file. Similarly, when the user copies or moves a document from a PenPoint computer to a connected volume, PenPoint prompts the user for the type of file to write.

This chapter covers the following topics:

- Export and import concepts.
- How to respond to import messages.
- How to respond to export messages.

Concepts

81.1

Most operating systems are designed so that the users run a single program and open and close files of a specific type from that program. In PenPoint, the user turns to a page that contains a particular document and the operating system finds and runs the correct application.

This reversal of perspective requires some translation when moving files from operating systems that have a program-data orientation to the PenPoint operating system, which has a document-application orientation.

When the user moves a file from a traditional operating system to PenPoint, the user must identify the application that will present the data. The browser's **file import** mechanism presents the user with a list of available applications. When the user chooses an application, the file import mechanism creates an instance of the application and tells that instance to translate the data.

Similarly, when the user needs to give a document created under PenPoint to someone who uses a different computer, the user must translate the document's instance data into a form that is understood by the other computer. The browser's **file export** mechanism presents the user with a choice of file format translators.

Import and export involve the use of the move or copy protocol and user interface between two browsers:

- A disk viewer that presents the directory/file view of a foreign disk.
- A table of contents that presents the PenPoint document view.

The user simply drags an icon from one browser to another. The import and export mechanisms prompt the user to select the appropriate file translation on the fly.

Import Overview

81.1.1

When the user selects a file in a browser acting as a disk viewer and moves or copies the file to a location in the Table of Contents (TOC), the TOC browser examines the file's **appAttrClass** file system attribute. If it exists, then the TOC browser creates an application instance of that application class in the application hierarchy and copies the data. However, if the file does not have an **appAttrClass** attribute, then the TOC browser assumes it isn't a PenPoint document and needs to be imported. The user must specify the type of document to use for displaying the data.

This discussion will make more sense if you try import and export yourself with a plain text file and a MiniText document.

The TOC browser imports the file by:

1. Querying all installed application classes to see if they can import the file by sending them **msgImportQuery**.
2. If an application responds affirmatively to the query, the browser adds it to a list of applications that can import the file.
3. The browser displays the import dialog box to the user, listing all applications that can import the document. The list will always contain at least one application, the Placeholder application, that stores the data as a stream of bytes. (If the user chooses the Placeholder application and later turns to the imported document, the Placeholder will prompt the user to choose an application with which to activate the document.)
4. The user selects an application and taps **Move** or **Copy**, depending on the operation.
5. The browser creates a new instance of the application selected by the user. The new document is at the location in the TOC where the user dragged the file icon.
6. The browser sends **msgImport** to the new document, telling it the file to import.
7. The selected application class does whatever it has to do to translate the chosen file's data into its representation.

If everything succeeds, the user has created a new document in the TOC holding the converted file contents.

Export Overview

81.1.2

The user exports a document to a file by copying or moving a document from a TOC browser to a disk viewer. Typically, the user moves or copies a document from the Notebook Table of Contents to a the disk viewer directory in the Connections notebook. At this point **clsApp** takes over and performs the following tasks:

1. Activates the selected document, if it isn't currently active, by sending **msgAppMgrActivate** to its class.
2. Sends **msgExportGetFormats** to the document to query the document for the file formats that it can write.

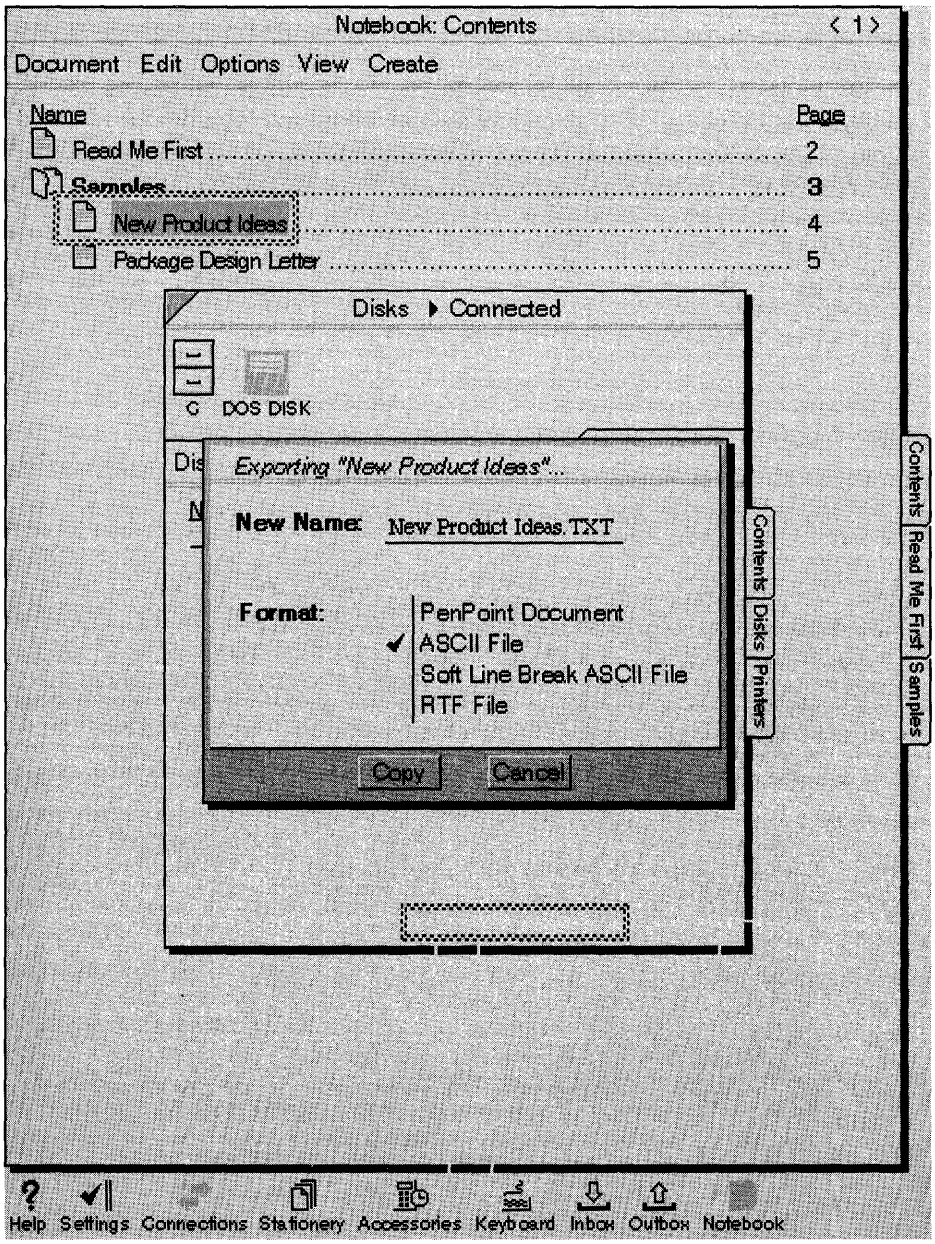
3 The application passes back its export format types and the UID of an object that will translate the data. Usually this object is self, but applications can use this UID to identify a separate translator object that will do the work.

4 **clsApp** presents the export dialog box to the user, listing the export file formats provided by the application.

5 The user chooses a file format and name for the exported file, then taps the **Export** button.

6 The disk browser creates the destination file and sends **msgExport** to the translator. **msgExport** tells the translator which format to write and also gives the translator the handle on the destination file.

Figure 81-1
Export Dialog



Application Responsibilities 81.1.3

The **clsBrowser** messages that lead to import and export episodes are not really important to most application developers (although you can use them if you want to force import or export to take place). The important thing is that all applications that import or export files must respond to the messages defined by **clsImport** and **clsExport**.

clsImport and **clsExport** are abstract classes that define the messages used to communicate information about importing and exporting files.

There are no instances of **clsImport** or **clsExport**.

Handling the clsImport Messages 81.2

The messages and defines for **clsImport** are defined in IMPORT.H. Table 81-1 lists the **clsImport** messages.

Table 81-1
clsImport Messages

Message	Takes	Description
msgImportQuery	P_IMPORT_QUERY	Queries each app class to see if it is capable of importing the file.
msgImport	P_IMPORT_DOC	Initiates the import procedure.

Responding to msgImportQuery 81.2.1

When the user drags an icon from a disk viewing browser to a TOC browser, the TOC browser sends **msgImportQuery** to each installed application class.

msgImportQuery is sent to your application class, not to an instance of your application. This means that to receive this message, your application class must set the **objClassMessage** flag in its method table entry for **msgImportQuery**, as follows:

```
MSG_INFO myAppClassMethods [] = {
    ...
    msgImportQuery, "MyImportQueryHandler", objClassMessage,
    0
};
```

When your application class receives **msgImportQuery**, it should determine if it can import the file. The message arguments for **msgImportQuery** are a pointer to an IMPORT_QUERY structure that contains:

file An open file handle on the file. Your application class can use the file handle to read data from the file to see if import would succeed. The browser resets the file pointer before sending **msgImportQuery** to the next application class.

fileName The file's name.

fileType The file's type, a file system attribute of the file. These file types are defined in FILETYPE.H:

fileTypeUndefined Indicates that the file type is undefined. (This will be the case for files from foreign operating systems which don't use PenPoint file system attributes.)

fileTypeASCII Specifies that the file contains ASCII data; each line in the file ends with a hard line break.

fileTypeASCIISoftLineBreaks Specifies that the file contains ASCII data; however, hard line breaks in the file are treated as soft line breaks.

fileTypeRTF Specifies that the file contains Microsoft's RTF (Rich Text Format) data.

fileTypeTIFF Specifies that the file contains TIFF (Tagged Image File Format) data.

fileTypePicSeg Specifies that the file contains data in GO Corporation's picture segment format.

canImport Passed back, a BOOLEAN value specifying whether the application can import the file format.

suitabilityRating Passed back, a value from 0 to 100 indicating how suitable the file format is to the application. 0 indicates that the file is not suitable to the application; 100 indicates that the file is very suitable to the application; 50 is the average value.

Developers can register new file types with GO. If you have a special file type that you want to register, please contact GO Developer Support for more information.

Your application class can check the file type, analyze the file name (for example, the extension), and read the file contents to determine whether it can import the file. Your application class should pass back an indication of whether it can import the file in the **canImport** BOOLEAN field of the IMPORT_QUERY structure. If you set this to **true**, the browser will add your application to the import dialog.

Responding to msgImport

81.2.2

When the user chooses an application to import the file, the browser creates a document of that application, starts it up, and sends **msgImport** to the document. The message argument for **msgImport** points to an IMPORT_DOC structure which contains:

file An open handle on the file.

fileName The file's name.

fileType The file type, as described in the previous section.

sequence The sequence number of the destination.

destHandle The directory handle on the destination directory.

When your application receives **msgImport**, it should use the information in the IMPORT_DOC structure to read the data from the file and attempt to translate it into information that it can understand.

If your application can't import the file contents, then it should return an error. If **clsApp** gets an error from **msgImport** then it deletes the newly-created document.

If possible, it's better to detect that import is impossible when your application class receives **msgImportQuery** so that your application never shows up in the import list. However, you may not discover that the file can't be imported until you try (for example, if the file is corrupt or otherwise unreadable).

Handling the clsExport Messages 81.3

The messages and defines for **clsExport** are defined in EXPORT.H. Table 81-2 lists the **clsExport** messages.

Table 81-2
clsExport Messages

Message	Takes	Description
msgExportGetFormats	P_EXPORT_LIST	Passes back the export format array from from the source of the export.
msgExport	P_EXPORT_DOC	Initiates export by the translator.
msgExportName	P_EXPORT_FORMAT	Passes back a possibly modified destination name from the translator.

How Export Happens 81.3.1

The export protocol comes into play when the user moves or copies an icon from a TOC browser to a disk viewer. Typically, the user moves or copies a document from the Notebook Table of Contents to a disk viewer directory in the Connections notebook.

When the user releases the move or copy icon over a disk viewer, the disk viewer asks the selection owner for supported transfer types: the TOC viewer supplies **clsExport** as one of the data transfer types. This is how the disk viewer knows that the copy is an export operation and not a simple copy operation to back up a document onto disk.

This interaction with the selection and transfer protocols allows anything that can be moved or copied to invoke export, although only selections from the TOC currently support export.

The disk viewer sends the source of the copy **msgExportGetFormats**. The source of the copy is the TOC browser, which does not know what export formats the document supports. So the TOC browser returns **stsExportActivateSource**. This tells the disk viewer to activate the source of the selection. The disk viewer sends **msgAppMgrActivate** to the application class of the document that the user originally selected.

Responding to msgExportGetFormats 81.3.2

After activating the selected document, the disk viewer then sends **msgExport-GetFormats** to the document. Your application is responsible for responding to **msgExportGetFormats** with the file formats that it can write.

msgExportGetFormat's message argument points to an EXPORT_LIST structure that contains:

format A pointer to an array of EXPORT_FORMAT structures. You must allocate this array from global memory. Each EXPORT_FORMAT structure describes one file format that your application can write.

numEntries The number of EXPORT_FORMAT structures in the array.

You should fill in each EXPORT_FORMAT structure with:

translator The UID of a translator that can convert the information from the source document type to the export file type. Usually the **translator** is **self**.

documentType The source document type. This field is meaningful only when the **translator** field specifies a translator other than self. A translator might be able to translate a number of different document types.

exportName A user-visible name for the export type.

exportType The type of file for the export destination. These file types are defined in FILETYPE.H:

fileTypeUndefined Indicates that the file type is undefined. (This will be the case for files from foreign operating systems which don't use PenPoint file system attributes.)

fileTypeASCII Specifies that the file contains ASCII data; each line in the file ends with a hard line break.

fileTypeASCIISoftLineBreaks Specifies that the file contains ASCII data; however, hard line breaks in the file are treated as soft line breaks.

fileTypeRTF Specifies that the file contains RTF data.

fileTypeTIFF Specifies that the file contains TIFF data.

fileTypePicSeg Specifies that the file contains data in GO Corporation's Picture Segment format.

You can use the **translator** field to identify a separate translator object that will do the work.

clsApp puts up an export dialog showing the export types (using the **exportNames** in the EXPORT_FORMAT array).

Responding to msgExportName 81.3.3

When the user selects an export type, **clsApp** sends **msgExportName** to the translator specified in the EXPORT_FORMAT structure. **exportName** contains the name of the source document; the translator, if necessary, can pass back a suggested destination file name in the same **exportName** field. For example, it might append .TXT to the end. You can ignore this message. Regardless, the user can write in a different name for the exported file.

The message argument for **msgExportName** is a pointer to an EXPORT_FORMAT structure, described above.

Responding to msgExport 81.3.4

When the user selects a particular export format, **clsApp** sends **msgExport** to that format's translator. The message argument for **msgExport** points to an EXPORT_DOC structure that contains:

exportType A tag that indicates the export type in the EXPORT_FORMAT structure that the user selected.

source A locator for the source document.

destination An open file handle on the destination.

path The path to the destination document.

The translator should use this information to export the information in the document into the file. It is the exporting application's responsibility to clean up any invalid file handles. If the export fails, this includes the destination file handle provided by **msgExport**.

Chapter 82 / The Selection Manager

The selection manager provides a mechanism for keeping track of what process owns the **current selection**, the data the user has selected for subsequent action such as copying or deleting. Because the selection can be owned by many different types of objects, the selection manager does not do any formatting.

The selection manager keeps track of the selection owner, even when the object that contains the selection is not on screen.

clsSelection defines messages that allow objects to request ownership of the selection. **clsSelection** can record the current selection owner before changing ownership to another object.

An instance of **clsSelection**—**theSelectionManager**—keeps track of the current selection owner and the preserved selection, if any. **theSelectionManager** is the only instance of **clsSelection**.

Topics covered in this chapter:

- Selection concepts.
- Determining the selection.
- Existing PenPoint classes that handle the selection.
- Selection messages that operate on the selection.
- Selection messages sent to selection owners.
- Selection messages passed to the selection manager.

Concepts 82.1

No more than one object can own the current selection at any one time. Objects can request ownership of the selection. There doesn't always have to be a selection. If the user hasn't selected anything, there is no selection owner.

The Selection Manager 82.1.1

The ownership of the selection is administered by **theSelectionManager**, the only instance of **clsSelection**. **theSelectionManager** has the following responsibilities:

- It handles the transition between the current selection owner and the new selection owner.
- It keeps track of the current selection owner.
- It sends messages to observers of **theSelectionManager** when selection ownership changes.

The **theSelectionManager** is the only instance of the selection class, **clsSelection**, which defines two categories of messages:

- Messages that provide function for **theSelectionManager**.
- Abstract messages for common operations performed by owners of the selection. These abstract messages fall into two categories:
  - Messages that an object or one of its ancestors must respond to (such as "delete the selection" or "yield the selection"). If these messages reach **clsObject**, it sends **msgNotUnderstood**.
  - Messages that an object and its ancestors have the option of ignoring (such as "make yourself the selection"). If these messages reach **clsObject**, it returns **stsIgnored**.

You must always use **ObjectCall**() when you pass messages to **theSelectionManager**.

Selection Owners

82.1.2

Just about any object can own the selection, so long as it handles the required **clsSelection** messages. For example, when an object that owns the selection receives a message asking it to yield the selection, it must yield the selection and return.

Certain object types can't own the selection, either because there is no way for them to receive messages from **theSelectionManager**, or because other objects cannot communicate with them. These object types are:

- Objects that do not have global scope.
- Global objects that cannot receive messages (those for which **objCapSend** is disabled).

Any attempt to give an object of this type ownership of the selection will return a scope violation status code, **stsScopeViolation**.

Preserving the Selection

82.1.3

There are times when you need to preserve the current selection while allowing the user to make a selection in another window. Generally, the only time this is true is when using an option sheet. For example, the user might select some text in a text editor and then put up an option sheet. **theSelectionManager** preserves the text selection while the option sheet is up. The user can make a selection in the option sheet, do something with the selection. When the user closes the option sheet, the preserved text selection is restored.

Selection Transitions 82.1.4

While **theSelectionManager** requests one object to yield ownership and gives ownership to another object, there is a time when the owner of the selection is not defined. If another **clsSelection** message arrives in this time, problems could arise. To avoid these problems, some **clsSelection** messages return **stsSelYieldInProgress** while it is in transition from one owner to another. For example, if you request the UID of the current selection owner (by sending **msgSelOwner** to **theSelectionManager**) while ownership is in transition, **msgSelOwner** returns **stsSelYieldInProgress**.

Certain other messages, rather than return **stsSelYieldInProgress**, just wait longer than usual to complete, until the new owner is established. These messages are:

msgSelSetOwner

msgSelDelete

A deadlock situation can occur if you receive **msgSelYield** and immediately send **msgSelSetOwner** to **theSelectionManager**, with your UID as the object to own the selection. Eventually the block on the requests times out, allowing your object to continue.

Determining What is Selected 82.2

If you inherit from **clsEmbeddedWin**, you will probably receive selection messages at some time. If you present information on screen and do not inherit from a class that handles **clsSelection** messages (as described below), you or one of your component classes will need to:

- Handle **clsInput** messages to detect when the user makes a selection.
- Request the selection (by sending **msgSelSetOwner** to **theSelectionManager** and specifying **self** as the new owner).
- Determine the type of selection.
- Show the user what is selected.

It is up to your application to determine what is selected.

Classes that Handle Selection 82.3

Some classes already handle selection ownership for you. If you subclass these classes, you inherit their selection behavior. In particular, **clsEmbeddedWin** and its subclasses all have selection ownership behavior built in.

The Selection Class Messages 82.4

Table 82-1 lists the **clsSelection** messages. The SEL.H header file declares these messages. There are no **msgNew** or **msgNewDefaults** messages because **theSelectionManager** is the only instance of **clsSelection** ever created.

Table 82-1
clsSelection Messages

Message	Takes	Description
		Messages Clients Send to theSelectionManager
msgSelSetOwner	OBJECT	Sets the selection owner.
msgSelSetOwnerPreserve	OBJECT	Sets the selection owner with the preserve option.
msgSelOwner	P_OBJECT	Passes back the selection owner.
msgSelPrimaryOwner	P_OBJECT	Passes back the primary selection owner (the preserved owner if any, else the current owner).
msgSelOwners	P_SEL_OWNERS	Passes back both selection and preserved owners.
		Messages theSelectionManager Sends to Observers
msgSelChangedOwners	P_SEL_OWNERS	Notifies observers when either of the selection owners changes.
msgSelPromotedOwner	P_SEL_OWNERS	Notifies observers when the preserved owner has been promoted back to the selection owner.
		Messages theSelectionManager Sends to Selection Owners
msgSelYield	BOOLEAN	theSelectionManager requires the release of the selection.
msgSelDemote	nothing	Informs the owner that it is becoming the preserved owner.
msgSelPromote	nothing	Informs the preserved owner that it is becoming the owner.
		Abstract Messages for clsEmbeddedwin and its Subclasses
msgSelSelect	nothing	Sets self to be the selection owner.
msgSelIsSelected	nothing	Returns TRUE if self is current selection owner.
		Abstract Messages for Move and Copy
msgSelBeginCopy	P_XY32	Initiate a copy operation.
msgSelBeginMove	P_XY32	Initiates a move operation.
msgSelCopySelection	P_XY32	The receiver should copy the selection to self at (x, y).
msgSelMoveSelection	P_XY32	The receiver should move the selection to self at (x, y).
msgSelDelete	U32	The selection owner should delete the selection.
		Abstract Message for Link Protocol
msgSelRememberSelection	P_XY32	The receiver should "remember" the selection and place the "remembrance" at (x, y).

Messages from Clients to theSelectionManager

82.5

Clients send messages to **theSelectionManager** to set the selection owner and to get information about the selection owner.

Setting the Selection Owner 82.5.1

To make an object the selection owner, send **msgSelSetOwner** to **theSelectionManager**. **msgSelSetOwner** takes as its sole argument the UID of the object which is to become the selection owner. **theSelectionManager** may send **msgSelSelect** (described in "Embedded Window Messages," below) to an object to ask it to become the selection owner. The object should respond by sending **msgSelSetOwner** with **self** as the argument.

When setting the selection owner, you can preserve the previous selection for later restoration by sending **msgSelSetOwnerPreserve** instead of **msgSelSetOwner** to set the new selection owner. For example, option sheets use **msgSelSetOwnerPreserve** when the user makes a selection within the option sheet. This preserves the original selection (the item to which the options apply) so that the option sheet can later restore the original selection and apply the options to it.

Both **msgSelSetOwner** and **msgSelSetOwnerPreserve** return **stsScopeViolation** if the object specified as the argument cannot receive messages from other objects (either because the object is not a global object or because its capability flags prevent it from receiving messages). In this case, the selection owner does not change.

Handling msgSelIsSelected 82.5.2

When your object receives **msgSelIsSelected**, it should return a BOOLEAN value that indicates whether it owns the selection or not. The message has no arguments.

If you don't inherit from an ancestor that handles **msgSelIsSelected**, the easiest way to handle the message is to send **msgSelOwner** to **theSelectionManager**. **msgSelOwner** sends back the UID of the current selection owner. If the returned UID matches **self**, return **true** to **msgSelIsSelected**; otherwise return **false**.

Messages Sent to Selection Owners 82.6

theSelectionManager sends certain messages to the selection owner. A class which can own the selection (or one of its ancestor classes) must handle these messages. If no one responds to the required messages, **clsObject** sends **msgNotUnderstood** to **self**.

These messages perform the following functions:

- Tell the owner to give up the selection (**msgSelYield**).
- Tell the owner to demote the selection to the preserved selection or to promote the selection from preserved selection (**msgSelDemote** and **msgSelPromote**).
- Tell the owner to delete the selection (**msgSelDelete**).
- Tell the owner to display the option sheet for the selection (**msgSelOptions**).
- Tell the owner to begin a move or copy operation (**msgSelBeginMove** and **msgSelBeginCopy**).

Handling msgSelYield

82.6.1

theSelectionManager sends you **msgSelYield** when you no longer own the selection. The message has a single argument, a BOOLEAN value that indicates whether you lost the selection or the preserved selection. If the argument is **true**, yield the selection; if the argument is **false**, yield the preserved selection.

You should always return **stsOK**.

Handling msgSelDemote and msgSelPromote

82.6.2

If you are the selection owner and a client sends **msgSelSetOwnerPreserve** to **theSelectionManager**, **theSelectionManager** sends you **msgSelDemote** to inform you that your selection has been preserved.

If that client later sends **msgSelSetOwnerPreserve** to **theSelectionManager** with a null argument, **theSelectionManager** sends you **msgSelPromote** to inform you that your selection has been restored.

You can respond to **msgSelDemote** by graying the selection (or some other response that shows the user that the selection is preserved, but not current).

These messages are essentially informative. You should always return **stsOK**.

If you maintain your own selection status, you can use these messages to update your status indicators.

Handling msgSelDelete

82.6.3

If you receive **msgSelDelete** and you have the selection, delete the current selection. The message argument is a U32 that represents flags that specify the visual behavior for your object after the delete. The flags specify:

SelDeleteReselect Display a selection after deleting the current selection.

SelDeleteNoSelect Show no selection after deleting the current selection.

After you receive and handle **msgSelDelete**, you still own the selection.

Handling msgSelOptions and msgSelOptionTagOK

82.6.4

If your object receives **msgSelOptions**, it should activate the option sheet for the current selection. The message has no arguments.

An option sheet sends **msgSelOptionTagOK** to your object to check if its options can be applied to the current selection. The message passes an option sheet tag. If your object receives **msgSelOptionTagOK**, it should examine the option sheet tag and see if the options can be applied to the selection.

Beginning Move and Copy Operations

82.6.5

The user can start a move or copy operation by making a selection and either holding the pen on the selection or tapping on the Move or Copy commands in the Edit menu. Either of these actions sends **msgSelBeginMove** or **msgSelBeginCopy** to the selection owner.

If you own the selection and receive either of these messages, you should obey the rules of the Embedded Window move/copy protocol. Usually, you send the message to your ancestor (**clsEmbeddedWin**) which handles the protocol for you. For a detailed explanation of the Embedded Window move/copy protocol, see Chapter 9, Embedded Windows, in *Part 2: The Application Framework* of volume I.

clsEmbeddedWin Handles Selection Messages 82.6.6

While you can handle all of the selection messages yourself, **clsEmbeddedWin** provides message handlers for most of the selection messages. If your class inherits from **clsEmbeddedWin**, you can simply pass the messages to your ancestor.

The metrics of an embedded window object contains information about whether it should preserve the selection or not before taking the selection. The client that creates the embedded window sets this style information.

If you inherit from **clsEmbeddedWin**, you should pass **msgSelSelect** to your ancestor. The message will trickle up to **clsEmbeddedWin**, which handles the message. **clsEmbeddedWin** examines the Embedded Window metrics for the selection style. If the selection style is **ewSelect**, **clsEmbeddedWin** sends **msgSelSetOwner** to the **theSelectionManager**; if the style is **ewSelectPreserve**, **clsEmbeddedWin** sends **msgSelSetOwnerPreserve** to **theSelectionManager**. If the selection style is **ewSelectUnknown**, **clsEmbeddedWin** runs up the window hierarchy to find a style that is not **ewSelectUnknown**. The messages **msgSelSetOwner** and **msgSelSetOwnerPreserve** are described later in this chapter.

Messages Passed to the Selection Manager 82.7

You pass messages to **theSelectionManager** for three reasons:

- You want to know who the current and preserved selection owners are.
- You want to set a selection owner.
- You want to set a selection owner and preserve the current selection owner.

Finding the Selection Owners 82.7.1

If you receive a message that instructs you to something with the selection, but you don't know who the current owner is, you can pass **msgSelOwner** to **theSelectionManager**. The message takes a pointer to the OBJECT location that receives the UID of the current selection owner.

If the message completes successfully, it returns **stsOK**. The OBJECT location contains the UID of the selection owner.

To find out the current owner and the owner of the preserved selection, send **msgSelOwners** to **theSelectionManager**. The message takes a pointer to a SEL_OWNERS structure, which **theSelectionManager** uses to send back the UIDs of the owners. The structure contains:

owner The UID of the selection owner. **objNull** is a valid value.

preservedOwner The UID of the owner of the preserved selection. **objNull** is a valid value.

hasPreservedOwner A BOOLEAN indicating whether **preservedOwner** is defined.

If the selection was between owners when you sent **msgSelOwner** or **msgSelOwners**, **theSelectionManager** might return **stsSelYieldInProgress**. The best thing to do is wait and try again.

Setting the Selection Owner 82.7.2

To set the selection owner, send **msgSelSetOwner** to **theSelectionManager**. The message takes the UID of the object that will become the new selection owner.

Preserving the Selection Owner 82.7.2.1

To set the selection owner and preserve the current owner, send **msgSelSetOwnerPreserve** to **theSelectionManager**. This message also takes the UID of the object that will become the new selection owner.

When **theSelectionManager** receives **msgSelSetOwnerPreserve** with a valid argument, it:

- Sends **msgSelDemote** to the current owner.
- Sets the current preserved owner to be the current owner.
- Sets the current owner to be the UID received in **pArgs.**
- Sends **msgSelChangedOwners** to observers of **theSelectionManager.**

Restoring the Selection Owner 82.7.2.2

To restore the preserved selection owner, send **msgSelSetOwnerPreserve** to **theSelectionManager** with a null argument value.

When **theSelectionManager** receives **msgSelSetOwnerPreserve** with a null argument, it:

- Sends **msgSelYield** to the current owner, if one exists.
- Sends **msgSelPromote** to the current preserved owner.
- Sets the current owner to the current preserved owner.
- Sets the current preserved owner to null.
- Sends **msgSelChangedOwners** to observers of **theSelectionManager.**

Observer Notification

82.8

An object that wants to watch the current selection can be an observer of **theSelectionManager**. For example, property sheets need to know when the selection owner changes. If the user selected some text, requested the property sheet for text, and then selected a scribble object in a MiniNote document, the text property sheet should inform the user that it cannot affect the new selection (by making itself gray).

When the owner of the selection or the preserved selection owner changes, **theSelectionManager** sends **msgSelChangedOwners** to observers of **theSelectionManager**. When the preserved selection owner is promoted back to selection owner, **theSelectionManager** sends **msgSelPromotedOwner** to observers.

The argument to the message is a pointer to a SEL_OWNERS structure that contains:

owner The UID of the new selection owner.

preservedOwner The UID of the preserved selection owner.

hasPreservedOwner A BOOLEAN indicating whether **preservedOwner** is defined.

Chapter 83 / Transfer Class

Although most messages transfer data between two objects, usually the objects have a relationship of ownership or inheritance. The transfer class, **clsXfer**, defines a general mechanism for exchanging information between two unrelated objects. This mechanism becomes particularly useful when responding to move or copy gestures. When two objects participate in a move or copy, they might have never communicated before.

Using **clsXfer**, the destination can send a message requesting the types of data that the source can transmit. When the source responds with the data types that it supports, the destination can decide whether it wants the data in one of the source's data types. If the destination can handle one of the source's data types, it asks the source to send the data using that data type.

clsXfer provides three different models for exchanging data, which allow for small or large transfers, one-shot or stream transfers, and formatted or unformatted transfers.

Topics covered in this chapter:

- Transfer concepts
- Agreeing on a transfer type
- One-shot transfers
- Stream transfers
- Using transfer messages
- Using transfer functions.

Concepts

83.1

The greatest single use of data transfers occur when the user moves or copies data from one location to another.

When an object receives a move or copy gesture, it is responsible for finding the owner of the selection and attempting to move or copy the selection to itself at the hot point of the gesture. The PenPoint™ operating system, through the application framework, allows users to attempt to move or copy any object they can select to any location they can draw a move or copy gesture.

This means that any object that responds correctly to application framework (embedded window) messages can be asked to move or copy information from any object to itself, perhaps from a class of object with which it has never communicated before.

The transfer class, **clsXfer**, provides protocols that allow unrelated objects to determine if they both understand the same data types. If the objects can agree on a data type, they use **clsXfer** protocols to transfer data using that data type.

General Scenario 83.1.1

In transferring data there are always two participants: the sender and receiver. The **sender** is an object in a PenPoint task that sends data to the **receiver**, which is another PenPoint object. In the transfer protocols, the receiver always requests data from the sender.

When responding to move or copy gestures, the sender is the owner of the selection. The receiver can find out the selection owner by sending **msgSelOwner** to the selection manager, which sends back the UID of the selection owner.

All transfers begin the same way. The receiver sends a message to the potential sender asking it to provide a list of the data transfer types that it can send. A data **transfer type** identifies a specific data format (such as a string or a structure) and transfer protocol. The receiver examines the sender's list and finds the best transfer type that it can use.

Tags for Data Transfer Types 83.1.2

The data transfer type is identified by a well-known tag that specifies the format of the data. The data transfer type is associated with a transfer protocol, although the protocol is not encoded in the tag.

clsXfer defines tags for several transfer types that are commonly used by PenPoint components. The tags and uses for the data transfer types are listed in Table 83-1. The table also lists the protocol implied by each transfer type. The following section discusses protocols in more detail.

Table 83-1
clsXfer Transfer Types

Transfer Type Tag	Protocol	Data Type
xferString	one-shot	A string up to 256 bytes.
xferLongString	one-shot	A variable length string.
xferName	one-shot	A label (such as a GoTo button).
xferFullPathName	one-shot	A full path name.
xferFlatLocator	one-shot	A flat locator file path.
xferASCIIMetrics	one-shot	Metrics for a block of ASCII text (doesn't return the text).
xferRTF	stream	A stream of RTF data.
xferScribbleObject	one-shot	A scribble object.
xferPicSegObject	one-shot	A picture segment object (see Part 3, Windows and Graphics).

The **clsXfer** transfer types are defined in XFER.H.

You can use the **MakeTag()** macro (defined in GO.H) to define tags for other transfer types. **clsXfer** is the class for the PenPoint transfer type tags. If you use any other class, it implies that the data transfer type uses a client-defined protocol, defined by that class.

If you define your own transfer types, they must be understood by both the sender and receiver. Thus, you cannot use your own transfer types to transfer data with PenPoint components, unless you subclass a PenPoint component to handle your transfer types.

Transfer Protocols 83.2

When the receiver finds an acceptable data transfer type in the list sent back by the sender, it initiates the data transfer protocol. The data transfer type implies the data transfer protocol that will be used to exchange data. There are three protocols for transferring data:

- One-shot. The receiver sends a single block of data to the receiver. One-shot transfers also identify the type of data being transferred (such as string, long string, or path name).
- Stream. The sender and receiver create a data stream. Stream transfers are used to transfer large amounts of data or continually arriving data.
- Client-defined protocol. The sender and receiver agree on a special protocol for transferring data. The client-defined protocol is usually defined by another class. For example, embedded windows (**clsEmbeddedWin**) establish their own protocol for transferring data.

One-Shot Transfers 83.2.1

In one-shot transfers, the receiver asks the sender for a block of data by sending **msgXferGet** to the sender. The specific structure used with the message depends on the transfer type. XFER.H defines the following transfer buffer structures:

XFER_FIXED_BUF Transfers a fixed length buffer of 256 bytes.

XFER_BUF Transfers a variable length buffer (of up to 64K bytes).

XFER_ASCII_METRICS Transfers ASCII metrics (this type is only used by the **xferASCIIMetrics** transfer type).

XFER_OBJECT Transfers an arbitrary object.

Each structure includes a TAG field representing the transfer type being used and a buffer or pointer to a buffer for the data to be transferred. All structures also include a U32 value that the receiver can use to communicate information to the sender, such as more specific information on the requested data.

If you create other transfer types, you can also define other buffer structures. Your transfer types will be known only to your senders and receivers, unless you make them available to other application developers by publishing information about them.

When the sender receives **msgXferGet**, it should move the information into the buffer and return **stsOK**.

Stream Transfers 83.2.2

In stream transfers, the receiver and sender must create and initialize a stream. When the stream is established, the sender and receiver use **clsStream** messages to read from and write to the stream (usually **msgStreamRead** and **msgStreamWrite**).

Because the steps that the receiver and the sender take to create a stream are so common, **clsXfer** defines a set of functions that do most of the work for you.

Before we describe the functions, we should describe the stream itself.

Streams 83.2.2.1

The stream consists of two stream objects; one belonging to the sender and one belonging to the receiver. The stream objects are instances of a private class that inherits from **clsStream**, they respond to **clsStream** messages, but have additional features to support the transfer protocol.

The two stream objects share a common **stream buffer**, a shared storage area. The sender's stream object handles **msgStreamWrite** by copying data from the sender's buffer into the stream buffer. The receiver's stream object handles **msgStreamRead** by copying data from the stream buffer into the receiver's buffer.

Stream Protocols 83.2.2.2

There are two stream protocols variations that you can use. The variations are:

- **Blocking protocol**, in which **clsXfer** blocks the sender when its buffer is full and releases the sender when the receiver empties the buffer sufficiently for it to continue. Blocking protocol works only when the sender and receiver are in separate tasks.
- **Producer protocol**, in which **clsXfer** communicates with an object (called a **producer**) that works on behalf of the sender to manage the transmission. When the sender and receiver are in the same task, they must use producer protocol (or limit their transfer to 64K bytes of data).

Blocking Protocol 83.2.2.3

In stream transfers, the stream uses an intermediate buffer to store the data being transferred. The sender specifies the size of the stream buffer when it calls **XferStreamAccept**.

Usually, blocking protocol is fairly straightforward. The sender uses **msgStreamWrite** to copy data from its buffer into the stream. **clsXferStream** receives the data and stores it in the stream buffer. When the receiver sends **msgStreamRead** to its stream object, **clsXferStream** copies the data from the stream buffer to the receiver's buffer.

However, if the receiver doesn't read enough data from the stream (either because it didn't send **msgStreamRead** or it only read a portion of the data), the stream buffer can become full. Before data gets lost, **clsXferStream** blocks the sender's task (by setting a semaphore).

When the receiver sends **msgStreamRead** and empties the stream buffer, **clsXferStream** clears the sender's semaphore, allowing **clsStream** to send more data.

All this occurs while the sender's **msgStreamWrite** is being handled. The sender doesn't have to know anything about being blocked. When **msgStreamWrite** returns **stsOK** to the sender, all data has been transferred.

Blocking Protocol Deadlocks 83.2.2.4

Thus far we have assumed that the sender and receiver are in different tasks. If the sender and receiver are in the same task, however, blocking protocol presents some synchronization problems. If the sender and receiver are in the same task and **clsXfer** blocks the sender's task, the receiver is blocked also. A deadlock exists; the sender is blocked until the receiver removes information from the buffer, but the receiver is blocked because it is in the same task as the sender.

clsXfer does as much as it can to avoid full-buffer deadlocks. If the sender and receiver are in the same task, and there is no producer, and the buffer is smaller than the data to be transferred, **clsXfer** will allocate additional space for the stream transfer buffer (up to 64K). However, if there is more than 64K to be transferred, this will not work because the maximum size of a stream transfer buffer is 64K.

Producer Protocol 83.2.2.5

Producer protocol avoids the blocking protocol's deadlock situation by making the producer keep track of the amount of information that has been transferred. **clsXfer** communicates with the producer to let it know when it can copy more information into the transfer buffer. The producer works for the sender; it can be a separate object or it can be the sender.

The receiver initiates the transfer by sending **msgStreamRead** to its stream object. The stream object knows that there is a producer, so it sends **msgXferStreamWrite** to the producer. The producer uses **msgStreamWrite** to copy the sender's data to the stream buffer. If the stream buffer is unable to accommodate all of the data, **msgStreamWrite** returns to the producer and passes back the number of bytes that it accepted. The producer must remember the location of the last byte accepted.

The producer then returns **msgXferStreamWrite** and the receiver's stream object copies the stream data to the receiver's buffer. If it reaches the end of data, it sends **msgXferStreamWrite** to the producer again. The producer sends **msgStreamWrite** to copy more data to the stream buffer.

Note that the sender never issues a message during the transfer. The producer acts as the sender's agent to handle the transfer. Of course the producer has to know what buffer the sender wanted to be transferred. There are two ways to accomplish this:

- When the sender initially creates the producer, part of the instance data can be the address of the send buffer.
- The receiver can use **msgXferStreamSetAuxData** to store auxiliary data in the stream (such as the address of the sender's buffer). The producer can send **msgXferStreamAuxData** to the stream to read the data.

Eventually the producer will have sent all the data from the sender's buffer. To terminate the stream, the producer sends **msgFree** to the stream object. When the stream is freed, the receiver can read the remaining data from the stream buffer, but when there is no more data, the receiver gets an EOF. The receiver should free its end of the stream.

If the receiver needs to abort a transfer that is in progress, it can free its stream object. When it does so, the sender's stream object sends **msgXferStreamFreed** to the producer. The producer should free its stream object.

Client-Defined Protocols 83.2.3

Client-defined protocols can encompass a wide range of data transfer schemes, from clones of the one-shot or stream protocols to specialized transfer methods that use a transfer medium other than shared buffers or message data.

As described above, if the sender and receiver agree on a transfer type that is defined by a class other than **clsXfer**, the receiver should initiate the transfer using the protocol defined by that class.

For one example of a client-defined protocol, see the embedded window move/copy protocol described in Chapter 9, Embedded Documents, in *Part 2: Application Framework* of volume I.

The Transfer Functions and Messages 83.3

Because the steps used to start and perform a transfer are common, no matter which transfer type you finally agree on, **clsXfer** defines a set of functions that perform most of the work for you.

Table 83-2 lists the **clsXfer** functions.

Table 83-2
clsXfer Functions

Function	Description
XferMatch()	The receiver calls XferMatch() to find a mutually acceptable data transfer type.
XferListSearch()	Searches two sets of data transfer types for a match.
XferAddIds()	Adds data transfer types to a list of acceptable types.
XferStreamConnect()	A receiver calls this function to create a stream connection to a sender.
XferStreamAccept()	Called by sender in response to msgXferStreamConnect.

Table 83-3 lists the **clsXferStream** messages. Generally, these messages are used by the **clsXferStream** functions; most clients shouldn't need to use them.

Table 83-3
clsXferStream Messages

Message	Takes	Description
msgXferList	OBJECT	Ask sender for its list of data transfer types.
msgXferGet	lots of things	Sent by a receiver to get one-shot data transfer information.
msgXferStreamConnect	XFER_CONNECT	Sent to the sender to ask it to link the sender's and receiver's pipes.
msgXferStreamAuxData	PP_UNKNOWN	Passes back auxiliary information associated with the pipe.
msgXferStreamSetAuxData	P_UNKNOWN	Stores arbitrary client data with the pipe.
msgXferStreamWrite	STREAM	Asks the sender to write more data to the stream.
msgXferStreamFreed	STREAM	Sent to the sender when the receiver's side of the stream has been freed.

Establishing a Transfer Type

83.4

The job of establishing a transfer type is made fairly easy by calling the **clsXfer** functions. However, before describing the functions, let's take a look at how the receiver and sender interact to establish the transfer type.

1. The receiver calls **XferMatch**(), which creates two lists:
   - An array of the transfer types that it can use.
   - An empty **clsXferList** object.
2. **XferMatch**() sends **msgXferList** to the potential sender. The messages arguments include the empty **clsXferList** object.
3. When the sender receives **msgXferList**, it uses the function **XferAddIds**() to add its transfer types to the list. The sender then sends **msgXferList** to its ancestor.
4. When the ancestor returns the message, the sender returns **msgXferList** to the receiver.
5. **XferMatch**() uses the **XferListSearch**() function to compare the list of returned transfer types against the array of acceptable transfer types provided by the receiver.
6. When the first match is found, **XferMatch**() places the matched transfer type in the location specified by the receiver and returns **stsOK**.

The order the array of transfer types and the order of the transfer types in the **clsXferList** object is extremely important. **XferAddIds**() adds transfer types to the end of the **clsXferList** object. **XferListSearch**() starts at the beginning of both the array of transfer types and the **clsXferList** object.

If the receiver has a preferred transfer type, it should put it at the beginning of the transfer type array.

If the sender (or more importantly one of its ancestors) has a strong preference for a transfer type, it should use **clsList** messages to insert the transfer type at the beginning of the list object (**XferAddIds**() adds transfer types to the end of the list).

Requesting Transfer Types 83.4.1

The process of looking for a transfer type is made fairly simple by the **XferMatch**() function. The prototype for **XferMatch**() is:

```
STATUS EXPORTED XferMatch(
  OBJECT        sender,
  TAG       ids[],
  SIZEOF        idsLen,
  P_TAG     pId
);
```

The parameters to **XferMatch**() are:

sender The UID of the potential sender of data.

ids An array of transfer types familiar to the receiver.

idsLen The number of elements in the **ids** array.

pId A pointer to a TAG that will receive the returned transfer type.

If **XferMatch**() does not find a matching transfer type, it returns **stsNoMatch**. On receiving **stsNoMatch**, the receiver should call ancestor with the message that caused it to call **XferMatch**() (usually **msgGWinGesture**). This enables the receiver's ancestors to attempt to find a transfer type.

For example, **clsText** intercepts **msgGWinGesture** and uses **XferMatch**() to determine if the selection owner can send text data. If the selection is actually an an object or application, **XferMatch**() returns **stsNoMatch. clsText** sends the **msgGWinGesture** to its ancestor. Eventually **clsEmbeddedWin** receives the message, which is able to move an object or application.

Listing Transfer Types 83.4.2

To get a list of the available transfer types from the receiver, most clients use the **XferMatch**() function. However, if you need to provide special transfer type handling, you can send **msgXferList** on your own.

Before you send **msgXferList**, you need to do two things:

- You must identify the object that is the potential sender.
- You must create a transfer list (by sending **msgNew** to **clsXferList**).

Then you can send **msgXferList** to the sender; the only argument for the message is the UID of the transfer list.

Adding a Transfer Type to a List 83.4.3

If you are acting as a sender and receive **msgXferList**, you must add your transfer types to the list indicated by **pArgs**. To make this job easier, you can call **XferAddIds**(). The prototype for **XferAddIds**() is:

```
STATUS EXPORTED XferAddIds(
  OBJECT        listObject,
  TAG       ids[],
  SIZEOF        idsLen
);
```

The parameters are:

listObject The transfer list object indicated by **pArgs**.

ids An array of transfer types that you support.

idsLen The number of transfer types in the **ids** array.

The function sends **msgListAddItem** to the list for each transfer type in the array.

Remember that the order of the transfer types in **ids** is important. **XferAddIds**() adds the transfer types to the end of the list object as they appear in **ids**.

After adding your transfer types to the list, you must send it to your ancestor. When **msgXferList** returns from your ancestor, the transfer list object contains the transfer types supported by your class and all your ancestors. At this point you can return from **msgXferList**.

Searching a Transfer Type List 83.4.4

When the sender and its ancestors return **msgXferList**, the **XferMatch**() function calls **XferListSearch**(), which searches the transfer list returned by **msgXferList**, looking for a transfer type that matches one in an array of acceptable transfer types. The first array element is compared to all list elements, then the second array element, until every array element has been tried. Thus, the array should contain the optimal transfer types first.

If your class provides special operations, you can call **XferListSearch**() yourself. The prototype for **XferListSearch**() is:

```
STATUS EXPORTED XferListSearch(
  OBJECT        listObject,
  TAG       ids[],
  SIZEOF        idsLen,
  P_TAG     pId
);
```

The parameters are:

listObject The transfer list object sent to the sender.

ids The list of transfer types that the receiver supports.

idsLen The number of elements in the **ids** array.

pId A pointer to the location to receive the matched transfer type.

Performing One-Shot Transfers 83.5

If the transfer type is a one-shot type transfer, the receiver sends **msgXferGet** to the sender. The message takes a pointer to a transfer buffer. Transfer buffers can take on a number of forms. XFER.H defines the following types of transfer buffers:

- XFER_FIXED_BUF transfers up to 256 bytes in a single transfer.

- XFER_BUF transfers a variable length buffer (of up to 64K bytes).
- XFER_ASCII_METRICS is used to transfer ASCII metrics. This type is only used by **xferASCIIMetrics** transfer type.
- XFER_OBJECT is used to transfer an arbitrary object.

The type of transfer buffer depends on the transfer type. Table 83-4 lists the various one-shot transfer types and the corresponding buffer type. (The information in this table was obtained from XFER.H, which includes the transfer buffer type as a comment when defining the transfer types. If you define your own transfer types, it is a good idea to follow this practice.)

Table 83-4
Transfer Buffer Types

Transfer Type	Buffer Type
xferString	XFER_FIXED_BUF
xferLongString	XFER_BUF
xferName	XFER_FIXED_BUF
xferFullPathName	XFER_FIXED_BUF
xferFlatLocator	XFER_FIXED_BUF
xferASCIIMetrics	XFER_ASCII_METRICS
xferRTF	(stream protocol)
xferScribbleObject	XFER_OBJECT
xferPicSegObject	XFER_OBJECT

If you define your own transfer types, you can use these transfer buffers or you can define your own transfer buffers. Of course, transfer types that you create are known only to your senders and receivers.

Fixed-Length Buffer Transfers 83.5.1

If the transfer type is **xferString**, **xferName**, **xferFullPathName**, or **xferFlatLocator**, the argument to **msgXferGet** is a pointer to an XFER_FIXED_BUF structure, which contains:

id The transfer type.

buf A 256 byte buffer that contains the data.

len The length of the data in **buf**.

Variable-Length Buffer Transfers 83.5.2

If the transfer type is **xferLongString**, the argument to **msgXferGet** is a pointer to an XFER_BUF structure, which contains:

id The transfer type.

pBuf A pointer to a buffer that contains the data.

len The length of the data in **buf**.

The buffer indicated by **pBuf** must be shared. The sender should allocate the buffer by calling **OSSharedMemAlloc**() or by calling **OSHeapBlockAlloc**() with a shared heap such as **osProcessSharedHeapId**.

Whenever possible, the client that knows how big the data is should allocate the shared buffer.

When the receiver has read the data from the shared buffer, it should deallocate the buffer (a shared buffer does not have to be allocated and deallocated by the same task).

Whenever possible, the client that requested the data should deallocate the shared buffer.

When the message sends back XFER_BUF, the **len** field contains the length of the data in **pBuf**.

ASCII Metrics Transfers

83.5.3

If the transfer type is **XferASCIIMetrics**, the argument to **msgXferGet** is a pointer to an XFER_ASCII_METRICS structure, which contains:

id The transfer type.

When the sender returns **msgXferGet**, XFER_ASCII_METRICS contains:

first The text index of the first character in the range.

length The length of the text range.

level The parts of text being transferred. The level enables word processors to apply the correct styles to the data moved into a document. The possible values are:

0 ignore

1 characters

2 words

3 sentences

4 paragraphs

This example shows a receiver sending **msgXferGet** to a sender.

```
STATUS GetShortString(
    P_TAG   pID,        // pointer to ID from XferMatch
    P_MY_DATA   pMyData)    // pointer to instance data
{
    XFER_FIXED_BUF  fb; // Fixed buffer
    STATUS      status;

    fb.id   = *pID;
    fb.data = pMyData;
    status = ObjectSendUpdate(msgXferGet, pMyData->sender, &fb);

    if (status >= stsOK)
    {
        strncpy(pMyData->pFixedData, fb.buf, fb.len);
        pMyData->fixedLen = fb.len;
        return stsOK;
    }
    ...
}
```

Replying to One-Shot Transfers 83.5.4

When the sender receives **msgXferGet**, it should move the information into the buffer and return the message. This example shows how the sender responds when it receives **msgXferGet**:

```
// Handle msgXferGet for fixed data
STATUS ReplyFixedData(
    P_XFER_FIXED_BUF    pArgs)
{
    P_MY_DATA   *myData;    // pointer for data
    STATUS  rstatus;    // returned status

    rstatus = stsOK;

    // Find data to transfer
    FindData(mydata);

    if (myData->len > 256)
    {
        pArgs->len = 256;
        rstatus = stsTrunc; // data truncated
    }
    else
        pArgs->len = myData->len;

    strncpy(pArgs->buf, myData->data, pArgs->len);

    return rstatus;
}
```

Performing Stream Transfers 83.6

If the transfer type is a stream transfer, the receiver and sender must create their halves of a stream.

Creating the Receiver's Stream 83.6.1

The receiver always creates its half of the stream first, by calling the function **XferStreamConnect**(). The function's arguments are:

- The UID of the sender.
- The transfer type.
- An optional pointer to client data for the sender. This client data might indicate more specifically what portions of the data the receiver is interested in. When the stream sends **msgXferStreamWrite**, it passes this pointer to the producer.
- A pointer to the location that receives the UID of the receiver's stream object.

The function does the following:

1. Initializes and creates a stream object (by sending **msgNewDefaults** and **msgNew** to **clsXfer**).
2. Tells the sender to create its own stream object by using **ObjectPostAsync**() to send **msgXferStreamConnect** to the sender.

3 Initializes the stream by sending **msgXferStreamInit** to its stream object.

If the function completes correctly, it returns **stsOK**.

Creating the Sender's Stream 83.6.2

When the sender receives **msgXferStreamConnect**, it should create its half of the stream by calling the function **XferStreamAccept**. The function arguments are:

- The receiver's stream object (**pArgs->stream** in **msgXferStreamConnect**).
- The size of the stream transfer buffer (can be up to 64K bytes).
- An optional producer UID. If this argument is **null**, the stream uses blocking protocol; if this argument indicates an object, the stream uses producer protocol, with the indicated object as the producer.
- A pointer to the location that receives the UID of the sender's stream object.

The function:

1 Initializes the stream object (by sending **msgNewDefaults** to **clsXfer**).

2 Establishes that the stream object has a producer and identifies the receiver.

3 Creates the stream object (by sending **msgNew** to **clsXfer**).

4 Copies the UID of the stream object to the location specified by the caller.

If the function completes correctly, it returns **stsOK**.

Freeing the Stream 83.6.3

When the transfer is complete, the sender or the producer frees the stream by sending **msgFree** to its stream object. When **clsXfer** receives **msgFree**, it sends **msgXferStreamFreed** to the producer.

When the receiver gets **msgXferStreamFreed**, it frees its half of the stream.

Accessing the Stream's Auxiliary Data 83.6.4

The stream's data includes a pointer value for auxiliary data. The receiver and the sender can write and read this value to exchange information about the transfer.

To store information in the stream's auxiliary data, send **msgXferStreamSetAuxData** to the stream object. The message takes a pointer to any type of data. When the message completes successfully, it returns **stsOK**.

To read the stream's auxiliary data, send **msgXferStreamAuxData** to the stream object. The message takes a pointer to the location that receives the pointer stored in the stream.

When the message completes successfully, it returns **stsOK** and the location contains the pointer stored in the stream.

Connecting a Stream to a Producer 83.6.5

When the receiver in a stream transfer creates its half of the stream, it sends **msgXferStreamConnect** to the sender. The message takes an XFER_CONNECT structure that contains:

id The transfer type.

stream The UID of the receiver's stream object.

clientData A pointer to optional, client-specified data.

When the sender receives **msgXferStreamConnect**, it should create its stream object by calling the function **XferStreamAccept**().

Initializing a Stream 83.6.6

When the sender returns **msgXferStreamConnect**, the receiver should initialize the stream by calling **msgXferStreamInit**. The message takes no arguments.

Chapter 84 / Help

There are two help facilities built into the PenPoint™ operating system:

- Quick Help, which provides object-specific reminders when the user:
  - Makes the question mark 0 gesture over an object.
  - Taps on the Help icon, then taps on an object.
- The Help notebook, which provides users with full on-line help documentation.

Application designers can add both types of help to their application.

Topics covered in this chapter:

- Concepts of Help and Quick Help.
- How to add help to the Help notebook.
- How to define Quick Help resources.
- How to use the Quick Help messages.

Help Concepts 84.1

There are two help components in PenPoint: Quick Help and the Help notebook. Quick Help provides a reminder mechanism for windows which support Quick Help. The user invokes Quick Help either by making the question mark ? gesture over a window, or by tapping the Help icon, and then tapping on a window. Both methods display a brief help message in the Quick Help window.

The Help notebook is the location in which the full on-line help documentation for the system and applications exists. It is a true notebook and has a table-of-contents, tabs, sections, etc. The user invokes the Help notebook by tapping the Help icon, then tapping the Help notebook button in the Quick Help window.

The Help Notebook 84.1.1

The Help notebook contains tutorial Help information. It is a true notebook that can contain any application—there is no requirement on the type of application that can be placed in this notebook. An application can even put a instance of itself in the Help notebook.

Help Directories 84.1.1.1

To add a help application to the Help notebook, create a HELP directory in your application directory (\PENPOINT\APP\MYAPP\HELP) and place directories containing help applications in this directory.

When the user installs your application, the installer copies the help applications into the Help notebook, just as stationery documents in a STATNRY directory are copied into the Stationery notebook.

If you don't want to create a help application, you can use **clsTexteditApp** to display your help text. To use the text editor:

1. Create an ASCII text file called HELP.TXT or a Rich Text Format (RTF) file called HELP.RTF that contains your help text.
2. Store the text file in a subdirectory of your document's HELP directory. The name of the subdirectory is the title of the document in the Help notebook.

You can provide more than one help document (or help application), but each requires its own subdirectory under the HELP directory.

HELP subdirectories that are application documents must be labeled with the class of the application. If a directory is not labeled with an application class when the installer copies it into the Help notebook, the installer labels it with **clsTexteditApp** (the MiniText application class). When the user turns to your help text, the help notebook activates the text as a text editor document.

The following directory tree shows the help for an application named MyApp. Under the directory named \MyApp is a HELP directory. The HELP directory contains two subdirectories for two separate help text files, Summary Help and Detailed Help.

```
\PENPOINT
  └─ \APP
       └─ \MyApp
            └─ \HELP
                 ├─ \Summary Help
                 │    └─ HELP.TXT
                 └─ \Detailed Help
                      └─ HELP.TXT
```

When the files in this example are loaded by the Installer, the Help notebook would contain two documents named Summary Help and Detailed Help.

Creating Help Text

84.1.1.2

If you use **clsTexteditApp** to display your help, your help text can be either an ASCII text file called HELP.TXT or an RTF file called HELP.RTF.

You can create an ASCII text file in any text editor or word processor. If you use a word processor, make sure that you save the file as a plain text document—not the word processor's format.

RTF is a document description language that allows you to transfer formatted documents among different word processors. You can create RTF files by editing your help text in a word processor that can save its documents as RTF files.

An additional benefit of using RTF for your help text is that you can include gesture characters in your documents, using the PenPoint Gesture font (GS80). For information about how to add the PenPoint Gesture font characters to your help text, see "Advanced Topics," later in this chapter.

Quick Help Concepts

84.1.2

The system support for Quick Help consists of a well-known object, **theQuickHelp**, which is the window which displays the current help information. The Quick Help window is a floating window with two buttons, Done and Help notebook.

The default support in the system for Quick Help is based in the gesture window class, **clsGWin**. A Quick Help ID can be stored with a gesture window as a property of the object. When the question mark gesture gets to **clsGWin**, it will send this Quick Help ID to the Quick Help window. The Quick Help window will then attempt to find the resource with the Quick Help ID. If it finds the resource, it reads in the text and displays it.

The resource described above currently contains the strings for the title and summary (there is also a gesture string which is unused). It is the responsibility of the developer to provide the Quick Help resources and store them in the application or system directories.

To use the Quick Help facility, developers create Quick Help resources and associate them with PenPoint objects. When the user makes a help gesture ? over the object, **clsGWin** intercepts the gesture, and sends **msgQuickHelpShow** to put the Quick Help window on-screen and present the text to the user. When the user taps on another object while the Quick Help window is on-screen, the Quick Help window simulates the gesture.

For objects that do not descend from **clsGWin**, the Quick Help API enables clients to direct the Quick Help manager to display text from a help resource.

Adding Quick Help to an object that inherits from **clsGWin** requires two steps:

- You define a Quick Help resource in a resource file, either by saving the resource to disk from an application or by using the resource compiler to compile a resource definition file (see *Part 11: Resources* for more information).
- You store the ID portion of the Quick Help resource ID in the metrics of the **clsGWin** object.

When the user makes a Quick Help gesture on the object, **clsGWin** receives the gesture (if it isn't intercepted) and sends messages to the Quick Help manager to display the Quick Help resource.

If the object does not inherit from **clsGWin**, adding Quick Help is almost as easy. After defining the Quick Help resource, you ensure that the object stores the Quick Help resource ID. When needed, the object sends messages to the Quick Help manager, directing it to display the Quick Help resource.

Quick Help Resources

84.1.2.1

This discussion assumes that you are familiar with resources.

The Quick Help resource for an object consists of three strings that contain:

- A title for the Quick Help window.

- A gesture string (currently unused; should be empty).
- The Quick Help summary.

The strings can either contain plain text or RTF strings. RTF is useful if you need to use multiple fonts or add other stylistic changes to your text. For example, an RTF string can include characters from the PenPoint Gesture Font. For information on adding PenPoint Gesture Font characters to your help strings, see the "Advanced Topics," later in this chapter.

You define a Quick Help resource as a string-array resource that contains all of the Quick Help strings for the class.

The Quick Help resources for an application must be stored in the APP.RES file for that application. The Quick Help resources for system-wide objects should be stored in the system resource file.

Quick Help and clsGWin 84.1.2.2

When you create an instance of an object that inherits from **clsGWin**, you and store a Quick Help resource ID in the **gwin.helpID** field for the **clsGWin** object.

If the user makes the Quick Help gesture on an object that inherits from **clsGWin** and no subclass intercepts the gesture, **clsGWin** receives the gesture and:

1. Uses the application UID to locate the application's resource list.
2. Uses the Quick Help ID in **gwin.helpId** to identify the resource.
3. Sends **clsQuickHelp** messages to the Quick Help manager (**theQuickHelp**).

Quick Help without clsGWin 84.1.2.3

If you use a class that does not inherit from **clsGWin**, but you want to be able to display Quick Help for instances of that class, you can send Quick Help messages to **theQuickHelp** (the same way that **clsGWin** invokes Quick Help).

You can also use this technique if you want to intercept the Quick Help gestures and display the Quick Help information yourself.

The messages defined by **clsQuickHelp** allow clients to:

- Display Quick Help.
- Open and close the Quick Help window.
- Determine which Quick Help string to display.

"Advanced Topics," later in this chapter, describes the Quick Help messages and how to use them.

theQuickHelp Object 84.1.2.4

There is only one Quick Help object in the system: **theQuickHelp. theQuickHelp** is defined when the PenPoint operating system is booted. You do not need to send **msgNew** to any class to create **theQuickHelp** (in fact, there is no well known UID for the Quick Help class).

Defining Quick Help Resources 84.2

You define the Quick Help resources in C language files that are compiled by the Resource Compiler. Before you read about defining Quick Help resources, you should be familiar with the material in *Part 11: Resources.*

Each resource is defined by a string resource that defines the title and summary strings. All of the Quick Help string resources are combined into a single string array resource.

Defining the Quick Help String Array 84.2.1

To define a Quick Help string array resource you define a static string array and a resource definition that points to the string array. Each string in the string array combines the title and summary strings for a single Quick Help resource. Each of the Quick Help strings in the array has the following format:

```
static CHAR label-of-string[] = {
    // title
    "title text||"
    // summary
    "summary text "
    "more summary text"
};
```

The title and summary strings are combined into a single string, with a sequence of two vertical bar characters (||) separating the two parts of the string. Note that ANSI C concatenates consecutive strings, so the above template actually defines a single string.

All of the Quick Help strings for a class are combined into a single string array, plus a null string to indicate the end of the array. This string array is the data for the Quick Help resource for the class.

The resource definition has this format:

```
static RC_INPUT res-label = {
    MakeListResId(class-UID, resGrpQhelp, list-number),  // list-number is typically 0
    label-of-string-array,      // Name of the string array
    0,                          // dataLength is not needed for strings
    resTaggedStringArrayResAgent        // Use string array resource agent
};
```

The following example shows a typical Quick Help resource using string resources.

Example 84-1
Defining a Quick Help Resource

This example shows how to define the Quick Help resource. It comes from the Quick Help for the view of the Tic-Tac-Toe sample program, in \PENPOINT\SDK\SAMPLE\TTT. The tag for the resource is defined in TTTQHEIP.RC as:

```
#ifndef RESCMPLR_INCLUDED
#include <rescmplr.h>
#endif
#ifndef QHELP_INCLUDED
#include <qhelp.h>
#endif
#ifndef TTTVIEW_INCLUDED
#include "tttview.h"
#endif
//
// Quick Help string for ttt's option card.
//
static CHAR tttOptionString[] = {
    // Title for the quick help window
    "TTT Card||"
    // Quick help text
    "Use this option card to change the thickness of the lines "
    "on the Tic-Tac-Toe board."
};
//
// Quick Help string for the line thickness control in ttt's option card.
//
static CHAR tttLineThicknessString[] = {
    // Title for the quick help window
    "Line Thickness||"
    // Quick help text
    "Change the line thickness by writing in a number from 1-9."
};
//
// Quick Help string for the view.
//
static CHAR tttViewString[] = {
    // Title for the quick help window
    "Tic-Tac-Toe||"
    // Quick help text
    "The Tic-Tac-Toe window lets you to make X's and O's in a Tic-Tac-Toe "
    "grid. You can write X's and O's and make move, copy "
    "and pigtail delete gestures.\n\n"
    "It does not recognize a completed game, either tied or won.\n\n"
    "To clear the game and start again, tap Select All in the Edit menu, "
    "then tap Delete."
};
// Define the quick help resource for the view.
static P_RC_TAGGED_STRING   tttViewQHelpStrings[] = {
    tagCardLineThickness,   tttOptionString,
    tagTttQHelpForLineCtrl, tttLineThicknessString,
    tagTttQHelpForView,     tttViewString,
    pNull
};
```

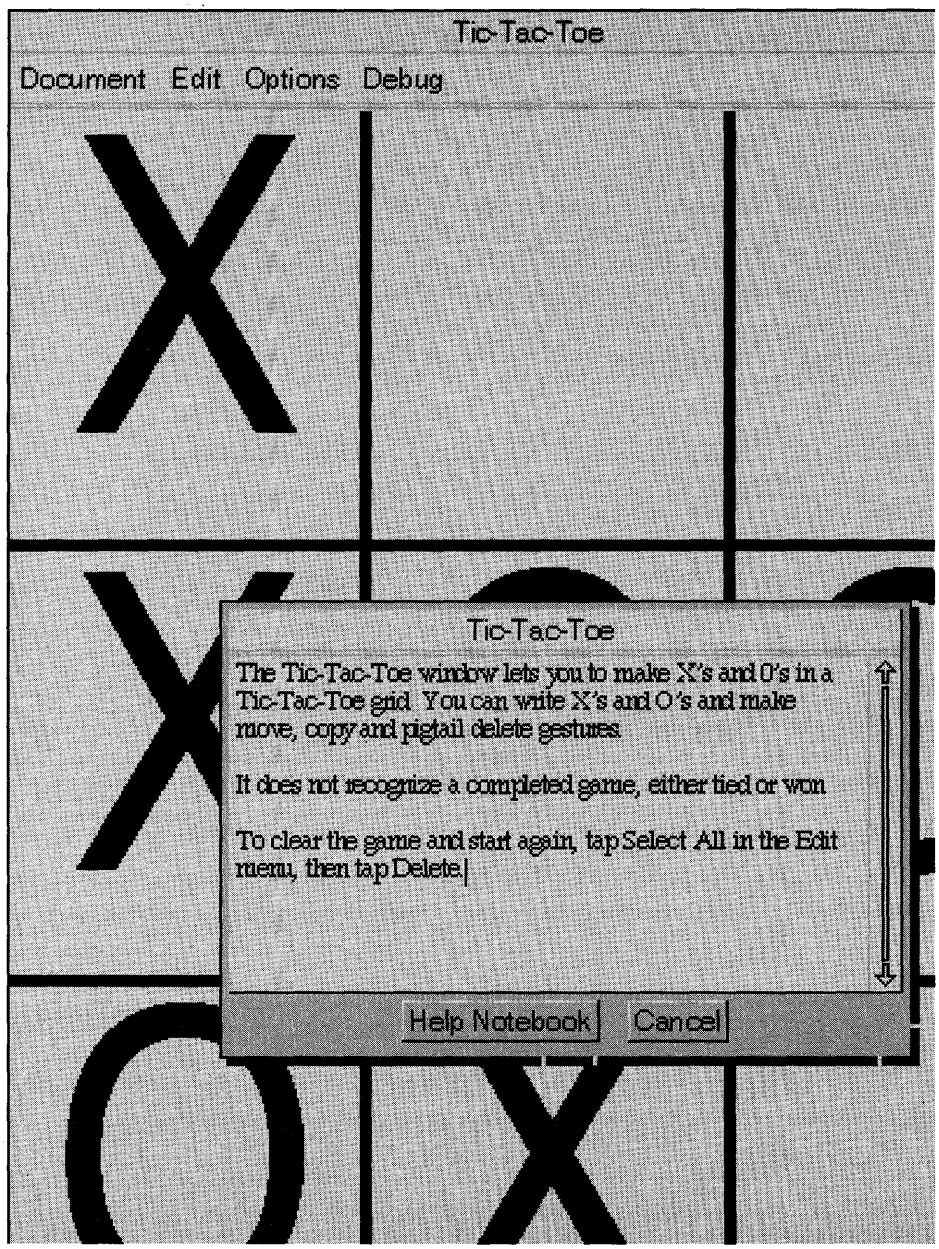
continued

Example 84-1 (continued)

```
static RC_INPUT tttViewHelp = {
    MakeListResId(clsTttView, resGrpQhelp, 0),
    tttViewQHelpStrings,            // Name of the string array
    0,
    resTaggedStringArrayResAgent    // Use string array resource agent
};
/*****************************************************************************
    The glue that ties everything together -- resInput.
*****************************************************************************/
// resInput is an exported variable that the resource compiler expects.
// Each element is a pointer to a structure describing the next resource.
// The list is terminated with a null pointer.
P_RC_INPUT  resInput [] = {
    &tttViewHelp,   // this is the one defined in this example
    // any other resource pointers would go here
    pNull
};
```

Figure 84-1 illustrates the Quick Help that results from the resource shown here:

Figure 84-1
A Quick Help Window



Storing the Resource ID in a Gesture Window

84.2.2

To associate a Quick Help resource with a window class that inherits from **clsGWin**, store the resource ID in the **gWin.helpId** field of the window. For example, while handling **msgNewDefaults**, **clsTTTView** sets its **gWin.helpID** to the resource ID of one of the strings defined in Example 84-1 (this code fragment is from \PENPOINT\SDK\SAMPLE\TTT\TTTVIEW.C):

```
pArgs->gWin.helpId = tagTttQHelpForView;
```

Advanced Topics 84.3

Most application designers shouldn't need to communicate with **theQuickHelp**. However, if you create a class that does not inherit from **clsGWin** or want to intercept the Quick Help messages and handle them on your own, you can send messages to **theQuickHelp**.

Quick Help Message Summary 84.3.1

The Quick Help messages and structures are defined in QHELP.H.

Table 84-1 lists the messages defined by Quick Help.

Table 84-1
clsQuickHelp Messages

Messages	Takes	Description
msgQuickHelpHelpShow	P_XY32	Sent to a window to request it to display quick help. The window typically responds by posting msgQuickHelpShow.
msgQuickHelpShow	P_QUICK_DATA	Sent to theQuickHelp to displays the Quick Help associated with a resource ID.
msgQuickHelpOpen		Forces the Quick Help window to appear.
msgQuickHelpHelpDone	OBJECT	Sent to a window when quick its quick help is no longer displayed.
		Messages Sent to Observers
msgQuickHelpOpened	nothing	Indicates that the quick help window has been opened.
msgQuickHelpClosed	nothing	Indicates that the quick help window has been closed.
msgQuickHelpInvokedNB	nothing	Indicates that the notebook associated with quick help should be open.

Using Quick Help Messages 84.3.2

This section describes how to use the Quick Help messages. You should rarely need to send any of these messages since default Quick Help handling is implemented by **clsGWin**, and most application windows inherit from **clsGWin**.

Displaying Quick Help Text 84.3.2.1

To tell the Quick Help window to open and display help text, send **msgQuickHelpShow** to **theQuickHelp**. Normally, **theQuickHelp** will send **msgQuickHelpHelpShow** to your window, and your window will respond by using **ObjectPost()** to send **msgQuickHelpShow** to **theQuickHelp**.

msgQuickHelpShow takes as its argument a pointer to a QUICK_DATA structure that contains:

helpId The Quick Help resource identifier.

appUID The UID of the application that owns the Quick Help resource.

The Quick Help window remains open until the user closes it.

Opening the Quick Help Window 84.3.2.2

You can force the Quick Help window to appear on screen. To open the window, send **msgQuickHelpOpen** to **theQuickHelp**. The message takes no arguments. The Quick Help window displays the text that was last displayed by **msgQuickHelpShow**.

Using the PenPoint Gesture Font 84.3.3

The PenPoint Gesture font allows you to incorporate glyphs that resemble gestures in your Help and Quick Help documents. The PenPoint Gesture font file is in \PENPOINT\FONT\GS80.PCK. You must use Rich Text Format (RTF) documents to include the gesture font with ordinary text in your document.

Table 84-2 shows the characters in the Gesture font as they appear on the PenPoint computer screen, their ASCII values, and the meanings of the characters. Not all gestures are currently used; not all have glyphs in the gesture font. The ASCII values are assigned tags in the file \PENPOINT\SDK\INC\XGESTURE.H.

Table 84-2
PenPoint Gesture Font

Gesture Tag	Symbol	ASCII Value
xgsLeftParens	[	40
xgsRightParens	]	41
xgsPlus	+	43
xgs1Tap	!	46
xgsQuestion	?	63
xgsAGesture	A	65
xgsBGesture	B	66
xgsCGesture	C	67
xgsDGesture	D	68
xgsEGesture	E	69
xgsFGesture	F	70
xgsGGesture	G	71
xgsHGesture	H	72
xgsIGesture	I	73
xgsJGesture	J	74
xgsKGesture	K	75
xgsDownRight, xgsLGesture	L	76
xgsMGesture	M	77
xgsNGesture	N	78
xgsCircle, xgsOGesture	O	79
xgsPGesture	P	80
xgsQGesture	Q	81

continued

Table 84-2 (continued)

Gesture Tag	Symbol	ASCII Value
xgsRGesture	R	82
xgsSGesture	S	83
xgsTGesture	T	84
xgsUGesture	U	85
xgsWGesture	W	87
xgsCross, xgsXGesture	X	88
xgsYGesture	Y	89
xgsZGesture	Z	90
xgs2Tap		128
xgs3Tap		129
xgs4Tap		130
xgsCheckTap		136
xgsTapHold		137
xgsPressHold		138
xgsScratchOut		140
xgsPigtailVert		141
xgsCircleTap		142
xgsUpCaret		143
xgsCircleLine		146
xgsCircleFlickUp		147
xgsCircleFlickDown		148
xgsUpCaretDot		149
xgsDblCircle		152
xgsUpArrow		153
xgsUp2Arrow		154
xgsDownArrow		155
xgsDown2Arrow		156
xgsLeftArrow		157
xgsLeft2Arrow		158
xgsRightArrow		159
xgsRight2Arrow		160
xgsDblUpCaret		161
xgsRightUp		165
xgsRightUpFlick		166
xgsRightDown		167
xgsDownRightFlick		168
xgsDownLeft		169
xgsDownLeftFlick		170

continued

Table 84-2 (continued)

Gesture Tag	Symbol	ASCII Value
xgsParagraph		171
xgsUpRight	⌐	173
xgsFlickUp	⏐	174
xgsFlickDown	⏐	175
xgsFlickLeft	—	176
xgsFlickRight	—	177
xgsDblFlickUp	⏐⏐	178
xgsDblFlickDown	⏐⏐	179
xgsDblFlickLeft	=	180
xgsDblFlickRight	=	181
xgsTrplFlickUp	⏐⏐⏐	186
xgsTrplFlickDown	⏐⏐⏐	187
xgsTrplFlickLeft	≡	188
xgsTrplFlickRight	≡	189
xgsQuadFlickUp	⏐⏐⏐⏐	190
xgsQuadFlickDown	⏐⏐⏐⏐	191
xgsQuadFlickLeft	≡	192
xgsQuadFlickRight	≡	193
xgsLeftDown	⌐	197
xgsLeftUp	⌐	198
xgsUpLeft	⌐	199
xgsVertCounterFlick	⏐⏐	200
xgsHorzCounterFlick	=	201
xgsCircleCrossOut	⊗	203
xgsBordersOn		204
xgs2TapHold	⏐	244
xgs3TapHold	⏐	245
xgs4TapHold	⏐	246

Adding Gestures to Help Text

84.3.3.1

To add the gesture characters to help text, edit the help text file using a text editor that supports multiple fonts and can save a document in RTF format. Insert the value for the gesture font character and change the font of the character to symbol-h.

When MiniText reads an RTF document, it interprets characters styled with the symbol-h font as using the PenPoint Gesture font.

Adding Gestures to Quick Help Strings

84.3.3.2

Adding gestures to Quick Help strings is somewhat more complicated, because you have to create your Quick Help strings in RTF to take advantage of the PenPoint Gesture font.

If you examine a few RTF strings, you will be able to understand most of the language. A complete description of RTF is available in the *Microsoft Word for Windows Technical Reference*, which is available from Microsoft Press.

The escape character for RTF strings is a backslash. When defining RTF strings in C, you must remember to double the backslash.

The first part of an RTF description of a document assigns fonts to font numbers, describes the style sheet (if there is one), and describes the document layout. PenPoint provides a shorthand method for describing this information with the **\qh** control word.

The change to the PenPoint Gesture font begins is specified with the string **\\f63**; the return to the normal font is specified with the string **\\f0**. RTF files cannot contain characters other than the 127 ASCII characters, so characters beyond decimal 127 must be specified with the RTF hexadecimal character representation (\\'*hex-digits*).

Chapter 85 / The Busy Manager

Occasionally your application might need to perform some time-consuming work—time-consuming enough for the user to notice that the machine is not responding. Such work might include performing compute-intensive work or copying large files across a network. To assure the user that the computer is still working, you can put up a **busy clock**, a small animated image of a clock face, on the screen.

The PenPoint™ Application Framework ensures that all applications automatically bring up the busy clock if they take more than about half a second to respond to an input event, then automatically take down the busy closk when they are no longer busy. Furthermore, you can control the busy clock programmatically by sending messages to **theBusyManager**. Messages for **theBusyManager** are defined in BUSY.H.

Using theBusyManager 85.1

theBusyManager responds to the message, **msgBusyDisplay**. When your application starts some work that will not change the display for a number of seconds, send **msgBusyDisplay** to **theBusyManager** with **busyOn** (a U32) as the argument. When your application is no longer busy, send **msgBusyDisplay** to **theBusyManager** with **busyOff** (a U32) as the argument.

This example shows a use of **theBusyManager**.

```
#include <busy.h>
STATUS  s;

s = ObjectCall(msgBusyDisplay, theBusyManager, busyOn);

    // (Perform some time-consuming task)

// Done, take down busy display
s = ObjectCall(msgBusyDisplay, theBusyManager, busyOff);
```

Placing the Busy Display 85.1.1

If you want to locate the busy clock at a particular point on-screen, send **msgBusySetXY** with a pointer to an XY32 as its argument. The next time **theBusyManager** receives **msgBusyDisplay** with an argument of **busyOn**, the busy clock will appear a the root window coordinates specified by the XY32.

msgBusySetXY sets the location of the busy clock only for the duration of one send of **msgBusyDisplay**. When the busy clock is turned off, the coordinates for the next display of the busy clock are set to **minS32, minS32**.

The Busy Clock Delay and Reference Count 85.2

Normally, **theBusyManager** allows a short delay from the time it receives **msgBusyDisplay** with an argument of **busyOn** and the time it displays the busy clock. This usually prevents situations in which the busy clock appears on screen for so brief a period that it simply flickers. However, if you know that your application will be busy for an extended period and would like the busy clock to come up immediately, you can use an OR operation to combine the flag **busyNoDelay** with **busyOn**. If you pass the result as the argument to **msgBusyDisplay**, **theBusyManager** will put the busy clock up with no delay.

theBusyManager maintains a reference count which records how many objects have turned on the busy clock and how many have turned it off. Using the reference count, **theBusyManager** can handle **msgBusyDisplay** more efficiently. For example, suppose two clients send **msgBusyDisplay** with an argument of **busyOn**. When the first client send **msgBusyDisplay** with an argument of **busyOff**, **theBusyManager** does not need to take down the busy clock (which is still needed for the second client), and instead simply reduces the reference count and returns **stsOK**. **theBusyManager** doesn't execute the code to take down the busy clock until the reference count comes back down to zero.

It is possible to override the reference count mechanism, although this is not recommended. If you use an OR operation to combine the flag **busyNoRefCount** with **busyOn**, **msgBusyDisplay** will do nothing if the reference count is greater than zero. If you combine **busyNoRefCount** with **busyOff**, **msgBusyDisplay** will set the reference count to zero and bring down the busy clock.

Chapter 86 / Search and Replace

The search and replace API provides a protocol used by clients that need to search and replace text strings in embedded objects. Additionally, the search and replace library provides functions that search for and replace text in specified objects.

Topics covered in this chapter:

- Writing an application that searches and writing a class that can be searched.
- The search and replace protocol.
- Responding to traversal messages.
- The search and replace library.
- Advanced topics (for those not using the search and replace driver provided by the PenPoint™ operating system).

Concepts

86.1

Before reading this chapter, you should be familiar with embedded documents and using marks, which are both described in *Part 2: PenPoint Application Framework.*

A search and replace operation is a specialized form of traversal. The search and replace operation scans a document looking for a particular pattern of text. Traversal is necessary, because the document might contain embedded documents; those documents might contain embedded documents, and so on. When initiating the search, the user can specify whether to search in embedded documents or to only search the document that contains the selection.

At any one time, there are two interesting participants in a traversal: the driver and the slave. If you are writing a class that will contain data that can be searched, instances of the class will be the slave.

A search and replace operation is managed by a search and replace driver. The search and replace driver sends traversal messages to the objects being searched.

Most applications do not need to create a search and replace driver themselves. If an application allows **clsApp** to handle **msgAppSearch**, **clsApp** presents the user with a search dialog and creates the search and replace driver. (You can read about how to handle Standard Application Menu messages in *Part 2: PenPoint Application Framework.*)

If your class will be a slave (that is, instances of your class contain data that can be searched), you must be prepared to handle both mark messages and the search and replace messages. Most of this chapter discusses how to handle those messages.

Writing a Class That Can Be Searched 86.2

To start a search or search and replace operation, an application should allow the class manager to pass **msgAppSearch** to **clsApp**. **clsApp** displays the search dialog and searches the appropriate portion of the document.

If your application needs to start a search by itself, you can send **msgAppSearch** to **self**. The message takes no arguments.

If you want instances of your class to be searched, you must respond to:

- The **clsMark** messages sent to you by the search and replace driver.
- The search and replace messages.

Search and Replace Protocol 86.2.1

The following sections describe the protocol exchanged between **theSearchManager** and the object being searched. The search (and replace) operation follows these steps:

1. **clsMark** asks the object to create a token for a mark.
2. **theSearchManager** asks the object to set the initial search position.
3. **theSearchManager** asks the object to position to the next group of characters.
4. **theSearchManager** asks the object to pass it characters delimited by the token.
5. **theSearchManager** searches the characters for its search string. It repeats steps 3 through 5 until it finds the text (or reaches the end of data).
6. If **theSearchManager** finds a match, it asks the object to reposition its token to the matched string.
7. **theSearchManager** asks the object to select take the selection and show the matched string to the user.
8. If replacing, **theSearchManager** asks the object to replace the characters.
9. If replacing all, repeat steps 3 through 9 until the object reaches the end of its data.

Creating a Mark 86.2.2

When the user starts a search and replace operation, **theSearchManager** creates an instance of **clsMark**, which in turn requests the object being searched to create a mark by sending it **msgMarkCreateToken**.

The object that receives this messages should create a token for the mark, as described in *Part 2: PenPoint Application Framework.*

Setting the Initial Search Position 86.2.3

When the searched object has created the token, **theSearchManager** requests the object to position its token to the beginning (or end) of the data that it will search by sending one of **msgMarkPositionAtEdge**, **msgMarkPositionAtSelection**, or **msgMarkPositionAtGesture**.

theSearchManager does not currently send **msgMarkPositionAtSelection**, but might at some time in the future.

Getting the Next Group 86.2.4

To search for text, **theSearchManager** requests the object to position its token to the next group of characters that might contain match the search. The arguments for **msgSRNextChars** identify the token to be moved.

The method that handles **msgSRNextChars**, and all methods that handle search and replace messages should call the function **MarkHandlerForClass()**. The only parameter for the function is the well-known UID of the class to which the method belongs.

Usually a group ends at a non-text element (such as an embedded document). However, the group can end anywhere that is convenient for your data.

The method must also set the **blockStart** and **blockEnd** BOOLEAN values. These indicate whether the group of characters is the beginning or end of a block of characters. Text within groups is not matched across block boundaries, but is matched across other groups.

There are three status values your method can return:

stsOK Next group found and token repositioned.

stsEndOfData There is no more data to be searched. (When your method finds the last group, it still returns **stsOK**; only when another **msgSRNextChars** arrives should it return **stsEndOfData**.)

stsMarkEnterChild The next item is an embedded document.

Passing the Found Characters 86.2.5

If your method for **msgSRNextChars** returned **stsOK**, **theSearchManager** asks the object to pass back the characters matched by the token by sending **msgSRGetChars**.

The message passes a pointer to an SR_GET_CHARS structure, which contains:

first An offset to the first character in the token to copy.

len The number of characters to copy.

bufLen The size of the buffer.

pBuf A pointer to the buffer to which your method copies the characters.

Your method must copy a null terminate string into **pBuf**.

Searching the Text 86.2.6

theSearchManager does the actual searching by comparing its search string to the characters passed in by **msgSRGetChars**.

If **theSearchManager** finds a match, it asks the object to position its token to the matched characters by sending it **msgSRPositionChars**. The message passes a pointer to an SR_POSITION_CHARS structure, which identifies the new position for the token.

Highlighting the Text

86.2.7

The search manager then asks the object to display the found text by:

- Asking the object to take the selection by sending it **msgMarkSelectTarget**.
- Asking the object to display the matched characters to the user by sending it **msgMarkShowTarget**.

Replacing Characters

86.2.8

If the user is using find and replace and chooses to replace the matched text, **theSearchManager** asks the object to replace some or all of the characters matched by the token with new text by sending it **msgSRReplace**. The message passes a pointer to an SR_REPLACE_CHARS structure, which contains:

first The offset to starting character within the token to replace.

len The number of characters to replace.

bufLen The number of characters in the replacement string.

pBuf A pointer to the replacement string.

The **first** field can be negative, indicating that the text to be replaced starts before the token.

After replacing the text, your method *must* update the token to reflect any change in size of the replaced text.

Your method must update the token.

Classes That Respond to Search Messages

86.3

If your class inherits from a class that responds to the search and replace messages, you may not have to do anything.

Currently **clsText** is the only class that responds to the search and replace messages.

The Search and Replace Messages

86.4

Table 86-1 lists the messages defined by **clsSR** in the file SR.H.

Table 86-1
Search and Replace Messages

Message	Takes	Description
msgSRNextChars	P_SR_NEXT_CHARS	Asks the client to move the token to the next group of characters.
msgSRGetChars	P_SR_GET_CHARS	The component passes back the characters from the location identified by the token.
msgSRReplaceChars	P_SR_REPLACE_CHARS	Ask the component to replace some of the characters at the location identified by the token.
msgSRPositionChars	P_SR_POSITION_CHARS	Asks the component to reposition the token to some of the characters in the current group.

Chapter 87 / Undo

The undo manager provides the mechanism that allows applications to respond to the standard application menu undo command.

Topics covered in this chapter:

- The concepts behind the undo manager.
- Undo manager messages.
- Using the undo manager messages.

Concepts

87.1

The undo manager is not a general database transaction undo facility.

The **undo manager** provides a centralized facility within each application for managing undo information and handling undo commands local to a document. Applications use the undo manager to store records of user actions and can request the undo manager to undo those user actions. Currently there is no support for undoing actions between documents (such as move or copy between documents); each document sees its part of such operations as a separate undo item.

When designing the user interface for an application or component, you need to identify particular user actions that the user might want to undo. Each user action that is undoable is called a **transaction**. One or more objects contribute one or more **undo items** to a single transaction.

A transaction should appear to the user a single action, such as deleting a spread-sheet cell, inserting text in a document, or changing all the text in the selection to italics.

When the user issues an undo command, the undo manager undoes the most recent transaction by sending a message to the objects mentioned in the transaction. Those objects must know how to undo their parts of the transaction, but the undo manager keeps track of what to undo. The undo manager allows applications to support a transaction history, so that subsequent undo commands remove transactions from the history in the reverse order in which they were added.

Because PenPoint™ applications are built by integrating a number of components, the PenPoint undo is slightly different than undo under other operating environments. In traditional operating environments, the program that performs the undo keeps track of all of its own actions. However, under PenPoint, actions may be performed by the application or any of its component objects.

Each component that performs a function that a user might want to undo must cooperate in the undo strategy. If a component doesn't cooperate in the undo strategy, changes made by that component are not undoable; if the component

contributes to an overall action that is undoable, the undo might not work correctly.

The General Strategy

87.1.1

When the user turns to a document, the PenPoint Application Framework creates an instance of the undo manager for that document (named **theUndoManager**).

When the user performs some action that is undoable, the application tells **theUndoManager** that a transaction is beginning. Applications and components divide the steps that it takes to complete the transaction into a series of items. An undo item describes an operation by a class and how to undo that operation. The application and its components add items to the transaction data until the transaction ends. The application tells **theUndoManager** when the transaction ends.

When the user taps on Undo, **theUndoManager** gets the data for the most recent transaction. **theUndoManager** removes the last item in the transaction, examines it, and sends a message to the object that created the item. The object's class (or one of its ancestors) uses the item data to undo that part of the operation and then frees the item data. **theUndoManager** continues to remove and examine the items in the transaction (in the reverse order in which they were received), until the transaction is completely undone.

When the user turns away from the document, the PenPoint Application Framework destroys **theUndoManager** and the undo history as part of deactivating the document.

At any time there is at most one undo transaction open. The data associated with each transaction includes:

- A unique identification of type UNDO_ID.
- A nesting count that tracks the number of "begin undo" transaction messages that have not been matched by a corresponding "end undo" transaction message.
- A heap with global scope, from which clients can allocate space to hold undo item information.
- A list of undo items contributed by applications or components.
- A variety of transaction state information.

The transaction information is stored in the UNDO_METRICS structure; applications can get this information by sending **msgUndoGetMetrics** to **theUndoManager**.

Transaction Data 87.1.2

The undo manager stores transaction data in the undo history. An application can change the size of its undo history, thereby allowing larger transaction histories.

The data for a transaction consists of one or more items. An **item** describes a change made to data by an application or component. For example, if a user replaced a value in a cell, the transaction might consist of a single item, the original value for the cell. On the other hand, a search and replace operation could potentially create items for each replacement.

An item contains:

- The object and class that performed the change.
- A 32-bit value that the class uses to store its own information about the change.
- A variety of attributes stored in a 16-bit flag variable.

In simple cases, the 32-bit value can contain the actual data that is changed; in more complex cases, it points to a buffer that describes the change. The object that creates an item and data is also responsible for restoring that item from the data. Thus, the organization of the data for each item is up to you.

Your application allocates the buffer used in the item. When you undo an item, you are also responsible for deallocating the buffer.

However, there are two other reasons why you might need to deallocate the buffer; in these cases either you or the undo manager can do the deallocation.

- When the transaction history is full, the undo manager removes the oldest transaction from the history. As part of removing a transaction, the undo manager must coordinate deallocation of the item data buffers.
- When an application or component aborts a transaction, the undo manager removes the items from the aborted transaction and must coordinate deallocating the data buffers for those items.

When you add an item to the transaction history, you can tell the undo manager how the data buffer was allocated. You can also tell the undo manager to deallocate the item's buffer automatically when either of the above events occur (or you can deallocate the buffer yourself).

If you don't tell the undo manager how to deallocate the buffer, the undo manager sends you a message telling you to deallocate the buffer.

The Undo Messages 87.2

The messages used by **theUndoManager** are described in the file UNDO.H. Table 87-1 lists the undo messages.

Table 87-1
clsUndo Messages

Message	Takes	Description
msgUndoAbort	pNull	Aborts the current undo transaction.
msgUndoAddItem	P_UNDO_ITEM	Adds a new item to the current undo transaction if and only if it is still open.
msgUndoBegin	RES_ID	Creates a new undo transaction if there is no current transaction, or increments the nesting count if there is a current transaction.
msgUndoCurrent	pNull	Undoes the most recent undo transaction.
msgUndoEnd	pNull	Decrements the nesting count of (and thus may end) the current transaction.
msgUndoGetMetrics	P_UNDO_METRICS	Passes back the metrics associated with an undo transaction.
msgUndoLimit	U32	Sets the maximum number of remembered undo transactions.
		Messages Sent to Clients
msgUndoItem	P_UNDO_ITEM	Sent to pArgs->object to have the item undone.
msgUndoFreeItemData	P_UNDO_ITEM	Sent to pArgs->object to have pArgs->pData freed.

Using the Undo Messages 87.3

The following sections describe how to use the **clsUndo** messages to save transactions and then how to restore them when the user taps on Undo.

Beginning a Transaction 87.3.1

When the user initiates an action that your application or component might need to undo, start a new transaction by sending **msgUndoBegin** to **theUndoManager**. The message takes no arguments.

If an application or component attempts to start a transaction while a transaction is already in progress, **theUndoManager** increments a counter that counts the number of begins; **theUndoManager** does little else. This is necessary because a component is not expected to know what happened in its owning application before it receives a message (nor should it know what application or component might own it). If your component performs some task that can be undone, it might send **msgUndoBegin** just to be on the safe side. If the owning application also sent **msgUndoBegin**, it won't matter.

By nesting transactions, the undo manager allows separately implemented components to behave consistently when used together in a transaction. Each component can add items to the current transaction, but the transaction shows no indication of the nesting.

The most important thing is that for each **msgUndoBegin**, there must be the same number of **msgUndoEnd** messages at the end of the transaction (**msgUndoEnd** is described below). Keep this in mind before you use the **ObjCallRet()**, **ObjCallJmp()**, **StsRet()**, or **StsJmp()** macros.

To prevent run-away applications from nesting transaction-begins too deeply (and to detect errors when a **msgUndoBegin** does not have a matching **msgUndoEnd**), **theUndoManager** returns **stsFailed** if you exceed the nesting limit, which is approximately 1000.

When **msgUndoBegin** completes successfully, it returns an UNDO_ID. This value identifies the transaction; you can use it to get metrics of a specific transaction.

The memory allocated for transactions is finite. When you start a new transaction, the undo manager might need to make space in the transaction history, which it does by freeing the earliest transaction. Thus, you shouldn't be surprised that before **msgUndoBegin** returns you receive a **msgUndoFreeItemData**, asking you to free buffers used by items in the freed transaction. You should free the buffers, return **msgUndoFreeItemData** and, eventually, **msgUndoBegin** returns.

Adding Items to a Transaction 87.3.2

As your application or component performs the steps within the transaction, it needs to note what change took place in each of the steps. For each change, send **msgUndoAddItem** to **theUndoManager**. The message takes a pointer to an UNDO_ITEM structure that describes a change to data. The structure contains:

object The UID of the object that is performing the transaction.

subclass The UID of the class that is making the change.

flags Flags that specify how the undo manager should free the item. The flags are described below.

pData A 32-bit value that either is the change data or points to a buffer that contains the change data.

dataSize A value that contains the size of the data in **pData**. If this field is non-zero, **theUndoManager** assumes that **pData** points to a data buffer and copies that data into the transaction's heap.

Item Flags 87.3.2.1

There are two sets of flags in the **flags** field.

The first set contains four flags that are not interpreted by **theUndoManager**. You can use these flags to represent what ever you want in the undo item. The value **ufClient** is a mask that you can use to access the client-specific portion of **flags**.

The other set of flags describe how the **pData** buffer for an item was allocated. If you specify one of these flags, the undo manager frees the **pData** buffer automatically when it removes an old transaction from the history or when it aborts a transaction. The flags can be one of the following:

ufDataInUndoHeap **pData** points to a stand-alone node from the current undo transaction's heap; the undo manager can free the buffer by freeing the entire heap.

ufDataIsHeapNode **pData** points to a stand-alone node from a global heap; the undo manager can free the buffer with **OSHeapBlockFree(pData)**.

ufDataIsObject **pData** contains the UID of an object; the undo manager can free the object by an **ObjectSend** of **msgDestroy**.

ufDataIsSegment **pData** points to a stand-alone segment; the undo manager can free the buffer with **OSMemFree()**.

ufDataIsSimple **pData** is a simple value (for example a U32); the undo manager can free the value by just forgetting it.

You can use the value **ufDataType** as a mask to access the data type flags in the **flags** field. The data type flags are 12-bits long. If you store the **ufDataType** portion, use a U16 value.

If you do not specify one of these flags when you add an item, the undo manager sends you **msgUndoFreeItem** when it needs to remove an item from a transaction.

The transaction must be open when you send **msgUndoAddItem**. If there is no open transaction when you send **msgUndoAddItem**, the message returns **stsFailed**.

If there is an open transaction, but there isn't enough memory to add the item to the transaction, **msgUndoAddItem** returns **stsOSOutOfMem**.

If **msgUndoAddItem** returns **stsUndoAbortingTransaction**, the transaction is aborting. You must free an storage allocated for the item that you attempted to add (unless the storage is in the transaction's heap).

Ending a Transaction 87.3.3

When you conclude the transaction (before returning control to the user), you tell the undo manager to close the current transaction by sending **msgUndoEnd** to **theUndoManager**. The message takes no arguments.

For every **msgUndoBegin** there must be a corresponding **msgUndoEnd**. **msgUndoEnd** decrements the nesting count; if the message lowers the nesting count to zero, the undo manager closes the transaction. You cannot add items to a closed transaction.

Aborting a Transaction 87.3.4

When your application or component is unable to complete its work because of an error, you will probably want to abort the current transaction.

If you need to abort a transaction, send **msgUndoAbort** to **theUndoManager**. The message takes a **pNull** value.

When **theUndoManager** receives **msgUndoAbort**, it marks the current transaction as aborting. If you send **msgUndoAddItem** to an aborting transaction, it will return

stsUndoAbortingTransaction. You must deallocate the item's data buffer, unless the buffer was allocated from the transaction's heap.

In an aborting transaction, the **state** field in the UNDO_METRICS structure has the flag **undoStateAborting** set.

Aborting a transaction does not close that transaction; you are still responsible for closing the transaction. The **undoStateAborting** flag remains set until the final **msgUndoEnd** closes the transaction.

Getting Transaction Metrics 87.3.5

You can get the transaction metrics for any of the transactions in the transaction history by sending **msgUndoGetMetrics** to **theUndoManager**. The message takes a pointer to an UNDO_METRICS structure. To get the metrics of the current or latest transaction, set the **id** field in the UNDO_METRICS structure to **pNull**. To get the metrics for another transaction, set the **id** field to the UNDO_ID value for that transaction.

When the message completes successfully, it returns **stsOK** and sends back the UNDO_METRICS structure with:

id An UNDO_ID value that contains the transaction ID.

heapId An OS_HEAP_ID value that indicates the heap that you can use to store item data.

state A U16 that indicates the transaction's current state. The state field does not contain a value that indicates the state, rather it contains a set of flags that indicate attributes of the current transaction. The flags are:

undoStateBegun The transaction is open.

undoStateUndoing The transaction is being undone.

undoStateAborting The transaction is aborting. If the **state** field contains the value **undoStateNil**, all these flags are clear.

transactionCount A count of the number of transactions in the undo history.

itemCount A count of the number of items in the transaction.

limit The maximum number of transactions allowed in the transaction history. The default for the **limit** value is 2; you can modify this value with **msgUndoLimit**.

resID A resource ID identifying the string to use for the Undo menu item. This resource ID should specify a **resGrpTK** string resource list.

info A U32 fields reserved for future system use.

Changing the Size of the Transaction History 87.3.6

To change the size of the transaction history, send **msgUndoLimit** to **theUndoManager**. The message takes a U32 value that contains the new maximum number of transactions that the undo manager can store. If the value is 0, you effectively disable the undo capabilities of your application or component.

Undoing a Transaction 87.3.7

When the user taps on the undo button in the Edit menu the menu sends **msgAppUndo** to self (the document that is open). When your application receives **msgAppUndo**, the PenPoint Application Framework sends **msgUndoCurrent** to **theUndoManager**; the message argument is always **pNull**. (For more information on Standard Application Menu messages, see *Part 2: PenPoint Application Framework.*

When the undo manager receives **msgUndoCurrent**, it locates the latest transaction (whether it is still open or not) and removes the last item from that transaction. Because each UNDO_ITEM structure contains an object UID and a class UID, the undo manager sends the item to the object UID with **msgUndoItem** (you must be prepared to receive and handle **msgUndoItem**, described below). The undo manager continues to remove items from the transaction and send them to their corresponding owners until the transaction is empty.

When the transaction is empty, **msgUndoCurrent** returns. If there is a previous transaction in the transaction history that transaction becomes the next transaction to be undone (the next time the undo manager receives **msgUndoCurrent**.

Handling msgUndoItem 87.3.8

When you receive **msgUndoItem**, compare the class in the UNDO_ITEM structure to your class. If the class doesn't match, send the message to your ancestor. If the class does match, use the data indicated by **pData** to undo the action.

Again, the way that you store the data in an item and undo that action is totally up to you.

Handling msgUndoFreeItem 87.3.9

If you did not specify one of the data type flags in UNDO_ITEM, the undo manager does not know how to free **pData**, so it sends **msgUndoFreeItem** to you. The message sends you a pointer to an UNDO_ITEM structure.

As with **msgUndoItem**, you should compare the class field in the structure with your class, if they don't match, send the message to your ancestor. If they do match, free the data. It is up to you to know how the data was allocated and how to free it.

Chapter 88 / Byte Buffer Objects

The byte buffer object class (**clsByteBuf**) allows clients to create a simple data object that contains an array of bytes. **clsByteBuf** allocates space for the byte array, handles filing messages, and deallocates the space when the client destroys the byte buffer object.

Concepts

88.1

Frequently applications maintain some data in an array of bytes. If this data is stateful, you need to file the data when you receive filing messages. One way to do this is to keep the data in one or more data objects and file the objects using **msgResPutObject**.

To save you from writing your own class to maintain and file byte arrays, PenPoint provides **clsByteBuf**, which you can use to store byte arrays. If you need to save a string, use the string object class defined in Chapter 89, String Objects.

If you have an array of bytes that you need to save, you create a **clsByteBuf** object and store the bytes in the object. You can store any type of bytes in the **clsByteBuf** object. **clsByteBuf** only sees the data as an array of bytes; the organization of the data is up to your application. **clsByteBuf** handles the allocation, deallocation, and filing messages for you. All you have to do is ensure that your byte buffer object receives filing messages at the proper time.

clsByteBuf allocates its memory from the system heap. When you ask a byte buffer object for its data, it sends back a pointer to the system heap, so you don't have to allocate space to accomodate the data.

Because the storage for byte buffer data is in a system heap. The location in the heap changes when the data changes, so you cannot maintain or file other pointers to that buffer. When the byte buffer object is saved and restored, there is no guarantee that the object will be restored at the same address. If you need to maintain a location within a byte buffer object, use an index rather than a pointer.

clsByteBuf has no concurrency support. If two clients access the same byte buffer object at the same time, they manipulate the same data.

Using the Byte Buffer Messages 88.2

The **clsByteBuf** messages are listed in Table 88-1. The messages are defined in the file BYTEBUF.H.

Table 88-1
clsByteBuf Messages

Message	Takes	Description
msgNew	P_BYTEBUF_NEW	Creates a new buffer object.
msgNewDefaults	P_BYTEBUF_NEW	Initializes the BYTEBUF_NEW structure to default values.
msgByteBufGetBuf	P_BYTEBUF_DATA	Passes back a pointer to the object's buffer.
msgByteBufSetBuf	P_BYTEBUF_DATA	Copies the specified buffer data into the object's buffer.
msgByteBufChanged	OBJECT	Sent to observers when the object data changes.

Creating a Byte Buffer Object 88.2.1

To create a byte buffer object, send **msgNewDefaults** and **msgNew** to **clsByteBuf**. The messages take a pointer to a BYTEBUF_NEW structure that contains an OBJECT_NEW_ONLY structure and a BYTEBUF_NEW_ONLY structure. The BYTEBUF_NEW_ONLY structure contains:

allowObservers A BOOLEAN value that specifies whether the object send messages to observers.

data A BYTEBUF_DATA structure that contains:

pBuf A byte pointer to the byte array to be saved.

bufLen A U16 value that specifies the length of the byte array in **pBuf**.

When the message completes successfully, it returns **stsOK**.

Getting the Byte Buffer Data 88.2.2

To get the address of the byte buffer data, send **msgByteBufGetBuf** to the byte buffer object. The message takes a pointer to an empty BYTEBUF_DATA structure.

When the message completes successfully, it returns **stsOK** and passes back the BYTEBUF_DATA structure containing:

pBuf A byte pointer to the byte array.

bufLen A U16 value that indicates the length of the byte array in **pBuf**.

Resetting a Byte Buffer Object 88.2.3

When you create a byte buffer object, you set its initial value, but if you want to change the contents of a byte buffer object, you send **msgByteBufSetBuf** to the byte buffer object. The message takes a pointer to a BYTEBUF_DATA structure that contains:

pBuf A byte pointer to the byte array.

bufLen A U16 value that indicates the length of the byte array in **pBuf**.

If **bufLen** is different from the size of the byte buffer that was stored there before, **clsByteBuf** automatically changes the size of the allocated storage.

When the message completes successfully, it returns **stsOK**.

Notification of Observers 88.2.4

Clients can observe a byte buffer object (provided that the creator of the object specified **allowObservers** when it sent **msgNew**). When a client sends **msgByteBufSetBuf** to a byte buffer object, **clsByteBuf** sends **msgByteBufChanged** to all observers of that byte buffer object. The message passes an OBJECT value that identifies the byte buffer object that changed.

Chapter 89 / String Objects

The string object class (**clsString**) allows clients to create a simple data object that contains a null-terminated ASCII string. **clsString** allocates space for the string, handles filing messages, and deallocates the space when the client destroys the string object.

clsString inherits from **clsByteBuf**. The difference is that you must supply the length of a byte buffer as well as a pointer to it, whereas string objects are null-terminated, so you need only supply a pointer to the string.

Concepts

89.1

Most applications maintain some data in the form of null-terminated ASCII strings. If this data is stateful, you need to file the data when you receive filing messages. One way to do this is to keep the data in one or more data objects and file the objects using **msgResPutObject**.

To save you from writing your own class to maintain and file string data, PenPoint provides **clsString**, which you can use to store strings. If you need to save a byte array, use the byte buffer object class described in Chapter 88, Byte Buffer Objects.

If you have a string that you need to save, you create a **clsString** object and store the string in the object (you must create a **clsString** object for each string). **clsString** handles the allocation, deallocation, and filing messages for you. All you have to do is ensure that your string object receives filing messages at the proper time.

clsString allocates its memory from the system heap. When you ask a string object for its data, it sends back a pointer to the system heap, so you don't have to allocate space to accomodate the string.

Because the string object is in system heap, you cannot maintain (and file) other pointers to that string. When the string object is saved and restored, there is no guarantee that the object will be restored at the same address. If you need to maintain a location within a string object, use an index rather than a pointer.

clsString has no concurrency support. If two clients access the same string object at the same time, they manipulate the same data.

Using the String Object Messages 89.2

The **clsString** messages are listed in Table 89-1. The messages are defined in the file STROBJ.H.

Table 89-1
clsString Messages

Message	Takes	Description
msgNew	P_STROBJ_NEW_ONLY	Creates a new string object.
msgNewDefaults	P_STROBJ_NEW	Initializes the STROBJ_NEW structure to default values.
msgStrObjGetStr	PP_CHAR	Passes back the object's string.
msgStrObjSetStr	P_CHAR	Copies the specified string data into the object's string buffer.
msgStrObjChanged	OBJECT	Sent to observers when the string object data changes.

Creating a String Object 89.2.1

To create a string object, send **msgNewDefaults** and **msgNew** to **clsString**. The messages take a pointer to a STROBJ_NEW structure that contains an OBJECT_NEW_ONLY structure and a STROBJ_NEW_ONLY structure. The STROBJ_NEW_ONLY structure contains a pointer to the string to be saved (**pString**).

Getting the String Object 89.2.2

To get a pointer to a string in a string object, send **msgStrObjGetStr** to the string object. The message takes a pointer to a string pointer (PP_STRING).

When the message completes, it returns **stsOK** and passes back the pointer to system heap in the specified location.

Resetting a String Object 89.2.3

When you create a string object, you set its initial value, but if you want to change the contents of a string object, you send **msgStrObjSetStr** to the string object. The message takes a pointer to the string that you want stored in the string object.

If the string is a different size from the string that was stored there before, **clsString** automatically changes the size of the allocated storage.

When the message completes successfully, it returns **stsOK**.

Notification of Observers 89.2.4

Clients can observe a string object. When a client sends **msgStrObjSetStr** to a string object, **clsString** sends **msgStrObjChanged** to all observers of that string object. The message passes an OBJECT value that identifies the string object that changed.

Chapter 90 / Table Class

The class **clsTable** provides a general-purpose table mechanism with random and sequential access. You can use **clsTable** as a superclass for specialized table classes.

You create, destroy, modify, and access tables using a row and column metaphor. Tables are PenPoint objects; the data for tables is stored in table files. **clsTable** also provides a semaphore mechanism that you can use to control concurrent table access.

Tables are observable objects. Any object can add itself to a table's observer list, so that the object will receive notification of changes in the table. Changes can include adding, removing, or changing entries, or destruction of the table.

clsTable inherits from **clsObject**.

A Distributed DLL 90.1

The table class component is implemented in a DLL, \PENPOINT\SDK\DLL\TS.DLL. This DLL is *not* automatically loaded at boot time—it is not mentioned in \PENPOINT\SDK\INC\BOOT.DLC. You need to mention it in your application's .DLC file and include it in your application's installation disk. This ensures that all applications that use the table class will load the DLL if necessary and share the same copy of the code.

Structures and `#defines` used by **clsTable** are defined in \PENPOINT\SDK\INC\TS.H. The library support routines for **clsTable** are in the table library, \PENPOINT\SDK\LIB\TS.LIB.

The send list application uses **clsTable** to maintain the user's address list.

Table Concepts 90.2

A table is a two-dimensional array consisting of a fixed number of **columns** and a variable number of **rows**. Each column contains a single type of data, such as U32, variable-length string, fixed size byte field, date and time, and so on.

When you create a table, you define the number of columns in the table and the data type of each column. Once you create a table, you cannot change its organization.

Describing a Table 90.2.1

You describe a table by creating a structure that contains the total number of columns in the table and a pointer to an array of **column descriptors**. For each column in the table, you must create a column descriptor. The order of the

column descriptors indicates the order of the columns in the table; you use an index into the column array to indicate specific columns.

Each of the column descriptors contains:

- The name of the column.
- The type of data in the column (such as U32, string, date and time, or UID).
- The width of the column.
- The number of times the columns is to be repeated.
- The byte offset to the column.
- Whether the column is a sort field or not.

Table Data Files

90.2.2

The first time you create a table object (by sending **msgNew** to **clsTable**), **clsTable** creates a **table file** in which it stores the data for that table. The **msgNew** arguments include the file name and file options. If you destroy the table object and send **msgNew** again, **clsTable** accesses the table data stored in the table file.

The table object is transitory; the table file can last forever.

You also use arguments to **msgNew** to indicate whether the table should be destroyed when it has no observers or no clients, and whether the table file should be deleted when the table object is destroyed.

clsTable opens the file with exclusive access rights; this means that only one table object can be associated with a given table file at one time. However, multiple clients can access the table by using the same table object.

Beginning Table Access

90.2.3

After creating a table object, you register as a user of the table by sending **msgTBLBeginAccess** to the table object. Each client that accesses the table object must send a separate **msgTBLBeginAccess** (Even if you created the table object, you must still register as a table user.) When you no longer need to access a table, send **msgTBLEndAccess** to the table object.

The table object maintains a count of the number of accessing clients. When a client begins access, the table increments the count; when a client ends access, the table decrements the count. You cannot destroy a table object until the number of accessing clients is zero. (One of the table destruction options uses this count to destroy the table automatically when the number of accessors goes to zero.)

You can access a table without using **msgTBLBeginAccess** and **msgTBLEndAccess**, but it is not recommended. If you use a table object for which you haven't registered, the table object might vanish without warning (if another accessor destroys the object or table file). The table object has no indication that you are an accessor of the table.

Positioning in Tables 90.2.4

There are two ways to locate records in a table:

- Searching for a specific value in a column, starting at the beginning of the table.
- Searching for a specific value in a column, starting at the current position.

The order in which the records are searched depends on the column that you search. Unlike other data bases, the table class has no concept of a last record.

When you request a new position from **clsTable**, it sends back a TBL_ROW_POS value that indicates the row position. This value is not an index or offset within the table. You cannot advance to the next row in a table by simply incrementing the row position value. When you request **clsTable** to advance to the next record, you must specify the current TBL_ROW_POS value.

If you know that you will need to examine records in the order in which they were added to the table, one of the columns in your table should be a sorted column containing a sequence number. When you add a record to the table, assign a new sequence number to the record.

Each table object has the concept of a current state. These states are "at the beginning," "at the end," and "somewhere in between." **tsBegin** indicates that the table's current row is the first row in that column; **tsEnd** indicates that the table's current row is the last row in that column; **tsPosition** indicates that the current row is not at the beginning or the end of the column. A client of an empty table is always positioned at **tsEnd**.

You use **msgTBLGetState** to get the current state and row position of a table.

Observing Tables 90.2.5

Table objects are observable. This means that an object can add itself to a table's observer list. When anything changes in the table or when other objects add or remove themselves from the table's observer list, the table object sends a message to objects in the observer list. A table client does not have to add itself to the observer list. In fact, *adding observers has a detrimental impact on table performance.* You should add an observer only when you really need it.

Shared Tables 90.3

Most clients use a table as an unshared, private database. The client creates the table object, accesses the table, and frees the object all on its own.

Clients can also share a table with other clients. Sharing a table raises several issues about simultaneous access to the table, such as:

Ownership An object exists only as long as its creator exists.

Access All clients that access a shared table must know the UID of the table object.

Concurrency Problems arise when two clients try to write to the table at the same time, or when one client writes a record which another client is reading.

Remember that the table object is transitory, but that the underlying table object file can exist practically forever. When **clsTable** creates a table object, it opens the table object file with exclusive access. This prevents any other client from creating a table object for the same table object file.

Ownership 90.3.1

The process that created a table object must remain active as long as any other process is using the table; the table object will be freed when the creating process terminates.

One way to handle ownership is through a requester-server model. In the requester-server model one client (the server) creates a table and serves requests from other clients (the requesters) that want to access the table. The server must be in existence before the first requester requests access. The server should exist as long as requesters needs to access the table.

Access to the Table Object 90.3.2

If you use the requester-server model, only the server has to know the UID of the table object. However, if you don't use the requester-server model, the other clients must be able to find the UID of the table object.

Making the UID well-known global is one way to accomplish this. Explicitly passing the UID to other processes is another approach (this works well in a server situation).

Another approach is to have each process that wants to use a table attempt to create it. If the creation is successful, the process should put the table object UID in a publicized global location. If the creation fails, another client has already created the table; client should look for the existing table object UID in the global location.

Concurrency 90.3.3

A table object has the following access concurrency characteristics:

- The last row in the table is always the last row that was added to the table. Because the table rows are enumerated in random order, there is no notion of an "end" to the table. However, while a client refers to a sorted column, the rows are sorted in the order determined by the data in the column.
- When a client writes data to the table file, it is permanently changed. Any other clients that hold data retrieved from the changed row and column now have invalid data.

clsTable provides a semaphore that you can use to synchronize access to a table among multiple clients. You can use this semaphore (by sending **msgTBLSemaRequest** to the table object) when you want to treat multiple updates as a single, atomic update.

If **msgTBLSemaRequest** is sucessful, you can access the table; all other clients that request the semaphore while you hold it will be suspended. If another client holds the semaphore, **msgTBLSemaRequest** will suspend your process until the other client releases the semaphore.

Using semaphores extensively can lead to a deadlock situation (that is, a circular list of clients waiting for each other's resources). You can avoid deadlocks by releasing the semaphore (with **msgTBLSemaClear**) on one table before requesting the semaphore on another.

Using Tables in a Database 90.4

There is no explicit database class in PenPoint. However, you can use a single table as a flat-file database. A table is simply a flat database. Each row is a record, each column is a field.

With a bit more effort you can link a series of tables together (a table of tables) to create a relational database.

Using Table Messages 90.5

This section describes the tasks associated with table objects.

Table 90-1 lists the **clsTable** messages.

Table 90-1
clsTable Messages

Message	Takes	Description
		Class Messages
msgNew	P_TBL_NEW	Creates a new table object.
msgNewDefaults	P_TBL_NEW	Initializes the TBL_NEW structure to default values.
		Instance Messages
msgTBLAddRow	P_TBL_ROW_POS	Adds a row/record with no data to the table server object.
msgTBLDeleteRow	P_TBL_ROW_POS	Deletes the specified row.
msgTBLColGetData	P_TBL_COL_GET_SET_DATA	Passes back the data for the specified row and column.
msgTBLColSetData	P_TBL_COL_GET_SET_DATA	Sets the data for the specified row and column.
msgTBLRowGetData	P_TBL_GET_SET_ROW	Gets the contents of an entire row.
msgTBLRowSetData	P_TBL_GET_SET_ROW	Sets the contents of an entire row.
msgTBLGetInfo	P_TBL_HEADER	Gets the table header information.
msgTBLGetColCount	P_TBL_COL_COUNT	Gets the number of columns in the table.

continued

Table 90-1 (continued)

Message	Takes	Description
msgTBLGetColDesc	P_TBL_GET_COL_DESC	Passes back the column description for the specified column.
msgTBLGetRowCount	P_TBL_ROW_COUNT	Gets the current number of rows in the table.
msgTBLGetRowLength	P_TBL_ROW_LENGTH	Gets the length (in bytes) of the specified row.
msgTBLGetState	P_TBL_GET_STATE	Gets the current state of a specified row.
msgTBLBeginAccess	P_TBL_BEGIN_ACCESS	Initiates table access by a client on this table.
msgTBLEndAccess	P_TBL_END_ACCESS	Ends client access to the table.
msgTBLSemaClear	nothing	Releases the table's semaphore.
msgTBLSemaRequest	nothing	Requests access to the table's semaphore.
msgTBLFindFirst	P_TBL_FIND_ROW	Finds the first record that meets the search specification.
msgTBLFindNext	P_TBL_FIND_ROW	Find the next record following the specified TBL_ROW_POS that meets the search specification.
msgTBLFindColNum	P_TBL_COL_NUM_FIND	Passes back the column number for the specifed column name.
msgTBLCompact	nothing	Compacts the table without closing it.
msgTBLRowNumToRowPos	P_TBL_CONVERT_ROW_NUM	Converts a TBL_ROW_NUM to its corresponding TBL_ROW_POS for the specified column.
		Observer Notification Messages
msgTBLRowAdded	P_TBL_ROW_POS	Sent to observers indicating that a row has been added.
msgTBLRowDeleted	nothing	Sent to observers indicating that a row has been deleted.
msgTBLRowChanged	P_TBL_ROW_POS	Sent to observers indicating that row data has been changed.

Defining a Table

90.6

Before you create a table with **msgNew**, you need to declare the organization of the table with a TBL_CREATE structure. The TBL_CREATE structure consists of a value that indicates the number of columns in the table (**colCount**) and the address of an array of one or more TBL_COL_DESC structures (**colDescAry**).

Each TBL_COL_DESC structure describes one column and contains:

name A string containing the name of the column. This name is used by applications when displaying a table. Internally, you usually identify columns by an index to their position. You can get the index from the name with **msgTBLFindColNum** or you can get the name using an index with **msgTBLColGetDesc**.

type A TBL_TYPES value that specifies the type of data in the column (such as U32, string, date and time, or UID). The values defined by TBL_TYPES are described in Table 90-2, below.

length The width of the column in bytes. This argument only has meaning for columns of type **tsChar** and **tsCaseChar**.

repeatFactor The number of times to repeat the column. This allows you to create an array in a column. You cannot address repeated columns individually; rather, you access the whole column and locate the appropriate bytes.

offset The byte offset to the column. This allows you to locate data in a row by its offset, rather than by column index. **clsTable** allows you to request the entire row, or just the individual item. It is often much faster to request the entire row and use byte offsets to find individual pieces of data. This will not work if any of the columns in the table are sorted.

sorted A BOOLEAN value that indicates whether the contents of the column should be sorted or not. When a column is sorted, data access on a specific column occurs in that column's sort order, regardless of the position of the row in the table.

Currently sorting is only ascending (in ASCII lexicographic order) and does not support alternate sorting keys. There is no limit to the number of columns in a table that can have the **sorted** flag set.

The data types defined by TBL_TYPES are listed in Table 90-2. If the column contains fixed length data types, the actual values are stored in the row data. However, if the column contains variable-length data types (such as **tsString** or **tsByteArray**), the actual values are stored in buffers; the value stored in the row data is a pointer to the buffer. These pointers to variable-length data buffers are internal and cannot be used by clients. For this reason, tables with variable-length columns cannot use the Get-Row and Set-Row operations.

Table 90-2
Table Column Data Types

Symbol	Meaning
tsChar	Fixed-length array of case-sensitive characters.
tsCaseChar	Fixed-length array of case-insensitive characters.
tsU16	Unsigned 16-bit integer.
tsU32	Unsigned 32-bit integer.
tsFP	GOMath floating point (GO_DP) value.
tsDate	Date field in system timestamp format.
tsString	Variable-length, case-sensitive ASCII string (null terminated).
tsCaseString	Variable-length, case-insensitive ASCII string (null terminated).
tsByteArray	Variable-length byte array, contained in unsigned characters. Use TS_STRING structure.
tsUUID	64-bit UUID structure.

Creating a Table Object

90.7

To create a table object send **msgNewDefaults** and **msgNew** to **clsTable**. Both messages take a pointer to a TBL_NEW structure, which contains:

name The name of the table. This name allows multiple clients to share a common name for the table and its data. (Note that this is not the file name; you specify the file name in the locator, below.)

locator A file locator for the table file, which includes a directory handle and a path. For more information on locators, see *Part 7: File System.*

exist A TBL_EXIST value that specifies what to do if the table file does or doesn't exist. The constants defined by TBL_EXIST are similar in name and function to the file system FS_EXIST constants.

create A TBL_CREATE structure that describes the columns in the table.

freeBehavior A TBL_FREE_BEHAVE value that describes how to dispose of the table file when the table object is destroyed. This structure also identifies conditions under which **clsTable** should automatically destroy the table. These options are described below.

createSemaphore A BOOLEAN value that specifies whether to create a semaphore for the table.

Use the values defined by TBL_FREE_BEHAVE to specify what to do with the table file when the table is freed (and when to automatically free the table). The values are:

tsFreeDeleteFile Delete the file when the table is destroyed.

tsFreeWhenNoClients Free the table when the number of accessors goes to zero.

tsFreeNoObservers Free the table when the number of observers goes to zero.

The default (**tsFreeDefault**) is not to delete the file when the table is destroyed, do not free the table when accessors or observers goes to zero.

Observing Tables

90.8

There are two ways to add yourself as the observer of a table. You can either include your UID in the TBL_BEGIN_ACCESS structure when you send **msgTBLBeginAccess** to table object (see below) or you can send **msgAddObserver** to an existing table object (before you send **msgTBLBeginAccess**).

If you use **msgAddObserver** to add yourself as an observer, you should use **msgRemoveObserver** to remove yourself from the observer list. If you send **msgTBLEndAccess** and include your UID in the message arguments, the message will send **msgRemoveObserver** to the table object automatically.

Example 90-1
Creating a Table

This example shows how to create a table with two columns. One column holds a 40-byte string (a name), the other column uses a date to store a birthday:

```
STATUS              s;
TBL_NEW             tn;
TBL_COL_DESC        colDesc[2]; // two column table
s = ObjectCall(msgNewDefaults, clsTable, &tn);
tn.table.exist          = tsExistOpen | tsNoExistCreate;
tn.table.freeBehavior   = tsFreeNoDeleteFile;
tn.table.createSemaphore    = false;
tn.table.locator.uid    = theWorkingDir;
tn.table.locator.pPath  = "\\MyDir\\Table Data";
strcpy(colDesc[0].name, "Name");
colDesc[0].type         = tsChar;
colDesc[0].length       = 40;
colDesc[0].repeatFactor = 0;
strcpy(colDesc[1].name, "Birthday");
colDesc[1].type         = tsDate;
colDesc[1].length       = 1;
colDesc[1].repeatFactor = 0;
strcpy(tn.table.name, "Names and Birthdays");
tn.table.create.colCount    = 2;        // Number of columns
tn.table.create.colDescAry  = colDesc; // First column descriptor
tn.table.createSemaphore    = true;
s = ObjectCall(msgNew, clsTable, &tn);
```

Start Access 90.9

To initiate access to a table, send **msgTBLBeginAccess** to the table you want to access. **msgTBLBeginAccess** takes a pointer to a TBL_BEGIN_ACCESS structure, which contains your object's UID (**sender**). The sender value is required if you want to add yourself (or another object) to the table's observer list. If you don't want to add the object to the table's observer list, use **objNull**. When **msgTBLBeginAccess** completes successfully, it sends a TBL_ROW_LENGTH value containing the table's width (**rowLength**).

When you begin access to a table, the current row position is at the end of the table. When you access a table, it is your responsibility to keep track of your position within the table. There is no message to indicate where you are.

Example 90-2
Beginning Access to a Table

```
STATUS TBL_NEW          tn; s;
    TBL_BEGIN_ACCESS    tba;
    TBL_ROW_LENGTH  width;
    ...
    s = ObjectCall(msgNew, clsTable, (P_ARGS)(&tn));
    sharedTable = tn.object.uid;
    // Fill in TBL_BEGIN_ACCESS structure
    tba.sender = objNull;
    s = ObjectCall(msgTBLBeginAccess, sharedTable, &tba);
    width = tba.rowLength;
```

Using Semaphores

90.10

To ensure that your task is the only one accessing a table, you can request a table semaphore. Each table has one semaphore, which is managed by that table object. You specify whether the semaphore should be available when you create the table.

The semaphore does not actually control access to the table. Applications that use the table must agree beforehand (at programming time) to use the semaphore to signal among themselves who has access to the table.

You acquire the semaphore for a table by sending **msgTBLSemaRequest** to the table. The message doesn't require any arguments. If the semaphore is available, the call completes immediately. If the semaphore is in use, your task will be suspended until the semaphore becomes available.

When you complete the operations that require exclusive access to the table, you release the semaphore with **msgTBLSemaClear**.

It is a good idea to acquire the semaphore just before the operations and release it as soon as possible. This reduces the chance that other processes that require access to the table will be suspended.

Example 90-3
Using Table Semaphores

This example shows an object that requests a table's semaphore, performs some action, then releases the semaphore.

```
TBL_BEGIN_ACCESS tba;
STATUS  s;
...
tn.table.createSemaphore = true;
s = ObjectCall(msgNew, clsTable, &tn);
sharedTable = tn.object.uid;
// Fill in TBL_BEGIN_ACCESS structure
tba = Nil(OBJECT);
s = ObjectCall(msgTBLBeginAccess, sharedTable, &tba);
if (ObjCallFailed(msgTBLSemaRequest, sharedTable, void) {
    // Handle error, if any (there should be no error if
    // the table created a semaphore)
    ...
}
// Perform protected operation
 ...
s = ObjectCall(msgTBLSemaClear, sharedTable, void);
```

Adding Rows to a Table

90.11

Use **msgTBLAddRow** to add a row to a table. In the table objects there is no concept of a last row; sequential ordering of rows is not guaranteed. However, if you define a column with the sorted attribute and use that column to access rows, access will occur in an ordered manner.

msgTBLAddRow has one argument, a pointer to a row position value of type TBL_ROW_POS. The message uses this location to return the position of the newly added row.

This code fragment shows an application adding a row to a table

```
TBL_ROW_POS curPos;
...
s = ObjectCall(msgTBLAddRow, myTable, &curPos);
```

Setting Data 90.12

You can set data in a single column of a row or you can set data in an entire row. To set data in a column, send **msgTBLColSetData** to the table object; to set data in a row, send **msgTBLRowSetData**. Tables with variable-length columns cannot use **msgTBLRowSetData**, because the data for variable-length columns is stored using an internal, private format.

msgTBLColSetData takes a pointer to a TBL_COL_GET_SET_DATA structure, which contains:

tblRowPos The row position in the table that will receive the data.

colNumber The column number in the table that will receive the data.

tblColData A pointer to the data buffer.

To set data in a variable-width column, the **tblColData** field should contain the address of a TBL_STRING structure that specifies:

strLen A U16 that specifies the length of the data.

strMax A U16 that specifies the size of the buffer. Usually **strLen** should be the same as **strMax**.

pStr A pointer to the buffer that receives the data.

msgTBLRowSetData takes a pointer to a TBL_GET_SET_ROW structure that contains:

tblRowPos A TBL_ROW_POS value that will receive the data.

pRowData A pointer to the data buffer that contains an image of the entire row. **msgTBLRowSetData** returns **stsTBLContainsIndexedCols** if any of the columns in the table are variable-length.

Getting Data 90.13

Getting data is similar to setting data. You can get data for a single column within a row (by sending **msgTBLColGetData** to the table object), or you can get data for an entire row (by sending **msgTBLRowGetData** to the table object).

Again the structures are similar. **msgTBLColGetData** takes a pointer to a TBL_COL_GET_SET_DATA structure that contains:

tblRowPos A TBL_ROW_POS value that specifies the row position.

colNumber A TBL_COL_INX_TYPE value that specifies the column number.

tblColData A pointer to the buffer that will receive the data.

If your client allocates the data buffer on an as-needed basis, you can use **msgTBLGetColDesc** to find out the current width and the data type of

fixed-width columns. Note that tables do not allocate the data buffer; it is your client's responsibility.

To get data for variable-width columns, store the address of a TBL_STRING structure in the **tblColData** field. The TBL_STRING structure specifies:

strLen A U16 to receive the length of the returned data.

strMax A U16 that specifies the size of the buffer.

pStr A pointer to the buffer that receives the data.

If the size of the data is larger than the buffer (**strMax**), the data is truncated, **strLen** contains the size of the data returned, and the message returns the status **stsTBLStrBufTooSmall**.

msgTBLRowGetData takes a pointer to a TBL_GET_SET_ROW structure that contains:

tblRowPos A TBL_ROW_POS value that specifies the row that we want.

pRowData A pointer to a data buffer that will receive an image of the entire row.

If you allocate the data buffer dynamically, you can use **msgTBLGetRowLength** to find out the length of a row.

Deleting a Row

90.14

You delete a row from a table by sending **msgTBLDeleteRow** to the table object. The row is not actually deleted until the client sends **msgTBLCompact** to the table object or until the table object is freed and the file is closed. If you want to prevent compaction when the file is closed, specify **tsFreeNoCompact** in the TBL_FREE_BEHAVE argument to **msgNew**.

After you delete a row, you can no longer access it, even though it hasn't actually been deleted from the file.

msgTBLDeleteRow takes one argument, a pointer to a TBL_ROW_POS value that identifies the row that you want to delete.

Searching a Table

90.15

To search a table for a particular item, use the messages **msgTBLFindFirst** and **msgTBLFindNext**.

Use **msgTBLFindFirst** to search for the first occurrence of a particular item in a table. Use **msgTBLFindNext** to search for the next occurence of an item when searching from a specified position.

Both messages take a pointer to a TBL_FIND_ROW structure that contains:

rowPos A TBL_ROW_POS value that specifies the current table position. When the message completes, **rowPos** will contain the row position of the located row.

rowNum A TBL_ROW_NUM value that specifies the index position in the specified column.

srchSpec A TBL_SEARCH_SPEC structure that contains the search specification. In this structure you specify:

colOperand The column number.

relOp A TBL_BOOL_OP value that specifies the operator used to match the search string against the column string in each row. The operators are described below in Table 90-3.

pConstOperand A pointer to a buffer containing the search item.

pRowBuffer A pointer to a ROW_BUFFER that specifies the client's buffer space (this might be **pNull**).

sortCol A TBL_COL_INX_TYPE value that specifies the column to sort the search by, if any. If **sortCol** is **null**, there is no sort.

The operands in the table search specification read the way they would if they were written in an equation, that is: column operand, operator, search constant. Thus, a less-than operator means "search until the column operand is less than the search constant."

The BOOLEAN operators are defined by TBL_BOOL_OP. Table 90-3 lists the BOOLEAN operators.

Table 90-3
Table BOOLEAN Operators

Operator	Meaning
tsEqual	Satisfied only if both items the same object.
tsLess	Satisfied if the column operand is less than the search constant.
tsGreater	Satisfied if the column operand is greater than the search constant.
tsGreaterEqual	Satisfied if the column operand is greater than or equal to the search constant.
tsLessEqual	Satisfied if the column operand is less than or equal to the search constant.
tsNotEqual	Satisfied if the column operand is not equal to the search constant.
tsSubstring	Satisfied if the column operand is a substring of the search constant. This operator is currently limited to case-dependent searches, even when searching a tsCaseChar or tsCaseString column.
tsStartsWith	Satisfied if the column starts with the specified string.
tsAlwaysTrue	Matches everything. Use tsAlwaysTrue to match the first row that the search encounters. For msgTBLFindFirst, this is the first row in the table; for msgTBLFindNext, this is the next row in the table (unless you are at the end of the table).

If the message finds a match, it returns **stsOK** and passes back the TBL_FIND_ROW structure with:

rowPos A TBL_ROW_POS value that indicates the row where the match was found.

rowNum A TBL_ROW_NUM value that indicates the indexed row number for sorted columns. If the column was not a sorted column, this value always contains 0.

If either **msgTBLFindFirst** or **msgTBLFindNext** does not find a match, or if the row position is at the end of the table, the message returns **stsTBLEndOfTable.**

Getting Information About a Table 90.16

clsTable provides a number of ways to get information about a table. Table 90-4 lists the messages and the information they return. The sections following the table describe the messages in detail.

Table 90-4
Table Information Messages

Message	Takes	Description
msgTBLFindColNum	P_TBL_COL_NUM_FIND	Passes back the column number for the specifed column name.
msgTBLRowNumToRowPos	P_TBL_CONVERT_ROW_NUM	Converts a TBL_ROW_NUM to its corresponding TBL_ROW_POS for the specified column.
msgTBLGetInfo	P_TBL_HEADER	Gets the table header information.
msgTBLGetColCount	P_TBL_COL_COUNT	Gets the number of columns in the table.
msgTBLGetColDesc	P_TBL_GET_COL_DESC	Passes back the column description for the specified column.
msgTBLGetRowCount	P_TBL_ROW_COUNT	Gets the current number of rows in the table.
msgTBLGetRowLength	P_TBL_ROW_LENGTH	Gets the length (in bytes) of the specified row.
msgTBLGetState	P_TBL_GET_STATE	Gets the current state.

The following sections describe these messages.

Finding a Column Number 90.16.1

If you have a column name string and need to find out the number of the column, send **msgTBLFindColNum** to the table. The message takes a pointer to a TBL_COL_NUM_FIND structure, in which you specify a pointer to the column name string (**name**).

When the message completes successfully, it returns **stsOK** and passes back the TBL_COL_NUM_FIND structure with a TBL_COL_INX_TYPE value that contains column number (**number**).

Converting a Row Number to a Row Position 90.16.2

To covert a row number to a row position for a specific column, send **msgTBLRowNumToRowPos** to the table object. The message takes a pointer to a TBL_CONVERT_ROW_NUM structure that contains:

rowNum A TBL_ROW_NUM value that specifies the row number to convert.

colNum A TBL_COL_INX_TYPE value that specifies the sorted column to use in the conversion.

If the message completes successfully, it returns **stsOK** and passes back a TBL_ROW_POS value in **rowPos** that specifies the position of the row.

If the column is not sorted, the message returns **stsTBLColNotIndexed.**

Getting the Number of Columns in a Table 90.16.3

Send **msgTBLGetColCount** to a table get the number of columns in the table. The only argument for this message is a pointer to the TBL_COL_COUNT value that will receive the column count. When the message completes successfully, it returns **stsOK** and passes back the column count.

Getting the Description of a Column 90.16.4

Send **msgTBLGetColDesc** to a table to get the description of a column in the table. The message takes a pointer to a TBL_GET_COL_DESC structure that contains a TBL_COL_INX_TYPE value that specifies the index of the column that you want (**colInx**).

When the message completes successfully, it returns **stsOK** and passes back a TBL_COL_DESC structure that will contain the column descriptor (**colDesc**) information.

Getting the Entire Table Description 90.16.5

Send **msgTBLGetInfo** to a table to get the entire description of that table. The only argument for this message is a pointer to a TBL_HEADER structure that will receive the table description.

Getting the Number of Rows 90.16.6

Send **msgTBLGetRowCount** to a table to get the number of rows in that table. The only argument for this message is a pointer to a TBL_ROW_COUNT value that will receive the number of rows.

Getting the Length of a Row 90.16.7

Send **msgTBLGetRowLength** to a table to get the number of bytes in a table row. The only argument for this message is a pointer to a TBL_ROW_LENGTH value that will receive the number of bytes in a row.

The length passed back by this message does not include the length of variable-length data. To get the width of a variable length column for a particular row, send **msgTBLColGetData** to the table object, specifying the row, column, a pointer to a TBL_STRING structure, and specify **strMax** as 0. When the message returns **strLen** contains the length of the data.

Getting a Table's State 90.16.8

Occasionally you might need to find out a table's state. To get the state, send **msgTBLGetState** to a table object. The message takes a pointer to a TBL_GET_STATE structure, that contains:

tblState A TBL_STATE enum value that will receive an indicator of the position within the table.

tblRowPos A TBL_ROW_POS value that specifies the row for which you are requesting the table state.

Ending Access

90.17

When you have no longer need to access a table, send **msgTBLEndAccess** to the table. The message takes a pointer to a TBL_END_ACCESS structure that contains a single element, the UID of the sender (**sender**). This is usually self. If you specify **sender**, the message will remove the sender from the table's observer list.

The message also decrements the table's reference count.

Freeing a Table

90.18

When a table is no longer useful, destroy it by sending it **msgDestroy**. The options specified when the table was created determine if the file should be preserved and whether the rows should be compacted.

If a table's owner terminates without explicitly destroying the table, PenPoint sends **msgFree** to the table object.

Chapter 91 / The NotePaper Component

The NotePaper component, consisting primarily of the **clsNotePaper** view and the **clsNPData** data object, provides a capable building block for applications that manage ink as a data type. For example, the NotePaper component provides much of the function of the the MiniNote note-taking application that comes bundled with the PenPoint™ operating system.

clsNotePaper is a subclass of **clsView**. Like all subclasses of **clsView**, **clsNotePaper** is designed to interact with and and display a data object—in this case an instance of **clsNPData**. A **clsNPData** data object manages a collection of data items whose classes inherit from the abstract class **clsNPItem**.

This chapter presents the API for **clsNotePaper**, **clsNPData**, and **clsNPItem**. To get a better understanding of the way these classes interact, you should study the **NotePaperApp** sample application, a simple note-taking application. The source code for this application is in the SDK sample application directory \PENPOINT\SDK\SAMPLE\NPAPP.

The clsNotePaper View

91.1

clsNotePaper is a subclass of **clsView** designed to observe a data object of **clsNPData**. **clsNotePaper** supports embedding, undo, move and copy, import, export, and option sheets. It also supports marks, which in turn provide support for search and replace, spell checking, and reference buttons. With all of these features, **clsNotePaper** is a very capable class.

clsNotePaper displays and alters the contents of a NotePaper data object, an instance of **clsNPData**. The data object maintains a database of items. The view sends messages to the data object to alter or query the database, and the data object notifies the view when it needs to update its presentation of the data items.

In displaying the data items, **clsNotePaper** maintains a coordinate system whose origin is the upper left corner of the view. This has the advantage that, as the NotePaper window changes in width and height, its contents remain relative to the upper left corner of the page (the expected behavior for notes). One thing to be aware of, though, is that an upper left origin means that all y (vertical) coordinates are negative.

NotePaper Metrics

91.2

clsNotePaper maintains a set of metrics including a paper style, a pen style, font and line spacing for displaying text, and a set of flags that determines various behaviors of the instance. All of this information is represented in a NOTE_PAPER_METRICS data structure, which includes the following fields (the data type follows the field name in parentheses):

paperStyle (NP_PAPER_STYLE) The style of the "paper" the **clsNotePaper** instance displays. **paperStyle** can have any one of the following enumerated values:

npPaperRuled Horizontal rules but no vertical rules.

npPaperRuledLeftMargin Horizontal rules with a single vertical rule down the left side of the page.

npPaperRuledCenterMargin Horizontal rules with a single vertical rule down the center of the page.

npPaperRuledLegalMargin Horizontal rules with two vertical rules dividng the page into thirds.

npPaperBlank No horizontal or vertical rules.

npPaperLeftMargin No horizontal rules and a single vertical rule running down the left side of the page.

npPaperCenterMargin No horizontal rules and a single vertical rule running down the center of the page.

npPaperGrid Horizontal rules with vertical rules across the page with the same spacing as the horizontal rules.

penStyle (U8) The pen color and weight. To generate valid values, use the **NPPenStyle()** macro.

paperFont (SYSDC_FONT_SPEC) The font for displaying text items.

lineSpacing (COORD16) The font size and distance between horizontal rules, measured in twips (a twip is 1/20 of a point, or 1/1440 of an inch.

style (NOTE_PAPER_STYLE) A set of bit fields that determine various behaviors of the view. The bit field names and their meanings are:

bEditMode Gesture mode if **true**, ink mode if **false**.

bAutoGrow If **true**, automatically grow in height as user enters data.

bWidthOpts Include page width in option sheet if **true**.

bHideTopRule If **true**, don't display the top-most horizontal rule when **paperStyle** is set to one of the **npPaperRuled...** styles.

NotePaper Messages

91.3

Table 91-1 summarizes the messages **clsNotePaper** defines. See NOTEPAPR.H and the NPAPP sample application for more information about their use.

Table 91-1
clsNotePaper Messages

Message	Takes	Description
		Class Messages
msgNewDefaults	P_NOTE_PAPER_NEW	Initializes pArgs.
msgNotePaperGetMetrics	P_NOTE_PAPER_METRICS	Passes back receiver's metrics.
		Instance Messages
msgNotePaperSetEditMode	BOOLEAN	Sets receiver to either gesture or edit (true) or writing/ink (false) mode.
msgNotePaperSetPaperAndPen	P_NOTE_PAPER_METRICS	Sets paperStyle, lineSpacing, penColor, and penWeight.
msgNotePaperSetPenStyle	U32	Sets the pen style for selected items as well as the default for new items.
msgNotePaperGetPenStyle	U32	Gets the pen style for selected items (or the default if nothing selected).
msgNotePaperAddMenus	OBJECT	Modifies the passed in menu bar and appends standard NotePaper menus.
msgNotePaperAddModeCtrl	OBJECT	Adds the standard NotePaper mode icon to the passed in menu bar.
msgNotePaperClear	pNull	Deletes all items in receiver.
msgNotePaperClearSel	pNull	Deletes all selected items in receiver.
msgNotePaperInsertLine	P_NULL	Inserts a blank line above the selection.
msgNotePaperSetStyle	P_NOTE_PAPER_STYLE	Sets the receiver's style values.
msgNotePaperGetStyle	P_NOTE_PAPER_STYLE	Passes back the receiver's style values.
msgNotePaperGetSelType	P_NOTE_PAPER_SEL_TYPE	Passes back information about the types of items selected in receiver.
msgNotePaperTranslate	P_NULL	Translates untranslated scribbles in the selection.
msgNotePaperUntranslate	P_NULL	Untranslates translated scribbles in the selection.
msgNotePaperEdit	P_NULL	Edits text and translates and edits scribbles in the selection.
msgNotePaperGetDcInfo	P_NOTE_PAPER_DC_INFO	Passes back the drawing contexts used by receiver.
msgNotePaperTidy	P_NULL	Tidies the selection by normalizing the spacing of items each line.
msgNotePaperCenter	P_NULL	Centers the entire selection.
msgNotePaperAlign	U32	Aligns the selection according to pArgs.
msgNotePaperMerge	P_NULL	Joins scribbles and text in the selection.
msgNotePaperSplit	P_NULL	Splits scribbles and text.
msgNotePaperSelectRect	P_RECT32	Selects items within rect in the receiver's data.
msgNotePaperSelectLine	P_RECT32	Selects items whose baselines intersect rect in the receiver's data.

continued

Table 91-1 (continued)

Message	Takes	Description
msgNotePaperDeselectLine	P_RECT32	Deselects items whose baselines intersect rect in the receiver's data.
msgNotePaperDeleteLine	P_RECT32	Deletes items whose baselines intersect rect in the view's data.
msgNotePaperScribble	OBJECT	Handles scribble (including creating and insert object into view's data).
msgGWinGesture	P_GWIN_GESTURE	Self-sent to process the gesture.
msgAppSelectAll	P_NULL	Selects all items in the view.
msgSelDelete	P_NULL	Deletes selected items in the view.
msgOptionAddCards	P_OPTION_TAG	Creates and adds the Pen and Paper option sheets.
msgImportQuery	P_IMPORT_QUERY	Indicates whether or not passed-in file can be imported.
msgImport	P_IMPORT_DOC	Imports the passed in file.
msgExportGetFormats	P_EXPORT_LIST	Passes back list of formats that can be exported.
msgExport	P_EXPORT_DOC	Writes an ASCII version of receiver's data to the passed in file.
msgNotePaperUpdateSel	NULL	Takes or releases the selection as is appropriate.
msgNotePaperSplitAsAtoms	NULL	Splits the selected item to its constituent pieces.
msgNotePaperSplitAsWords	NULL	Splits the selected scribbles and text into words.
msgNotePaperGrowHeightTo	COORD32	Grows the height of the view to at least COORD32.
msgNotePaperGrowHeightBy	COORD32	Grows the height of the view by COORD32.

NotePaper Data

91.4

Like all views, **clsNotePaper** is designed to display a rendition of the data in an observed data object. The data object it uses is an instance of **clsNPData**, which mantains a database of "items," accepts requests to change the items, and notifies observers of the changes.

clsNPData maintains items of any type, so long as they support the protocol defined by the abstract class **clsNPItem** (discussed later). All **clsNPData** has to do is maintain a set of objects whose classes *inherit* from **clsNPItem.** Each of the different subclasses of **clsNPItem** (PenPoint includes scribble and text item classes) responds differently to a single protocol of messages which **clsNPData** uses.

Table 91-2 summarizes the messages **clsNPD**ata defines.

Table 91-2
clsNPData Messages

Message	Takes	Description
		Class Messages
msgNewDefaults	P_NP_DATA_NEW	Initializes pArgs.
		Database Manipulation Messages
msgNPDataInsertItem	OBJECT	Adds item to the data base.
msgNPDataInsertItemFromView	P_NP_DATA_ADDED_NP_ITEM_VIEW	Adds item to the data base.
msgNPDataDeleteItem	OBJECT	Deletes an item from the data base.
msgNPDataMoveItem	P_NP_DATA_XY	Moves an item within the data base.
msgNPDataMoveItems	P_MOVE_ITEMS	Moves all items below pArgs->y by pArgs->yDelta.
		Enumeration Messages
ENUM_CALLBACK()		This template describes the the callback function used in item enumeration.
msgNPDataEnumOverlappedItems	P_ENUM_RECT_ITEMS	Enumerates each item that overlaps the given rectangle.
msgNPDataEnumBaselineItems	P_ENUM_RECT_ITEMS	Enumerates each item whose baseline overlaps the given rectangle.
msgNPDataEnumSelectedItems	P_ENUM_ITEMS	Enumerates each item that is selected (in paint order).
msgNPDataEnumSelectedItemsReverse	P_ENUM_ITEMS	Enumerates each item that is selected (in reverse paint order).
msgNPDataEnumAllItems	P_ENUM_ITEMS	Enumerates each item (in paint order).
msgNPDataEnumAllItemsReverse	P_ENUM_ITEMS	Enumerates each item (in reverse paint order).
msgNPDataSendEnumSelectedItems	P_SEND_ENUM_ITEMS	Enumerates each selected item (in paint order).
msgNPDataGetCurrentItem	P_OBJECT	Passes back the current item in the receiver.
msgNPDataGetNextItem	P_OBJECT	Increments the current item to the next item and sets *pArgs to it.
		Database Attributes Messages
msgNPDataItemCount	P_U32	Passes back the count of items in the receiver.
msgNPDataSelectedCount	P_U32	Passes back the count of selected items in receiver.
msgNPDataSetBaseline	P_XY32	Sets the receiver's baseline (used for alignment).
msgNPDataGetBaseline	P_XY32	Gets the receiver's baseline (used for alignment).
msgNPDataSetLineSpacing	P_XY32	Sets receiver's line spacing (used as the font size).
msgNPDataGetLineSpacing	P_XY32	Gets receiver's line spacing (used as the font size).
msgNPDataGetBounds	P_RECT32	Passes back the bounding rectangle for all items in receiver.
msgNPDataGetSelBounds	P_RECT32	Passes back the bounding rectangle for all selected items in receiver.
msgNPDataGetFontSpec	P_SYSDC_FONT_SPEC	Passes back the receiver's font specification.
msgNPDataSetFontSpec	P_SYSDC_FONT_SPEC	Sets the receiver's font specification.
msgNPDataGetCachedDCs	P_NP_DATA_DC	Passes back DC's with normal and bold fonts at the given line spacing.

continued

Table 91-2 (continued)

Message	Takes	Description
		Messages Sent to Observers
msgNPDataAddedItem	P_NP_DATA_ADDED_ITEM	Sent to observers when item has been has been added or moved.
msgNPDataItemChanged	P_NP_DATA_ITEM_CHANGED	Sent to observers when item has been changed.
msgNPDataHeightChanged	P_NP_DATA_ITEM_CHANGED	Sent to observers when receiver's height has been changed.
msgNPDataItemEnumDone	NULL	Sent to observers when an enumeration that deleted or moved items is complete.

NotePaper Data Items

91.5

The NotePaper data item class, **clsNPItem**, defines a protocol of messages that defines the interactions possible between an instance of **clsNPData** and the items it maintains. **clsNPItem** is an abstract class; it handles only the generic behavior of the messages it defines. Instances of **clsNPItem** are not generally useful. Instead, the items a **clsNPData** object maintains are instances of subclasses of **clsNPItem**, not of **clsNPItem** itself. PenPoint includes two such subclasses: **clsNPScribbleItem**, an ink scribble, and **clsNPTextItem**, a text item.

Table 91-3 summarizes the messages that **clsNPItem** and its subclasses handle:

Table 91-3
clsNPItem Messages

Message	Takes	Description
		Class Messages
msgNewDefaults	P_NP_ITEM_NEW	Initializes pArgs.
		Instance Messages
msgNPItemGetPenStyle	P_U32	Gets the pen style of an item. (Pen styles are defined in notepapr.h.)
msgNPItemDelete	pNull	Deletes item from its data.
msgNPItemPaintBackground	P_NP_ITEM_DC	Paints a gray background if the receiver is selected.
msgNPItemSelect	BOOLEAN	Selects or deselects item.
msgNPItemSelected	P_BOOLEAN	Passes back item's selection status.
msgNPItemMove	P_XY32	Moves item to the indicated position.
msgNPItemDelta	P_XY32	Moves item by the indicated amount.
msgNPItemGetViewRect	P_RECT32	Passes back the receiver's bounding rectangle.
msgNPItemHitRect	P_RECT32	Returns stsOK if the receiver's bounds overlaps pArgs.
msgNPItemGetMetrics	P_NP_ITEM_METRICS	Gets the item's metrics.
msgNPItemSetBaseline	P_XY32	Sets receiver's baseline.
msgNPItemSetBounds	P_RECT32	Sets receiver's bounds.
msgNPItemHold	NULL	Increments the reference count for the item.
msgNPItemRelease	NULL	Decrements the reference count for the item.

continued

Table 91-3 (continued)

Message	Takes	Description
msgNPItemAlignToBaseline	P_XY32	Moves item so that it aligns to passed-in line spacing.
msgNPItemPaint	P_NP_ITEM_DC	Paints item using the passed in drawing contexts.
msgNPItemSetPenStyle	U32	Sets the item's pen style. (Pen styles are defined in NOTEPAPR.H.)
msgNPItemSetOrigin	P_XY32	Set the receiver's origin.
msgNPItemScratchOut	P_RECT32	Handles the scratch-out gesture on an item.
msgNPItemSplitGesture	P_XY32	Handles the split gesture on an item.
msgNPItemSplit	NULL	Splits an item into its constituent items.
msgNPItemSplitAsWords	NULL	Splits receiver into words. Deletes receiver, inserts new items.
msgNPItemJoin	OBJECT	Joins receiver and OBJECT and deletes OBJECT.
msgNPItemTie	OBJECT	Joins OBJECT and receiver and deletes them. Inserts new object.
msgNPItemGetScribble	P_OBJECT	Pass back the item's scribble.
msgNPItemGetString	PP_STRING	Passes back the text string for the item.
msgNPItemSetString	P_STRING	Sets the text string for the item.
msgNPItemToText	P_OBJECT	Item converts itself to a text item, passes back text item.
msgNPItemToScribble	P_ARGS	Item converts itself to a scribble item.
msgNPItemHitRegion	P_RECT32	Returns stsOK if receiver's path overlaps pArgs.
msgNPItemCalcBaseline	P_XY32	Calculates and sets the receiver's baseline.
msgNPItemCalcBounds	OBJECT	The receiver calculates and sets its new bounds.
msgNPItemGetWordSpacing	P_U16	The receiver passes back the size of its "space" character.
msgNPItemCanBeTranslated	pNull	The receiver returns stsOK if it can be translated.
msgNPItemCanBeUntranslated	pNull	The receiver returns stsOK if it can be untranslated.
msgNPItemHasString	pNull	The receiver returns stsOK if the item has a string.
msgNPItemCanJoin	OBJECT	Subclasses should return stsOK of they can join with OBJECT.
msgNPItemSetDataObject	OBJECT	Sets the receiver's data (e.g. instance of clsNPData).
msgNPItemSetAdjunct	OBJECT	Sets the receiver's adjunct item.
msgNPItemMark	P_U32	The receiver marks itself and provides its mark token.
msgNPItemUnmark	P_ARGS	The receiver unmarks itself and passes back the mark ID if applicable.
msgNPItemGetMarkId	P_U32	Passes back the mark ID of an item.

Part 10 / Connectivity

List of Tables

Chapter 92 / Introduction

The PenPoint™ operating system allows applications to communicate with devices and networks through device ports in the PenPoint computer.

For most operating systems, this level of connectivity is sufficient. However, other operating systems expect connections to be always present, uninterrupted, and require the user to reboot the machine between installing a new device driver and using it.

The PenPoint approach to connectivity enables users to:

- Store data so that it will be sent only when the machine connected to the correct network (deferred connectivity).
- Disconnect the machine from a network and reconnect without losing the current data transfer (automatic connection detection).
- Install and deinstall new device drivers (or other non-application software) without rebooting the machine (service architecture).

The PenPoint operating system also defines a protocol for applications or services that contain addressing information. These applications or services are called **address books**. By defining a common address book protocol, all service providers can access a single resource for all addresses, phone numbers, and other such information.

Layout of This Part

92.1

Part 10 is organized into nine chapters.

Chapter 92, this chapter, presents a brief overview of the PenPoint remote interface.

Chapter 93, Concepts, provides you with the fundamental concepts needed to understand the PenPoint remote interface.

Each of the following chapters describes one remote interface.

Chapter 94, Using Services, describes the service manager and how to access services through the service manager. *Part 13: Writing PenPoint Services* describes how to implement a service.

Chapter 95, Serial I/O, describes the serial I/O interface.

Chapter 96, Parallel I/O, describes the parallel I/O interface.

Chapter 97, Data Modem Interface, describes the interface to the data modem.

Chapter 98, The Transport API, describes PenPoint support for local area network communication using the AppleTalk protocol.

Chapter 99, In Box and Out Box, describes support for delayed data transfer through the In box and Out box.

Chapter 100, The Address Book, describes the address book protocol used to query and modify the system address book.

Chapter 101, The Sendable Services, describes the protocol used by the address book for communicating with services that provide Send capabilities, such as fax and e-mail.

Other Sources of Information 92.2

For useful insights on the topics covered in this part, refer to these books:

- For further reading on data communication, see *Computer Networks,* 2nd. Edition by Tannenbaum (Prentice Hall, 1989).
- For an excellent summary of AppleTalk, see *Inside AppleTalk* by Gursharan S. Sidhu, Richard F. Andrews, and Alan B. Oppenheimer (Addison Wesley, 1989).

If you are developing MIL devices (device drivers that interface to the PenPoint machine interface layer), you may need to refer to the documentation in the PenPoint HDK (hardware development kit). For more information on the HDK and MIL Devices, please contact GO Developer Technical Support.

Chapter 93 / Concepts and Terminology

The PenPoint™ operating system has a flexible architecture that can accomodate many forms of networking and connectivity.

This chapter presents the "big-picture" concepts that tie together all of the PenPoint communications and networking software. This chapter covers these topics:

- The principles of PenPoint connectivity.
- The hardware ports.
- Software access to those ports.
- The service manager.
- A summary of the actual implementation of PenPoint connectivity.
- How to integrate other network protocols with PenPoint.
- A survey of the remote interface features.

Principles of PenPoint Connectivity 93.1

There are four recurrent principles of PenPoint connectivity:

1. Many different communication facilities can coexist in a running PenPoint system.
2. All device drivers can be installed and deinstalled dynamically, unlike some other operating systems, where device drivers must be configured as part of the cold-boot process. To add a new device driver to these systems, you must shut the system down, add the device driver, and reboot.
3. PenPoint expects that there might be a chain of device drivers that handle communication between an application and a device (rather than just one driver per device).
4. All devices can be dynamically connected and disconnected. The operating system and the device drivers are prepared to handle disconnection and reconnection events while accessing a device.

PenPoint Connectivity Strategies 93.2

PenPoint was designed to allow many connectivity options. The PenPoint connectivity strategies include:

- A volume connectivity strategy that enables users to install and configure volumes from many different file systems on the fly. Volumes include internal disks, hard or floppy disk volumes, and volumes on remote file systems. PenPoint detects when a volume is connected or disconnected and manages volume connection.
- An adaptable file system designed to use multiple existing file systems that allows PenPoint to offer data sharing capabilities with many file system architectures.
- A device connectivity strategy enabling users to install and configure devices, device drivers, and network protocol stacks on the fly. As with volumes, PenPoint provides automatic connection detection and management.
- Basic hardware support, including a parallel port, serial port, high-speed packet, and a SCSI interface. With these hardware interfaces, PenPoint machines can connect (through adapters) to many networks and peripherals.
- Multiple network protocol stacks that can coexist concurrently. A protocol stack is a layered set of protocols, each of which handles a specific communication task, such as establishing and maintaining connections, transporting data, or presenting the data to the application.
- A general-purpose document import and export architecture. The operating system and its user interface makes it easy to exchange information between PenPoint applications and other file formats.
- An In box and an Out box that allows deferred document I/O for printing, faxing, e-mail, and so on. If the user makes an output request while the machine is disconnected, the Out box queues the document. The document is output automatically when the machine is reconnected. While the machine is connected, input accumulates in the In box; the user can review the input documents after the machine is disconnected.

PenPoint Computer Connectivity 93.3

It is up to the manufacturers of PenPoint computers to determine what connectivity their machine will offer. While some machines will not have any ports, most machines will include at least one, if not several of these connectors:

Serial connectors

Parallel connectors

SCSI connectors

AppleTalk connectors

Modem connectors

Other communications connectors

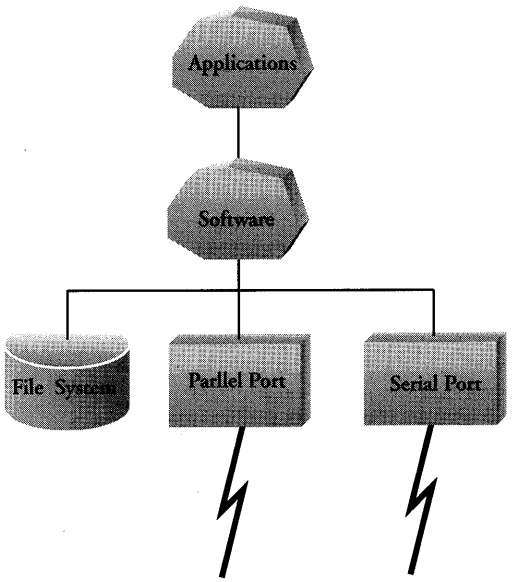
If a machine doesn't implement a port, the user doesn't have to install the service for that port. Applications can query service managers for available services. If the service is not installed on a machine, the application that uses the service can handle the situation by notifying the user or suggesting an alternate service.

Additionally, hardware manufacturers can easily create and distribute services that support non-standard ports, or ports that are not supported by the PenPoint operating system.

PenPoint Connectivity 93.4

The essential point of any connectivity architecture is to allow applications and other programs to communicate with hardware devices. The problem is in translating the applications needed to write and read bytes of data into device instructions to perform those tasks.

Figure 93-1
Applications and Ports



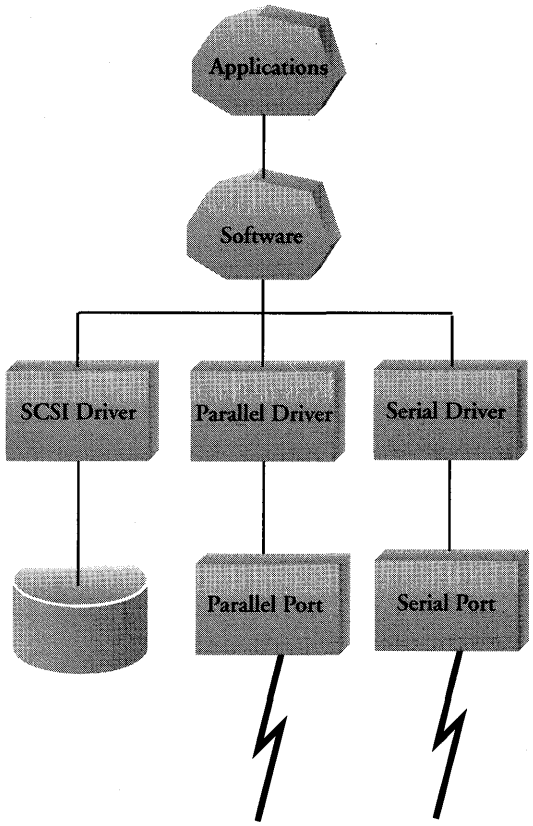
MIL Services 93.4.1

MIL services (PenPoint device drivers) provide an interface between programs and devices. The MIL service can configure and initialize the device, buffer data (if necessary), and inform the program when a device error has occurred. MIL services are usually written by GO and other hardware vendors.

Although different devices might perform equivalent functions, they take different instructions to perform those functions. For example, data can be written to a disk volumes or to the serial port, but the instructions to control those devices are very different. Thus, each device requires a separate MIL service.

Most MIL services use the stream interface, you can use the same stream messages to send and receive data from the MIL service. However, most MIL services also provide control functions in their API; these control functions vary from device to device. Your application should always be aware of the type of device with which it is communicating.

Figure 93-2
Applications, Drivers, and Devices



MIL Services and Other Services

93.4.2

MIL services control physical ports, such as the serial port or the SCSI port. There is a fixed set of MIL services created at boot time for all of the available hardware ports. Additional MIL services can be loaded after boot time for things like networks or plug-in peripherals.

Each MIL service has a programmatic interface; MIL services that perform related functions have similar interfaces. These interfaces can themselves be controlled by another service, which has a more general interface or provides another layer of functionality. Networks use services to implement the various network protocols.

In the PenPoint operating system a service is an instance of a particular service class. A service class provides the interface to a particular type of device (for

example, there is a service for Hewlett-Packard's LaserJet printers and there is a service class for Microsoft MS-DOS disk drives).

When the user attaches a device to a PenPoint computer and identifies it through the device option sheet, PenPoint creates an instance of a service instance that corresponds to that device. An instance of the LaserJet class might handle the user's LaserJet; an instance of the MS-DOS disk drive class handles the floppy disk volume named DISK1. The service instance contains configuration information (for example one paper tray or two), has a user-visible name, and can be bound (directly or through another service) to a MIL service which represents an actual hardware port.

Binding

93.4.2.1

A service is joined to a port or another service in a process called **binding**. Binding can be static or dynamic. Static binding is performed at compile time and is permanent (such as binding a MIL service to a port). Dynamic binding is performed when a service is installed, which allows the service to bind to a service chosen by the user.

More than one service can be bound to a given service. For example, the serial port could have two different services, such as a printer service and the modem service.

Some services, such as networks or the SCSI device, have no problem with this situation, because the peripherals connected to these devices are self-identifying. However, a device such as the serial port cannot be shared by peripherals; only one thing can be connected to it at any time. Devices of this nature can be accessed by only one service at a time.

To solve this problem, the user must identify the application or service that owns the service (the **owner**). A service keeps track of all the services that are bound to it, but only allows communication with its owner. Services that can be shared by peripherals can allow more than one owner.

Connection Management

93.4.2.2

MIL services can recognize when actual connections are made and broken. For intelligent peripherals, the services are able to detect connection by monitoring their hardware port. For dumb peripherals, those that aren't able to detect connections, the user must tell the service which device is connected. For example, the SCSI port can detect when SCSI devices come and go, but standard PC floppy drives can't. Therefore, the user must triple tap on the Connections notebook for it to recognize a new floppy.

When a service detects that a connection is made or broken, it sends object notification messages to the services that are bound to it. In turn, a service can relay the connection status message to any services that are bound to it. Any object can add itself to the notification list to receive these connection status messages. All MIL services support a common set of connection status messages.

Services also broadcast connection status. They observe the MIL service to which they are bound and essentially pass the connection messages on to their own observers.

Figure 93-3 illustrates the logical and MIL services.

Figure 93-3
Layered Services

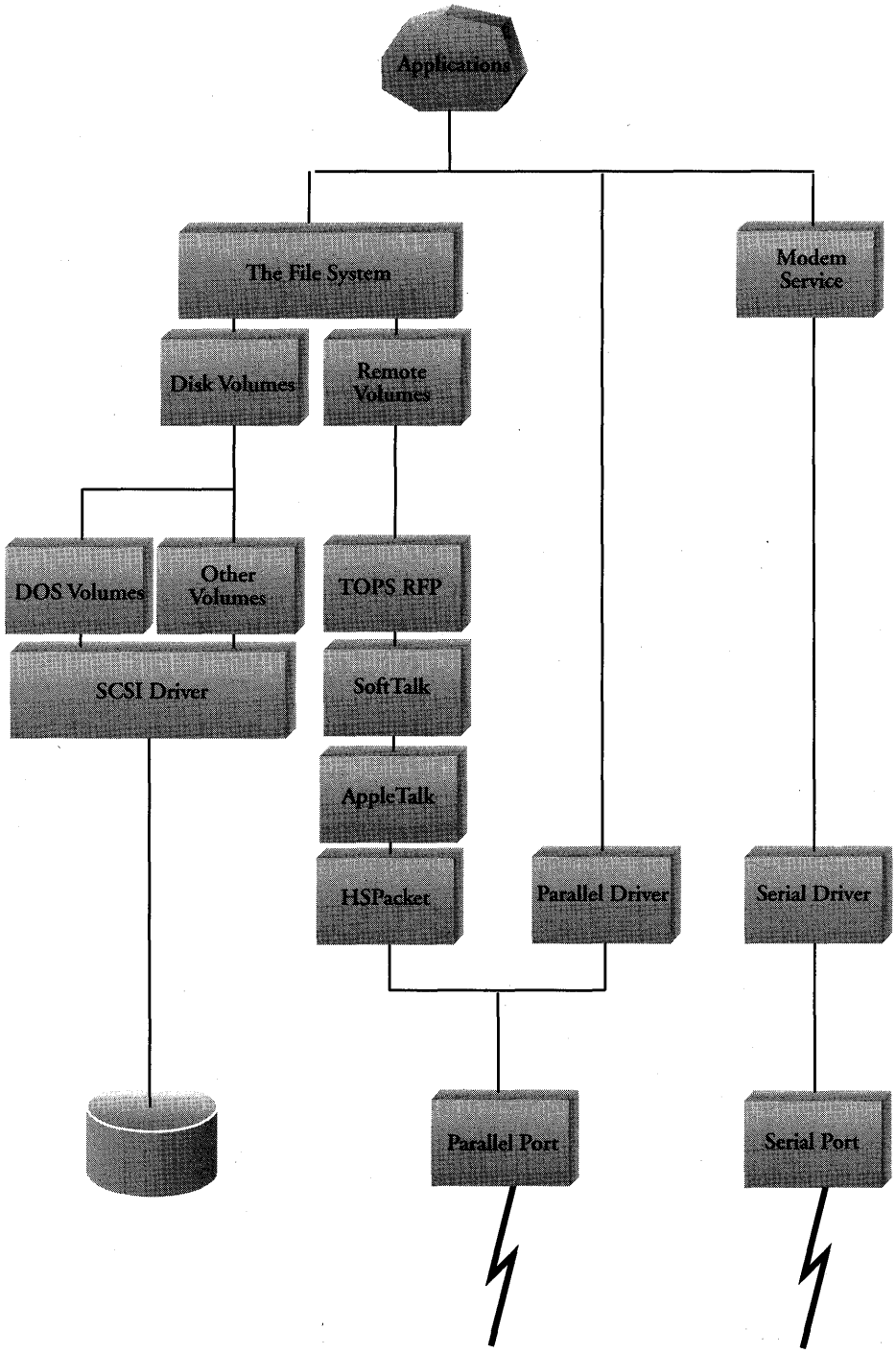
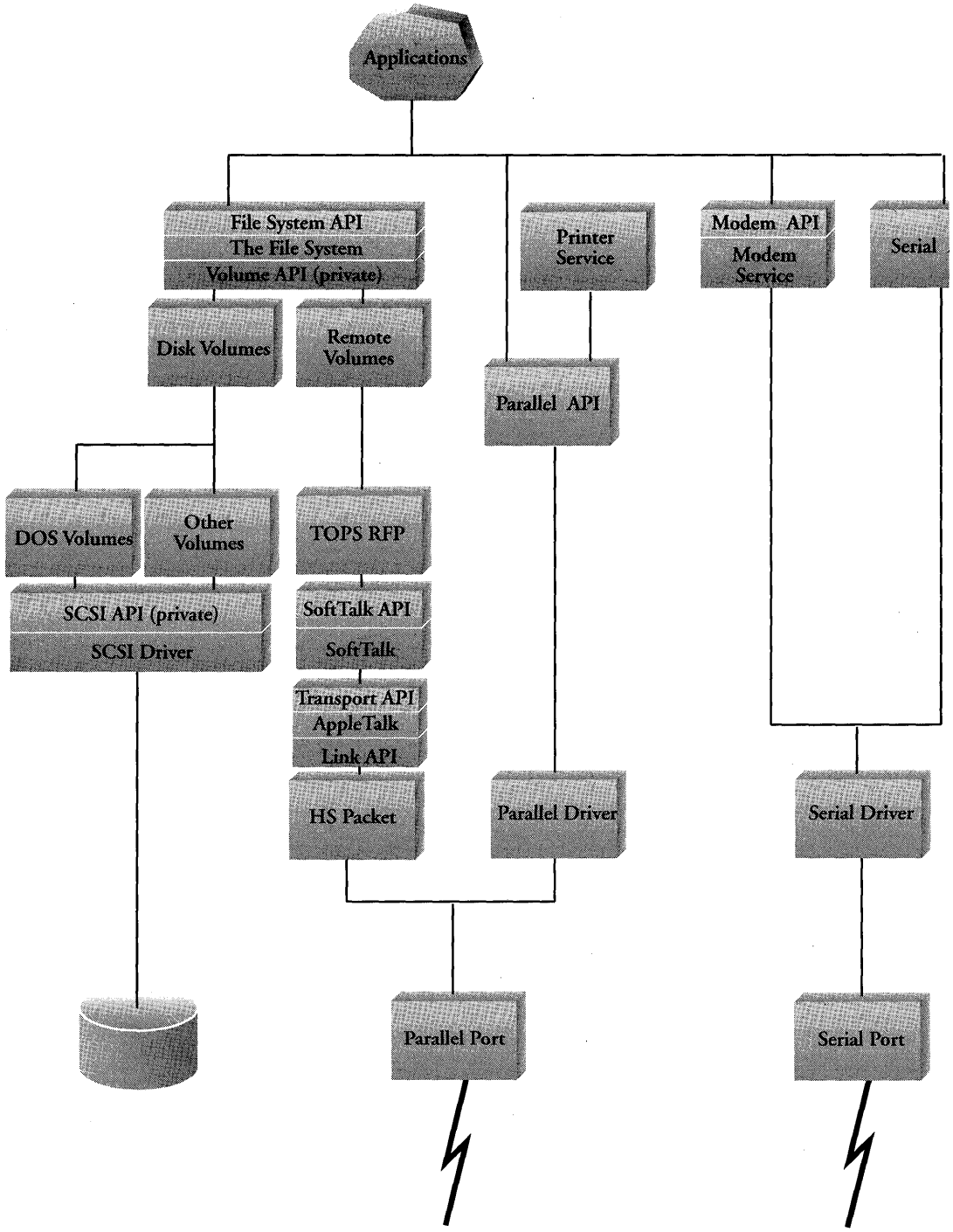


Figure 93-4
Devices and Interfaces



Services and Interfaces

93.4.3

Figure 93-4 shows the PenPoint networking and connectivity architecture. Each interface in the figure (denoted by dotted lines) is a PenPoint class. Applications can send messages to instances of these classes to control individual devices. Thus an application might use the file system interface to communicate with a remote

computer, but it can also use the SoftTalk interface (available from Sitka Corporation) to communicate with the remote computer.

The interface that an application uses depends on the level of control that the application needs to exercise, offset by the amount of work the application wants to perform itself. Usually in bypassing one of the upper-level interfaces, an application takes on more work for itself.

The Service Manager

93.5

At the root of PenPoint connectivity architecture is the service manager class. A **service** is any general, non-application DLL that enables PenPoint clients to communicate with a device or to access a function, such as a database engine.

Related services are managed by an instance of the service manager class. A service manager instance performs these tasks:

- Locates and accesses the service.
- Manages the connections between a client and a service (services may themselves by clients of another service).
- Notifies its observers of additions and deletions.
- Monitors the state of each connection between a service and its target and passes change notifications to its observers.

PenPoint Facilities

93.6

Using the principles and architecture described above, PenPoint provides these facilities for networking and connectivity:

- A file system that works on top of MS-DOS disk organization.
- A Connections notebook, in which the user can view the available volumes and printer queues.
- Basic Appletalk services at the ATP (AppleTalk Transport Protocol) level and below. This does not include ASP (AppleTalk Session Protocol) and ADSP (AppleTalk Data Stream Protocol).
- 19.2K asynchronous serial support, which allows a PenPoint computer to communicate with a single IBM PC through the PC's standard serial port.
- Appletalk connections between a PenPoint computer with a modem and another computer with a modem.
- High-speed serial (115K) and parallel data connections.
- Printer services for 8- and 24-pin dot-matrix printers and the H-P LaserJet printer.

Adding Network Protocols 93.7

PenPoint can support multiple protocol stacks and multiple remote volumes.

To allow users to connect a PenPoint computer directly to a network, you have to obtain or write a network protocol stack, or supplement an existing one and write support for another remote file system.

The service manager allows users to add new network protocol stacks dynamically; they don't have to cold-boot the system to add a new protocol. To connect a PenPoint computer to a new network device (provided the device uses SCSI or AppleTalk connectors), all the user has to do is:

- Install the protocol stack for the new network.
- Connect the PenPoint computer to the device.
- Tell the connection manager which protocol stack to use with the device.

Survey of the Remote Interfaces 93.8

The rest of this chapter provides an overview of the remote interface APIs provided by the PenPoint operating system. Most of these APIs are described in full in the remaining chapters.

Most of the device interfaces described here descend from **clsStream**. To read from and write to these devices, applications use the stream read and stream messages. **clsStream** is described in *Part 9: Utility Classes.*

Serial I/O 93.8.1

The serial I/O interface provides access to and control of a serial port. The serial interface is managed by **theSerialDevices** service manager. When an application gets a handle on a serial port from **theSerialDevices**, it can perform these tasks:

- Alter the serial port configuration, including baud rate, line control, and flow control.
- Transmit and receive data on the serial port.
- Detect events on the serial port.

For more information on the serial port, see Chapter 95, Serial I/O.

Parallel I/O 93.8.2

The parallel I/O interface provides access to and control of a parallel port. The parallel interface is managed by **theParallelDevices** service manager. When an application gets a handle on a parallel port from **theParallelDevices**, it can:

- Initialize a printer attached to the parallel port.
- Transmit and receive data on the parallel port.
- Change the auto-line-feed characteristics of a printer.
- Get and set the initialization and interrupt time-out intervals.

For more information on the parallel port, see Chapter 96, Parallel I/O.

High-Speed Packet I/O 93.8.3

The high-speed packet I/O interface (HSPKT) provides access to a protocol that performs high-speed data transfers using either a serial or parallel port. The high-speed packet interface is managed by **theHighSpeedPacketHandlers** service manager.

High-speed packet I/O implements a builtin RTS/CTS type protocol by sending a lead in character and expecting a data acknowledge character in return before actually sending a packet of data.

High-speed packet I/O is also discussed in Chapter 96, Parallel I/O.

File System 93.8.4

The PenPoint file system provides access to files and directories on a RAM volume, local disk volumes, and remote volumes. The file system API provides all standard file system control functions. In addition, it provides these capabilities:

- Reliable handling of disconnect and reconnect events for volumes.
- Memory-mapped files that allows you to open files with direct byte addressing capability.
- A volume traversal mechanism that allows you to visit all file system nodes that match a particular criterion.

The PenPoint file system currently is layered on the MS-DOS volume structure. Implementations using other volume structures (such as Apple's HFS) are possible in the future.

For more on the PenPoint file system, see *Part 7: File System.*

File Import Export 93.8.5

The PenPoint operating system provides system-based support for importing and exporting documents in different file formats; each application developer determines which import and export formats to supply.

When the user moves or copies a file into a PenPoint computer, PenPoint examines the file to see if it is a PenPoint document. If not, PenPoint asks every application that is currently installed whether it can import the file. Those applications that can import the file are displayed in a dialog box. When the user chooses an application, the import mechanism tells the application to translate the file into a document of that application type.

To export a file, the export mechanism asks the application what file formats it can write and displays the list of formats in a dialog box. The user selects a file format and the export mechanism tells the application to write the file using that format.

An additional mechanism allows applications and file translators to communicate with each other, allowing third parties to provide additional file translators.

The text editor application, MiniText, that is bundled with PenPoint imports and exports using three file formats:

- PenPoint internal text format.
- ASCII text.
- Microsoft's Rich Text Format (RTF).

For more information on the import/export mechanism see Chapter 81, File Import and Export, in *Part 9: Utility Classes.*

Modem Interface 93.8.6

The modem interface provides access to modem control functions through a high-level API, which allows you to configure the modem, dial out, and auto-answer.

The modem interface handles all the low-level modem line functions for you.

To use the modem interface, you open the serial port, create a modem object using the serial port handle, and then send messages to the modem object.

For more information on the modem manager, see Chapter 97, Data Modem Interface.

Networking Interface 93.8.7

As described previously in this chapter, PenPoint includes support for networking protocols. PenPoint provides these protocols:

- A transport protocol, which establishes communication with another program that understands the same protocol and transports data between the two programs.
- Several link protocols, which send and receive the data using various physical media (parallel and serial lines).

The session layer protocols are available from other vendors, such as Sitka Corporation, who provides TOPS for PenPoint.

Transport 93.8.7.1

The transport protocol establishes communication with a partner and handles data exchange with the partner. Currently the only transport protocol supported by the transport API is the AppleTalk transport protocol (ATP).

For more information on the Transport Protocol, see Chapter 98, Transport API.

Link 93.8.7.2

The link protocol provides communication on physical network devices (LocalTalk). The interface to the link protocol is not described in this part. For further information, please contact GO Developer Technical Support.

Chapter 94 / Using Services

PenPoint™ service classes provide installable, configurable system extensions. To access a particular service instance, clients need to communicate with a service manager. The service manager controls access to service instances and keeps track of all clients that are interested in a particular service instance.

There are a number of service managers in PenPoint. Each service manager is responsible for a particular category of services, such as the modems, the printing devices, or the handwriting translators.

Some of these categories may actually overlap (such as the printing devices and the parallel ports). A particular service instance can be managed by several service managers.

This chapter describes some fundamental service concepts, but is primarily concerned with the API for the service managers.

Chapter 94 covers these topics:

- Service concepts, including user installation and configuration of services, service managers, binding and opening services, and chaining services.
- Messages for service managers.
- How to use the service manager messages.

This chapter does not describe how to write services; for that information, see *Part 13: Writing PenPoint Services.*

Concepts

94.1

A **service** is a general, non-application DLL that provides an extension to the system. Services can perform many types of work, including—but not limited to—database engines, e-mail backends, and device drivers.

Each service is a class that inherits from **clsService**. For some services the service writer provides a user interface so that the user can create instances of a service; for other services, their instances are created automatically when the service is installed.

The services architecture can be though of as being quite similar to the PenPoint application framework. Services are similar to application classes; service instances are similar to documents.

However, the key concept to services is not with the services themselves, but the service manager architecture. Most clients of services deal far more with the service managers and service manager messages than with the actual services.

Installing Services

94.1.1

There are three ways to install services:

- The user can explicitly install a service through the services page of the Connections notebook. This action may be initiated by the service developer enabling service quick installation on a distribution disk.
- Applications or services can list a set of services in a SERVICE.INI file. If the service is not already installed in the system, PenPoint will install the service (if it is already installed, PenPoint will increase its reference count).
- A program can explicitly install a service by sending **msgIMInstall** to **theInstalledServices** (most applications will not do this).

You cannot list a service DLL file in any DLC file.

Warning You cannot include a service DLL file in any DLC file.

When an application requests a service in a SERVICE.INI file, the application is said to be dependent on the service. When someone attempts to deinstall the service, any application that is dependent on the service can veto the deinstallation.

The user can deinstall services by the Connections notebook interface or **theInstalledServices**. When the user deinstalls a service, the service manager destroys the service handles and removes the service's code and all saved service instances from PenPoint.

Clients that are bound to a service receive **msgIMDeinstalled** when the service class is deinstalled. Clients can observe the service manager to find out when the service is reinstalled.

A service cannot be deinstalled if it is marked as being in use when any instance of the service is open. By default, services are marked in use when anyone has their instances open.

Service Managers

94.1.2

A service manager provides a system-wide way of managing categories of services.

A service manager is an instance of **clsServiceMgr**. There is no single, central service manager; rather, there are a number of service managers. For example, the print services are managed by the print service manager; the serial ports are managed by the serial port manager.

A service manager performs several functions:

- It maintains a list of service instances.
- It provides protocol that allow clients to access service instances.
- It controls access to service instances.
- It notifies all observers when service instances are added or removed from its list.

However, when the client that initially loaded the service is deinstalled, the dependent applications receive notification, but cannot veto the deinstallation.

A service can appear on more than one service manager list. For example, **theSerialDevices** lists the available serial ports, but **thePrinterDevices** lists all the devices that can support printers, including the serial ports. This frees clients from having to search many lists to find the correct service; they just look for a service listed on by the most likely service manager.

All services controlled by a particular service manager support the same minimal set of functions.

Access Overview 94.1.3

The service manager provides access protocols that allow clients to:

- Find a particular service.
- Express an interest in a particular service instance (called binding).
- Open and close service instances.
- Acquire and release ownership of service instances.

Rather than perform these actions explicitly, the service manager also provides access messages that perfor all of these actions.

For example, when a client needs to access a specific serial port driver, the client performs the following tasks:

1. Sends a message to a service manager that manages the driver (such as **theSerialDevices**), giving it the name of the serial port and asking it to find the service for that device. **theSerialDevices** replies with a handle on the service.
2. The client sends a message to **theSerialDevices** asking to bind with that service.
3. When client needs to send or receive serial data, it sends an open message to **theSerialDevices**.
4. When the client is done sending or receiving, it sends a close message to **theSerialDevices** and eventually unbinds from the service.

A client should open a service only when it is ready to actually use the service. Opening a service returns the service object. The client should close the service as soon as it is done with the service.

Ownership 94.1.4

The service manager also works to control access to service instances.

Some services (such as those that communicate with ports) can only be used by one client at a time. For example, if the fax service owns a serial port and a fax/data modem is connected to that port, you don't want an E-mail service to be able to access the port.

A service manager can maintain an owner of a service instance and, if suitably configured, will allow only the owner of a service instance to open that service.

Targeting 94.1.5

A service can have a **target**, which can be either a physical device or another service. By using targeting, several services can be chained together, much like a network protocol stacks.

Targeting is used to pass both data and control information up and down target chains. (Here data is the actual information that a client is trying to transmit through a device; control information is information about the other services in the chain—such as connection information.)

Connections 94.1.6

Services can maintain connection status. Usually connection status is important to services that control devices, but connection status is not limited to those services.

Changes in connection state are transmitted to observers of the service (in addition to observers of the service manager in which the service is listed). By default, a service's connection state follows that of it's target.

With targeting and connection information, PenPoint applications can easily inform their users that a required device is available (or unavailable).

Accessing Services 94.2

To access a service, a client must observe the service protocol of binding to the service when interested in it, opening the service when access is needed, closing the service when done, and releasing the service when no longer interested in it.

Clients use messages defined by both **clsInstallMgr** and **clsServiceMgr** to communicate with the service manager. For example, your application gets the name of a service given its handle by sending **msgIMGetName** to the service manager.

clsInstallMgr is described in Chapter 112, Installation Managers of *Part 12: Installation API.*

Predefined Service Managers 94.2.1

GO defines a number of service managers in UID.H.

theMILDevices
theParallelDevices
theAppleTalkDevices
theSerialDevices
thePrinterDevices
thePrinters
theSendableServices
theTransportHandlers
theLinkHandlers
theHWXEngines

theModems
theHighSpeedPacketHandlers
theFaxIOServices

The names of these service managers make them fairly self-explanatory.

Binding to a Service 94.2.2

A client binds to a service by sending **msgSMBind** to the service's manager. The service manager then adds the client to the service's notification list. That way the service can inform the client about its availability through notification messages.

These notification messages include messages defined by the service, plus the following service manager messages:

msgIMActiveChanged
msgIMDeinstalled
msgIMModifiedChanged
msgIMInUseChanged
msgIMCurrentChanged
msgSMConnectChanged

Opening a Service 94.2.3

Most services have service-specific arguments that the client must include in the arguments to **msgSMOpen**. The structure and organization of these arguments is described in the documentation for the specific service. Some services provide their own defaults for their open arguments. To initialize the service specific arguments to their default values and to allow the **clsService** to perform other work for the service, the client must always call **msgSMOpenDefaults** before calling **msgSMOpen**.

A client opens a service by sending **msgSMOpen** to the service's manager. If the service has no other openers, or if the service can be shared, the service manager passes back the UID of the service object. If the service manager refuses the open request, it returns **stsFailed**.

Once the client has the UID of the service object, it can send service-specific messages to the service.

The client should open a service just before it needs to use it, and should close the service as soon as its use is completed. Services are a resource; many of them only allow one client at a time. An open service cannot be deinstalled.

The Service Manager Messages 94.3

Most **clsServiceMgr** messages are sent by clients attempting to access a service; they are sent to instances of the service manager.

Table 94-1 lists the **clsServiceMgr** messages.

Table 94-1
clsServiceMgr Messages

Message	Takes	Description
		Modified Ancestor Messages
msgIMGetState	P_IM_GET_STATE	Gets the state of a service manager.
msgIMSetModified	P_IM_SET_MODIFIED	Changes an item's modified setting.
		Instance Messages
msgSMAccess	P_SM_ACCESS	Accesses a service instance, given its name.
msgSMRelease	P_SM_RELEASE	Releases a service instance.
msgSMBind	P_SM_BIND	Binds to a service.
msgSMUnbind	P_SM_BIND	Unbinds from a service.
msgSMAccessDefaults	P_SM_ACCESS	Sets pArgs defaults for msgSMAccess.
msgSMOpenDefaults	P_SM_OPEN_CLOSE	Initializes SMOpen pArgs to default value.
msgSMOpen	P_SM_OPEN_CLOSE	Opens a service, given its handle.
msgSMClose	P_SM_OPEN_CLOSE	Closes an open service.
msgSMGetState	P_SM_GET_STATE	Gets the state of a service.
msgSMFindHandle	P_SM_FIND_HANDLE	Finds a handle, given a service instance UID.
msgSMGetOwner	P_SM_GET_OWNER	Gets the current owner of a service.
msgSMSetOwner	P_SM_SET_OWNER	Sets a new service owner.
msgSMSetOwnerNoVeto	P_SM_SET_OWNER	Sets a new service owner without giving owners veto power.
msgSMQueryLock	P_SM_QUERY_LOCK	Gets the UID of a service and locks out any opens.
msgSMQuery	P_SM_QUERY_LOCK	Gets the UID of a service.
msgSMQueryUnlock	P_SM_QUERY_UNLOCK	Unlocks a service that was locked via msgSMQueryLock.
msgSMSave	P_SM_SAVE	Saves a service instance to a specified external location.
msgSMGetClassMetrics	P_SM_GET_CLASS_METRICS	Gets the service's class metrics.
msgSMRemoveReference	P_SM_REMOVE_REF	Removes a service from a service manager without destroying the service.
		Notification Messages
msgSMConnectedChanged	P_SM_CONNECTED_NOTIFY	A service's connection state changed.
msgSMOwnerChanged	P_SM_OWNER_NOTIFY	A service's owner has changed.

Using the Service Manager 94.4

Whenever a client needs to access a service, it sends install manager and service manager messages to a service manager. The service managers are always present in a running system.

Accessing a Service 94.4.1

Your application can access the service in one of two ways:

- It can use the **msgSMAccess** to find, bind to, set owner, and then open a service.
- It can explicitly find, bind to, set owner, and open the service.

This section discusses **msgSMAccess**. The following sections discuss **msgIMFind**, **msgSMBind**, and **msgSMOpen**.

msgSMAccess provides a convenient way for clients to perform the most common sequence of messages used to access a service. **msgSMAccess** takes a pointer to an SM_ACCESS structure that contains:

pServiceName The name of the service that your application needs to access.

caller The UID of the object making the call (usually **self**).

pArgs A pointer to a set of arguments, if required by the service. If the service requires arguments, your application must send **msgSMAccessDefaults** first.

If the message does not succeed, it can return these status values:

stsNoMatch The specified service instance wasn't found.

stsSvcLocked An exclusive-access service is locked by another client.

stsSvcNotOwner Your application is not the current owner of the service.

stsSvcAlreadyOpen An exclusive-open service is open by another client.

If the message does succeed, it passes back:

handle The handle on the service object.

service The UID of the service instance.

Applications should never store an device's object UID in their instance data. While a document is saved and the application is terminated, the user could deinstall the service, or reconfigure the service, rendering the UID invalid. Your application should find and bind to a service when it receives **msgAppInit** or **msgAppRestore**; it should unbind from the service when it receives **msgFree**.

Applications should never file a device's object UID.

Finding a Service 94.4.2

Before your application can bind to a service, it must get the name of the service and a handle on the service.

To get the name of a service, your application can send **msgIMGetList** to a service manager, which passes back a list of service instance UIDs. Your application can

then use **msgIMGetName** to find the name of each service; the application then displays display the names to the user and allows the user to choose one.

If your application knows the name of the service ahead of time, it can send **msgIMFind** to the service manager for that type of service, specifying the name. **msgIMFind** passes back the handle on the service.

This example gets a handle on parallel I/O port:

```
STATUS                  s;
IM_FIND                 imf;
SM_BIND                 sm;
SM_OPEN                 so;
OBJECT                  sioUid;
imf.pName = PPortName;  // PPortName is defined by the user.
ObjCallRet(msgIMFind, theParallelDevices, &imf, s);
```

Binding to a Service

94.4.3

When your application binds to a service, the service manager adds your application to the observer list for that service. Observers of a service receive messages that relate to the status and availability of the service.

When your application has the handle on the service, it can send **msgSMBind** to the handle. The message takes a pointer to an SM_BIND structure that contains:

handle The handle on the service.

caller The UID of the object sending the message. Usually caller is **self**.

When the message completes successfully, it returns **stsOK**. The message does not send back anything. If the handle is not found, the message returns **stsNoMatch**.

This example continues from the example above. The caller binds to the option slot serial I/O port:

```
sm.handle   = imf.handle;
sm.caller   = self;
ObjCallRet(msgSMBind, theParallelDevices, &sm, s);
```

Opening and Closing a Service

94.4.4

When your application is ready to use the service, your application can open it by sending **msgSMOpenDefaults** and then **msgSMOpen** to the service manager for the service. **msgSMOpenDefaults** allows the service class to provide defaults for its arguments, and also allows **clsService** to initialize other internal data structures, such as open service objects.

Open service objects are described in Part 13: Writing PenPoint Services.

Clients should only open the service when they are ready to use it and should leave the service open for as little time as possible.

Both messages take a pointer to an SM_OPEN_CLOSE structure that contains:

handle The handle on the service. This is the same handle that your application sent with **msgIMFind**.

caller The UID of the object sending the message. Usually **caller** is **self**.

pArgs A pointer to service-specific arguments. Your application must check the description of the service to see if it has any service-specific arguments. Some services can initialize their **pArgs** structure to default values; for these services, call **msgSMOpenDefaults** before calling **msgSMOpen**.

If the message completes successfully, it returns **stsOK** and sends back the UID of the service in the **service** field of the SM_OPEN_CLOSE structure.

If the service manager refuses the request, it returns **stsRequestDenied**. A common reason for refusal is that only one client is allowed to open the service at a time and the service is busy. See the documentation for individual services for the exact reasons for returning **stsRequestDenied**.

This example continues from the previous two examples to show the client opening the service:

```
so.handle   = imf.handle;
so.caller   = self;
ObjCallRet(msgSMOpen, theSerialParallel, &so, s);
pportUid = so.service;
```

When your application has finished with a service, send **msgSMClose** to the service manager for that service. The message takes a pointer to an SM_OPEN_CLOSE structure that contains:

handle The handle of the service to close.

caller The UID of the object sending the message. Usually **caller** is **self**.

pArgs A pointer to service-specific arguments.

service The UID of the service to close.

Your application must specify both the handle on the service and the UID of the service.

Unbinding from a Service 94.4.5

To remove yourself from a service's observer list, send **msgSMUnbind** to the service manager for that service. If your application has the service open when it send **msgSMUnbind**, the service manager also sends **msgSMClose** to close the service. The message takes a pointer to an SM_BIND structure, which contains:

handle The handle on the service.

caller The UID of the object sending the message. Usually **caller** is **self**.

When the message completes successfully, it returns **stsOK**.

Finding a Handle 94.4.6

If your application has the UID of a service object, but don't have the handle, it can send **msgSMFindHandle** to the service manager for the service. The message takes a pointer to an SM_FIND_HANDLE structure that contains the service UID (**service**).

When the message completes successfully, it sends back the handle on the service in the **handle** field of the SM_FIND_HANDLE structure.

Receiving Connection State Notification 94.4.7

Most services support the notion of being connected. When the connection state of a service changes, clients that are bound to that service receive **msgSMConnectedChanged**, indicating that the connection state has changed. The message **pArgs** point to an SM_CONNECTED_NOTIFY structure that contains:

manager The UID of the manager that sent the notification.

handle The handle of the service whose state changed.

connected A BOOLEAN value that indicates the new connection state. When connected is TRUE, the service is connected.

Setting a Service Owner 94.4.8

To set a new owner of a service, send **msgSMSetOwner** to a service manager. The message takes a pointer to an SM_SET_OWNER structure that contains:

handle The handle of the service that your application is changing.

owner The UID of the new owner. To make yourself the new owner of a service, **owner** should be **self**.

When your application sends this message to a service manager, the service manager sends **msgSvcOwnerReleaseRequested** to the current owner and **msgSvcOwnerAcquireRequested** to the new owner. The current owner and new owner have the option to veto the change owner.

If the current and new owner do not veto, the service manager sends **msgSvcOwnerChangeRequested** to the owned service, so that the service has the opportunity to veto the change owner.

If the service doesn't veto the change owner, the service manager sends **msgSvcOwnerReleased** to the current owner, **msgSvcOwnerAcquired** to the new owner, and **msgSMOwnerChanged** to all clients that are bound to the service.

If the current or new owner, or the owned service vetoes the change, the message returns any status value less than **stsOK**.

If your application sends **msgSMSetOwnerNoVeto** instead of **msgSMSetOwner**, the service manager does not send **msgSvcOwnerChangeRequested** to the current owner.

Chapter 95 / Serial I/O

This chapter presents **clsMILAsyncSIODevice**, the serial port device driver interface class. The class provides an object-oriented interface to the serial port and supports the functionality necessary for a wide variety of serial applications.

To access a serial port, you send open and bind messages to the serial device service manager (**theSerialDevices**), requesting the port by name. If that port is available, the service manager gives you a handle on the port.

clsMILAsyncSIODevice inherits from **clsStream**. Structures and `#defines` used by **clsMILAsyncSIODevice** are in \GO\INC\SIO.H.

Serial I/O Concepts 95.1

The following sections discuss the concepts of serial I/O under the PenPoint™ operating system.

Interrupt Driven I/O 95.1.1

Serial communications can burden a system with a high volume of asynchronous real-time events. The serial hardware generates interrupts in response to these events. The serial driver takes full advantage of this interrupt capability to buffer the data before passing it to its client.

Buffered Data 95.1.2

When data is received, the hardware generates a receive character interrupt. The serial driver interrupt handler takes the received character and places it in the **input buffer**. Thus, the client code avoids the responsibility of responding in real time to each input character.

Output is similar. The client code does not wait around sending characters one by one. Instead, the client places outgoing data in an **output buffer** and passes the buffer to the serial driver. The serial driver moves the characters to the serial port as the port becomes ready for them. When a character is loaded, the hardware generates a send character interrupt.

The serial port client selects the size of the input and output buffers.

Flow Control 95.1.3

At high data rates, or when the system is busy with other tasks, it's possible for receive data to arrive in the input buffer faster than the client task can remove it. To prevent buffer overflow the serial driver utilizes two **flow control** protocols: XON/XOFF flow control and hardware RTS/CTS flow control. Of course, both sides of the serial connection must be using the same protocol for proper operation.

XON/XOFF flow control is limited to working with ASCII data, but has the advantage of being independent of the serial hardware and cable. Two characters, XON (usually Ctrl-Q) and XOFF (usually Ctrl-S), have special meaning. When the input buffer is nearly full and in danger of overflowing the driver sends an XOFF character to the remote serial port. When the remote serial port receives the XOFF character it immediately suspends transmission. When there is enough room in the input buffer the driver sends an XON character to the remote serial port which can start transmitting again.

Hardware RTS/CTS flow control works with any data but requires a particular hardware setup. It uses the serial port hardware input clear-to-send (CTS) and output request-to-send (RTS) control lines; these lines must be connected to the remote serial port. The CTS input enables data transmission to the remote serial port. The RTS output disables transmission from the remote serial port.

Events

95.1.4

The serial driver includes an event mechanism that can notify you when an interesting serial event happens. The event mechanism allows you to respond quickly to serial events without polling loops, which drain batteries and waste machine cycles. You can select which event messages you want to receive by sending **msgSioEventSet** to the serial driver. When one of the events occurs, the serial driver uses **ObjectSend** to send **msgSioEventHappened** and an event indication to you.

The possible interesting serial events are:

- CTS input line has changed state.
- DSR input line has changed state.
- DCD input line has changed state.
- RI input line has changed state.
- Input buffer is no longer empty.
- Break character has been received.
- Output buffer has become empty.
- Receive error condition has occured (parity, framing error, or overrun error).

Concurrency Issues

95.1.5

Only one client can access the serial port at a time. If you request a handle for a port that is owned by another client, **clsMILAsyncSIODevice** returns an error status code **stsSioPortInUse**.

You can define a global handle for a serial port, however, the serial port has no built-in access control mechanism. If you share a port with other clients, you must create your own access control mechanism.

Using Serial Messages

95.2

Table 95-1 lists the messages defined by **clsMILAsyncSIODevice.**

Table 95-1
clsMILAsyncSIODevice Messages

Message	Takes	Description
		Modified Ancestor Messages
msgStreamRead	P_STREAM_READ_WRITE	Reads data from stream.
msgStreamWrite	P_STREAM_READ_WRITE	Writes data to stream.
msgStreamReadTimeOut	P_STREAM_READ_WRITE_TIMEOUT	Reads data from stream with timeout.
msgStreamWriteTimeOut	P_STREAM_READ_WRITE_TIMEOUT	Writes to the stream with timeout.
		Instance Messages
msgSioInit	P_SIO_INIT	Initializes the serial device to its default state.
msgSioBaudSet	U32	Sets the serial port baud rate.
msgSioLineControlSet	P_SIO_LINE_CONTROL_SET	Sets serial port data bits per character, stop bits, and parity.
msgSioControlOutSet	P_SIO_CONTROL_OUT_SET	Controls serial port output lines dtr and rts.
msgSioControlInStatus	P_SIO_CONTROL_IN_STATUS	Reads the current state of the serial port in put control lines.
msgSioFlowControlCharSet	P_SIO_FLOW_CONTROL_CHAR_SET	Defines serial port XON/XOFF flow control characters.
msgSioBreakSend	P_SIO_BREAK_SEND	Sends a break for the specified duration.
msgSioBreakStatus	P_SIO_BREAK_STATUS	Sends back the number of breaks received so far.
msgSioInputBufferStatus	P_SIO_INPUT_BUFFER_STATUS	Provides input buffer status.
msgSioOutputBufferStatus	P_SIO_OUTPUT_BUFFER_STATUS	Provides output buffer status.
msgSioFlowControlSet	P_SIO_FLOW_CONTROL_SET	Selects flow control type.
msgSioEventStatus	P_SIO_EVENT_STATUS	Sends back current state of event word, and then clears the event word.
msgSioEventSet	P_SIO_EVENT_SET	Enables event notification.
msgSioEventGet	P_SIO_EVENT_SET	Gets the current sio event setting.
msgSioEventHappened	P_SIO_EVENT_HAPPENED	Notifies client of event occurance.
msgSioGetMetrics	P_SIO_METRICS	Sends back the sio metrics.
msgSioSetMetrics	P_SIO_METRICS	Sets the sio metrics.
msgSioReceiveErrorsStatus	P_SIO_RECEIVE_ERRORS_STATUS	Sends back the number of receive errors and the number of dropped bytes (due to buffer overflows).
msgSioInputBufferFlush	pNull	Flushes the contents of the input buffer.
msgSioOutputBufferFlush	pNull	Flushes the contents of the output buffer.
msgSioSetReplaceCharProc	P_SIO_REPLACE_CHAR	Replaces the built in receive character interrupt routine.

Requesting and Releasing a Serial Handle 95.2.1

Before you can communicate through the serial port, you must request a handle on the port from **theSerialDevices** service manager. To locate the port by name, send **msgIMFind** to **theSerialDevices**, then bind the port to your process by sending **msgSMBind** to **theSerialDevices**. Finally, you open the port by sending **msgSMOpen** to **theSerialDevices**.

This example shows how a client requests a handle on a serial port.

```
STATUS                  s;
IM_FIND                 imf;
SM_BIND                 sm;
SM_OPEN                 so;
OBJECT                  sioUid;
imf.pName = userName;    // The name was requested from the user earlier
ObjCallRet(msgIMFind, theSerialDevices, &imf, s);
sm.handle   = imf.handle;
sm.caller   = self;
ObjCallRet(msgSMBind, theSerialDevices, &sm, s);
so.handle   = imf.handle;
so.caller   = self;
ObjCallRet(msgSMOpen, theSerialDevices, &so, s);
sioUid = so.service;
```

The symbol **sioUid** now contains the UID of the serial port object. You can communicate with the serial port by sending messages to this object.

When you have finished with the serial port, you should free the port by sending **msgSMClose** to **theSerialDevices**. Do not send **msgDestroy** to the serial port object.

This example shows the correct way to free a port:

```
...
sioUid = so.service;
...
ObjCallRet(msgSMClose, theSerialDevices, wknKey);
```

Reinitializing the Serial Port 95.2.2

To reinitialize a serial port to its default state and change the buffer sizes, send **msgSioInit** to the handle on the serial port. The message takes a pointer to an SIO_INIT structure that contains:

inputSize A U16 value that specifies the size of the input buffer.

outputSize A U16 value that specifies the size of the output buffer.

Serial Port Configuration 95.2.3

Before you communicate over the serial port, you must configure the port so that can communicate with the device at the other end of the line. Both devices must be configured identically, or communication will not occur. The configurable items are:

- Baud rate
- Number of bits per byte

- Parity
- Stop bits
- Flow control
- Flow control characters.

When you first create a handle on a serial port, it has these defaults:

- 8 bits
- No parity
- One stop bit
- XON/XOFF flow control
- Ctrl-Q and Ctrl-S are the XON and XOFF characters
- DTR and RTS are on.

Setting the Baud Rate 95.2.3.1

You set the baud rate by sending **msgSioBaudSet** to the serial port handle. The message takes a single argument, a U32 value that specifies the data rate in bits per second. The maximum allowed setting is 115200; there is no default setting.

Setting the Line Control 95.2.3.2

You set the number of data bits, the stop bits, and the parity by sending **msgSioLineControlSet** to the serial port handle. **msgSioLineControlSet** takes a pointer to an SIO_LINE_CONTROL_SET structure that specifies:

dataBits The number of bits in a byte. Three constants define the possible byte sizes: **sioSixBits**, **sioSevenBits**, and **sioEightBits**.

stopBits The stop bits. Three constants define the possible stop bits: **sioOneStopBit**, **sioOneAndAHalfStopBits**, and **sioTwoStopBits**.

parity The parity. Three constants define the possible parity settings: **sioNoParity**, **sioOddParity**, and **sioEvenParity**.

Specifying the Flow Control 95.2.3.3

You specify the flow control for a serial port by sending **msgSioFlowControlSet** to a serial port handle. The message takes a pointer to an SIO_FLOW_CONTROL_SET structure. The structure contains a single member, **flowControl**, which indicates whether the port will use XON/XOFF, CTS/RTS, or no flow control. The constants defined by SIO_FLOW_TYPE are:

sioNoFlowControl No flow control.

sioXonXoffFlowControl Use XON/XOFF flow control. Use **msgSioFlowControlCharSet** to change the control characters from their defaults).

sioHardwareFlowControl Use the CTS and RTS lines for flow control.

Changing the Flow Control Characters 95.2.3.4

If, for some reason, you cannot use Ctrl-Q (ASCII 17) as the XON character or Ctrl-S (ASCII 19) as the XOFF character, you can to change the default flow control character values by sending **msgSioFlowControlCharSet** to the serial port handle. The message takes a pointer to an SIO_FLOW_CONTROL_CHAR_SET structure that specifies:

xonChar A U8 value for the XON character.

xoffChar A U8 value for the XOFF character.

Controlling DTR and RTS For Output 95.2.3.5

If both the local and remote hardware support data-terminal-ready (DTR) and request-to-send (RTS) lines, you can set the state of the output DTR and RTS lines by sending **msgSioControlOutSet** to the serial port handle. The message takes a pointer to an SIO_CONTROL_OUT_SET structure, which contains:

dtr A BOOLEAN value that specifies the state of the DTR line.

rts A BOOLEAN value that specifies the state of the RTS line.

In both BOOLEAN values, **true** activates the line.

Requesting the Input Line States 95.2.3.6

If the local and remote hardware supports DTR and RTS lines, you can request the states of the input lines by sending **msgSioControlInStatus** to the serial port handle. The message takes a pointer to an SIO_CONTROL_IN_STATUS structure, which contains:

cts A BOOLEAN value that receives the state of the CTS line.

dsr A BOOLEAN value that receives the state of the DSR line.

rlsd A BOOLEAN value that receives the state of the RLSD line.

ri A BOOLEAN value that receives the state of the ring-indicator (RI) line.

In all BOOLEAN values, **true** means active.

Requesting All Serial Port Settings 95.2.3.7

You can request all the serial port settings by sending **msgSioGetMetrics** to the serial port handle. The message takes a pointer to an SIO_METRICS structure that contains:

baud An SIO_BAUD_SET structure that receives the baud rate.

line An SIO_LINE_CONTROL_SET structure that receives the line control.

controlOut An SIO_CONTROL_OUT_SET structure that receives the serial port output line settings.

flowChar An SIO_FLOW_CONTROL_CHAR_SET structure that receives the flow control characters.

flowType An SIO_FLOW_CONTROL_SET structure that receives the flow control settings.

All of the structures here are described in the foregoing message descriptions.

You can use the same SIO_METRICS structure with **msgSioSetMetrics** to set all of the current serial port settings.

Reading and Writing with the Serial Port 95.2.4

To read from or write to the serial port, send **msgStreamRead** or **msgStreamWrite** to the serial port handle. Both messages take a pointer to a STREAM_READ_WRITE structure that specifies:

numBytes The number of bytes to read or write.

pReadBuffer A pointer to a buffer that receives the data, or containing data to be written. On **msgStreamRead**, the buffer must hold at least **numBytes** of data.

To read or write with a timeout value, send **msgStreamReadTimeout** or **msgStreamWriteTimeout** to the serial port handle. These messages require a STREAM_READ_WRITE_TIMEOUT structure that contains **numBytes** and **pReadBuffer** and a timeout value in milliseconds (**timeOut**).

For more information on reading or writing streams, see Chapter 79, Class Stream in *Part 9: Utility Classes.*

Input and Output Buffer Status 95.2.4.1

To find out the number of characters in the input or output buffer and the amount of room left in the buffer, send **msgSioInputBufferStatus** or **msgSioOutputBufferStatus** to the serial port handle. The **msgSioInputBufferStatus** message takes a pointer to an SIO_INPUT_BUFFER_STATUS structure that contains:

bufferChars A location that receives the number of characters in the buffer.

bufferRoom A location that receives amount of room left in the buffer.

The **msgSioOutputBufferStatus** message takes an SIO_OUTPUT_BUFFER_STATUS structure that contains:

bufferChars A location that receives the number of characters in the buffer.

bufferRoom A location that receives amount of room left in the buffer.

transmitterFrozen A BOOLEAN value that indicates whether the transmitter is frozen. This can happen when the serial port receives XOFF or the RTS line is not active. For more information, see "Flow Control," below.

Flushing the Input and Output Buffers 95.2.4.2

To flush (delete the contents of) the input or output buffers, send **msgSioInputBufferFlush** or **msgSioOutputBufferFlush** to the serial port handle. The messages do not take any arguments.

Flow Control

95.2.5

Now comes the moment when all the flow control information becomes useful. If you are performing your own buffer management and detect that your buffer is in danger of overflowing, you need to tell the device with which you are communicating to stop sending data; usually you do this with CTS/RTS.

Sending BREAK

95.2.6

A more drastic way to signal your partner to stop transmission is to send a BREAK signal (a series of zeros). BREAK sends a series of zeros to the stream. Of course, you can't use a stream write message, because you don't want the zeros buffered. Instead, you send **msgSioBreakSend** to the serial port handle. The message takes a pointer to an SIO_BREAK_SEND structure, which contains a single member, **milliseconds. milliseconds** specifies the length of time that zeros should be sent on the line, in milliseconds. A typical break duration is 200 to 400 milliseconds.

Detecting Events

95.2.7

The previous section discussed how to halt data transmission. This section describes how to detect those signals.

The best way to detect the halt signals is to make yourself an observer of the serial port manager. To do this, send **msgSioEventSet** to the serial port handle. The message takes a pointer to an SIO_EVENT_SET structure that contains:

eventMask An event mask, which describes the events for which you want to receive notification. Table 95-2 lists the event mask indicators.

client The UID of an object to inform when the event happens. This is usually yourself.

Table 95-2
Event Mask Indicators

Indicator	Meaning
sioEventCTS	The CTS line changed state.
sioEventDSR	The DSR line changed state.
sioEventDCD	The DCD line changed state.
sioEventRI	The RI line changed state.
sioEventRxChar	Your receive buffer is no longer empty.
sioEventRxBreak	Received a break condition.
sioEventTxBufferEmpty	The sender's transmission buffer is empty.
sioEventRxError	A parity, framing, or overrun error occurred.

If you send **msgSioEventSet** to the serial port handle and one of the specified events occurs, the object named in the message receives **msgSioEventHappened.** The argument for this message is a pointer to an SIO_EVENT_HAPPENED structure, which contains:

eventMask An SIO_EVENT_MASK structure that indicates the event or events that occurred. When the serial port manager sends **msgSioEventHappened**, it also clears its event mask.

self The UID of the object that generated this message.

Note that some **eventMask** indicators might be set for events that you are not observing.

To get the current SIO_EVENT_SET structure, send **msgSioEventGet** to the handle on the serial port. The message takes a pointer to an SIO_EVENT_SET structure that will receive the event information.

Polling for Events 95.2.7.1

An alternative method for detecting events is to poll the event word, by sending **msgSioEventStatus** to the serial port handle. The message takes a pointer to an SIO_EVENT_STATUS structure that contains a location to receive the current state of the event mask (**eventMask**).

When the serial port manager receives this message, it returns the event mask to the requestor and clears the mask.

Checking BREAK Status 95.2.7.2

You can also poll the BREAK counter by sending **msgSioBreakStatus** to the serial port handle. The message takes a pointer to an SIO_BREAK_STATUS structure, which contains the location to receive the current break count (**breaksReceived**).

When the serial port manager receives the message, it sends back the number of breaks received since the last time the counter was cleared and then clears the counter.

High-Speed Packet I/O Concepts 95.3

The high-speed packet I/O interface (HSPKT) provides access to a protocol that performs high-speed data transfers using either a serial or parallel port. The high-speed packet interface is managed by **theHighSpeedPacketHandlers** service manager.

High-speed packet I/O implements a builtin RTS/CTS type protocol by sending a lead in character and expecting a data acknowledge character in return before actually sending a packet of data.

HSPKT on Serial Lines 95.3.1

When running running on a parallel line, HSPKT uses a connection detection protocol. When running on a serial line, DSR high signals that it is connected, regardless of what the serial port is connected to.

Also when running on serial lines, the high-speed packet I/O can dynamically negotiate the baud rate.

In case of send errors, baud rates are renegotiated with remote station automatically.

Parallel Cable Connection Detection 95.3.2

The parallel connection protocol involves sending a parallel connect character and expecting to receive a connect acknowledge character back.

Protocol Variations 95.3.3

By setting **leadInChar** to 0, no lead in character is sent (and of course no **dataAckChar** is expected).

By setting **dataAckChar** to 0, no acknowledge character is sent upon receiving the lead in character, i.e. DVHSPKT goes on expecting data to arrive right after the lead in character.

By setting **parConnectChar** to 0, DVHSPKT reports always connected, leaving it up to users at a higher level to determine actual connection.

By setting **parConnectAckChar** to 0, no connect acknowledge character is sent upon receiving the connect character.

Notes 95.3.4

As data is transmitted/received in parallel mode, DVHSPKT remains synchronized with the other side during the entire data transfer. As a result, both transmissions and receptions are subject to failure, making the use of a lead in/ack protocol not always a necessity when communicating through the parallel port. The use of at least a lead in character may however improve performance as fake interrupts would be noticed early (by DVHSPKT itself) saving the upper layer code the trouble of validating the beginning of a packet.

Parallel transfer speeds depend on the speed of the machines transmitting/receiving data.

In asynchronous serial mode, DVHSPKT synchronizes itself with the other side only upon receiving the first byte (lead in) by sending a data ack character to inform the other side. The absence of a lead in/ack protocol might then cause overruns on slower machines.

See MIL specifications for an explanation of the protocols used by this device.

Chapter 96 / Parallel I/O

This chapter presents both **clsParallelPort**, the parallel port device driver interface class, and **clsHighSpeedPacket**, the high-speed packet I/O class (HSPKT).

Parallel Port Concepts 96.1

Usually application writers don't need to communicate directly with the parallel port. Rather, applications (with the assistance of the PenPoint™ Application Framework) communicate with a printer driver, the printer driver then communicates with the parallel port. However, you can use the parallel port to communicate with devices other than printers.

To access a parallel port, a printer driver sends open and bind messages to the parallel device service manager (**theParallelDevices**), requesting the port by name. If that port is available, the service manager gives the printer driver a handle on the parallel port.

clsParallelPort inherits from **clsMILService**, which is a descendent of **clsStream**. Structures and `#defines` used by **clsParallelPort** are in \GO\INC\PPORT.H.

Parallel Port Interrupts 96.1.1

Because of a problem in the 8259 programmable interrupt controller (PIC) used by most PCs, some machines can generate sporadic interrupt 7s under certain, unpredictable conditions. The symptom is that you see several "Int w/o RB: 7" messages at boot time. We have not seen this behavior on tablet hardware.

The PenPoint operating system attempts to avoid hanging conditions by disabling interrupt 7 whenever too many bad interrupts occur, and the re-enabling interrupt 7 at a later time. This does not limit PenPoint's functionality.

Theoretically, parallel port I/O could become impossible, if PenPoint were to constantly disable and enable interrupt 7. However, we have not seen this situation.

Parallel Port Messages 96.2

Table 96-1 lists the messages defined by **clsParallelPort**. These messages, their structures, and `#defines` are all defined in PPORT.H.

Table 96-1
Parallel Port Messages

Message	Takes	Description
		Class Messages
msgNew	P_PPORT_NEW	Creates a new pport object.
msgNewDefaults	P_PPORT_NEW	Initializes a structure cto create a new pport object.
		Instance Messages
msgPPortStatus	P_PPORT_STATUS	Returns the current status of the printer.
msgPPortInitialize	P_NULL	Initializes the printer.
msgPPortAutoLineFeedOn	P_NULL	Inserts a line feed after each carriage return.
msgPPortAutoLineFeedOff	P_NULL	Disables inserting a line feed after each carriage return.
msgPPortGetTimeDelays	P_PPORT_TIME_DELAYS	Gets the initialization and interrupt time-out intervals.
msgPPortSetTimeDelays	P_PPORT_TIME_DELAYS	Sets the initialization and interrupt time-out intervals.
msgPPortCancelPrint	P_NULL	Cancels the printing of the buffer currently being printed.

Using the Parallel Port 96.3

Like other device drivers, the parallel driver is a service. To access a parallel port, you must use the services protocol to find a parallel port service, bind to the service, and then open it. The service manager for parallel ports, **theParallelDevices**, controls access to the parallel ports.

Requesting a Parallel Port Handle 96.3.1

Before you can use a parallel port, you must request a handle on a port from **theParallelDevices** service manager. To locate the port by name, send **msgIMFind** to **theParallelDevices**. To bind the port to your process, send **msgSMBind** to **theParallelDevices**. Finally, to open the port, send **msgSMOpen** to **theParallelDevices**. This example demonstrates how to open a parallel port.

```
STATUS                  s;
IM_FIND                 imf;
SM_BIND                 sm;
SM_OPEN                 so;
OBJECT                  pportUid;
imf.pName = userName;    // The name was requested from the user earlier
ObjCallRet(msgIMFind, theParallelDevices, &imf, s);
sm.handle   = imf.handle;
sm.caller   = self;
ObjCallRet(msgSMBind, theParallelDevices, &sm, s);
so.handle   = imf.handle;
so.caller   = self;
ObjCallRet(msgSMOpen, theParallelDevices, &so, s);
pportUid = so.service;
```

The symbol **pportUid** now contains the UID of the parallel port object. You can communicate with the parallel port by sending messages to this object.

Releasing the Parallel Port Object 96.3.2

When you have finished with the parallel port, you should release the port by sending **msgSMClose** to **theParallelDevices**, as shown in the example below. Do not send **msgDestroy** to the parallel port object.

```
...
pportUid = so.service;
...
ObjCallRet(msgSMClose, theParallelDevices, wknKey);
```

Parallel Port Configuration 96.3.3

When you have the UID of the parallel port object, you should configure the parallel port for the printer that is attached to it. This involves setting the auto line feed state and setting the initialization and interrup time-out intervals.

Setting Auto Line Feed 96.3.3.1

Some printers allow you to specify whether the printer should do a line feed after each carriage return. Mostly it is up to your application to determine whether it should send a line feed or enable the printer to insert line feeds automatically.

To turn on auto line feed, send **msgPPortAutoLineFeedOn** to the parallel port object. To turn off auto line feed, send **msgPPortAutoLineFeedOff** to the parallel port object. Both messages take a pointer to NULL.

Get and Set Time Delays 96.3.3.2

The parallel port driver allows you to get and set two time values:

- The duration of the initialization pulse.
- The interval at which characters can be sent to the printer.

To get or set these values, send **msgPPortGetTimeDelays** or **msgPPortSetTimeDelays** to the parallel port object. Both messages take a pointer to a PPORT_TIME_DELAYS structure, which contains:

initDelay A U32 that specifies the duration of the initialization pulse (in microseconds).

interruptTimeOut A U32 that specifies the maximum amount of time to wait for the printer to indicate it is ready to accept another character (in milliseconds).

Initializing the Printer 96.3.4

Before printing, you should initialize the printer attached to the parallel port by sending **msgPPortInitialize** to the parallel port object. The message takes no arguments.

msgPPortInitialize sends the initialization signal for the amount of time specified by the **initDelay** argument to **msgPPortSetTimeDelays**.

Writing to the Parallel Port 96.3.5

Your application sends data through the parallel port by sending **msgStreamWrite** to the parallel port object. This is the only **clsStream** message that **clsParallelPort** handles.

Getting Status 96.3.6

To get the current printer status, send **msgPPortStatus** to the printer. The message takes a pointer to a PPORT_STATUS structure that contains a single U16 value (pportStatus), which contains one or more of the following values:

pportStsBusy The printer is busy.

pportStsAcknowledge The printer has accepted a character.

pportStsEndOfPaper The paper is out.

pportStsSelected The printer is on line.

pportStsIOError There was an I/O error on the printer.

pportStsInterruptHappened An interrupt occurred.

Cancelling Printing 96.3.7

To cancel printing, send **msgPPortCancelPrint** to the parallel port object. The message takes a pointer to NULL.

Chapter 97 / Data Modem Interface

This section describes the modem interface implemented by **clsModem**. **clsModem** provides device-independent access to a data modem attached to a serial port and makes the data modem command sets transparent to clients.

Chapter 97 covers these topics:

- How to access the data modem.
- Sending modem commands and data.
- The data modem command set.

Concepts 97.1

The data modem plugs into an option slot on the PenPoint computer. Before you communicate with the data modem, you need to establish communication with the option slot serial port. You establish communication with the serial port by sending bind and open messages to **theSerialDevices**.

When you have access to a serial port, there are two ways to communicate with the data modem:

- Communicating through the modem interface.
- Sending commands and data directly through the serial port.

The modem interface is implemented by **clsModem** and provides a device-independent, object-oriented interface to the modem. If you use the modem interface, you let **clsModem** perform all of the management tasks associated with establishing data modem communications. **clsModem** can also auto-answer the modem.

Communicating directly with the modem through the serial port is not recommended, but certain applications may need to do so. If you choose to communicate with the modem through the serial port, your code will be device-dependent. You must not initiate the modem driver (**clsModem**) when you communicate with the modem directly. Additionally, you are responsible for separating modem responses from data received by the modem.

Getting a Serial Port Handle 97.1.1

The data modem connects to a serial port on a PenPoint computer. You access the serial port by sending bind and open messages to **theSerialDevices** service manager; the open message sends back a handle on the serial port, you send commands and data to the port by sending serial I/O messages to the handle.

To get a handle on the serial port, you must send **msgSMBind** and **msgSMOpen** to **theSerialDevices**, specifying the name of the serial port. For example:

```
STATUS                  s;
IM_FIND                 imf;
SM_BIND                 sm;
SM_OPEN                 so;
OBJECT                  serialHandle;
imf.pName = "Option Slot";
ObjCallRet(msgIMFind, theSerialDevices, &imf, s);
sm.handle   = imf.handle;
sm.caller   = self;
ObjCallRet(msgSMBind, theSerialDevices, &sm, s);
so.handle   = imf.handle;
so.caller   = self;
ObjCallRet(msgSMOpen, theSerialDevices, &so, s);
serialHandle = so.service;
```

Configuring the Serial Port

97.1.2

You can change the configuration of the serial port before or after you create the modem object. Typically you might want to set the baud rate, data bits, parity, stop bits to match the configuration of the remote modem.

When you first reinitialize the serial port handle, it has these defaults:

- 8 bits
- No parity
- One stop bit
- XON/XOFF flow control
- Ctrl-Q and Ctrl-S are the XON and XOFF characters
- DTR and RTS are on.

You can either use the get and set metrics messages for **clsSio**, or if you only need to adjust one or two characteristics, you can send messages to configure those characteristics independently.

In the following example, the application reconfigures the serial port to communicate at 2400 baud with 7 bit bytes by sending **msgSioBaudSet** and **msgSioLineControlSet** to the serial port handle opened in the previous example (**serialHandle**).

```
STATUS              s;
SIO_BAUD_SET        sioBaud;
SIO_LINE_CONTROL_SET    sioLineControl;

sioBaud.baudRate = 2400;
s = ObjectCall(msgSioBaudSet,serialHandle,&sioBaud);
sioLineControl.dataBits = sioSevenBits;
sioLineControl.StopBits = sioOneStopBit;
sioLineControl.parity = sioNoParity;
s = ObjectCall(msgSioLineControlSet,serialHandle,&sioLineControl);
```

The clsModem API

97.2

The modem interface provides an object-oriented interface for you to communicate with a modem. The modem interface also provides two other capabilities:

- Auto-answer and connection detection.
- Asynchronous event handling.

To use the modem interface, you must get a handle on the serial port to which the modem is attached. When you have the serial port handle, you send **msgNew** to **clsModem**, specifying the serial port handle. **clsModem** sends back a new handle, to which you send all modem, serial, and stream messages until you destroy the modem interface object.

Do not send modem commands directly to a serial port that is being used by a modem interface object; you must send messages to the modem object. **clsModem** expects the modem to be configured in a certain way. If you send an AT command that changed the modem's responses, **clsModem** will produce unpredictable results.

The clsModem Messages

97.3

The **clsModem** messages are defined in the file MODEM.H. Table 97-1 lists the **clsModem** messages.

Table 97-1
clsModem Messages

Message	Takes	Description
		Class Messages
msgNew	P_MODEM_NEW	Creates a new instance of a modem service.
msgNewDefaults	P_MODEM_NEW	Initializes the MODEM_NEW structure to default values.
		Instance Messages
msgModemReset	nothing	Resets the modem firmware, I/O port, and service state.
msgModemOnline	nothing	Forces the modem online into data mode.
msgModemSetDialType	MODEM_DIAL_MODE	Establishes the mode for dialing telephone numbers.
msgModemHangUp	nothing	Hang-ups and disconnects to terminate a connection.
msgModemOffHook	nothing	Picks up the phone line.
msgModemSetSpeakerControl	MODEM_SPEAKER_CONTROL	Enables, disables and controls modem speaker behavior.
msgModemSetAutoAnswer	P_MODEM_SET_AUTO_ANSWER	Disables or enables the modem auto-answer feature.
msgModemSendCommand	P_MODEM_SEND_COMMAND	Sends a specified command to the modem.
msgModemSetDuplex	MODEM_DUPLEX_MODE	Sets the duplex mode for inter-modem-communications while on-line.

continued

Table 97-1 (continued)

Message	Takes	Description
msgModemDial	P_MODEM_DIAL	Performs dialing and attempts to establish a connection.
comsgModemSetResponseBehavior	P_MODEM_RESPONSE_BEHAVIOR	Set the modem response mode, and comand-to-response time-out values.
msgModemGetResponseBehavior	P_MODEM_RESPONSE_BEHAVIOR	Passes back the current modem response mode and the current command-to-response time-out values.
msgModemGetConnectionInfo	P_MODEM_CONNECTION_INFO	Passes back information about the current connection.
msgModemSetAnswerMode	MODEM_ANSWER_MODE	Filters the type of calls to answer and connection reporting.
msgModemAnswer	nothing	Immediately answers a telephone call.
msgModemSetSignallingModes	P_MODEM_SIGNALLING_MODES	Restricts the modem to use specific signalling modes or standards.
msgModemSetToneDetection	MODEM_TONE_DETECTION	Enables or disables busy tone or dial tone detection.
msgModemSetSpeakerVolume	MODEM_SPEAKER_VOLUME	Sets the volume of the modem speaker.
msgModemSetCommandState	nothing	Sets the modem into command mode.
msgSvcGetMetrics	P_SVC_GET_SET_METRICS	Passes back the current modem metrics.
msgSvcSetMetrics	P_SVC_GET_SET_METRICS	Set current modem metrics, and re-initialize modem with specified metrics.
msgSvcCharactersticsRequested	P_SVC_CHARACTERISTICS	Passes back the characteristics of the modem service.
msgModemSetMNPMode	MODEM_MNP_MODE	Sets the MNP mode of operation.
msgModemSetMNPCompression	MODEM_MNP_COMPRESSION	Sets MNP class 5 compression on or off.
msgModemSetMNPBreakType	MODEM_MNP_BREAK_TYPE	Specifies how a break is handled in MNP mode.
msgModemSetMNPFlowControl	MODEM_MNP_FLOW_CONTROL	Specifies the flow control to use in MNP mode.
Observer Messages		
msgModemConnected	nothing	The modem has connected with a remote node modem.
msgModemDisconnected	nothing	The current connection has been terminated.
msgModemRingDetected	nothing	A ring indication has been received from the modem.
msgModemErrorDetected	nothing	An unexpected error indication has been received from the modem.
msgModemTransmissionError	nothing	An error has been detected during data transmission.

Creating a clsModem Object

97.3.1

To create the **clsModem** object, you first get a handle on the serial port to which the modem is connected. You then send **msgNewDefaults** and **msgNew** to

clsModem. The messages take a pointer to a MODEM_NEW structure that contains an OBJECT_NEW_ONLY structure (**object**) and a MODEM_NEW_ONLY structure (**modem**). The MODEM_NEW_ONLY structure contains:

modem.client The UID of the client that will use the modem object. This is usually **self**.

modem.sioPort The UID of the serial port handle.

When the message completes, the **object.uid** field of the MODEM_NEW structure contains the UID of the new modem object.

Configuring the Modem

97.3.2

When you get the modem object, the first thing you should do is reset the modem to its default settings; that way you know the state of the modem before continuing. To reset the modem, send **msgModemReset** to the modem object. The message has no arguments. When the message completes successfully, it returns **stsOK**.

Table 97-2 lists the default settings established by **msgModemReset**. **clsModem** requires certain settings so that it can interpret responses from the modem and pass its interpretation on to the client. Because you are using **clsModem**, you shouldn't have any reason for setting these values. The required settings are:

- E0 Echo mode must be off.
- Q0 Return result codes.
- V1 result codes must be whole words.

Table 97-2
Modem Reset Settings

Attribute	AT Command	Meaning
Bell or CCITT protocol	B1	Use Bell protocol.
Duplex	F1	Use full duplex.
Speaker	M1	Speaker on until carrier.
Dialing mode	T	Use touch tone dialing.
Result code range	X4	Wait for dial tone, detect busy signal.
Long space disconnect	Y0	Disabled.
Carrier detect (CD)	&C1	On in presence of carrier.
DTR off action	&D2	Hang up, no auto-answer.
Pulse dial ratio	&P0	Ratio is 39/61 (USA).
Guard tones	&G0	No guard tones.
RDL test	&T4	Grant RDL test request.
Auto-answer mode	S0=000	Auto-answer disabled.
Escape character	S2=043	Escape character is +.
Carriage return	S3=013	Carriage return is 13.
CD timeout	S7=30	Wait 30 seconds for CD.
Response to carrier	S9=6	Respond to CD after .6 seconds.
Lost carrier hang-up	S10=14	Wait 1.4 seconds after loss of carrier before hang-up.
Touch tone spacing	S11=95	Wait 70 ms between tones.
Escape code guard time	S12=50	Wait 1 second before sensing escape characters.
Test timer	S18=0	Test timer is 0.
DTR detect delay	S25=5	Wait .05 seconds for DTR.

clsModem provides messages that allow you to set the following modem characteristics:

- Dial type
- Autoanswer mode
- Carrier state
- Speaker mode
- Command/data mode
- Duplex mode
- MNP mode.

Setting the Dial Type 97.3.2.1

The modem can dial in either pulse or touch-tone mode. To set the dialing type of the modem, send **msgModemDialTypeSet** to the modem object. The message takes a pointer to a MODEM_DIAL_TYPE_SET structure that contains a single element, a MODEM_DIAL_TYPE value (**dType**) that specifies **pulseDialing** or **touchtoneDialing**.

Setting the Auto-Answer Mode 97.3.2.2

You can configure the modem so that it automatically answers the phone after a specified number of rings. To set the modem's auto-answer mode, send **msgModemAutoAnswerSet** to the modem object. The message takes a pointer to a MODEM_AUTO_ANSWER_SET structure that contains:

answerType An AUTO_ANSWER_TYPE value that specifies the answer mode. Possible values are:

autoAnswerOff Do not answer the phone.

dataModemAnswer Answer the phone in data mode.

rings The number of rings after which to answer the phone. This value can be between 0 and 255. If the value is 0, or is not specified, the modem answers after one ring; if the value is greater than 255, **clsModem** uses 255.

Setting the Carrier State 97.3.2.3

When you have a connection with another modem, you can enable or disable the carrier state by sending **msgModemCarrierStateSet** to the modem object. The message takes a pointer to a MODEM_CARRIER_STATE_SET structure that contains a single element, a MODEM_CARRIER_STATE value (**carrierState**) that specifies either **enableCarrier** or **disableCarrier**.

Controlling the Speaker 97.3.2.4

You can turn the modem speaker on and off. When the speaker is on, you can choose to turn it off when the carrier is detected or you can keep it on all the time. Most applications turn the speaker on and then turn it off when the carrier is detected. This

provides the user with an audible signal when the connection is made (a tone, followed by a higher tone, and then a burst of noise indicates that a carrier was detected).

To set the speaker, send **msgModemSpeakerControlSet** to the modem object. The message takes a pointer to a MODEM_SPEAKER_STATE_SET structure that contains a single element, a SPEAKER_STATE value that can specify:

speakerOff Turn the speaker off.

speakerOnConnectOff Turn the speaker on, but turn it off when the carrier is detected.

speakerOn Turn the speaker on.

Setting Command and Data Modes

97.3.2.5

When the modem is in command mode, it can receive the AT commands. In data mode, the modem sends data to and receives data from the modem to which it is connected.

To put the modem in command mode, send **msgModemCommandModeSet** to the modem object. The message takes no arguments.

To put the modem in data mode, send **msgModemOnline** to the modem object. The message takes a pointer to a MODEM_ONLINE structure that contains a single object, a pointer to a MODEM_CONN_TYPE value. When the message completes successfully, it sends back the connection type in the MODEM_CONN_TYPE value. Table 97-3 lists the modem connection types and their meanings.

If the modem connects successfully, the message returns **stsOK**. If the modem does not connect within a reasonable amount of time, the message returns **stsTimeOut**. Otherwise, the message returns **stsModemUnexpectedResponse**.

When the modem detects a carrier, it automatically goes to data mode.

Table 97-3
Modem Connection Types

Symbol	Meaning
noConnection	No connection.
connect300	Data connection at 300 baud.
connect600	Data connection at 600 baud.
connect1200	Data connection at 1200 baud.
connect2400	Data connection at 2400 baud.
connect4800	Data connection at 4800 baud.
connect9600	Data connection at 9600 baud.
connect19200	Data connection at 19200 baud.
connectMNP1200	MNP connection at 1200 baud.
connectMNP2400	MNP connection at 2400 baud.
connectLAPM1200	Lap M connection at 1200 baud.
connectLAPM2400	Lap M connection at 2400 baud.

Setting Duplex Mode

97.3.2.6

The modem allows you to choose either duplex or half duplex mode. In duplex mode, the modem echoes characters as they are sent; in half duplex mode, the modem does not echo the characters.

To set the duplex mode, send **msgModemDuplexSet** to the modem object. The message takes a pointer to a MODEM_DUPLEX_SET value that contains a single element, a DUPLEX_TYPE value that can be either **halfDuplex** or **fullDuplex**.

Setting MNP Mode

97.3.2.7

The Microcom Network Protocol (MNP) provides date compression and enhanced error checking. If both modems in a connection implement MNP, the modems communicate using MNP.

The MNP mode specifies how the modem will act when it connects to another modem that does or does not support MNP. To set the MNP mode, send **msgModemMNPModeSet** to the modem object. The message takes a pointer to a MODEM_MNP_MODE_SET structure that contains a single element, a MNP_MODE value that specifies:

mnpAutoReliableMode Attempt to connect using MNP at the baud rate specified in **msgModemDial** or **msgModemOnline**. If not successful, drop the baud rate back until you get an MNP connection. If you still don't get a connection, attempt a connection at the highest baud rate without MNP. If not successful at that baud rate, drop the baud rate back until you get a connection.

mnpReliableMode Attempt to connect using MNP at the baud rate specified in **msgModemDial** or **msgModemOnline**. If not successful, drop the baud rate back until you get an MNP connection. If you still don't get a connection, give up.

mnpDirectMode Communicate directly with no error checking or compression, that is, without MNP.

mnpLapMMode Use Link Access Protocol for Modems (LAP-M) Mode. LAP-M is the CCITT V.42 error correcting code. LAP-M also includes support for MNP levels 2 through 4.

Further messages that affect the MNP protocol are described in the section titled "MNP Data Communication."

Sending Your Own AT Commands

97.3.2.8

If you need to send specific commands to the modem through the modem interface, you can send **msgModemSendCommand** to the modem object. However, this message does not work with all modem commands. Do not use **msgModemSendCommand** to send dial commands or to set the echo mode (En), quiet mode (Qn), and result code style (Vn); **clsModem** will fail if these values are modified.

msgModemSendCommand takes a pointer to a MODEM_SEND_COMMAND structure that contains:

pCmd A pointer to the command string.

responseTimeout A timeout value for a response from the modem.

When the message completes, it sends back the response from the modem in the **response** field of the MODEM_SEND_COMMAND structure.

Establishing a Connection with a Data Modem 97.3.3

To establish a connection, you can use **clsModem** commands to dial or connect directly with another modem.

To dial another modem, make sure the dial type matches your phone equipment (it is usually touch-tone) and send **msgModemDial** to the modem object. The message takes a pointer to a MODEM_DIAL structure that contains:

pPhoneNumber A pointer to the phone number to dial in ASCII.

pCType A pointer to the MODEM_CONN_TYPE value that will receive the connection type.

The phone number usually contains the number to dial. It can also contain a number of **dial string modifiers** defined by the AT command set. These dial string modifiers are described in the following section Dial String Modifiers.

When the other modem answers, **clsModem** waits for the connection to be established, then sends back the connection type in the value indicated by **pCType**.

When **msgModemDial** successfully completes, it establishes a connection and send back the connection type. If you go back to command mode (by sending **msgModemCommandModeSet** to the modem object) to change the modem configuration, you can return to data mode by sending **msgModemOnline** to the modem object.

When you have finished with a connection by either telephone or direct wiring, send **msgModemHangup** to the modem object. The message takes no arguments.

The message terminates the connection and, if you are connected by telephone, hangs up the phone.

Dial String Modifiers 97.3.4

The phone number in **pPhoneNumber** usually contains the number to dial. It can also contain a number of **dial string modifiers** defined by the AT command set. These dial string modifiers can:

- Pause dialing (useful when waiting for an outside line or using alternative long distance companies).
- Wait for silence (waiting through a prerecorded message).

- Switch between pulse and tone dialing (useful when dealing with hetrogenous phone systems).
- Flash the switch hook.

The phone number can contain these characters:

- The numbers 0 through 9, the alphabetic characters A B C D, and the special characters * and #.
- The alphabetic characters: P T R W.
- The special characters: comma (,), semicolon (;), at sign (@), exclamation point (!), and slash (/).
- The string S=**n**.

The characters 0-9, A, B, C, D, *, and #, are the same as the keys on a touch-tone phone. The characters A B C D, and the symbols * and #, can be used only during tone dialing; they are typically used to access newer features of modern telephone systems.

The character P directs the modem to pulse dial the digits that follow it. The character T directs the modem to tone dial the digits that follow it. These modifiers are useful when you dial into systems that require a mix of tone and pulse signals.

The character R forces the modem to use answer mode frequencies after dialing the number. This allows you to dial up an originate-only modem. This character must only be at the end of the dialing string.

The character W causes the modem to wait a specified amount of time for a dial tone before proceeding. The default is 30 seconds.

The semicolon character (;) causes the modem to go back into the command state after dialing, which allows you to enter other commands while online.

The comma (,) causes the modem to pause. The default time for the pause is two seconds, and can be changed by modifying register S8.

The at sign (@) causes the modem to wait for a 5 second period of quiet before proceeding. It will wait up to 30 seconds until the period of quiet begins. This is often used to detect the end of a prerecorded message. The default wait time is 30 seconds.

The exclamation point (!) causes a "hookflash." This simulates hanging up for 0.5 second and then reconnecting. It is typically used for transferring calls.

A slash (/) causes the modem to wait for 0.125 second before proceeding with the rest of command line.

The S=n dial string modifier causes the modem to dial one of the four phone numbers previously stored in the modem's non-volatile memory. You store numbers with the &Zn=number command.

Waiting for a Connection with a Data Modem 97.3.5

You can tell the modem object to automatically answer the phone, or you can answer the phone yourself (with **clsModem** messages).

To instruct the modem to answer the phone automatically, send **msgModemAutoAnswerSet** to the modem object, specifying **dataModemAnswer**. When another modem dials your number and the phone rings, **clsModem** picks the phone up, determines the type of connection, and sends you **msgModemConnected**, which indicates the type of connection and the baud rate.

To answer the phone yourself, send **msgModemAutoAnswerSet** to your modem object, specifying **autoAnswerOff**.

When the phone rings, the modem object sends you **msgModemRingDetected**. The message has no arguments. You answer the phone by sending **msgModemOffHook** to the modem object (the message takes no arguments).

You then send **msgModemOnline** to the modem object. The message takes a pointer to a MODEM_ONLINE structure that contains a pointer to a MODEM_CONN_TYPE. When the message returns, it sends back the connection type in the MODEM_CONN_TYPE value. The connection types are listed above in Table 97-3.

It is up to you to examine the connection type and determine if you want that connection or not.

Sending and Receiving Data 97.3.6

To send data to the other modem, send **msgStreamWriteTimeout** to the modem object. To receive data from a modem, send **msgStreamReadTimeout** to the modem object.

If the connection is lost at any time, you will receive **msgModemDisconnected**.

MNP Data Communication 97.3.7

As mentioned earlier, MNP performs additional error checking and data compression when two MNP-capable modems have a connection. To set MNP mode, send **msgModemMNPModeSet** to the modem object. This message is described above in "Setting MNP Mode."

To turn MNP compression on or off, send **msgModemMNPCompressionSet** to the modem object. This message takes a pointer to a MODEM_MNP_COMPRESSION_SET structure that contains a single MNP_COMPRESSION_TYPE value (**mnpCompression**), which specifies **mnpNoDataCompression** or **mnpDataCompression**.

If you use MNP, you can specify when **clsModem** will send break messages to the other modem. Sometimes you want to send break immediately, at other times you want to wait until the send buffer is empty. To set the break type, send **msgModemMNPBreakTypeSet** to the modem object. The message takes a

pointer to a MODEM_MNP_BREAK_TYPE_SET structure that contains a single element, an MNP_BREAK_TYPE value that specifies:

mnpSendNoBreak Do not send breaks.

mnpEmptyBuffersThenBreak Send breaks when the buffer is empty.

mnpImmediatelySendBreak Send breaks immediately.

mnpSendBreakInSequence Send breaks in the sequence that they are received.

When using MNP, you can direct it to use different types of flow control, or not to use flow control at all. To set the MNP flow control, send **msgModemMNPFlowControlSet** to the modem object. The message takes a pointer to a MODEM_MNP_FLOW_CONTROL_SET structure that contains a single element, an MNP_FLOW_CONTROL value (**mnpFlowControl**), which specifies:

mnpDisableFlowControl Do not use flow control.

mnpXonXoffFlowControl Use XON/XOFF flow control.

mnpCtsRtsFlowControl Use the hardware CTS/RTS flow control.

Direct Communication with the Data Modem 97.4

If you do not want to use **clsModem** to interpret the modem's responses and handle asynchronous events, you can communicate directly with the modem.

After configuring the serial port to which the modem is attached, use **clsStream** messages to send information to and receive information from the modem.

Important! If you write an application that communicates directly with the modem, your application will not be device-independent. Additionally, you cannot communicate directly with the modem and use the modem interface at the same time.

You send the following instructions to the modem:

- Commands to control and configure your modem.
- Data to be transmitted to another modem.

You receive the following information back from the modem:

- Responses from your modem (about your modem commands).
- Data transmitted by another modem.

The Data Modem AT Command Set 97.4.1

You use the AT command set to control the modem switch-hook operations, baud rate, and other standard functions.

This section contains a brief summary of the AT command set.

The AT commands have the following syntax:

```
ATcommand[arg] [=n] [command...]
```

The only commands that do not follow this syntax are the A/ and +++ commands. All commands can be in either upper or lowercase. After the initial AT you can append a number of AT commands on the same command line, however the total length of the line cannot exceed 40 characters.

If you omit a parameter, its value is assumed to be 0.

Table 97-4
Summary of AT Command Set

Command	Meaning
+++	Escape from modem data mode.
A	Answers a call, regardless the of S0 setting.
A/	Re-executes the last command.
Bn	Selects Bell (B0) or CCITT (B1) protocols. Ignored at 2400 baud.
Cn	Turns the carrier signal on and off. C0 turns the carrier off; C1 turns the carrier on.
Dn..n	Dials a phone number using most recently used dialing method (pulse or tone).
DTn..n	Dials a phone number using pulse dialing.
DTn..n	Dials a phone number using tone dialing.
En	Sets echo mode. E0 turns echo mode off; E1 turns echo mode on.
Fn	Sets Halfduplex (F0) or Fullduplex (F1).
Hn	Operates the switch hook. H0 is on switch hook (hang up); H1 is off switch hook (pick up).
In	Asks the modem to identify itself. I0 returns the product identification code; I1 returns the firmware ROM checksum; I2 computes the firmware ROM checksum and returns either OK or ERROR.
Ln	Sets speaker volume. Values for n are between 0 and 3; L0 is lowest volume, L3 is highest volume.
Mn	Turns speaker on and off. M0 means speaker is always off, M1 means speaker is on until carrier is detected, M2 means speaker is always on, and M3 means the speaker goes on after the last digit is dialed and goes off after carrier is detected.
On	Returns modem to data state. O0 returns without breaking connection; O1 returns after an equalizer retrain sequence.
P	Sets dial mode to pulse.
Qn	Sets quiet mode. Q0 reports result codes; Q1 remains quiet.
Sr?	Returns the current value of register r. r is between 0 and 27.
Sr=n	Sets the value of register r. r is between 0 and 27; n is between 0 and 255.
T	Sets dial mode to tone.
Vn	Sets reports to either textual or numeric result codes. V0 returns numeric result codes; V1 returns textual result codes.
Xn	Sets extended result code reporting. See the data modem documentation for details.
Yn	Enables and disables long space disconnect mode. Y0 disables the mode; Y1 enables it.
Zn	Resets the modem to one of two stored profiles. Z0 resets the modem to stored profile 0; Z1 resets it to profile 1.
&Cn	Sets how the modem controls the CD signal. &C0 forces CD on; &C1 sets CD on when there is a valid carrier signal.

continued

Table 97-4 (continued)

Command	Meaning
&Dn	Sets how the modem reponds to a DTR OFF signal. &D0 ignores DTR; &D1 causes the modem to enter command state when DTR goes off; &D2 causes the modem to hang up, disable auto-answer, and enter command state when DTR goes off; &D3 causes the modem to reset and use the stored profile set with the &Yn command.
&F	Replaces the active profile with the factory standard profile stored in ROM.
\Vn	Enables or disables MNP and V.42 result codes. When Q0 is set, \V0 disables MNP and V.42 result codes and \V1 enables MNP and V.42 result codes.
\Y	Switch from MNP direct mode to MNP reliable mode.
&Gn	Selects which guard tones to generate (not used in the United States). &G0 sets no guard tone; &G1 sets 550Hz guard tone; &G2 sets 1800Hz guard tone.
&Pn	Sets the pulse dialing switch hook interval. &P0 sets a 39%:61% make:break ratio (United States); &P1 sets a 33%:67% make:break ratio (United Kingdom and Hong Kong).
&Rn	Sets CTS state. Both &R0 and &R1 set CTS on.
&Sn	Sets DSR state. Both &S0 and &S1 set DSR on.
&Tn	Controls the test mode. See the Data Modem documentation for details.
&V	Displays the currently active configuration profile, both stored configuration profiles, and any stored telephone numbers. This command cannot be accompanied by any other commands.
&Wn	Stores the currently active configuration profile in one of two non-volatile memory locations (&W0 or &W1).
&Yn	Sets the default configuration profile. &Y0 sets the default to the profile stored by &W0; &Y1 sets the default to the &W1 profile.
&Zn=x	Stores the phone number, x, in the non-volatile storage location n. n is between 0 and 3.
%Cn	Enables of disables data compression in MNP mode. %C0 disables compression; %C1 enables MNP data compression.
\Kn	Sends a specific break. \K0 does not send break; \K1 empties data buffers and sends break; \K2 sends a break immediately; \K3 sends a break in sequence with data.
\Nn	Sets the MNP operating mode for the modem. \N0 and \N1 set direct mode; \N2 sets reliable mode; \N3 sets auto-reliable mode; \N4 sets V.42 (LAP-M) mode.
\O	Force modem to initiate an MNP reliable link.
\Qn	Sets the flow control. \Q0 disables MNP flow control; \Q1 enables XON/XOFF flow control; \Q2 enables RTS/CTS flow control.
\U	Accepts an MNP reliable link.

In the following example, the application sends the commands to set the result codes to numeric and then dials a phone number, using tone dialing:

```
STREAM_READ_WRITE   srw;
U8 setnum[] = "ATV0\n";
U8 dialnum[] = "ATDT5551234\n";

        // Send V0 command to set status reports to numeric
            srw.numBytes = strlen(setnum);
srw.pReadBuffer = setnum;
s = ObjectCall(msgStreamWrite, pInst->ModemHandle, &srw);

// Check returned status report for OK (0)
srw.numBytes = 256;
s = ObjectCall(msgStreamRead, pInst->ModemHandle, &srw);
if (srw.pReadBuffer != '0') // If not OK, handle error
    goto Error1;

// Send dial instructions to modem
srw.numBytes = strlen(dialnum);
srw.pReadBuffer = dialnum;
s = ObjectCall(msgStreamWrite, pInst->ModemHandle, &srw);
```

Chapter 98 / The Transport API

This section addresses how to communicate through a local area network (LAN) with programs running on other computers.

The Transport API provides a number of features for communicating through a local area network. If you are writing an application that communicates through the network with another program, GO recommends that you read this section for background information, but encourages you to consider using the TOPS SoftTalk API, provided by Sitka Corporation. TOPS SoftTalk provides session-layer protocols, which are much easier to use.

Chapter 98 covers these topics:

- Transport concepts, including transport service types and conventions.
- Using **clsTransport**, including how to access a socket, sending and receiving datagrams, requesting and responding to transaction services, and binding to local transport addresses.
- Using **clsTransport** for AppleTalk, including AppleTalk protocol and AppleTalk name and zone protocols.

Transport Concepts 98.1

The aim of data communications is to move information from one device, through a network, to another device.

The PenPoint™ operating system transport API provides end-to-end services between the PenPoint computer and other computers. You can use Transport API services to send information to and receive information from a program running on another computer. The same services that are available to you are available to the other program. This set of common services and their encoding is called a protocol.

There are many different protocols for transporting information. The PenPoint Transport API provides a general set of capabilities, which can be used by a number of different transport protocols. Currently PenPoint supports only the AppleTalk transport protocol (ATP).

Participants in Communication 98.1.1

When you communicate, you exchange data with a remote server. A **remote server** is a program or device on another computer that can communicate over the network.

To access the network, you must access a **socket**, through which you send and receive transport messages. A socket is a communication endpoint. The remote

server also accesses the network through its own socket. A **connection** is an association between two sockets.

Each socket is assigned a transport address. When other programs (usually on other computers) want to establish communication with your program, they search for your socket's **transport address**. A transport address consists of identifiers for these network components:

- Network
- Node (or computer)
- Socket.

The socket identifier is also known as a **protocol port** or **port**. There are two types of ports: **well-known ports** that have pre-assigned, specific uses, and **dynamic ports** that are assigned when they are requested.

Transport Service Types

98.1.2

There are two types of transport services: connection-oriented and connectionless communication.

In **connection-oriented communication**, you establish a connection with another socket, exchange data, and then break the connection. Connection-oriented communication is useful when the connection will last a long time. Currently the PenPoint Transport API does not support connection-oriented communication.

In **connectionless communication**, data is transferred from one socket to another without explicitly establishing a connection. The data transfer is accomplished at the transport layer—the layer that knows the location of each socket. This method of communication is also called **datagram delivery**. In each datagram you specify the transport address of the other socket.

There is no guarantee that the datagram will be delivered to the receiving socket; nor is there a guarantee that several datagrams will be delivered in the order that they were sent.

However, the advantage of datagram delivery is that on a fast, highly reliable medium, such as a LAN, datagrams are an efficient way of communicating information.

There are two types of datagram delivery. **At-least-once delivery** guarantees that the datagrams are delivered to their destination at least once. **Exactly-once delivery** guarantees that the datagrams are delivered to their destination exactly once.

Datagram delivery also provides transaction services. The **transaction services** send a datagram to another socket and expect the receiver to reply to it with another datagram.

Agreeing on Conventions 98.1.3

Communication is based on agreement. When you design and write data communication applications, you must either create conventions that both you and your communications partner agree on or use established conventions (especially if your partner was written separately and has already specified how communication is to take place).

When creating conventions, you must make these specifications:

- Communication protocol and the layer you will use.
- Type of communication (connection-oriented or connectionless).
- Service type (transaction or datagram).
- Order in which you will send or receive data, including establishing who sends first.

A good source of information on conventions for communicating information is *Computer Networks* by Tannenbaum (see Chapter 92 for publishing details).

Asynchronous Communication 98.1.4

When you send a **clsTransport** I/O message, you must wait until the message returns (the I/O operation succeeds or fails) — it's communication is totally synchronous. If you need to communicate asynchronously, you must create another task with **OSSubtaskCreate**. The subtask sends the I/O message for you and returns the received data and some completion status when it is done.

You can read more about creating tasks and **OSSubtaskCreate**() in *Part 8: System Services.*

Using clsTransport 98.2

clsTransport provides a set of messages that allow you to communicate with remote processes. **clsTransport** can support a variety of transport protocols. This means that you can potentially connect the PenPoint computer to a variety of different networks. Currently AppleTalk (ATP/DDP) is the only protocol supported by GO.

The **clsTransport** messages are defined in the file TP.H. Table 98-1 lists the **clsTransport** messages.

Table 98-1
clsTransport Messages

Message	Takes	Description
msgTPBind	P_TP_BIND	Binds a socket to an address.
msgTPRecvFrom	P_TP_RECVFROM	Receives a datagram.
msgTPSendTo	P_TP_SENDTO	Sends a datagram.
msgTPSendRecvTo	P_TP_SENDRECVTO	Sends a request, wait for a response.

Accessing a Socket

98.2.1

Each socket is a service instance maintained by the **theTransportHandlers** service manager. When the user configures ATP, the Connections notebook creates a service instance for a socket.

To establish transport-level communication with another socket, you must locate, bind to, and open a local socket by:

- Sending **msgIMFind** to **theTransportHandlers** to locate a socket service handle.
- Sending **msgSMBind** to the socket service handle.
- Sending **msgSMOpenDefaults** to the socket service handle.
- Sending **msgSMOpen** to the socket service handle, which passes back the UID for the socket.

Both **msgSMOpenDefaults** and **msgSMOpen** take a standard SM_OPEN_CLOSE structure. **pArgs** in SM_OPEN_CLOSE contains a pointer to a TP_NEW structure that contains an OSO_NEW structure (**oso**) and a TP_NEW_ONLY structure (**tp**). The OSO_NEW (open service object) structure is used internally by **clsTransport**. For more information on open service objects, see *Part 13: Writing PenPoint Services*. The TP_NEW_ONLY structure contains:

pArgs.tp.service A TP_SERVICE value that specifies the service type. The possible service types are:

tpReliableService

tpDatagramService

tpTransactionService

When the message completes successfully, **clsTransport** passes back the UID of the service in the **service** field of the SM_OPEN_CLOSE structure as in the following example:

For example:

```
STATUS PASCAL OpenTransportHandle(
    P_TP_NEW            pTPnew,
    P_OBJECT            pTPhandle,
    OBJECT          self)
{
    SM_OPEN_CLOSE       smOpen;
    STATUS              s;
    smOpen.caller = self;
    smOpen.handle = targetServiceHandle;
    smOpen.pArgs = ( P_ARGS ) pTPnew;
    s = ObjectCall( msgSMOpenDefaults, theTransportHandlers, &smOpen );

    s = ObjectCall( msgSMOpen, theTransportHandlers, &smOpen );
    *pTPhandle = smOpen.service;
    return( stsOK );
}
```

Closing a Socket Handle 98.2.2

To close a socket handle, send **msgSMClose** to **theTransportHanders**. You must specify both the handle of the ATP service and the UID of the service that you received from **msgSMOpen**, as shown in the following example:

```
STATUS PASCAL CloseTransportHandle(
    OBJECT              tpHandle,
    OBJECT              self )
{
    SM_OPEN_CLOSE       smClose;
    STATUS              s;

    smClose.caller = self;
    smClose.handle = targetServiceHandle;
    smClose.service = tpHandle;
    smClose.pArgs = pNull;

    Debugf( "Closing socket handle %lx. pArgs=%lx, %lx", tpHandle, &smClose, smClose.pArgs );

    s = ObjectCall( msgSMClose, theTransportHandlers, &smClose );
    if ( s != stsOK ) {
        //Debugf( "msgSMClose failed %lx.", s );
        return( s );
    }

    //Debugf( "Closed socket handle." );

    return( stsOK );
}
```

Sending Datagrams 98.2.3

To send a datagram, send **msgTPSendTo** to the socket handle. The message takes a TP_SENDTO structure that specifies:

pBuffer A pointer to the buffer of data. A datagram can contain up to 586 bytes of data.

count The length of the data.

pOptions A pointer to a transport options block. This block varies, depending on the transport protocol. The AppleTalk options are described in "Using **clsTransport** for AppleTalk."

pAddress A pointer to a buffer that contains the transport address of the destination socket.

When the message completes successfully, it returns **stsOK**. If you attempt to send more than 586 bytes you will receive the status message **stsTPlength** from **ObjectCall**.

Receiving Datagrams 98.2.4

When you are ready to receive a datagram, send **msgTPRecvFrom** to the socket handle. The message takes a TP_RECVFROM structure that contains:

pBuffer A pointer to the buffer that will receive the data.

length The size of the buffer.

count A location that receives the actual number of bytes written to **pBuffer**.

pAddress A pointer to the buffer that receives the transport address of the sending socket.

pOptions A pointer to a transport options block. This block varies depending on the transport protocol. The AppleTalk options are described below "Using **clsTransport** for AppleTalk."

When the message completes successfully, it returns **stsOK** and sends back the TP_RECVFROM structure in which:

- The buffer indicated by **pBuffer** contains the data received.
- **count** contains the length of data in **pBuffer**.
- The buffer indicated by **pAddress** contains the transport address of the socket that sent the data.

Requesting a Transaction Service 98.2.5

Frequently you will send a datagram to a socket and expect the socket to send you a datagram in return. You could use both **msgTPSendTo** and **msgTPRecvFrom** messages, or you can use **msgTPSendRecvTo**. To send **msgTPSendRecvTo**, you must specify **tpTransactionService** in the **service** field of TP_NEW when you create your socket handle.

msgTPSendRecvTo takes a TP_SENDRECVTO structure that contains:

pSendBuffer A pointer to the buffer of data to send.

sendCount The length of the data be sent.

pRecvBuffer A pointer to the buffer that receives data.

recvLength The size of the receive buffer.

recvCount A location that receives the actual number of bytes written to **pRecvBuffer**.

pAddress A pointer to a buffer that contains the transport address of the destination socket.

pOptions A pointer to a transport options block. This block varies, depending on the transport protocol. The AppleTalk options are described below "Using **clsTransport** for AppleTalk."

When the message completes successfully, it returns **stsOK** and sends back the TP_SENDRECVTO structure in which:

- The buffer indicated by **pRecvBuffer** contains the data received.
- **recvCount** contains the length of data in **pBuffer**.

Responding to a Transaction Service 98.2.6

When you use transaction services, both your application and the server must agree on certain conventions. Among these conventions are the types of communication (connection-oriented or connectionless) and the service type (transaction or datagram). If you have agreed to transaction services and you receive an unsolicited message from the remote server, then it is implied that you must respond to the message.

Binding to a Local Transport Address 98.2.7

Before a server can locate your socket, you must bind your socket to a local transport address.

To bind your socket, send **msgTPBind** to the socket handle. The message requires a TP_BIND structure that contains a pointer to the buffer that receives the address (**pAddress**).

Using clsTransport for AppleTalk 98.3

This section describes how to use **clsTransport** to communicate on an AppleTalk network. If you need information on AppleTalk concepts and protocols, see *Inside AppleTalk* by Gursharan S. Sidhu (see Chapter 92 for publishing details).

Table 98-2 lists the messages that are defined in the file ATALK.H.

Table 98-2
NBP and ZIP Messages

Message	Takes	Description
msgATPRespPktSize	P_ATP_RESPPKTSIZE	Sets the size of the response packets.
msgNBPRegister	P_NBP_REGISTER	Registers a name with NBP.
msgNBPRemove	P_NBP_REMOVE	Removes a name from NBP.
msgNBPLookup	P_NBP_LOOKUP	Looks up a name in NBP.
msgNBPConfirm	P_NBP_CONFIRM	Confirms address and name.
msgZIPGetZoneList	P_ZIP_GETZONES	Gets list of zones.
msgZIPGetMyZone	P_ZIP_GETZONES	Gets my zone name.

Using the AppleTalk Protocol 98.3.1

AppleTalk Protocol Options 98.3.1.1

One of the arguments to the transport API messages msgTPSendTo, **msgTPRecvFrom**, and **msgTPSendRecvTo** is a pointer to a block of protocol options. When the Transport API builds its transport packets, is uses these options.

Protocol options for AppleTalk are contained in the ATP_OPTIONS structure (defined in ATALK.H). The AppleTalk options contained in the structure are:

ddpType A specifier for the type of ddp traffic.

flags A set of flags that specify ATP options. The flags are defined in ATP_FLAGS and specify:

ATP_XO_Flag Whether datagrams should be sent exactly once or at least once.

ATP_Checksum_Flag Whether datagrams should be send with a checksum. Checksums are used only for messages that will be sent through a bridge or a router (internet messages).

ATP_ALONoResponse_Flag Tells ATP not to expect a response to the datagram.

transactionID A transaction ID. When you reply to a datagram, you use the transaction ID to specify which datagram you are replying to.

interval The interval between send retries.

retries The number of retries to attempt. If the transport API exceeds the number of retries, it returns **stsTPfailed** in the message's completion code argument.

minRespPackets The minimum number of response packets that the transport API must use to send a response. This number can be in the range 0 through 8. Usually **minRespPackets** indicates the number of sets of **userBytes** in this array.

userBytes An array of up to eight sets of user bytes. Each set of user bytes is four bytes long. **userBytes** are used for communicating additional, encoded information.

Changing the Size of ATP Packets 98.3.1.2

For each AppleTalk request, a server can return up to eight AppleTalk Protocol (ATP) packets.

When you use AppleTalk for transaction services, the AppleTalk protocol specifies that the Transport API can create only one ATP packet for each request. Usually the ATP packets contain 578 bytes of data (586-byte datagram, minus an 8-byte header). Responses can contain up to eight ATP packets, or 4624 (578 * 8) bytes of data.

Some protocols, such as PAP (the printer access protocol), require a smaller response packet size.

You can change the size of ATP packets, by sending **msgATPRespPktSize** to the socket. The message takes a pointer to an ATP_RESPPKTSIZE structure that contains a single element, a U16 value that specifies the new size for ATP packets (**size**). The maximum size for an ATP packet is 578 bytes.

AppleTalk Name and Zone Protocols 98.3.2

AppleTalk defines messages that you can use to manipulate the names of the sockets on the network. The name binding protocol (NBP) messages allow you to search for, add, and delete names from the NBP tables.

Each station maintains its own NBP table. When you add a name, NBP adds it to your table. When you search for a name, NBP searches all NBP tables in the network.

NBP messages can accept wildcard characters, but they are valid only within a user-specified zone. A network is divided into two or more **zones** when it is joined by a bridge. A **bridge** is a computer or other smart device that can link two networks and route traffic from one zone to another.

The zone information protocol (ZIP) messages allow you to get a list of zone names, or get the name of your zone.

The following sections describe how to use NBP and ZIP messages. If you need to cancel any of these NBP requests, send **msgNBPCancel** to the socket.

Registering a Name 98.3.2.1

When you create a server on the network, you will want others to know where to find it. When your server starts, create a socket and send **msgNBPRegister** to it. The message requires an NBP_REGISTER structure that contains a pointer to the buffer that contains the name (**pName**).

The names have the format:

```
name:object@zone
```

where:

name Is the name of the actual server.

object Is the object type (such as TOPSServer, LaserWriter, and so on).

zone Is the name of the zone.

If you register a name that is already bound to a local transport address, the Transport API stores both the name and address in the NBP table. If the name is not bound to a local transport address, the Transport API creates a transport address and binds it to the name, then stores them in the NBP table.

Removing a Name 98.3.2.2

When your server is removed, you must remove its name from NBP by sending **msgNBPRemove** to the socket. The message requires an NBP_REMOVE structure that contains a pointer to the buffer that contains the name to delete (**pName**).

Looking for a Name 98.3.2.3

To look for a server name, send **msgNBPLookup** to the socket. The message requires a NBP_LOOKUP structure that contains:

pName A pointer to a buffer containing the name of the server you want to find. The name can contain wildcard characters, described at the end of this list.

pBuffer A pointer to the buffer that receives the names that match **pName.**

length The number of bytes in **pBuffer.**

numMatches A location that receives the number of matches.

The server name can contain the equal sign (=) as a wildcard in any field. An asterisk (*) in the zone field means the current zone. For example, `=:Printer@Marketing` would

find all printers in the zone `Marketing`; `MyServe:TOP2Server@=`would find all TOPS servers with the name `MyServe` in all zones.

If more names match **pName** than will fit in the buffer, the message stores as many as it can in the buffer and returns **stsTPNoRoom**.

You cannot search for a server registered on a PenPoint computer from that same PenPoint computer.

Confirming an Address 98.3.2.4

Because the user might disconnect the PenPoint computer from the network and reconnect it at a later time, your application might want to confirm that a server is still associated with the same transport address. If your application hasn't communicated with a server for a long time, it might also be a good idea to confirm the address.

To confirm the network address associated with a name send **msgNBPConfirm** to the socket handle. The message requires an NBP_CONFIRM structure that specifies pointers to two buffers containing:

pName The name

pAddress The address.

Listing the Zone Names 98.3.2.5

To get a list of the zone names, send **msgZIPGetZoneList** to the socket. The message takes a pointer to a ZIP_GETZONES structure that contains:

pBuffer A pointer to the buffer that will receive the list of zone names. You must allocate the buffer.

length A U16 value that specifies the length of the buffer. If **length** is less than the space required for the list of zone names, the message passes back only those zone names that will fit in the available space (it does not return partial zone names). If length is less than the first zone name, it will not pass back any zone names.

When the message completes successfully, it returns **stsOK** and stores the zone names in **pBuffer**. Each zone name is stored as a Pascal string (that is, a length byte followed by that number of characters).

The message also passes back:

length The total size of all zone names passed back in **pBuffer**.

numZones A U16 value that contains the number of zone names passed back in **pBuffer**.

Getting Your Zone Name 98.3.2.6

To get the name of your own zone, send **msgZIPGetMyZone** to your socket. The message takes a pointer to a ZIP_GETZONES structure, as described in the preceeding section.

Chapter 99 / In Box and Out Box

This chapter describes the In box and Out box services, how to insert or retrieve documents from the queues, and how you subclass the service classes for the In box and Out box (to create queues for new types of output devices).

Chapter 99 covers these topics:

- General device concepts.
- Out box service concepts.
- In box service concepts.
- In box and Out box service messages.

Introduction to the In Box and Out Box 99.1

One of the unique features of the PenPoint™ operating system is its capability for deferred input and output. Deferred input and output means that the user doesn't have to connect the PenPoint computer to an input or output device before beginning an input or output operation. The actual input or output process is deferred until the input or output device becomes ready.

For example, if a printer is not connected when the user prints a document, PenPoint places the document into an output queue associated with the printer. When a printer is connected, PenPoint prints documents that have been queued for that printer.

The PenPoint user interface presents the deferred input and output queues as sections within the In box and Out box notebooks. The user can open the notebook and look at a particular section to see documents in the queue.

In PenPoint, deferred input operations are handled by a special class of services known as In box services; deferred output operations are handled by Out box services. Input services are subclasses of **clsINBXService**; output services are subclasses of **clsOBXService**. Both **clsINBXService** and **clsOBXService** inherit from **clsIOBXService**. **clsIOBXService** creates the service sections and provides the queuing mechanism for the In box and Out box.

All three service classes, **clsINBXService**, **clsOBXService**, and **clsIOBXService** define many messages that must be implemented by subclasses.

If you are writing a service for deferred input or output, you must subclass one of these three services and implement methods to handle their input or output messages.

Before reading this section, you should be familiar with PenPoint services, which are described in Chapter 94. If you are going to write an In box or Out box service, you must also read *Part 13: Writing PenPoint Services.*

General Device Concepts 99.2

The PenPoint operating system expects that the PenPoint computer will not always be attached to most input and output devices. Therefore it must:

- Defer output until the output services are available.
- Gather input from input services to a central location when the services become available.

Service Sections 99.2.1

When the user creates an instance of an In box or Out box service class, the service class creates a corresponding section in the In box or Out box.

The service sections are different from normal sections because:

- Service sections must restrict what the user can do to documents in the service section. Usually the user cannot move or copy documents between service sections (because each service section can support a different type of document), nor can the user move documents directly into a service section.
- Each service section is bound to an instance of a specific service. For example, if the user has installed two printers named First Floor and Second Floor, there are two corresponding Out box sections, also named First Floor and Second Floor. The First Floor service section is bound to an instance of the printer service named First Floor; the Second Floor service section is bound to an instance of the printer service named Second Floor.
- Each Out box service section is related to the queue for the service to which it is bound. The user can change ordering of documents in a queue by moving the documents within the service section.

Services and Devices 99.2.2

Chapter 93, Concepts and Terminology, described how services, such as logical and physical device drivers enabled applications to communicate directly with devices. Chapter 94, Using Services, described how applications acquire access to particular services through the service managers.

Usually a PenPoint computer is not attached to any peripheral devices, such as printers, LAN servers, and the like. For this reason, PenPoint must be able to defer input and output operations until the user connects the appropriate peripheral device.

Each service section in the In box and Out box is associated with an instance of a service class. Each service instance is associated with a specific device—possible through a series of logical device drivers.

For example, the Out box service section for "Marketing Printer" might be associated with an instance of the HP LaserJet printer service. That instance of the LaserJet printer service owns and is connected to the parallel port service instance that controls a parallel port in the PenPoint computer.

As another example, the In box service section for fax might be associated with an instance of a fax receiver. The fax receiver owns and is connected to the serial port service instance that controls a serial port in the PenPoint computer.

Installing Devices and Services 99.2.3

Installing In box and Out box services is no different from installing any other service. Once the service is installed, the service must provide its own user interface by which the user creates new instances of the service. (Although users create new instances of printer services through the Connections notebook, there is no plan to add an extensible interface to the Connections notebook.)

When creating the service instance, the user:

- Names the specific device (such as "Accounting Printer: 4th Floor").
- Specifies the type of device (such as HP LaserJet II).
- Specifies the communication port used by the service (such as the parallel port).

Targeting Communications Devices 99.2.4

PenPoint communicates with its peripheral devices through its communciation devices (such as serial ports, parallel ports, data or fax modems, and LAN servers). The software that controls each of these communication devices is implemented as a PenPoint service.

As mentioned before, deferred input and output operations are handled by In box and Out box services. An In box or Out box service targets a communication service so that it will be notified whenever the physical communication device becomes connected or disconnected. See Chapter 94 for more information on targeting services.

Enabling and Disabling Services 99.2.5

An Out box service must be enabled before its output process can begin. This enabled state is represented by a checkbox in the Enabled column of the Out box notebook. Typically, a communications device permits only exclusive access. If multiple Out box services are connected to the same output device, only one can be enabled at a time. Enabling an Out box service causes it to become the owner of its target service. The service remains enabled until either:

- The user disables it (by unchecking the Enabled box).
- The service willingly releases ownership of the communications device so that another service can become the new owner.

Service ownership is discussed in more detail in Chapter 94.

Enabling or disabling an In box or Out box service also provides a convenient mechanism for managing communications devices that can't automatically determine when they become connected or disconnected. Because these devices cannot inform the Out box service when they are connected or disconnected, their status will always remain connected, regardless of the connection status of the physical device. Such services can be explicitly disabled to prevent documents from being sent to a device that is not ready for output.

Out Box Concepts 99.3

Each instance of an Out box service has a corresponding section in the system Out box notebook. The name of the service and the name of the section are the same. For example, the user can create two instances of a printer Out box service class. The instances are named "Engineering Printer" and "Marketing Printer." Each instance of the printer Out box service class has its own output queue. These output queues appear as sections in the Out box named "Engineering Printer" and "Marketing Printer."

Documents are placed in the Out box service sections by an output service manager. There are two output service managers, **thePrintManager** and **theSendManager. thePrintManager** is responsible for placing documents in the appropriate printer service sections. **theSendManager** supports the other service sections, including fax and e-mail. If you write a new output service, you can integrate it into **theSendManger**.

Out Box Operation 99.3.1

When the user gives a **Print** or **Send** command, PenPoint invokes the appropriate output manager (**thePrintManager** or **theSendManager**). These output managers are provided by GO, but have no API.

The output manager responds by performing these tasks:

- Prompts the user for the destination device.
- Prompts the user for the options that are related to that output manager.
- Adds the document to the queue for the device.

For **thePrintManager**, the output service is a printer service that is associated with a destination printer.

For **theSendManager**, the output service provides e-mail, fax, deferred file transfers, and so on. **theSendManager** is an open-ended mechanism, which allows it to handle any services that are installed and active.

Out Box Protocol Messages 99.3.2

The primary function of an Out box service is to manage the output queue for each service instance. This function is implemented by a standard Out box protocol consisting of eight interrelated messages.

1. The client of an Out box service sends **msgOBXSvcMoveInDoc** or **msgOBXSvcCopyInDoc** to the Out box service instance, telling the Out box to add an existing PenPoint document to its output queue.
2. Once a document is added to the Out box, **msgOBXSvcPollDocuments** informs an Out box service that it should check to see if conditions are right to start an output process.

   Other events may also cause the Out box service or the client to send **msgOBXSvcPollDocument** to the Out box service. For example, an Out box service will selfsend this message when the service has just been enabled.
3. If the service is enabled and the output device is connected, the service sends **msgOBXSvcNextDocument** to self to locate the next document ready for output.
4. If a document exists in the output queue but is not ready for output, the service selfsends **msgOBXSvcScheduleDocument** to reschedule output at a later time.
5. If a document is ready for output, the service will lock the document with **msgOBXSvcLockDocument**, and kick off the output process with **msgOBXSvcOutputStart**.
6. At the end of the output process, the document being sent will send **msgOBXDocOutputDone** to the Out box service.
7. Finally, if the output finished normally, the service selfsends **msgOBXSvc-PollDocuments** again to see if anything else is ready for output.

If the output didn't finish normally, the service selfsends **msgOBXSvcUnlockDocument** to restore the document to its preoutput state.

Documents in the Out Box 99.3.3

The primary focus of an Out box service is to manage its output queue. An output queue is essentially a collection of documents located in an Out box section. The primary focus of a document in the Out box is to manage a single output job.

An Out box document can be any PenPoint document, that is, an instance of an application inheriting from **clsApp**. The document can be created, opened, and closed just like a regular page in the notebook. There are two ways to implement Out box documents:

- The application that created the document knows how to respond to Out box messages. For example, an electronic mail application might also respond to Out box messages so that it can send its own documents to an electronic mail service. The document in the Out box would contain destination information for the document.

- The Out box document is a wrapper, which contains (embeds) the document being output. The wrapper document responds to the Out box messages and other PenPoint Application Framework messages. In response to these messages, the wrapper document controls how the embedded document is output. Printing in PenPoint is implemented in this way.

An Out box document is also responsible for interacting with the Out box service and controlling the output process, such as sending out an electronic mail message through a communication device. Thus, in addition to responding to **clsApp** messages, an Out box document also understand the following **clsOBXService** messages:

msgOBXDocOutputStartOK

msgOBXDocOutputStart

msgOBXDocOutputCancel

msgOBXDocOutputDone

msgOBXDocStatusChanged

Writing Your Own Out Box Service

99.3.4

clsOBXService is an abstract class. If you are writing an Out box service, you must create a subclass of **clsOBXService**. (**clsOBXService** manages the output queue only, it does not actually cause the output to happen.) Typically, your Out box service inherits its output queue management behavior from **clsOBXService**. You must add any servicespecific behaviors for the communication protocol or devices you need to handle.

By default, **clsOBXService** provides a simple first-in-first-out queue. If your Out box service requires sophisticated scheduling algorithms, you must replace the default behaviors with your own. In this case, your service might need to handle these messages:

msgOBXSvcMoveInDoc

msgOBXSvcCopyInDoc

msgOBXSvcNextDocument

msgOBXSvcLockDocument

msgOBXSvcUnlockDocument

msgOBXSvcScheduleDocument

msgOBXSvcOutputStart

Another example would be **msgOBXSvcLockDocument** and **msgOBXSvcUnlock-Document**. Their default behavior is to mark the document so that gestures over the document icon will not be processed while output is in progress (in fact they cause an error note to appear). A **msgOBXSvcUnlockDocument** typically indicates that the output has been aborted for some reason. You may wish to add to the default behavior, such as notifying your observers that some error has just occurred.

Working with Existing Out Box Services 99.3.4.1

All output operations should be performed through an Out box service in order to take advantage of PenPoint's deferred output feature. An application or a service can bypass the Out box protocol only if the output device is always present or is rarely detached from the PenPoint computer.

The key to working with an existing Out box service is to conceptually break up the output process into two distinct phases:

- The first phase is either adding an existing PenPoint document to the output queue, or creating a special document of some sort in temporary storage and and then move it into the output queue.
- The second phase is the actual output process, during which a devicespecific data stream is sent out through some communication device.

clsOBXService provides a framework for managing the transition from one phase to another.

The separation of these two phases of output operation has an additional benefit. In many cases, an application developer can avoid writing a new Out box service in order to handle application-specific output functions. It is often sufficient to handle only one of the two phases of the output operation. There are several options:

- One inexpensive solution is to have the application export the data into a format that is easier to output under an existing Out box service. For example, a database document can generate a report as an ASCII file or a word processor document and move it into a printer, fax or e-mail Out box section. Similarly, a spreadsheet document can export its pie chart into a popular drawing program document and move it to the Out box for output.
- Another approach is to allow the database or spreadsheet document itself to be moved or copied into the output queue. When the document receives **msgOBXSvcOutputStart**, it knows that the output device is ready. It then proceeds to perform the output operation the old-fashioned way. Such applications already have sophisticated output capabilities, and we only need to ensure not to start the output process until the device is ready. The obvious disadvantage of this approach is that it requires additional memory if we have to make a copy of the document in order to put it into the Out box.
- A third approach represents a compromise between the two. During the first phase of the output operation, a "surrogate" document, rather than the real one, is copied into the output queue. This surrogate document not only understands the Out box output protocol, but also knows how to communicate with the original document. It is effectively a "pointer" back to the original document. When the output process begins, the surrogate document communicates with the original one to cause the device-specific data stream to be sent to the correct output port.

Services that Handle Input or Output 99.3.4.2

clsOBXService deals only with output operations; **clsINBXService** deals only with input operations. If a service wants to handle both input and output (for example, an electronic mail service), it can use **clsIOBXService**, which is another abstract class (and the ancestor of both **clsINBXService** and **clsOBXService**). **clsIOBXService** associates the service with both an input queue and an output queue. The service, the In box section, and the Out box section all have the same name.

In Box Concepts 99.4

Although the In box contains service sections that are associated with queues and services, the similarity between the In box and Out box stops there. The Out box must schedule documents for output when the communication devices become available; the output service drives the output.

The In box on the other hand must handle incoming data and convert it into a PenPoint document, whenever possible.

Some services convert incoming data streams into PenPoint documents. Other services do not know what type of data they are receiving and must create a data file.

Passive and Active In Box Services 99.4.1

There are two type of In box services: passive and active. A passive In box service waits for an input event to happen. An active In box service initiates the communication process. For example, a fax input service may wish to periodically poll a store-and-forward facility (to receive a fax image).

Typically, when a user enables a passive In box service, the service becomes the owner of its communication device. While the In box service owns the I/O device, no other services can transmit or receive data through the same device. A simple fax In box service, for example, becomes the owner of the fax modem (and the serial port) and sets it up to start receiving fax images whenever a phone call comes in.

Some In box services may want to activly solicit input from a remote agent. For example, a service that queries a remote database will have to establish the communication link between the PenPoint computer and the remote database server. For these active In box services, **clsINBXService** provides default behaviors to manage three things:

- The state of the device (connected or disconnected).
- The protocol to initiate input operation (whether the service is enabled or disabled).
- Automatic polling behavior similar to that of an Out box service.

Thus, the user can defer the input operation until it becomes possible to establish a communication link with a remote agent. Note, however, that to enable such behavior for an In box service, the polling flag (**iobxsvc.in.autoPoll**) must be **true** when the service is created.

After a remote agent initiates the input operation, the In box service detects the input event and then receives the incoming data stream.

In Box Documents 99.4.2

Normally, an input event results in a PenPoint document being created in an In box section. For example, a fax In box section can create a document containing the fax images received by the fax modem. Such documents are normal PenPoint documents. Their contents have nothing to do with the input device or where the document came from.

Sometimes an In box document contains not only data, but also some control information about the input operation to be performed. For example, the user may construct a specific query statement for an online database and put it into the appropriate In box section before the PenPoint machine is connected to the remote database. When the input service becomes ready, the query statement is sent to the remote database, and the result is put into either another document or the same document containing the query statements. This type of In box document is very similar to the Out box document that controls the actual output operation.

Note that the deferred I/O protocol implemented by **clsINBXService** assumes that an input operation is controlled by an In box document. This assumption may be too cumbersome and confusing for many services. If this is the case, an In box service can simply store the input control information (such as a database query statement) with the service itself. When the service receives **msgINBXSvcPollDocuments**, it simply handles the input operation directly and bypasses the rest of the protocol.

In Box and Out Box Service Messages 99.5

The following three tables list the messages defined by **clsOBXService**, **clsINBXService**, and **clsIOBXService**. For more detailed description of these messages, see *Part 10: Connectivity* in the *PenPoint API Reference*, or read the header files (OBXSVC.H, INBXSVC.H, and IOBXSVC.H).

Table 99-1
clsOBXService Messages

Message	Takes	Description
msgOBXSvcMoveInDoc	P_OBXSVC_MOVE_COPY_DOC	Move a document into the Out box section.
msgOBXSvcCopyInDoc	P_OBXSVC_MOVE_COPY_DOC	Copy a document into the Out box section.
msgOBXSvcPollDocuments	nothing	Poll all documents in an output queue and output those that are ready.
msgOBXSvcNextDocument	P_OBXSVC_DOCUMENT	Pass back the next document ready for output.
msgOBXSvcScheduleDocument	P_OBXSVC_DOCUMENT	Schedule a document that is not ready for output.
msgOBXSvcLockDocument	P_OBXSVC_DOCUMENT	Lock the document in preparation for output.
msgOBXSvcUnlockDocument	P_OBXSVC_DOCUMENT	Unlock a document that was previously locked.
msgOBXSvcOutputStart	P_OBXSVC_DOCUMENT	Start the output process for a document in the output queue.
msgOBXDocOutputDone	P_OBX_DOC_OUTPUT_DONE	Tell the Out box service that output is finished.
msgOBXSvcSwitchIcon	nothing	Toggle the Out box icon (to empty or filled) if neccessary.
msgOBXSvcGetTempDir	P_OBJECT	Pass back a handle for a temporary directory.
msgOBXSvcOutputCancel	nothing	Cancel the output process.
msgOBXSvcOutputCleanUp	P_OBX_DOC_OUTPUT_DONE	Clean up after the current output is done.
msgOBXSvcStateChanged	OBJECT	Tell observers that the service state just changed.
msgOBXSvcQueryState	P_OBXSVC_QUERY_STATE	Pass back the state of the service.
msgOBXSvcGetEnabled	P_BOOLEAN	Get the enabled state of the service.
msgOBXSvcSetEnabled	BOOLEAN	Set the enabled state of the service.
msgOBXDocGetService	P_OBX_DOC_GET_SERVICE	Get the service name.
msgOBXDocInOutbox	P_OBX_DOC_IN_OUTBOX	Check if a document is in a section in the Out box.
msgOBXDocOutputStartOK	nothing	Ask the Out box document if it is OK to start the output process.
msgOBXDocOutputStart	nothing	Tell an Out box document to start the output process.
msgOBXDocOutputCancel	nothing	Tell an Out box document to cancel the output process.
msgOBXDocStatusChanged	P_OBX_DOC_STATUS_CHANGED	Tell the Out box service that the document status is changed.

Table 99-2
clsINBXService Messages

Message	Takes	Description
msgINBXSvcSwitchIcon	nothing	Toggle the In box icon (to empty or filled) if neccessary.
msgINBXDocGetService	P_INBX_DOC_GET_SERVICE	Get the service name.
msgINBXDocInInbox	P_INBX_DOC_IN_INBOX	Check if a document is in a section in the In box.
msgINBXSvcMoveInDoc	P_INBXSVC_MOVE_COPY_DOC	Move a document into the In box section.
msgINBXSvcCopyInDoc	P_INBXSVC_MOVE_COPY_DOC	Copy a document into the In box section.
msgINBXSvcGetTempDir	P_OBJECT	Pass back a handle for a temporary directory.
msgINBXSvcPollDocuments	nothing	Poll all documents in an input queue and input those that are ready.
msgINBXSvcNextDocument	P_INBXSVC_DOCUMENT	Pass back the next document ready for input.
msgINBXSvcLockDocument	P_INBXSVC_DOCUMENT	Lock the document in preparation for input.
msgINBXSvcUnlockDocument	P_INBXSVC_DOCUMENT	Unlock a document that was previously locked.
msgINBXSvcScheduleDocument	P_INBXSVC_DOCUMENT	Schedule a document that is not ready for input.
msgINBXSvcInputStart	P_INBXSVC_DOCUMENT	Start the input process for a document in the input queue.
msgINBXSvcInputCancel	nothing	Cancel the input process.
msgINBXSvcInputCleanUp	P_INBX_DOC_INPUT_DONE	Clean up after the current input is done.
msgINBXSvcStateChanged	OBJECT	Tell observers that the service state just changed.
msgINBXSvcQueryState	P_INBXSVC_QUERY_STATE	Pass back the state of the service.
msgINBXSvcGetEnabled	P_BOOLEAN	Get the enabled state of the service.
msgINBXSvcSetEnabled	BOOLEAN	Set the enabled state of the service.
msgINBXDocInputStartOK	nothing	Ask the In box document if it is OK to start the input process.
msgINBXDocInputStart	nothing	Tell an In box document to start the input process.
msgINBXDocInputDone	P_INBX_DOC_INPUT_DONE	Tell the In box service that input is finished.
msgINBXDocInputCancel	nothing	Tell an In box document to cancel the input process.
msgINBXDocStatusChanged	P_INBX_DOC_STATUS_CHANGED	Tell the In box service that the document status is changed.

Table 99-3
clsIOBXService Messages

Message	Takes	Description
msgIOBXSvcSwitchIcon	nothing	Toggle the In box or Out box icon (to empty or filled) if necessary.
msgIOBXDocGetService	P_IOBX_DOC_GET_SERVICE	Get the service name.
msgIOBXDocInIOBox	P_IOBX_DOC_IN_IOBOX	Check if a document is in a section in the In box or Out box notebook.
msgIOBXSvcMoveInDoc	P_IOBXSVC_MOVE_COPY_DOC	Move a document into the Out box section.
msgIOBXSvcCopyInDoc	P_IOBXSVC_MOVE_COPY_DOC	Copy a document into the In box or Out box section.
msgIOBXSvcGetTempDir	P_OBJECT	Pass back a handle for a temporary directory.
msgIOBXSvcPollDocuments	nothing	Poll all documents waiting for input/output.
msgIOBXSvcNextDocument	P_IOBXSVC_DOCUMENT	Pass back the next document ready for input/output.
msgIOBXSvcLockDocument	P_IOBXSVC_DOCUMENT	Lock the document in preparation for input/output.
msgIOBXSvcUnlockDocument	P_IOBXSVC_DOCUMENT	Unlock a document that was previously locked.
msgIOBXSvcScheduleDocument	P_IOBXSVC_DOCUMENT	Schedule a document that is not ready for input/output.
msgIOBXSvcIOStart	P_IOBXSVC_DOCUMENT	Start the input/output process for a document in the input/output queue.
msgIOBXSvcIOCancel	nothing	Cancel the input/output process.
msgIOBXSvcIOCleanUp	P_IOBX_DOC_OUTPUT_DONE	Clean up after the current input/output is done.
msgIOBXSvcStateChanged	OBJECT	Tell observers that the service state just changed.
msgIOBXSvcQueryState	P_IOBXSVC_QUERY_STATE	Pass back the state of the service.
msgIOBXSvcGetEnabled	P_BOOLEAN	Get the enabled state of the service.
msgIOBXSvcSetEnabled	BOOLEAN	Set the enabled state of the service.
msgIOBXDocIOStartOK	nothing	Ask the In box or Out box document if it is OK to start the input/output process.
msgIOBXDocIOStart	nothing	Tell an In box or Out box document to start the input/output process.
msgIOBXDocIODone	P_IOBX_DOC_OUTPUT_DONE	Tell the In box or Out box service that input/output is finished.
msgIOBXDocIOCancel	nothing	Tell an In box or Out box document to cancel the input/output process.
msgIOBXDocStatusChanged	P_IOBX_DOC_STATUS_CHANGED	Tell the In box or Out box service that the document status is changed.

Chapter 100 / The Address Book

The PenPoint™ operating system address book protocol allows you to write an application or service that responds to requests from services or other applications for address information. The addresses can be, but are not limited to, street addresses, voice phone numbers, phone numbers for data communication devices (such as fax machines, e-mail routers, and so on).

An address book application should be a subclass of **clsAddressBookApplication**. Although it doesn't have to, a subclass of **clsAddressBookApplication** inherits some additional address book behavior.

This chapter covers these topics:

- Concepts of the address book, including the address book and address book manager classes, organization of data, and groups.
- How to install and use the GO address book application.
- Using the address book messages to add, delete, set, and get address book entries and their service data.

The PenPoint SDK provides a simple address book (described later in this chapter) with a user interface that allows you to test your services and applications that access an address book.

The information in this chapter is not exhaustive. Please refer to the header files ADDRBOOK.H and ABMGR.H for more information.

Concepts

When you try to communicate with someone, you have to consider which communication method you want to use before you can make contact. If you phone someone, you have to find their phone number. If you send a fax to someone, you have to find their fax number. If you want to send electronic mail to someone, you need to find the phone number of the mail service — then you need to find the e-mail address for that person.

Services on PenPoint computers are faced with much the same problem. Any one person might have several different addresses for several different communications methods.

In traditional operating systems, it is up to each application to provide an address book through which the application can find a person's address. This means that the user has to enter names and phone numbers in a separate address book for each application.

To avoid this duplication and scattering of information, PenPoint defines a protocol for address books. An **address book** is an application or a service that

responds to the address book protocol. All clients that need to access the address book use the same protocol. The protocol specifies particular messages that get and set information in an address book; the protocol also specifies the types of information to be stored in address books and the structures that store this information.

All clients that want to access an address book do it by sending messages to the system object, **theAddressBookMgr**, which then forwards the message to the **system address book**. While there can be many address books running in PenPoint, the system address book is identified as the address book that is currently receiving messages through **theAddressBookMgr**. All address books must register with **theAddressBookMgr**, but only one address book can be the system address book.

The address book protocols allow an application to activate an address book, that is, to make it the system address book. The user chooses which address book to make the system address book through a a user interface provided by an address book, or by any application that chooses to do so. **theAddressBookMgr** provides a way for applications to provide this user interface through option sheets. All the application needs to do is forward **msgOptionAddCards** to **theAddressBookMgr** after the application has handled the message.

The user interface for a particular service or application can access an address book (through **theAddressBookMgr**) and allow the user to modify information in the system address book.

Participants

100.1.1

There are three principal participants in any address book operation:

- The client is any service or application that requests an address book operation.
- **theAddressBookMgr** is a well-known object, through which all address book requests are channeled.
- An address book is an application or a service that is registered with **theAddressBookMgr** and is made current by **theAddressBookMgr**. The address book is responsible for storing and retrieving address information.

An address book announces its availability by registering with **theAddressBookMgr**. Any number of address books can register with **theAddressBookMgr**.

The Address Book Protocols

100.1.2

There are three protocols used to communicate with the address book:

The address book protocol Enables clients to communicate with address books. This protocol is defined in the file ADDRBOOK.H.

The address book manager protocol Enables address books to register themselves with **theAddressBookMgr** and to get information about other

registered address books. This protocol is defined in ABMGR.H. The class for **theAddressBookMgr** is private.

The sendable services protocol Enables address books to request addressing information from a service that is accessed through **theSendableServices** service manager. This protocol is defined by **clsSendableService** in the file SENDSERV.H. The whole topic of sendable services is discussed in Chapter 101.

The Address Book Protocol

100.1.2.1

The address book protocol, defined in ADDRBOOK.H, allows clients to communicate with the system address book. The protocol allows the client to:

- Get information.
- Set information.
- Delete information.
- Get address book metrics.
- Search for information.

Remember that the address book is not a file; it is an application or service that responds to the **clsAddressBook** messages. Thus, it is better to think of an address book as a server; the client sends requests to the server and it responds with addresses.

Your client sends all address book requests to **theAddressBookMgr**. Before requesting information from **theAddressBookMgr**, your client must declare that it wants to use the system address book by sending **msgABMgrOpen** to **theAddressBookMgr**. If the system address book is an application, **theAddressBookMgr** activates the application; if the system address book is a service, **theAddressBookMgr** binds to the service.

When your client needs information from the address book, it sends a message to **theAddressBookMgr**. **theAddressBookMgr** forwards the message to the system address book (with **ObjectSend**()). Because **theAddressBookMgr** uses **ObjectSend**() (rather than **ObjectCall**()), your client must use shared memory to allocate buffers that it will use to send or retrieve information from the address book.

All address book requests that deal with a specific entry in the address book require a key to the address book. The key is *not* an index to the address book entries, rather it contains information that is used by the address book to locate an entry.

To get a key, send **msgAddrBookSearch** to **theAddressBookMgr**. If you are simply interested in retrieving the the information contained at that location, your search arguments can specify what information you need; **msgAddrBookSearch** returns the information when it finds the entry. (You can also cache the key passed back by **msgAddrBookAdd**.)

The Address Book Manager Protocol 100.1.2.2

The address book manager (**theAddressBookMgr**) keeps track of the system address book. When a client needs information from the address book, it uses **ObjectCall**() to pass a message to **theAddressBookMgr**. **theAddressBookMgr** then forwards the message to the system address book using **ObjectSend**().

Although any application or client can be an address book, an address book must register itself with **theAddressBookMgr**. The protocol for registering address books is defined in ABMGR.H. The protocol allows address books to:

- Register an address book.
- Unregister an address book.
- List the registered address books.
- Activate an address book (make it the system addresss book).
- Deactivate an address book.

If an address book is an application that inherits from **clsAddrBookApplication**, an instance of application is automatically registered with **theAddressBookMgr** when it is created; the application is automatically unregistered when it is destroyed. **clsAddrBookApplication** provides no other special behavior.

Organization of Data 100.1.3

The address book is organized by entries. An individual entry contains:

- Attributes, which contain individual information for the entry such as names, phone numbers, a street address, and so on.
- Service addresses, which contain service-related information such as e-mail addresses and so on.

For each entry in the address book there can be many addresses.

Entry Attributes 100.1.3.1

Within each entry, there are one or more attributes, which are used to store the information commonly thought of as "address book information." An attribute is described by the ADDR_BOOK_ATTR structure. Each attribute contains:

- An attribute identifier, which indicates what the data is used for (for example given name, surname, street, company, and so on). Table 100-1 lists the minimum set of attribute identifiers that all address books must implement.
- An attribute type, which indicates the type of data contained in this attribute. The possible types are:

  abNumber A 32-bit number.

  abString A null-terminated string.

  abPhoneNumber A phone number, as defined by **clsDialEnv**.

  abOther An encoded byte array.

- The actual value.
- A label that can be used when displaying the attribute value.

The address book protocol defines a minimum set of attribute identifiers and attribute types that all address books must implement. If you know of an identifier or type that is commonly used, but not represented in this set of attributes, please contact GO Developer Technical Support.

Table 100-1
Attribute Identifiers

Identifier	Type	Meaning
AddrBookGroupNameId	abString	Name of a group.
AddrBookGivenNameId	abString	A person's given name.
AddrBookSurNameId	abString	A person's surname (family name).
AddrBookHomePhoneId	abPhoneNumber	Home phone number.
AddrBookBussPhoneId	abPhoneNumber	Work phone number.
AddrBookBussPhone2Id	abPhoneNumber	Second work phone number.
AddrBookCountryId	abString	Country in postal address.
AddrBookStateId	abString	State or prefecture.
AddrBookZipId	abString	Zip code or post code.
AddrBookCityId	abString	City.
AddrBookDistrictId	abString	District within a city.
AddrBookStreetId	abString	Street, building, apartment, and so on.
AddrBookCompanyId	abString	Company name.
AddrBookTitleId	abString	A person's title.
AddrBookPositionId	abString	A person's position.
AddrBookNickNameId	abString	A person's nickname.
AddrBookFaxId	abPhoneNumber	A fax phone number.
AddrBookSvcNameId	abString	The name of a service.
AddrBookSvcNoteId	abString	User define nickname for service.

The identifier **AddrBookStreetId** can contain number, street, building, apartment number, suite, floor, or any other addressing information. If the actual address contains several lines when written, you can use the character \012 (LF in ASCII) to separate the lines. For example, an address might contain:

919 East Hillsdale Blvd,
Suite 400

You could store this information as:

```
"919 East Hillsdale Blvd,\012Suite 400"
```

But it is up to the address book how to display such information.

When requesting information from an address book, one of the fields in the ADDR_BOOK_ENTRY structure specifies the number of entry attributes for which you expect information (**numAttrs**). To specify all attributes, set **numAttrs** to

AddrBookAll. The address book will allocate the necessary storage for the information. It is up to the client to free these buffers.

Service Addresses

100.1.3.2

When first created, an address book contains the minimum set of information as described by the attribute identifiers (listed above). However, it has no address descriptors for service information. To gather the address descriptors, the address book queries the sendable services for the type of addressing information they require. The address book can then add the descriptors to its attributes. The sendable service protocol is described further in Chapter 101.

Within each entry there can be one or more service addresses. Each service address contains:

- A key for a service instance.
- An address descriptor that contains a series of attributes that pertain to the specific service. For instance, an e-mail address would contain both a string attribute for the e-mail address and a phone number attribute for the dial-up access line to the e-mail service.

Typically the service attributes use **AddrBookSvcNameId** to identify the service and **AddrBookSvcNoteId** for a user-specified nickname.

When requesting information from an address book, one of the fields in the ADDR_BOOK_ENTRY structure specifies the number of services for which you expect information (**numServices**). You can use this field to specify different combinations of services and their attributes.

- If you want all service attributes for all services, set **numServices** to **AddrBookAll.**
- If you want selected attributes for all services, set **numServices** to **AddrBookAllSvcSelectAttrs**. You must provide an additional attributes structure that specifies these attributes.
- If you want all attributes for selected services, set **numServices** to **AddrBookSelectSvcAllAttrs**. You must provide an addition services structure that specifies these services.
- If you want selected attributes for selected services, set **numServices** to **AddrBookSelectSvcSelectAttrs**. You must provide both additional attribute and service structures that specify these attributes and services.

The address book will usually allocate the necessary storage for the information. It is up to the client to free these buffers.

If **numServices** is 0, no information is returned.

Groups

100.1.4

The address book protocol can enable address books to collect entries into groups, which are accessed through a single entry. A group consists of a group identifier, which contains the name for the group, and an array of keys to the members of the group.

The protocol for groups is still under design.

The GO Address Book Application 100.2

The PenPoint SDK includes an address book (in \PENPOINT\SDK\APP\AB.EXE) that both serves as an address book and provides a user interface to its information. Although it is possible for an address book to both hold information and provide a user interface, usually an address book will simply contain the address information; other services and applications will access the address book and provide a user interface.

The GO Address Book allows you to test your services and applications that access an address book. You must have a separate license from GO Corporation to distribute the GO Address Book application with your software.

Important You need a separate license from GO Corporation to distribute the GO Address Book (AB.EXE).

Loading the GO Address Book 100.2.1

You can load the GO Address Book by adding this line to your APP.INI file in \PENPOINT\BOOT:

```
\\boot\penpoint\sdk\app\Address Book
```

To create an address book, make a caret ^ in the Notebook's table of contents and tap ! on Address Book in the stationery menu. Tap on the address book icon to turn to the Address Book.

Using the GO Address Book 100.2.2

The screen in Figure 100-1 shows the GO Address Book.

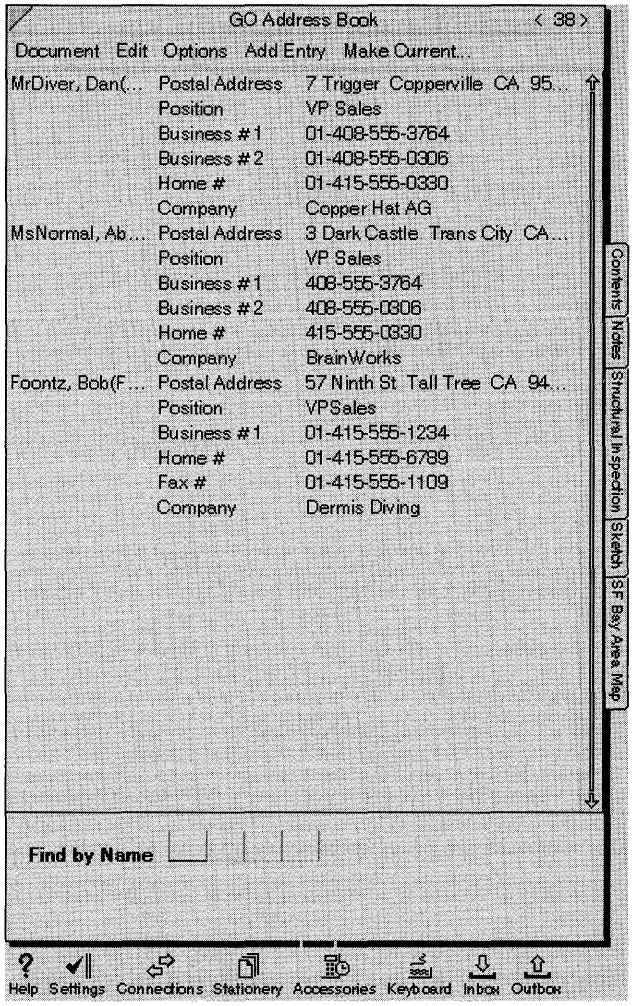
The Address Book is initially empty. You add new entries by tapping on the Add Entry... menu item and filling out information. Initially you add name and postal address information. To add information related to sendable services, select an entry, then tap on Add Service... in the Edit menu.

You can use many of the core gestures in the GO Address Book. This table lists the gestures that are specific to the GO Address Book. For quick help on the available gestures, make a Quick Help gesture ? on the Address Book.

Table 100-2
Address Book Gestures

Gesture	Meaning
! Tap	Selects the field.
!! Double tap	Selects the current line.
!!! Triple tap	Selects the entire entry.
○ Circle	Displays an edit pad for a selection.
^ Caret	Displays a new entry page; adds new lines to postal address information.
¬ Caret tap	Displays a pop-up list to add a new service to the selected entry.
? Delete	Deletes the selected information.
!. Tap press	Selects the entire entry and starts a copy operation.
! Press	Selects the entire entry and starts a move operation.

Figure 100-1
The GO Address Book



The Address Book Messages

100.3

Table 100-3 summarizes the **clsAddressBookApplication** messages. Following it, Table 100-4 summarizes the **clsABMgr** messages. Please see the header files ADDRBOOK.H and ABMGR.H for more detail on these messages.

Table 100-3
clsAddressBookApplication Messages

Message	Takes	Description
		Object Messages
msgAddrBookGet	P_ADDR_BOOK_ENTRY	Fills in the specified entry field data, given an address book key for the entry.
msgAddrBookSet	P_ADDR_BOOK_ENTRY	Sets the specified entry and service data.
msgAddrBookAdd	P_ADDR_BOOK_ENTRY	Adds the specified entry and service data.
msgAddrBookDelete	P_ADDR_BOOK_ENTRY	Deletes the specified entry or service data.

continued

Table 100-3 (continued)

Message	Takes	Description
msgAddrBookSearch	P_ADDR_BOOK_SEARCH	Searches for the entry that matches the search spec.
msgAddrBookCount	P_ADDR_BOOK_COUNT	Finds the number of entries that match the search spec.
msgAddrBookGetMetrics	P_ADDR_BOOK_METRICS	Passes back the metrics for the address book.
msgAddrBookGetServiceDesc	P_ADDR_BOOK_SERVICES	Gets the service address description from the address book.
msgAddrBookAddAttr	P_ADDR_BOOK_ATTR	Adds a new attribute to the active address book.
		Notification Messages
msgAddrBookEntryChanged	P_ADDR_BOOK_ENTRY_CHANGE	Sent to observers when an entry has been changed, added or deleted.

Table 100-4
clsABMgr Messages

Message	Takes	Description
		Class Messages
msgABMgrRegister	P_AB_MGR_ID	Registers an application or a service as an address book instance.
msgABMgrUnregister	P_AB_MGR_ID	Unregisters an application or a service as an address book instance.
msgABMgrOpen	nothing	Used by address book clients to begin access to address books.
msgABMgrClose	nothing	Used by address book clients to end access to address books.
msgABMgrList	P_LIST	Creates a list of currently registered address book in pArgs.
msgABMgrActivate	P_AB_MGR_ID	Make a registered address book the system address book.
msgABMgrDeactivate	P_AB_MGR_ID	Deactivates the current system address book.
msgABMgrIsActive	P_AB_MGR_ID	Passes back the UID of the system address book.
		Notification Messages
msgABMgrChanged	P_AB_MGR_LIST	Sent to observers of theAddressBookMgr when the system address book changes.

Using an Address Book

100.4

The rest of this chapter covers two topics:

- Developing an address book client.
- Developing an address book.

This section discusses the messages that an address book client sends. The section "Writing an Address Book" discusses the messages that an address book sends and receives.

Opening the Address Book 100.4.1

Before you can access the system address book, you must send **msgABMgrOpen** to **theAddressBookMgr**.

When you are done with the address book, you must send **msgABMgrClose** to **theAddressBookMgr**.

Searching the Address Book 100.4.2

The root behind most address books operations is in finding a specific entry. You use **msgAddrBookSearch** to find an entry and to return information from the found entry.

msgAddrBookSearch enables you to make fairly sophisticated searches. You can specify:

- A search specification that can contain one or more comparisons.
- A sort order for the entries matched by the search specification.
- A number of matching entries to skip.
- A direction for the search.

When you search the address book, you must always specify a key (**key** in ADDR_BOOK_SEARCH). When you are performing a series of searches, you start the next search with the key passed back by the previous search. For the first search, you should specify a null key; the direction field specifies whether the search begins at the first or last entry in the sort order.

You can specify a sort order by specifying an attribute identifier in the **sort** field. Attribute identifiers are described above.

To specify a search direction, set the **dir** field to **abEnumNext** to search forward and **abEnumPrevious** to search backwards. When **key** is null, **abEnumNext** begins the search at the first element, **abEnumPrevious** begins the search at the last element.

To specify the *n*th entry (from the current location) that matches the search specification, specify a non-zero value for the *n*th argument. If *n*th is 1, the search gets the next entry that matches the search.

The Search Query 100.4.2.1

A search query can contain a number of different comparisons. The **query** argument points to an ADDR_BOOK_QUERY structure that lists the number of comparisons (**numAttrs**) and contains a pointer to the first in a list of ADDR_BOOK_QUERY_ATTR structures (**attrs**), each of which specifies a separate comparison.

The ADDR_BOOK_QUERY_ATTR structure specifies:

id The attribute identifier of the attribute being compared.

length The length of an encoded byte array (used only if attribute type is **abOther**).

valueOp The comparison operator; the comparison operators are:

abEqual Tests if the attribute is equal to **value**.

abNotEqual Tests if the attribute is not equal to **value**.

abGreater Tests if the attribute is greater than **value**.

abLess Tests if the attribute is less than **value**.

abGreaterEqual Tests if the attribute is greater than or equal to **value**.

abLessEqual Tests if the attribute is less than or equal to **value**.

abMatchBeginning Tests if the string specified in **value** is a substring of the attribute, starting at the beginning.

abMatchEnd Tests if the string specified in **value** is a substring of the attribute, starting at the end.

abMatchPartial Tests if the string specified in **value** is a substring of the attribute (not anchored to the beginning or end).

value The value against which the attribute of the current entry is compared.

attrOp The operator that specifies the relationship between this attribute structure and the following attribute structure (if there is one). The last attribute in the list does not need to specify an **attrOp**. The possible values are:

abAnd Both the current **attr** structure and the next **attr** structure must be true for the comparison to succeed.

abOr Either the current **attr** structure or the next **attr** structure can be true for the comparison to succeed.

For example, if a client wants to specify a query that says match an entry whose last name is Smith and whose zip code is greater than or equal to 95000, the query would contain two **attr** structures:

```
pArgs->query    id  length  value   valueOp attrOp
fsp
attr[0]    AddrBookSurNameId   n/a "Smith" abEqual abAnd
attr[1]    AddrBookZipId       n/a 95000   abGreaterEqual  n/a
```

The Search Result

100.4.2.2

When **msgAddrBookSearch** successfully matches an entry, it passes back the information you specified in an ADDR_BOOK_ENTRY structure (**result**). The ADDR_BOOK_ENTRY structure contains one or more ADDR_BOOK_ATTR structures (described above) that specifies the actual attributes that you need.

Because **theAddressBookMgr** uses **ObjectSend**() to relay messages to address books, the ADDR_BOOK_ENTRY structure must be allocated from shared memory.

Important The ADDR_BOOK_ENTRY structure must be allocated from shared memory.

Getting More Information

100.4.2.3

To get more information from an entry, send **msgAddrBookGet** to **theAddressBookMgr**, specifying the key returned by **msgAddrBookSearch**.

You specify the information you want from the address book entry in the same way that you specify the search result in **msgAddrBookSearch**.

For example, you might use **msgAddrBookSearch** to find an entry that meets particular criteria. The message passes back the fundamental information that you need. You then compare that information against some other set of information and, if you have a match, you can then send **msgAddrBookGet**, using the same **key** to retrieve further information about the entry.

Changing Information

100.4.3

To change information in an address book entry, send **msgAddrBookSet** to **theAddressBookMgr**. The message takes a pointer to an ADDR_BOOK_ENTRY that contains the changed information for the entry.

Because **theAddressBookMgr** uses **ObjectSend()** to relay messages to address books, the ADDR_BOOK_ENTRY structure must be allocated from shared memory.

Important The ADDR_BOOK_ENTRY structure must be allocated from shared memory.

Adding a New Entry

100.4.4

To add a new entry to an address book, send **msgAddrBookAdd** to **theAddressBookMgr**. The message takes a pointer to an ADDR_BOOK_ENTRY that contains the new information for the entry.

As above, the ADDR_BOOK_ENTRY structure must be allocated from shared memory.

Deleting an Entry

100.4.5

To delete an entire entry from an address book (or to delete services from an entry), send **msgAddrBookDelete** to **theAddressBookMgr**. The message takes a pointer to an ADDR_BOOK_ENTRY that identifies the contains the changed information for the entry. The **key** field identifies the entry to delete.

To clear information within an entry, use **msgAddrBookSet** to set the specific field to null.

To delete an entire entry with services, the **numServices** field must be 0.

When deleting services, the **numServices** field specifies the number of services to delete. The **services** field points to the first in an array of ADDR_BOOK_SERVICE structures that contain the service IDs of the services to delete.

Writing an Address Book

100.5

When you write an address book, it must be prepared to receive all address book messages defined in ADDRBOOK.H.

In addition, your address book needs to send a number of address book manager messages, which are defined in ABMGR.H. Particularly, your address book must be able to:

- Register itself as an address book instance.
- Unregister itself when it is deleted.
- Give up the role as system address book, when appropriate.

The fundamental structure used in the address book manager messages is the AB_MGR_ID. This structure contains:

name A string that contains the name of the address book.

type An AB_MGR_ID_TYPE that indicates that the address book is an application (**abMgrApplication**) or a service or data object (**abMgrObject**).

value A `union` that contains a UID or a UUID, depending on whether the address book is a service or an application.

uid Is an OBJECT that contains the UID of the service.

uuid Is a UUID that contains the UUID of the application's working directory.

Registering an Address Book 100.5.1

When an instance of your address book is created, it should register itself by sending **msgABMgrRegister** to **theAddressBookMgr**. The message takes a pointer to an AB_MGR_ID structure that identifies the address book.

Only when an address book is registered with **theAddressBookMgr** can it later be selected as the system address book.

If your address book inherits from **clsAddrBookApplication**, it is registered automatically when it is created.

Unregistering an Address Book 100.5.2

When your address book is terminated (if an application, when it is deleted; if a service, when deinstalled), it should send **msgABMgrUnregister** to **theAddressBookMgr**. The message takes a pointer to an AB_MGR_ID structure that identifies the address book.

If your address book inherits from **clsAddrBookApplication**, it is unregistered automatically when it is deleted.

Becoming the System Address Book 100.5.3

When your address book needs to become the system address book, it sends **msgABMgrActivate** to **theAddressBookMgr**. The message takes a pointer to an AB_MGR_ID structure that identifies the address book.

In the current implementation of the address book manager, only one address book can be the system address book at one time.

If there is currently a system address book, **theAddressBookMgr** deactivates that address book first.

There are two important status values that you should note when sending **msgABMgrActivate**:

stsABMgrAddrBookOpen The current system address book is currently open, and therefore cannot be deactivated.

stsABMgrAddrBookNotRegistered The specified address book is not a registered address book.

Deactivating the System Address Book 100.5.4

To deactivate the system address book, send **msgABMgrDeactivate** to **theAddressBookMgr**. The message takes a pointer to an AB_MGR_ID structure.

Observing theAddressBookMgr 100.5.5

When an address book is activated or deactivated as the system address book, **theAddressBookMgr** sends **msgABMgrChanged** to its observers (which includes all registered address books). The messages passes a pointer to an AB_MGR_NOTIFY structure, which contains:

type An AB_MGR_CHANGE_TYPE value that indicates the type of change. Possible values are:

abMgrRegister An address book was registered.

abMgrUnregister An address book was unregistered.

abMgrActivated An address book was activated.

abMgrDeactivated An address book was deactivated.

abMgrOpened An address book was opened.

abMgrClosed An address book was closed.

addressBook An AB_MGR_ID structure that indicates the address book that changed.

Handling Option Sheet Protocol 100.5.6

To provide users with a common way of selecting the system address book, an address book or other applications that want to provide this facility must be prepared to handle **msgOptionSheetAddCards**. When it receives this message, the address book can add cards to the option sheet, if it needs. the address book must then forward the message to **theAddressBookMgr**.

When **theAddressBookMgr** receives the message, it creates a card that allows the user to select the current address book. Subsequent option card related messages are sent directly to **theAddressBookMgr**.

Chapter 101 / The Sendable Services

A sendable service is a service that provides some form of deferred data transmission, such as e-mail or fax. Before sending data, the user must be able to address the fax or e-mail to a particular recipient. The sendable service protocol allows address books to query sendable services for the type of addressing information they require; the protocol also allows address books to request a sendable service to present a user interface, through which the user can update address information in the current address book.

Sendable services inherit from the abstract superclass **clsSendableService**, which defines the sendable service protocol. All sendable services are managed by **theSendableServices** service manager.

The Sendable Services Protocol 101.1

The PenPoint™ operating system has two general categories of data transfer mechanisms:

- Printing, which is assumed to be accessible from any PenPoint computer, and which has a simple addressing mechanism: the name of the printer.
- Other forms of data transfer, which the user could install separately, and which has any number of transmission mechanisms and addressing complexities.

This division is reflected in the Document menu in the PenPoint Application Framework's standard application menus: it contains a Print button and a Send button. The Print button is specific to a single action (printing a document). However, the Send button provides access to all other deferred data transfer mechanisms. In other words, it provides access to the sendable services.

The Address Book uses the sendable services protocol at two different times:

- Gathering address descriptors from sendable services.
- Requesting the sendable service to display a user interface through which the user can add, modify, or delete address data for that service.

Creating Address Descriptors 101.1.1

As described in Chapter 100, all address books contain a fixed set of attributes for usual addressing information, such as names, postal addresses, voice-phone numbers, and so on. In addition to this fixed set, the address book can maintain addressing information for services. Some services (such as fax) just need a phone number; others (such as e-mail) need a phone number for the e-mail provider and one or more strings for the actual mail address.

However, until the address book and all the sendable services are installed, the address book does not know the addressing attributes that are required by each service.

The address book requests an attribute descriptor from a sendable service by sending **msgSendServGetAddrDesc** to the sendable service. In response to the message, the sendable service creates an address descriptor and passes it back to the address book. The address book then adds the descriptor to its attributes.

There are two times when an address book should send **msgSendServGetAddrDesc**:

- When a new instance of the address book is created, the address book should enumerate all the services that belong to **theSendableServices** service manager. It should then send **msgSendServGetAddrDesc** to each of the sendable services.
- When the user installs a new sendable service, **theSendableServices** notifies the address book that a new service is available (by sending **msgIMInstalled**). The address book should then send **msgSendServGetAddrDesc** to the new service. An address book should always observe **theSendableServices**.

Displaying a User Interface

101.1.2

When you, or anyone else, writes an application that presents the user interface to an address book, the application must allow additions or changes to all the required attributes (name, postal address, and so on). It is easy to know what is expected, by simply examining the list of attributes and ensuring that you have implemented them all.

Unfortunately, you can't plan an address book user interface for modifying service information, because the amount and types of information maintained for service addresses is entirely up to each service. The solution is to provide a message whereby the address book requests the service to present a user interface for its own addressing information.

When an address book sends **msgSendServCreateAddrWin** to a sendable service, the sendable service should create a window in which the user can add or modify address information for the service.

When the address book sends **msgSendServFillAddrWin** to a sendable service, the sendable service should fill or clear its window depending on the address information passed in by the address book.

The address book can send **msgSendServGetAddrSummary** to a sendable service to request a string that contains an address summary.

The Sendable Services Messages 101.2

The sendable services messages are defined in SENDSERV.H. These messages are listed in Table 101-1.

Table 101-1
Sendable Services Messages

Message	Takes	Description
msgSendServGetAddrDesc	P_ADDR_BOOK_SVC_DESC	Responsibility of a sendable service to return its service attribute-value pairs that describe its service address.
msgSendServCreateAddrWin	P_SEND_SERV_ADDR_WIN	Converts address data into a window displaying the data.
msgSendServFillAddrWin	P_SEND_SERV_ADDR_WIN	Refreshes pArgs->win with information in pArgs->attrs.
msgSendServGetAddrSummary	P_SEND_SERV_ADDR_WIN	Given pArgs->attrs, set pArgs->addrSummary to be a displayable string that sums up the the address.

Getting Address Descriptors 101.2.1

When an address book needs to get the address descriptor from a sendable service, it sends **msgSendServGetAddrDesc** to the service. The message takes a pointer to a P_ADDR_BOOK_SVC_DESC structure, which contains an uninitialized pointer for an array of address attributes (**attrs**).

The sendable service allocates storage for the attribute-value pairs and stores the addresss in **attrs**. The sendable service also sets the **numAttrs** field to the number of attributes used by the service.

Creating and Filling Address Windows 101.2.2

When an address book needs to present a user interface that gathers information about a sendable service, the address book sends **msgSendServCreateAddrWin** to request the sendable service to create an empty window for this information.

The address book then sends **msgSendServFillAddrWin** to the sendable service to request it to fill in or update the window using the data passed in by the message.

Both messages take a pointer to a SEND_SERV_ADDR_WIN structure, which contains a pointer to an array of address attributes (**addrAttr**) and the number of attributes in the array (**numAttrs**).

When the sendable service receives **msgSendServCreateAddrWin**, it should create a window suitable for containing its addressing information. The type of window it creates and whether the window is inserted in the window hierarchy or not is dependent on the implementation of the address book. For example, the GO address book actually uses the option sheet protocol; when it requests the sendable service to create an address window, the address book adds the new window to the list of option cards.

The sendable service should not fill information in the window when it creates it. Instead it should wait for the address book to send **msgSendServFillAddrWin**. When it receives **msgSendServFillAddrWin**, the sendable service should display its addressing information in the window with proper formatting and labels. If **numAttrs** is 0, the sendable service should display empty fields, presumably for the user to fill in information.

Summarizing Address Information 101.2.3

The user interface for an address book might simply display a summary of an address (or a series of addresses) to the user, rather than displaying all the addressing information. For instance an address book might want to present the e-mail names for recipients, but doesn't need to present things like the phone number used to access the e-mail system.

An address book can send **msgSendServGetAddrSummary** to a sendable service to request summary of addressing information. The message takes a pointer to a SEND_SERV_ADDR_WIN structure, which lists all the service attributes.

It is up to the sendable service to determine which attributes it can use and to create a summary string, which it passes back in the **addrSummary** field of the SEND_SERV_ADDR_WIN structure.

Part 11 / Resources

Chapter 102 / Introduction

Resources provide a mechanism for storing objects and data in a file for later retrieval. You can use resource files to store and retrieve application objects in response to **msgSave** and **msgRestore**, to manage document configuration information such as user preferences, and to store application-specific data such as user interface text strings.

Overview

102.1

A **resource** is an object or collection of data stored in a file. A **resource file** can contain several resources, each with a **resource ID** that is unique for the resource file. Resource files respond to messages for locating, reading, writing, updating, and deleting individual resources.

You can search for resources in an ordered list of resource files called a **resource list**. The PenPoint™ Application Framework provides every document with a default resource list that allows the document to override application resources, an application to override user preference resources, and user preference resources to override system defaults.

The PenPoint operating system has built-in support for **object resources**—filed representations of objects—as well as three kinds of **data resource**:

- **Byte array** resources are filed byte streams. These are the simplest kind of data resource, and your application must interpret the meaning of the bytes.
- **String** resources are filed, null-terminated text strings.
- **String array** resources are filed, indexed lists of text strings.

You can write **resource agents** to support additional semantics for the bytes of a resource.

To make it easier for you to create data resources, the PenPoint SDK includes a header file that lets you define the data resources in a C language source file and compile the source into a resource file with a resource compiler utility included with the PenPoint SDK.

Developer's Quick Start

102.2

As an application writer, you use resources to save and restore application instance data and to create objects and data from resources stored in a resource file.

If you need to access a replaceable resource, you need to know the resource ID of the resource and the resource file in which it is stored. It is the responsibility of resource creators to publish their resource IDs in a header file.

Once you have the file handle and the resource ID, you can send **msgResReadData** (for data resources) or **msgResReadObject** (for object resources) to read the resource.

In the following example, we want to create a menu from a resource. We know that the resource file MyResources contains the object, and that it's well-known resource ID is defined by the symbol **tagMyMenu**.

The first step is to generate a handle on the resource file as shown in the example below:

```
STATUS      status;
RES_FILE_NEW    resNew;
FILE_HANDLE resFile;
...
status = ObjectCall(msgNewDefaults, clsFileHandle, &resNew);
resNew.fs.locator.pPath = "MyResources";
status = ObjectCall(msgNew, clsFileHandle, &resNew);
resFile= fsNew.object.uid;
```

Once you have created the resource file handle (and thereby opened the resource file), you can use **msgResReadObject** to read the specific object from the resource file as shown in the example below:

```
RES_READ_OBJECT rro;
STATUS          status;
OBJECT          myMenu;
...
rro.mode = resReadObjectMany;  // let other procs have their own copy
rro.resId = tagMyMenu;             // resource ID of target
ObjectCallRet(msgNewDefaults, clsObject, &rro.objectNew, status)
status = ObjectCallWarn(msgResReadObject, resFile, &rro);
myMenu = rro.objectNew.uid;   // the UID of the retrieved object
```

Layout of This Part

102.3

Chapter 102, Introduction (this chapter) briefly introduces PenPoint resources.

Chapter 103, Concepts and Terminology, gives a more detailed overview of the concepts and terminology of PenPoint resources.

Chapter 104, Using **clsResFile**, describes the API for **clsResFile**, the resource file class.

Chapter 105, Defining Resources with the C Language, describes the resource language used to create generic resources.

Chapter 106, Compiling Resources, describes the DOS utility that converts the resource language files into resource files.

Chapter 107, System Preferences, describes the system preferences stored in the system resource file. This chapter also describes notification messages sent to observers when system preferences change.

Other Sources of Information 102.4

Part 7: File System describes the organization of the PenPoint file system and the messages used to access files. Resource files inherit characteristics (such as file handles) from ordinary files, so you should be familiar with ordinary files before programming with resource files.

Part 2: PenPoint Application Framework describes the message protocol involved in saving and restoring application instance data. Handling the PenPoint Application Framework save and restore messages is the most common reason for using object resources.

Chapter 103 / Concepts and Terminology

Resource files are used throughout the PenPoint™ operating system to store and recreate objects and data. Generally, you use resource files in the following ways:

- To file your application's objects in response to **msgSave**, or to unfile them in response to **msgRestore**.
- To read and modify configuration information, such as user preferences, from a list of resource files.
- To store application-specific objects or data.

Object Resources

An object resource contains information required for creating or restoring a PenPoint object. Object resources are used to file object instance data as well as store replaceable object resources.

Clients save and restore object instance data in response to the PenPoint Application Framework messages **msgSave** and **msgRestore**. The PenPoint Application Framework maintains one document resource file for each document.

When a document receives **msgSave**, it saves its state and sends **msgResPutObject** once for each of its child windows. By default, the child windows handle this by saving their state and sending **msgResPutObject** for each of their children, and so on, until the document has saved all of its state. When the document receives **msgRestore**, it simply reads the window objects from the document resource file rather than create the entire window tree from scratch.

Replaceable object resources are used to store information to create a specific object, such as a button, a menu, or a dialog box. You can improve code efficiency by storing a complex object to a resource file before run time (at install time, for example). At run time, rather than take the time to build the complex object while the user waits, you can simply read the object from the resource file.

If your application creates a number of objects that are the same, you can reduce the size of your executable file by storing one copy of the object in a resource file. At run time, you read the resource several times to create the multiple objects. You can also use this technique for objects that are not identical but are largely similar, using the resource to create most of the object and writing only the code necessary to modify each copy after reading it.

Once and Many Modes for Object Resources 103.1.1

When you read or write an object resource, you must specify either **once mode**, in which only one copy of the object exists in memory and only one copy of the resource exists in the file, or **many mode**. In many mode, any reader of the file can restore the object resource, creating its own copy of the object resource in memory (replacing the prior copy, if any); and any writer can replace the filed resource with an object resource of its creation. The only time you normally use once mode is when handling **msgSave** and **msgRestore**. For most other uses of resource files, you use many mode.

Data Resources 103.2

A data resource is an array of bytes stored in a resource file. You can write a resource agent to interpret the byte array in a meaningful way. For example, the PenPoint operating system provides resource agents for text string data resources and for string list data resources.

Later versions of PenPoint will provide specific support for multiple-language applications.

Data resources are useful for storing static data that the user might update or replace. For example, you can make it easier to port your application to a second language by using a resource file to store the all of the text strings your application displays. When you want to support a second language from your application, you can change the language of your application without writing new code, by simply providing the user with a resource file containing the text strings in the new language.

Resource Files 103.3

Resource files begin with a resource file header that contains general information about the file. Each resource in the file has its own resource header. The resource header contains the resource class, resource ID, and a resource type.

When you have created a resource file, you can write resources to it programmatically by sending messages to the file. There are separate sets of filing messages for the two types of resources. You can read and write object resources only with the object resource filing messages, and data resources only with the data resource filing messages. A single resource file can contain both object and data resources.

You can create data resources (but not object resources) by editing a resource definition file, which you then compile into a resource file with the C compiler.

Identifying Resources 103.4

Each resource is tagged with a unique resource ID—a 32-bit TAG that applications use to locate the resource. Each resource in a file has a resource ID that is unique within the file. As with most TAGs, the low 21 bits of a resource ID is the administered portion and scope of the ID. The next two bits identify the resource type of resource—well-known, dynamic, or well-known list. The remaining nine

bits include eight bits to identify the unique tag number (**tagNum**) of the resource. The high bit has a special meaning, explained below.

Resource Types 103.4.1

There are three types of resource ID: well-known resource IDs, dynamic resource IDs, and well-known list resource IDs. The flags of the resource ID TAG indicate which type of resource the ID identifies.

- A **well-known resource ID** (**flags** == 0) identifies a resource that any client can use.
- A **dynamic resource ID** (**flags** == 1) generally identifies an object that is nested within another object. For example, when you store an option sheet as an object resource, it can store its child windows in the same file using dynamic resource IDs.
- A **well-known list resource ID** (flags == 2) identifies a list resource such as an array of strings. "List Resources" later in this chapter describes list resources in more detail.

The high bit of the resource ID, when set, indicates that the object being identified is a well-known object, and that the remainder of the resource ID is the well-known UID of the object. You should take care not to modify the high bit yourself, as its special meaning is maintained by the application.

The file RESFILE.H defines macros and functions that you can use to create resource IDs of various types, and to extract individual values (such as **flags**) from a resource ID.

Well-Known Resource IDs 103.4.2

Well-known resource IDs are defined in the header file of the class that defines the resource, so any client of the class can access the identified resource. You use the same administered portion used in defining the class, and assign a unique **tagNum** value for each well-known resource ID that uses the same administered portion.

Use the **MakeWknResId**() macro to create a well-known resource ID when you compile your application. The macro has the following syntax:

```
MakeWknResId(wkn, tagNum)
```

For example:

```
RES_ID  myButtonID;          // create the resource ID
...
myButtonID = MakeWknResId(clsButton,1);
```

Dynamic Resource IDs 103.4.3

You normally send **msgResPutObject** in response to the PenPoint's Application Framework **msgSave**. **msgResPutObject** generates dynamic resource IDs for storing application objects that are not well-known objects. Dynamic resource IDs

are 29-bit numbers composed of the 21 bits normally used for the administered portion and the 8 bits normally used for the **tagNum** value.

If you want to store dynamic items without using **msgResPutObject**, you can create your own dynamic resource ID by sending **msgResNextDynResId** to a resource file handle. The message takes a pointer to a RES_ID value that will receive the dynamic resource ID.

If the message is successful, it returns **stsOK** and stores the newly generated resource ID in the specified RES_ID. In the example below:

```
RES_ID  myDataResource;
OBJECT  resFile;
STATUS  s;
...
// create the dynamic resource ID
ObjCallJmp(msgResNextDynResId,resFile,&myDataResource,s,error);
```

Be aware that dynamic resource ID values are not recycled. Once a file uses up its 29 bits worth of dynamic resource IDs, **msgResNextDynResID** returns **stsFailed**.

Well-Known List Resource IDs 103.4.4

A **well-known list resource ID** identifies a list of indexed resources such as an array of text strings. For list resource IDs, the eight bits normally used for the **tagNum** value is used to indicate a six-bit list group and a two-bit **list number** within that group. The list group identifies the type of list, while the list number identifies one of up to four lists of that type in the resource file.

- List groups numbered from 0 to 1F hex are available for your use.
- List group 20 hex is reserved for arrays of strings for toolkit tables.
- List group 21 hex is reserved for arrays of strings for standard message text.
- List group 22 hex is reserved for arrays of strings for Quick Help text.
- List groups numbered from 23 to 3F hexadecimal are reserved for system use.

The data of a list resource includes a pseudo-resource ID index for each of the elements of the list. These index IDs look like resource IDs, except that the 8 bits normally used for the **tagNum** value instead indicate the item's index in its list resource, while the **flags** indicate which list. This allows each list to include up to 256 entries. Since each list group can have 4 lists per group, this yields up 1,024 items per list group for each unique administered portion. To access a list resource item, you must have the resource ID as well as the index within the list. You can generate the resource ID and index from the group number and list resource ID.

Using Resource IDs 103.5

RESFILE.H defines several macros that let you determine the type of resource ID returned by a message. The macros are:

WknItemResId(resID) True if the resource ID is a well-known resource ID.

WknListResId(resId) True if the resource ID is a well-known list resource ID.

WknResId(resId) True if the resource ID is a well-known resource or resource list ID.

DynResId(resId) True if the resource ID is a dynamic resource ID.

WknObjResId(resId) True if the resource ID is for a well-known object (high bit is set).

Resource Agents

103.6

Agents do not read or write object resources.

Resource agents enhance the default reading and writing behavior of data resources, interpreting the resource data in special ways. The simplest resource agent is the default resource agent, which treats data resources as a stream of bytes. However, data isn't always just a byte stream; often the sequence of bytes has meaning. The data might be a null-terminated string, a series of unsigned 32-bit values, or a series of 8-byte floating point values. Agents work for you by interpreting the formats of the data they read from the data resource file, and converting data to a stream of bytes to write to the data file.

The PenPoint operating system comes with three resource agents:

- **resDefaultResAgent** is the default resource agent. This agent treats data resources as a stream of bytes.
- **resStringResAgent** handles data resources that are NULL-terminated strings.
- **resStringArrayResAgent** handles data resources that are arrays of NULL-terminated strings. The array of strings must be terminated by a **pNull** string pointer.

Chapter 104, Using **clsResFile**, explains how to write your own agents to handle other types of data resources.

Resource Lists

103.7

A resource list is an instance of **clsResList**, which inherits from **clsList**. The entries in a resource file are resource file handles, other resource file lists, or null entries. When you send a read or find message to a resource file list object, it sends the message to each of its entries in turn (skipping null entries) until the message returns **stsOK** (**msgResEnum**, which enumerates the items in each file, is a special case).

Each application class maintains a default resource list object in its class metrics. The default application installation process creates this list with four initial elements:

- The document resource file, DOC.RES.
- The application resource file, APP.RES.
- The system preferences resource file.
- The PenPoint system resource file.

The system resource file has the well-known file handle **theSystemResFile**; the system preferences resource file has the well-known file handle **theSystemPreferences**. Even though these resource file handles are well-known, they are on the default resource list for easier resource searching.

The application resource file is stored in the directory for the corresponding application (under \PENPOINT\SYS\APP). You should add dynamic resources to the application resource file when you install the application (that is, when running instance 0 of the application). For more information about adding dynamic resources during installation, see *Part 12: Installation API.*

You can create a resource list in addition to the default application resource list by sending **msgNewDefaults** and **msgNew** to **clsResList**. Instances of **clsResList** pass all other messages to **clsList**. For more information on **clsList** messages see the description of **clsList** in *Part 9: Utility Classes.*

Chapter 104 / Using clsResFile

The resource file class, **clsResFile**, inherits from **clsFileHandle**. This chapter presents the data structures used by **clsResFile** messages and discusses the messages as well. For more information on using **clsResFile**, see the RESFILE.H header file shipped with the PenPoint™ SDK.

clsResFile Messages 104.1

Table 104-1 summarizes the messages that **clsResFile** defines.

Table 104-1
clsResFile Messages

Message	Takes	Description
		Class Messages
msgNew	P_RES_FILE_NEW	Creates a resource file object.
msgNewDefaults	P_RES_FILE_NEW	Initializes the RES_FILE_NEW structure to default values.
		Data Resource Messages
msgResReadData	P_RES_READ_DATA	Reads resource data from a resource file or resource list.
msgResWriteData	P_RES_WRITE_DATA	Writes resource data to a file.
msgResUpdateData	P_RES_WRITE_DATA	Updates existing data resource data.
		Object Resource Messages
msgResReadObject	P_RES_READ_OBJECT	Reads a resource object from a resource file or resource list.
msgResWriteObject	P_RES_WRITE_OBJECT	Writes a resource object to a file.
msgResGetObject	P_OBJECT	Reads the filed object resource from the current file position. For use only during msgRestore.
msgResPutObject	OBJECT	Writes the object as a filed object resource to the current file position. For use only during msgSave.
msgResReadObjectWithFlags	P_RES_READ_OBJECT	Reads a resource object, passing the supplied flags.
msgResWriteObjectWithFlags	P_RES_WRITE_OBJECT	Writes a resource object, passing the supplied flags.
		Generic Resource Messages
msgResDeleteResource	RES_ID	Marks as deleted the resource identified by RES_ID.
msgResGetInfo	P_RES_INFO	Gets information on a data or object resource in a resource file or a resource list.
msgResEnumResources	RES_ENUM	Enumerates resources in a resource file or resource list.
msgResNextDynResId	P_RES_ID	Gets the next available dynamic resource ID from the file.

continued

Table 104-1 (continued)

Message	Takes	Description
		File Maintenance Messages
msgResCompact	void	Compacts the resource file, actually deleting the resources marked as deleted.
msgResFlush	void	Flushes the index of resources read from the file.
msgResAgent	P_RES_AGENT	Message sent by resource file to resource agent when forwarding messages.

Creating a Resource File Handle

104.2

To create a resource file handle, send **msgNewDefaults** and **msgNew** to **clsResFile**. When **msgNew** completes, the **object.uid** field of the RES_NEW structure contains the UID of the resource file handle.

msgNew and **msgNewDefaults** both take a pointer to a RES_FILE_NEW structure as their argument. The RES_FILE_NEW structure includes all the fields that **clsFileHandle's** FS_NEW structure includes. This is how **clsResFile** inherits from **clsFileHandle**. In addition to the FS_NEW fields, RES_FILE_NEW includes the following fields (the data type of each field is shown in parentheses following its name):

mode (RES_NEW_MODE) A set of flags that controls various attributes of the resource file handle. The flags can include any combination of the following:

resSharedResFile (default: false) More than one client can use this file handle concurrently. This does not mean that more than one client can open a file handle on the file, just that multiple clients can safely share the one file handle.

resCompactOnClose (default: true) Send **msgCompact** to file whenever the resource file is closed.

resCompactAuto (default: false) Send **msgCompact** to file when ratio of deleted to non-deleted resources in the file reaches **compactRatio.**

resVerifyVersions (default: true) Check that current system version is at least the minimum supported version for each resource.

compactMinimum (U16) The minimum number of resources required in the file before automatic compaction occurs.

compactRatio (U16) A percentage representing the minimum ratio of deleted resources marked to undeleted resources required before automatic compaction occurs.

When you delete a resource from a file, the resource is marked as deleted but is not deleted until the file is compacted. If **resCompactOnClose** is set, the file is compacted every time the controlling document closes. If **resCompactAuto** is set, the file is compacted automatically if there are more than **compactMinimum** resources in the file and a deletion causes the ratio of deleted resources to

undeleted resources to exceed **compactRatio**. For example, if **compactRatio** is 30, the file is compacted when the ratio of deleted resources to undeleted resources reaches 30%.

Locating a Resource 104.3

To search for and get information about a resource, send **msgResGetInfo** to a resource file handle or resource file list. **msgResGetInfo** takes a pointer to a RES_INFO structure as its argument. You pass in **resId**, and **msgResGetInfo** passes back information about the identified resource. RES_INFO includes the following fields (the data type of each field is shown in parentheses following its name):

resId (RES_ID) The ID of the resource to find.

file (RES_FILE) The file where the identified resource resides. This is mainly useful when you send **msgResGetInfo** to a resource list, so that you know which of the files in the list contains the resource.

agent (UID) The agent that saved the resource.

objClass (UID) If an object resource, the class of the object.

offset (U32) The offset in bytes from the start of the file to the first byte of the resource. Use only with caution.

size (U32) The size of the resource in bytes. Use only with caution.

minSysVersion (U16) The minimum system version with which the resource is compatible.

Reading a Data Resource 104.4

To search for and read a data resource, send **msgResReadData** to either a resource file handle or a resource file list. **msgResReadData** takes a pointer to a RES_READ_DATA structure as its argument. RES_READ_DATA includes the following fields (the data type of each field is shown in parentheses following its name):

resId (RES_ID) The resource ID of the resource to read.

pData (P_UNKNOWN) The retrieved resource data.

heap (OS_HEAP_ID) A heap from which to allocate memory for storing the retrieved resource data. Set to **Nil**(OS_HEAP_ID) if **pData** points to an allocated buffer.

length (U32) The length of the resource data.

pAgentData (P_UNKNOWN) Agent-specific data, such as the index into a list resource.

Writing and Updating Data Resources 104.5

To write a data resource to a resource file, send **msgResWriteData** to a resource file handle. To update a data resource, send **msgResUpdateData** to a resource file handle. Updating a data resource is like writing a data resource, except that the

update operation reads the resource file to determine the correct agent to use. You cannot send write or update messages to a resource file list, only to a resource file.

msgResWriteData and **msgResUpdateData** both take a pointer to a RES_WRITE_DATA structure as their argument. RES_WRITE_DATA includes the following fields (the data type of each field is shown in parentheses following its name):

resId (RES_ID) The resource ID with which to write the resource.

pData (P_UNKNOWN) The data to be written.

length (U32) The length of the data (agent might compute this value).

agent (UID) The agent to use in writing the data. Not used for **msgResUpdateData**.

pAgentData (P_UNKNOWN) Agent-specific data, such as the index into a list resource.

Reading an Object Resource

104.6

There are two messages that you can use to read object resources: **msgResReadObject** and **msgResReadObjectWithFlags**. Both messages search for and read an object resource from either a resource file handle or a resource file list. The difference is that **msgResReadObjectWithFlags** takes additional flags arguments, which it passes in **msgRestore** to the new object.

msgResReadObject and **msgResReadObjectWithFlags** both take a pointer to a RES_READ_OBJECT structure as their argument. RES_READ_OBJECT includes the following fields (the data type of each field is shown in parentheses following its name):

mode (RES_READ_OBJ_MODE) Whether to read the object in once mode (don't read the object from file if already read) or many mode (allow each read to create its own copy of the object). Possible values are:

resReadObjectOnce Read once mode.

resReadObjectMany Read many mode.

resId (RES_ID) The resource ID of the object resource to be read.

objectNew (OBJECT_NEW) Before reading the object resource, this field must be initialized with a **msgNewDefaults** to **clsObject**. After reading the object resource, the object UID will be **objectNew.uid**.

sysFlags (RES_SAVE_RESTORE_FLAGS) System-defined flags for **msgResReadObjectWithFlags**.

appFlags (U16) Application-defined flags for **msgResReadObjectWithFlags**.

When the message returns successfully, the RES_READ_OBJECT structure contains the UID of the newly created object in **objectNew.uid**. If you specified **resReadObjectOnce** and the object existed already, **objectNew.uid** contains the UID of the object created when the resource was first read, but the message does not result in a second copy of the object.

When you use **msgResReadObjectWithFlags**, you must be very careful in specifying the **sysFlags** and **appFlags** values. The values for **sysFlags** are specific to PenPoint, and are currently used only on copy operations. You can define specific **appFlags** for a class, but you must be careful that you only send the flags defined for a specific class when restoring objects of that class.

Writing an Object Resource

104.7

There are two messages that you can use to write object resources: **msgResWriteObject** and **msgResWriteObjectWithFlags**. Both messages write an object resource to a resource file; you cannot send these messages to a resource file list. The difference between the messages is that **msgResWriteObjectWithFlags** takes additional flags arguments, which it passes in **msgSave** to the object being written.

msgResWriteObject and **msgResWriteObjectWithFlags** both take a pointer to a RES_WRITE_OBJECT structure as their argument. RES_WRITE_OBJECT includes the following fields (the data type of each field is shown in parentheses following its name):

mode (RES_WRITE_OBJ_MODE) Whether to write the object in once mode or many mode. Possible values are:

resWriteObjectOnce Write once mode. Don't write the object resource to the file if it has already been written.

resWriteObjectMany Write many mode. Write the object reseource to the file, creating it if it isn't already in the file, or overwriting the old version if it is already in the file.

resId (RES_ID) The resource ID with which to write the object resource.

object (UID) The UID of the object to be written.

sysFlags (RES_SAVE_RESTORE_FLAGS) System-defined flags for **msgResWriteObjectWithFlags.**

appFlags (U16) Application-defined flags for **msgResWriteObjectWithFlags.**

When you use **msgResWriteObjectWithFlags**, you must be very careful in specifying the **sysFlags** and **appFlags** values. The values for **sysFlags** are specific to PenPoint, and are currently only used on copy operations. You can define specific **appFlags** for a class, but you must be careful that you send only the flags defined for a specific class when restoring objects of that class (the flags are passed along with recursive writes, which may end up at objects of a different class than the top-level object; use **msgResWriteObjectWithFlags** with care.

Enumerating Resources

104.8

To create an array of all resource IDs in a resource file or resource file list that match a particular selection criteria, send **msgResEnumResources** to a resource file handle or a resource file list.

msgResEnumResources takes a pointer to a RES_ENUM structure as its argument. RES_ENUM includes the following fields (the data type of each field is shown in parentheses following its name):

match (UID) The search key, for example an agent or class.

mode (RES_ENUM_MODE) How to filter the search. This can be one of the following values:

resEnumAll (the default) Find next resource in file.

resEnumByResIdClass Find next resource in file whose resource ID administrated part matches **match**.

resEnumByObjectClass Find next resource in file whose object class matches **match**.

resEnumByObjectUID Find next resource in file whose object UID matches **match**.

resEnumByAgent Find next resource in file whose agent matches **match**.

pResId (P_RES_ID) A pointer to the array of enumerated resource IDs.

pResFile (P_RES_FILE) A pointer to the array of file handles corresponding to each entry of **pResId**.

max (U16) Maximum number of entries allocated for **pResId** and **pResFile** arrays.

count (U16) The number of entries in the arrays. When passed in with a message, **count** specifies the number of entries requested. When passed back out, **count** specifies the number of entries actually retrieved.

When the message completes, **pResId**[] contains the resource IDs that match the criterion, and **pResFile**[] contains the resource file handles for the corresponding entries in **pResId**[]. If the final **count** is larger than **max**, the resource manager allocates heap to accomodate the additional resource IDs and resource file handles. You can tell that heap was allocated when the arrays indicated by **pResId** and **pResFile** are different from their original values when the message returns. If the resource manager allocated heap, you must free the heap when you are done.

If you are concerned about memory requirements, you can request the message to return only a few resource IDs at a time. To do so, you keep the **pResId** and **pResFile** arrays small and specify a small **count** value on the first call to **msgResEnumResources**. On subsequent calls, you specify small **count** values, and you must OR in **resEnumNext** in the mode field and repeat the data returned in **cache**.

Deleting a Resource

104.9

To mark a resource as deleted, send **msgResDeleteResource** to a resource file handle. **msgResDeleteResource** takes as its argument a pointer to the RES_ID that identifies the resource to be marked.

msgResDeleteResource marks a resource as deleted. Resources marked as deleted are not actually removed from the resource file until the resource file compacts in response to **msgResCompact**. You can send **msgResCompact** yourself to force a

resource file to compact, or it may compact automatically depending on the mode settings at **msgNew** time (see "Creating a Resource File Handle" earlier in this chapter).

Compacting and Flushing Resource Files 104.10

To explicitly compact a resource file, send **msgResCompact** to the resource file handle. This deletes all resources in the resource file that are marked as deleted. **msgResCompact** doesn't take any arguments.

Flushing the resource file has the effect of clearing the internal table maintained by the resource manager for the file. To do this, send **msgResFlush** to the resource file handle. The message doesn't require any arguments. This internal table keeps track of the resource IDs, the UIDs associated with object resources, and maintains the flags that indicate when an object resource has been written.

In addition to clearing the internal table associated with a resource file, **msgResFlush** flushes any buffered file output to disk.

Essentially, a flush restores the resource file to the state it was in when you opened it. This is particularly important if you are reading an object resource with **resReadObjectOnce** mode, because the resource manager uses the table to determine whether it has read the object before.

If you want to flush buffered output without flushing the resource file table, you can send the **clsFileHandle** message **msgFSFlush**.

Resource Agents 104.11

As mentioned in Chapter 103, data resources are usually managed by agents that interpret the bytes of a data resource in a special way. PenPoint comes with three data resource agents: one that interprets the bytes simply as bytes, a second that interprets them as NULL-terminated strings, and a third that interprets them as arrays of NULL-terminated strings. This section explains how the resource manager interacts with resource agents and how to write your own agents to handle special types of data resource.

Reading and Writing Data Resources 104.11.1

When you send **msgResWriteData** to a resource file handle, you specify the agent that will write the data. The resource manager finds a suitable location to store the resource and writes the header information and the agent's UID in the resource file at that location. The resource manager then sends **msgResAgent** to the agent, and the agent handles the rest of the write.

When you send **msgResReadData** or **msgResUpdateData** to a resource file handle or resource file list, the message determines the correct agent to use by looking at what **msgResWriteData** stored in the file. The resource manager then sends **msgResAgent** to the agent, and the agent handles the rest of the read or update.

Writing Your Own Agents

104.11.2

A resource agent is a well-known object that responds to **msgResAgent**. The easiest way to create your own agent is to create a single instance of the agent class and make the UID of that instance well-known.

The agent needs to handle just one message: **msgResAgent**. As discussed above, the resource manager will send **msgResAgent** to the agent during any **msgResReadData**, **msgResWriteData**, or **msgResUpdateData** that specifies the agent. **msgResAgent** takes a pointer to a RES_AGENT structure as its argument. RES_AGENT includes the following fields (the data type of each field is shown in parentheses following its name):

file (RES_FILE) The file containing the resource.

length (U32) Length of the resource entry, in bytes.

msg (MESSAGE) The original message (**msgResReadData**, **msgResWriteData**, or **msgResUpdateData**).

pArgs (P_UNKNOWN) The argument passed with the original message.

sysVersion (U16) The minimum system version compatible with the resource, to record during write operations.

When you handle **msgResAgent**, you must examine **msg** to determine what action you will take. You must use **clsStream** messages to read and write data. Do not use the **stdio** library functions. **clsStream** messages update the file pointer maintained by **clsResFile**. If the file pointer is not positioned where the resource manager expects, unpredictable results occur, potentially including loss of data. On the same note, do not send seek or rewind messages to the file handle, as these also alter the file pointer.

The arguments to **msgResReadData** and **msgResUpdateData** include a pointer to other data (**pAgentData**). You can use this information to locate specific information within a resource. For example, if your agent stores a number of variable length values, you can allow clients to specify an index to one of the values in **pAgentData**. When you receive **msgResAgent**, you can use the **pAgentData** to locate the specific value that the client wants.

Chapter 105 / Defining Resources with the C Language

You can define data resources in the C language. This section describes the specific format of static data declarations that you use to define resources. At the end of this chapter is a short example of a resource source file.

Resource definition files contain C code that define the data resource. To compile the code into a resource file, you follow these steps:

1. Include a special header file (RESCMPLR.H) into your code.
2. Define each data resource as an RC_INPUT data structure.
3. Define an array of pointers (**resInput**) to the data resources.
4. Use the RC command, described in Chapter 106 to compile the C code into a resource file.

Resource Source File Organization

105.1

Every resource definition file has pretty much the same structure, varying mainly in the number of resources and the data they contain. Example 105-1 shows the source for a resource file that contains a single NULL-terminated string resource.

Example 105-1
A Tiny Resource Definition File

This example shows the source for a resource definition file that defines a single resource, a NULL-terminated string reading "Hello, World." More complex resource definitions would simply include more RC_INPUT definitions and a larger **resInput**[] array to hold them. RESCMPLR.H provides examples for data types other than strings.

```
#ifndef RESCMPLR_INCLUDED
#include <rescmplr.h>
#endif
#include mydefine.h  // defines myResId to MakeWknResId(clsExample, 1)
static RC_INPUT myResource = {
    myResId,           // Resource ID for the resource
    "Hello, World.",   // Pointer to the resource data
    0,                 // Data length; 0 means let compiler figure it out
    resStringAgent,    // Resource agent for the resource
    }
P_RC_INPUT resInput[] = {
    &myResource,
    pNull
};
```

The first non-comment lines must contain an `#include <rescmplr.h>` statement. You should also include any other header files that your resource definitions require, such as the header file that defines the resource IDs.

Follow the `#define` statements with the resource definitions. Each resource definition is a static struct for which you specify the elements. The elements of the struct depend on the resource data type. The structs and the resource data types are described in the next section.

Finally, you define an array named **resInput** that contains pointers to each of the static struct resource definitions. **resInput** is an exported variable that is expected by the resource compiler. The array ends with a null entry.

Resource Definitions

105.2

The definition for each resource in the source file has the following common structure:

```
static RC_INPUT resource-label = {
    resId;              // the resource ID (RES_ID)
    pData;              // points to the resource data (P_UNKNOWN)
    dataLen;            // length of the resource data, in bytes (U16)
    agent;              // the resource agent, usually resDefaultResAgent (OBJECT)
    minSysVersion;      // min sys version for resource (U16)
    objectData;     // false means the resource is a data resource (BOOLEAN)
    pAgentWriteProc;    // pNull, unless supplying routine (P_AGENT_WRITE)
    pAgentWriteData;    // usually pNull (P_UNKNOWN)
};
```

All of the fields after agent default to zero, which is normally a correct value, so you shouldn't have to set them explicitly.

Example

105.3

Example 105-2, taken from TTTQHELP.RC in the \PENPOINT\SDK\SAMPLE\TTT directory of the PenPoint SDK distribution, shows the definition of four Quick Help resources. Quick Help resources determine the text that appears in the Quick Help window when you tap the pen on a window. Quick Help is described in more detail in *Part 9: Utility Classes.*

Note that in ANSI C, two consecutive quoted strings are treated as a single quoted string. This lets you break a long string into several parts, and this technique is used in the following example.

Example 105-2
Defining Quick Help Resources

```
#ifndef RESCMPLR_INCLUDED
#include <rescmplr.h>
#endif
#ifndef QHELP_INCLUDED
#include <qhelp.h>
#endif
#ifndef TTTVIEW_INCLUDED
#include "tttview.h"
#endif
```

continued

Example 105-2 (continued)

```
//
// Quick Help string for ttt's option card.
//
static CHAR tttOptionString[] = {
    // Title for the quick help window
    "TTT Card||"
    // Quick help text
    "Use this option card to change the thickness of the lines "
    "on the Tic-Tac-Toe board."
};
//
// Quick Help string for the line thickness control in ttt's option card.
//
static CHAR tttLineThicknessString[] = {
    // Title for the quick help window
    "Line Thickness||"
    // Quick help text
    "Change the line thickness by writing in a number from 1-9."
};
//
// Quick Help string for the view.
//
static CHAR tttViewString[] = {
    // Title for the quick help window
    "Tic-Tac-Toe||"
    // Quick help text
    "The Tic-Tac-Toe window lets you to make X's and O's in a Tic-Tac-Toe "
    "grid. You can write X's and O's and make move, copy "
    "and pigtail delete gestures.\n\n"
    "It does not recognize a completed game, either tied or won.\n\n"
    "To clear the game and start again, tap Select All in the Edit menu, "
    "then tap Delete."
};
// Define the quick help resource for the view.
static P_RC_TAGGED_STRING   tttViewQHelpStrings[] = {
    tagCardLineThickness,   tttOptionString,
    tagTttQHelpForLineCtrl, tttLineThicknessString,
    tagTttQHelpForView,     tttViewString,
    pNull
};
static RC_INPUT tttViewHelp = {
    MakeListResId(clsTttView, resGrpQhelp, 0),
    tttViewQHelpStrings,            // Name of the string array
    0,
    resTaggedStringArrayResAgent    // Use string array resource agent
};
/*****************************************************************************
    The glue that ties everything together -- resInput.
*****************************************************************************/
// resInput is an exported variable that the resource compiler expects.
// Each element is a pointer to a structure describing the next resource.
// The list is terminated with a null pointer.
P_RC_INPUT  resInput [] = {
    &tttViewHelp,   // this is the one defined in this example
    // any other resource pointers would go here
    pNull
};
```

Chapter 106 / Compiling Resources

When you have created the resource source file, you must compile it with the resource compiler to create the resource file. The resource compiler performs four tasks:

1. Creates a C file that `#includes` your resource definition file.
2. Uses the C compiler to compile your resource source file.
3. Links the resulting object file with RESCMPLR.LIB.
4. Runs the resulting executable file to produce a resource file.
5. Deletes its intermediate files.

Running the Resource Compiler

106.1

The resource compiler is the MS-DOS executable file RC.EXE. RC has the following syntax:

RC ***resInputFile*** [***resOutputFile***] [**/V**] [**/D**]

The ***resInputFile*** specifies the input source file. The input file can be either a resource source file (with the extension .C or .RC) or a previously compiled object file (with the extension .OBJ). If you omit the extension from the file name, RC looks for files with .C and .RC extensions.

Chapter 4, Defining Resources with the C Language, describes how to create the source file.

The optional ***resOutputFile*** specifies the name of the final resource file. If you omit ***resOutputFile***, RC creates a file with the same name as the ***resInputFile***, but with a .RES extension.

The optional **/V** flag directs RC to give verbose status messages. The verbose messages:

- Tell you the commands that RC executes.
- Report all of its steps.
- Give you information about the resources that it compiled.

The optional **/D** flag directs RC to report when its spawned processes complete or fail. The **/D** flag also turns on verbose status messages and prevents RC from deleting intermediate files.

RC creates a resource file (either using the name of the source file or using the output name specified). If the resource file already exists, RC appends the new resources to the resource file. If the resources already exist in the file, RC marks those resources as deleted and appends the new resources. To remove deleted resources from a resource file, use the RESAPPND utility described below.

To review the contents of a resource file, use the RESDUMP utility, also described below.

RC cleans up after itself by deleting any intermediate files that it created (.OBJ and .EXE). However, if the input file is an object file, RC does not delete that .OBJ file.

The RESAPPND Utility

106.2

The RESAPPND utility allows you to append all the resources from one resource file to another resource file. This allows you to create and compile a number of small resources and append those resources to one large resource file.

The syntax for RESAPPND is:

RESAPPND *sourceResFile destResFile*

The *sourceResFile* is the resource file that contains the resources that will be appended. The *destResFile* is the file to which the source resources will be appended.

While appending resources, RESAPPND ignores any resources that are marked as deleted. Thus, you can use RESAPPND to remove resources marked as deleted from a resource file. To do this, use RESAPPND to append the resources in a file to a new, temporary file. Then rename the temporary file to the name of the original resource file.

For example:

```
C:> REM myres.res contains deleted resources
C:> resappnd myres.res temp.res

C:> copy temp.res myres.res
    1 File(s) Copied

C:> del temp.res
```

The RESDUMP Utility

106.3

The RESDUMP utility allows you to display the contents of a resource file. The information displayed by RESDUMP includes:

- The file header, which describes the class and resource file version information.
- The resource ID for each resource.
- The length of the data in each resource.
- The data in each resource.

The syntax for RESDUMP is:

RESDUMP *resourceFile*

resourceFile is the name of the resource file to be dumped.

If any of the resources are marked as deleted, RESDUMP identifies them as marked as deleted.

Chapter 107 / System Preferences

The system preferences are stored as resources in the preferences resource file. This chapter describes system preference resources and the notification messages that observers receive when the system preferences change.

Topics covered in this chapter include:

- System preference concepts, including their storage location and typical uses.
- The system preferences and what they do.
- Observing system preferences.

Concepts

107.1

On a new PenPoint installation, the preferences resource file is \PENPOINT\SYS\PREF\GENERIC, but the user can change which preferences resource file is current. No matter what the current preferences resource file, the PenPoint™ operating system maintains **theSystemPreferences** as a handle on the current preferences resource file.

System preferences describe system settings, such as the current system font, screen orientation, left- or right-handed operation, and so on. Usually a user modifies the system preferences from the Settings notebook. However, if an application needs to examine or, more rarely, modify system preferences, it can access the system preferences in the preferences resource file.

The system preference resources are identified by well-known resource IDs. The preferences and their resource IDs are listed in the next section. The class used in the administered portion of the system preference resource IDs is **clsPreferences**. If you add resources for other preferences, the class should be the class that created the preference.

Any request to read or write a preference forces a read or write to a preference resource file. This minimizes the amount of space required to store preferences.

Clients can get and set the preferences resources by sending **msgResReadData**, **msgResWriteData**, and **msgResUpdateData** to the well-known object **theSystemPreferences** (which is an instance of **clsPreferences**). When users want to change the system preferences, they open the Preferences section of the Settings notebook, which then communicates with **theSystemPreferences** to alter the system preferences.

The preferences resource file is stored in a well-known directory, managed by **theInstalledPreferences**. If necessary, a client can supply an entirely new system preferences file, containing a different set of preferences.

When PenPoint is cold- or warm-booted, **theSystemPreferences** contains the set of preferences associated with the current preference set managed by **theInstalledPreferences**. If there is no current set of preferences at boot time, **theSystemPreferences** copies a generic set of preferences from \PENPOINT\SYS\PREF\GENERIC and makes that the system preferences file.

The System Preferences

107.2

The following sections describe the standard system preferences, defined in PREFS.H. In each section, the preference is described along with its resource ID and the symbols that identify possible states for that preference.

Table 107-1 summarizes the standard preferences and their resource IDs. These preferences are defined in the header file PREFS.H.

Table 107-1
System Preferences and Resource IDs

Preference	Resource ID
System font	prSystemFont
User font	prUserFont
Screen orientation	prOrientation
Hand preference	prHandPreference
Writing style	prWritingStyle
Handwriting timeout	prHWXTimeout
Press-hold timeout	prPenHoldTimeout
Gesture timeout	prGestureTimeout
Power management	prPowerManagement
Auto suspend timeout	tagPrAutoSuspend
Auto shutdown timeout	tagPrAutoShutdown
Floating allowed	prDocFloating
Zooming allowed	prDocZooming
Bell	prBell
Scroll margins	prScrollMargins
Input pad style	prInputPadStyle
Character box width	prCharBoxWidth
Character box height	prCharBoxHeight
Line height	prLineHeight
Pen cursor	prPenCursor
Time and date	prTime
Date format	prDateFormat
Time format	prTimeFormat
Display seconds	prTimeSeconds
Primary input device	prPrimaryInput
Unrecognized character	prUnrecCharacter

System and User Fonts 107.2.1

prSystemFont is the resource ID for the system font. **prUserFont** is the resource ID for the field or user font. Both of these resources affect the returned value from **PrefsSysFontInfo**().

Changing either of these resources with **msgResWriteData** will cause the entire system to layout after notification of observers, which degrades system performance. As a result, **clsPreferences** will compare this resource to its previous value to prevent layout and observer notification if the write did not change the value.

Both of these resources contain a PREF_SYSTEM_FONT_INFO structure that includes the following fields:

scale A U8 representing the font size in points.

sysFontId A U16 that identifies the font family (Courier, for example) of the system font.

userFontId A U16 that identifies the font family used to render translated user input.

See *Part 3: Windows and Graphics* of volume I for more information about font rendering under the ImagePoint™ imaging model.

Screen Orientation 107.2.2

prOrientation is the resource ID for the screen orientation preference. Changing this resource with **msgResWriteData** will cause the system to layout after notification of observers, expensive in terms of system performance. As a result, **clsPreferences** will compare this resource to the previous value to prevent layout and observer notification if the write did not change the value.

The screen orientation preference is a P_U8 that can have one of the following values:

prPortrait The long edge of the screen is vertical.

prLandscape The long edge of the screen is horizontal.

prPortraitReversed Similar to **prPortrait**, but rotated 180 degrees.

prLandscapeReversed Similar to **prLandscape**, but rotated 180 degrees.

Hand Preference 107.2.3

prHandPreference is the resource ID for the preference that indicates whether the user is left-handed or right-handed. This affects aspects of the screen layout such as whether scroll margins appear along the right or left sides of windows.

Changing this resource with **msgResWriteData** will cause the system to layout after notification of observers, degrades system performance. As a result, **clsPreferences** will compare this resource to the previous value to prevent layout and observer notification if the write did not change the value. Reads and writes of this ID use a P_U8 which can have one of two values:

prLeftHanded User is left-handed.

prRightHanded User is right handed.

Writing Style 107.2.4

prWritingStyle is the resource ID for the handwriting preference style. This preference indicates whether the user prefers to write in all capital letters or to use mixed upper and lower case. Reads and writes of this ID use a P_U8, whose possible values are:

prMixedCase Mixed case writer.

prCapsOnly All caps writer.

Handwriting Timeout 107.2.5

prHWXTimeout is the resource ID indicating the handwriting timeout, and is measured in 0.01 second increments. Reads and writes of this ID use a P_U16 indicating the number of 0.01-second increments from the time the pen stops moving to the time the handwriting translator begins to translate the strokes.

Press-Hold Timeout 107.2.6

prPenHoldTimeout is the resource ID for the press-hold timeout, and is measured in 0.01 second increments. Reads and writes of this ID use a P_U16 indicating the number of 0.01-second increments from the time the pen touches the screen to the time the gesture translator recognizes the gesture as a press-hold.

Gesture Timeout 107.2.7

prGestureTimeout is the resource ID for the gesture timeout, and is measured in 0.01 second increments. Reads and writes of this ID use a P_U16 indicating the number of 0.01-second increments from the time the pen stops moving to the time the gesture translator captures and begins to translate the strokes.

Power Management 107.2.8

prPowerManagement is the resource ID that indicates whether the system should attempt to limit the computer's power consumption by turning off inactive devices. **prPowerManagement** is a P_U8 that can have one of two values:

prPowerManagementOff No power management attempted.

prPowerManagementOn Power management attempted.

Auto Suspend 107.2.9

tagPrAutoSuspend is the resource ID for automatic suspend timeout (the amount of idle time allowed before the machine goes into a power-saving suspended mode). Reads and writes of this ID use a P_U16, whose units are minutes. If **tagPrAutoSuspend** is 0, the machine will not automatically suspend itself. Machines that do not support automatic suspend do not use the auto shutdown preference value. Instead, they use the auto suspend preference value as an auto shutdown timeout.

Auto Shutdown 107.2.10

tagPrAutoShutdown is the resource ID for automatic shutdown timeout (the amount of idle time before the system automacally shuts itself down). Reads and writes of this ID use a P_U16, whose units are hundredths of hours. If the value is 0, the machine will not shut itself down automatically.

Machines that do not support auto suspend use the automatic suspend timeout preference as the automatic shutdown timeout.

Floating Allowed 107.2.11

prDocFloating is the resource ID that indicates whether documents in notebooks can be floated (displayed in their own window, independent of the notebook frame). Reads and writes of this ID use a P_U8 which can have one of two values:

prDocFloatingOff Document floating not allowed.

prDocFloatingOn Document floating allowed.

Zooming Allowed 107.2.12

prDocZooming is the resource ID that indicates whether floating documents can be zoomed (expanded to fill most of the display). Reads and writes of this ID use a P_U8 which can have one of two values:

prDocZoomingOff Document zooming not allowed.

prDocZoomingOn Document zooming allowed.

Bell 107.2.13

prBell is the resource ID for the preference that indicates whether to sound the warning bell to gain the user's attention. It reads and writes a P_U8, whose possible values are:

prBellOn Sound the bell to indicate a warning condition.

prBellOff Don't sound the bell under any circumstances.

Scroll Margin Style 107.2.14

prScrollMargins is the resource ID that determines whether scrolling windows use "full" or "light" scroll bars.

Changing this resource with **msgResWriteData** will cause the system to layout after notification of observers, which degrades system performance. As a result, **clsPreferences** will compare this resource to the previous value to prevent layout and observer notification if the write did not change the value.

Reads and writes of this ID use a P_U8 which can have one of two values:

prScrollMarginsFull Use full scroll margins.

prScrollMarginsLight Use light scroll margins.

Input Pad Style

107.2.15

prInputPadStyle is the resource ID indicating the preferred style of handwriting pads. Reads and writes of this ID use a P_U8, which can have one of three values:

prInputPadStyleBoxed Input pads are boxed.

prInputPadStyleRuled Input pads are ruled.

prInputPadStyleRuledAndBoxed Input pads start ruled, then go to boxed for editing.

This preference affects only input pads created after the preference is changed.

Character Box Width

107.2.16

prCharBoxWidth is the resource ID indicating the width of character boxes for boxed writing fields. Reads and writes of this ID use a P_U8, which indicates the width of the box in points (a point is 1/72 inch). This preference affects only character boxes created after the preference is changed.

Character Box Height

107.2.17

prCharBoxHeight is the resource ID indicating the height of character boxes for boxed writing fields. Reads and writes of this ID use a P_U8, which indicates the width of the box in points (a point is 1/72 inch). This preference affects only character boxes created after the preference is changed.

Line Height

107.2.18

prLineHeight is the resource ID for the height of lines in ruled edit pads. Reads and writes of this ID use a P_U16, indicating 0.01 inch increments. Changing this preference only affects subsequently created ruled pads.

Pen Cursor

107.2.19

prPenCursor is the resource ID that determines whether the system displays a pen cursor (mainly useful for public demonstrations where an image of the screen in projected). Reads and writes of this ID use a P_U8 which can have one of two values:

prPenCursorOff Do not display pen cursor.

prPenCursorOn Display pen cursor.

Time and Date

107.2.20

prTime is the resource ID for the system time (including the date). Reads and writes of this ID use a P_PREF_TIME_INFO containing the current time information. The PREF_TIME_INFO structure includes the following fields:

dateTime An OS_DATE_TIME containing the date and time (see OS.H for a more detailed description of the OS_DATE_TIME structure).

mode A PREF_TIME_MODE determining which parts of **dateTime** to write.

Date Format 107.2.21

prDateFormat is the resource ID for the date format. This preference will affect the format of the string returned from **PrefsDateToString**(). Reads and writes use a P_U8, whose possible values are:

prDateMDYFull Example: January 15, 1990
prDateMDYAbbre Example: Jan. 15, 1990
prDateMDYSlash Example: 1/15/90
prDateMDYHyphe Example: 11590
prDateMDYDot Example: 1.15.90
prDateDMYFull Example: 15 January 1990
prDateDMYAbbre Example: 15 Jan. 1990
prDateDMYSlash Example: 15/1/90
prDateDMYHyphe Example: 15190
prDateDMYDot Example: 15.1.90.

Time Format 107.2.22

prTimeFormat is the resource ID for the preferred time format (military, 24-hour time or civilian, 12-hour time). This preference will affect the returned string from **PrefsTimeToString**(). Reads and writes of this ID use a P_U8, which can have one of two values:

prTime12Hour Display time in 12-hour format, including an A.M. or P.M. indicator.
prTime24Hour Display time in 24-hour format.

Display Seconds 107.2.23

prTimeSeconds is the resource ID indicating whether to show seconds in clock displays. This preference will affect the returned string from **PrefsTimeToString**(). Reads and writes of this ID use a P_U8, which can have one of two meanings:

prTimeSecondsDisplay Show seconds in time displays.
prTimeSecondsOff Don't show seconds in time displays.

Primary Input Device 107.2.24

prPrimaryInput is the resource ID defining the primary input device (pen or keyboard). Reads and writes of this ID use a P_U8 which can have one of two values:

prPrimaryInputPen The pen is the primary input device.
prPrimaryInputKbd The keyboard is the primary input device.

Unrecognized Character

107.2.25

prUnrecCharacter is the resource ID used for the unrecognized character glyph (the glyph shown in place of a handwritten character that the handwriting translation algorithm did not recognize). Reads and writes of this ID use a P_U8 which can have one of two values:

prUnrecCharacterQuestion Use a circled question mark to represent unrecognized characters.

prUnrecCharacterUnder Use an underscore character to represent unrecognized characters.

Preference Change Notification

107.3

You can make yourself an observer of the system preferences by sending **msgAddObserver** to **theSystemPreferences**. All applications observe the system preferences by default.

When the system preferences change, all observers of the system preferences receive **msgPrefsPreferenceChanged**. When you receive **msgPrefsPreferenceChanged**, the message sends you a pointer to a PREF_CHANGED structure. The structure contains:

manager The UID of the object that sent the notification. This is usually **theSystemPreferences**.

prefID The resource ID of the preference that changed.

If you need to know the details of the change, you can send **msgResReadData** to **theSystemPreferences** to get the new value for **prefID**.

Part 12 / Installation API

Chapter 108 / Introduction

This part describes the APIs used to install software in the PenPoint™ operating system. In describing the installation API, we also describe the organization of the files under PenPoint, the relationship of executable and DLL files, and the initialization files.

Overview

108.1

Most of the work that an application developer has to do is to make sure that the application directory is structured correctly and that the .DLC file is correct. If these things are attended to, the application installer takes care of the rest of the work.

The people who are interested in anything in this part beyond PenPoint directory organization and DLL file information are OEMs who want to turn off configuration, stationery, and installation; and people who create device drivers and other installable entities, in addition to fonts, handwriting prototypes, and applications. These people will have to understand how the auxiliary notebook manager works, in addition to the install manager.

Organization of This Part

108.2

This chapter introduces the topic of installation and describes the organization of the part.

Chapter 109, Installation Concepts, introduces the concepts needed to understand the rest of the part, including a brief overview of installation from the user's perspective and an internal description of installation.

Chapter 110, PenPoint File Organization, describes the directory structure used in PenPoint volumes and describes how to create application or service distribution volumes.

Chapter 111, Dynamic Link Libraries, describes the dynamic link library (DLL) files used by PenPoint and how application installation handles issues such as shared DLL files and version control.

Chapter 112, Installation Managers, describes the installation manager (**clsInstallMgr**), the application installation manager (**clsAppInstallMgr**), the font installation manager (**clsFontInstallMgr**), and other installation managers.

Chapter 113, The Auxiliary Notebook Manager, describes **clsAuxNotebookMgr** and its descendents.

Chapter 114, The System Class, describes **clsSystem**, which provides information about booting and other system-wide information.

Other Sources of Information

108.3

For a description of the application monitor class (**clsAppMon**), see *Part 2: PenPoint Application Framework.*

Chapter 109 / Installation Concepts

This chapter describes concepts related to installation. After describing the application installation process from the user's perspective, we describe how application installation works internally. This discussion leads to a description of the classes used in installation.

The installation process is essentially similar for applications, fonts, handwriting prototypes, device drivers and other objects.

When you distribute an application to users, you ship it on **application distribution diskettes**. The file structure on these diskettes is similar to the PenPoint™ volume structure in the boot volume and in your application development system. (The file structure is explained in Chapter 110, PenPoint File Organization.)

Installation Managers

109.1

An **installable item** is a collection of data that represents a specific object or group of objects used by PenPoint applications. Typical examples of installable items are applications, services, fonts, handwriting prototypes, device drivers, and dictionaries. As a rule, an installable item isn't vital to the operation the PenPoint operating system, but adds capabilities to it. Installable items are grouped into sets of similar installable items.

Installation Managers provide applications with the facilities needed to manage installable items. All installation managers are subclasses of **clsInstallMgr**.

An **installable manager** is an instance of **clsInstallMgr** that manages a set of similar items. Usually an installable manager is a well-known global object (called **theInstalled***Thing*), so that all applications can easily access the set of installable items.

Each installable item managed by an install manager has these traits:

- A name.
- An attribute that indicates whether it has been modified.
- An attribute that indicates whether it is the current item.

The name of an installable item can be between 1 and 31 characters. Any character is valid in the component name except backslash (\) and null (ASCII 0). These are the same naming conventions that apply to node names in the PenPoint file system.

The installable manager can identify one item as the current item. By identifying a current item, the installable manager can quickly return a specific item to clients

that request it. Additionally, the clients do not have to keep track of which is the current item.

In managing a set of installable items, instances of **clsInstallMgr** can:

- List all items in a set of items.
- Install a item.
- Deinstall a item.
- Get and set the current item.

The installable manager uses the PenPoint file system to implement much of its behavior. An instance of **clsInstallMgr** indicates a **item directory** in the RAM volume where a set of items is stored. **clsInstallMgr** creates a file handle or directory handle for each of the items in the item directory. If the item is a file, the file system uses a file node; if the item is a directory, the file system uses a directory node. The file or directory has the same name as the item it contains.

When a client requests a list of items, the item manager returns a list of all handles in the item directory.

The attributes (in use, modified, current, deinstalled) are saved as file system attributes. To modify these attributes, you should use the **clsInstallMgr** messages, rather than the file system attribute messages. The main reason for this is that it allows the item to send notifications to observers when it changes.

If you subclass **clsInstallMgr**, you can modify the contents of these attributes, or you can add other attributes.

clsInstallMgr monitors the item directory and sends notification whenever a change occurs in the item directory. Notification messages indicate when an installable item is added, installed, deinstalled, updated, modified, or becomes current. Most notification messages end in "ed" (such as **msgIMAdded**, **msgIMCurrentChanged**, and so on).

Installation Process

109.2

If you have used PenPoint 1.0 for any length of time, the mechanics of installation will not be new to you. This is just a brief review. The most common installation you perform is application installation. Remember, however, that installation applies to any installable item.

Installation can be initiated in one of three ways:

- If the distribution diskette was marked for quick install, PenPoint invokes the appropriate quick-installer automatically when the user inserts the diskette.
- The user opens the Connections notebook to the disks page, selects the view for a particular type of installable item, and then taps on the Install... menu item.
- The user opens the settings notebook to one of the installed software pages and then taps on the Install... menu item.

The user selects an item and taps on the installed checkbox for that item.

If this is the first time the user has installed the item, the item being installed can present an option sheet that allows the user to specify the configuration for the item. The user can choose whether to load stationery and any option modules, such as help or accessories. An example of an accessory might be a report generator. When the user has chosen the configuration, the installer installs the item and all other relevant pieces.

If this isn't the first time the user has installed the item, the installer locates the configuration for the item and installs the item and other relevant pieces.

Installing Applications 109.3

In brief, the file structure on the distribution volume and the PenPoint volume divides the installable item into pieces that are installed and managed by various system facilities. This is particularly true in the case of applications.

In addition to the application executable file, an application can include help templates, stationery documents, tools documents, and other miscellaneous files. The application installer must install all these items.

The **stationery documents** are created by either you or the user and already contain some information (such as a letterhead, margins, predrawn figures and so on). The application installer loads the stationery documents into the Stationery notebook. The **accessories documents** are similar to stationery documents, except the installer loads the documents into Accessories.

How Application Installation Works 109.3.0.1

When the user selects an application and taps on the install checkbox, the application installer starts the installation process. The application installation manager is a system application. There is only one instance of the application installation manager (**clsAppInstallMgr**) in the system; it has the well-known identifier **theInstalledApps**.

The application installation manager starts installation by:

1. Creating an application directory for the selected application.
2. Copying the application resource file from the distribution diskette to the new application directory.
3. Creating an attribute in the directory that specifies the application class.
4. Invoking **OSProgramInstall**() to start instance 0 of the application and the application monitor.

OSProgramInstall() copies the executable and DLL files into the loader database and starts the application. *Chapter 111, DLL Files*, describes how the installer locates DLL files.

Instance 0 of an application contains an application manager instance. The first thing that instance 0 of the application does is to call **AppMonitorMain**(), which fires up the

application monitor, an instance of **clsAppMonitor. AppMonitorMain()** is a part of PenPoint.

The application monitor drives the rest of the installation process. The application monitor:

1. Receives **msgAppInit** sent by **AppMonitorMain()**.
2. If this is the first time the application has been installed, the application monitor puts up the property sheet so the user can specify the configuration. The results from the property sheet are stored in the application's resource file. PenPoint defines a default property sheet; the application can override the defaults.
3. If it isn't the first time, the application monitor searches for the application's resource file in the application distribution disk.
4. The application monitor uses the resource file to drive the rest of the installation.
5. Using the resource file, the application monitor loads all other portions of the application, such as help and any miscellaneous resources.

When the application monitor finishes its work and returns from **msgAppInit**, the installation process is complete; **OSProgramInstall()** completes and the application is installed and ready to create instances.

The application monitor does not go away, however. The application monitor maintains the identity of its application class. When requested, the application monitor can perform actions such as deinstalling the application.

The application monitor is present for the life of the application's instance 0.

Installing Fonts and Handwriting Prototypes

109.4

Installing fonts and handwriting prototypes is similar to installing applications. The main difference is, of course, that fonts and handwriting prototypes have no instance 0, or related processes.

Both can be installed from either the disk view of the Connections notebook or the installed software section of the Settings notebook.

Font installation is controlled by **theInstalledFonts**, a unique instance of **clsFontInstallMgr**. Handwriting prototype installation is controlled by **theInstalledHWX**, a unique instance of **clsHWXInstallMgr**.

Service Installation

109.5

Service installation is similar to application installation, however, the services are DLLs—there are no EXEs to load.

The service installer starts installation by:

1. Creating a service directory for the selected service.
2. Creating an attribute in the directory that specifies the service class.
3. Invoking **OSProgramInstall()** to start instance 0 of the service class.

OSProgramInstall() copies the service DLL files into the loader database and starts the service class by invoking **DLLMain**(). **DLLMain**() is the service's external entry point.

The first thing that a service's **DLLMain**() should do is invoke **InitService**(), a function defined by **clsService**, that initializes the service class and searches the service INST directory for service nodes.

A service node is a service state file or a directory that contains a service state file and other information required by the service. If the **autoCreate** flag is specified, **InitService**() creates instances for each of the service nodes.

The Installation Classes 109.6

The PenPoint operating system defines a number of installation classes that assist users in installing applications, fonts, and so on. You can often use these classes as they are; you only need to subclass when you are defining a new installable entity or removing functionality from users. The classes are:

clsInstallMgr The installation manager, subclasses of which control the overall aspects of installing applications, fonts, services, and so on.

clsAppInstallMgr An instance of handles application installation.

clsFontInstallMgr An instance of handles font installation.

clsCodeInstallMgr The code installation manager, which controls the particular details of installing applications and services.

clsAppMonitor The application monitor, instances of which run in the process 0 of each application. The application monitor handles installing and deinstalling applications.

clsAuxNotebookMgr The auxiliary notebook manager, which creates and maintains the sections in the auxiliary notebooks and moves, copies, and deletes documents within those notebooks.

clsIniFileHandler The initialization file handler, which reads and processes APP.INI and SERVICE.INI files. These files contain the paths to applications and services that are required to run another application or service.

The classes described here are described in much greater detail in chapters 112 and 113.

The Installation Managers 109.6.1

The installation managers are all descendents of **clsInstallMgr**. Each installation manager has only one instance, which is created at boot time, and is called **theInstalled***Xxxx* (such as **theInstalledApps** and **theInstalledFonts**). **clsInstallMgr** defines the common tasks that the installation managers perform.

The application installation manager is an instance of **clsAppInstallMgr**. It is responsible for starting application installation. The application installation

manager creates the application directory and directs PenPoint to create instance 0 of the application.

The font installation manager is an instance of **clsFontInstallMgr**. It is responsible for locating and installing fonts.

The Application Monitor

109.6.2

The application monitor drives application installation. It locates or prompts the user for the configuration of the application and copies the necessary files into the boot volume of a running PenPoint computer.

Again, most application developers will have to subclass the application monitor for the particular requirements of your application. If you conform to the file organization specified in Chapter 110, the application monitor can locate and copy all necessary files.

Auxiliary Notebooks

109.6.3

All auxiliary notebooks are managed by **theAuxNotebookMgr**, which is defined by **clsAuxNotebookMgr**. This class defines the types of auxiliary notebooks that are available to the system. It performs the tasks required to create sections and documents in the notebooks and to move, copy, and delete documents within the notebooks.

The Configuration notebook, Stationery notebook, and the Help notebook are all auxiliary notebooks and, hence, are managed by **theAuxNotebookMgr**. Their APIs are through **clsAuxNotebookMgr**.

If you create another type of installable entity, you must use **theAuxNotebookMgr** to create a page for your entity in the configuration notebook.

Chapter 110 / PenPoint File Organization

This document describes the organization of files and directories on all PenPoint™ operating system volumes and how to organize application or service distribution volumes. These volumes include software distribution diskettes (for both applications and system software), hard disks, solid-state disks, and the PenPoint RAM file system.

If you intend to use the PenPoint-provided installer, your application distribution diskettes must conform to this organization.

Reasons for a Required Organization

The required organization is necessary to:

- Make a clean separation between the operating system and installable entities such as applications.
- Make a separation between the operating system files required at boot time and those used at run time.
- Provide an orderly development environment for application developers.
- Set up an environment where advanced filing facilities such as multiple notebooks can exist.
- Break out PenPoint's private, internal development facilities from what we deliver to the outside world.

When volumes are organized in a well-known structure, the PenPoint Application Framework, the installer, and many other tools and utilities can easily locate specific files and directories.

PenPoint volumes are used for these six purposes; the organization of files and directories allows PenPoint to accomodate all six uses:

- Volumes used to distribute PenPoint operating system software to end users.
- A volume that contains a running PenPoint system.
- Volumes used to distribute other installable resources such as fonts and dictionaries.
- Volumes used to distribute installable application software to end users.
- Volumes used to distribute PenPoint development software to applications developers (SDK).
- Volumes that contains GO's internal development environment.

PenPoint Directory Concepts 110.2

There are two basic areas on a PenPoint disk volume; the area administered by PenPoint (the \PENPOINT directory) and the area not administered by PenPoint. The \PENPOINT directory has a strict set of structural rules. GO discourages end-users from directly manipulating this area; it is meant for you—PenPoint application developers—and GO engineers.

The \PENPOINT directory includes subdirectories that can contain one or more of:

- The boot files for the PenPoint operating system.
- Files in use by an active PenPoint system.
- Installable items (applications, services, fonts, and so on).
- The PenPoint SDK software.

It is important to note that not all PenPoint volumes will have all the files and directories listed in this chapter. The following sections describes the union of all possible files and directories that can exist on a PenPoint volume.

For example, an application distribution diskette will contain a \PENPOINT\APP directory that contains an application directory. A PenPoint system distribution diskette will contain a \PENPOINT\BOOT directory for files loaded at boot time, and a \PENPOINT\SYS directory for the active system.

On the other hand, a PenPoint SDK distribution diskette probably won't have a \PENPOINT\APP, \PENPOINT\BOOT, or \PENPOINT\SYS directory, but will have a \PENPOINT\SDK directory.

Other Directories 110.2.1

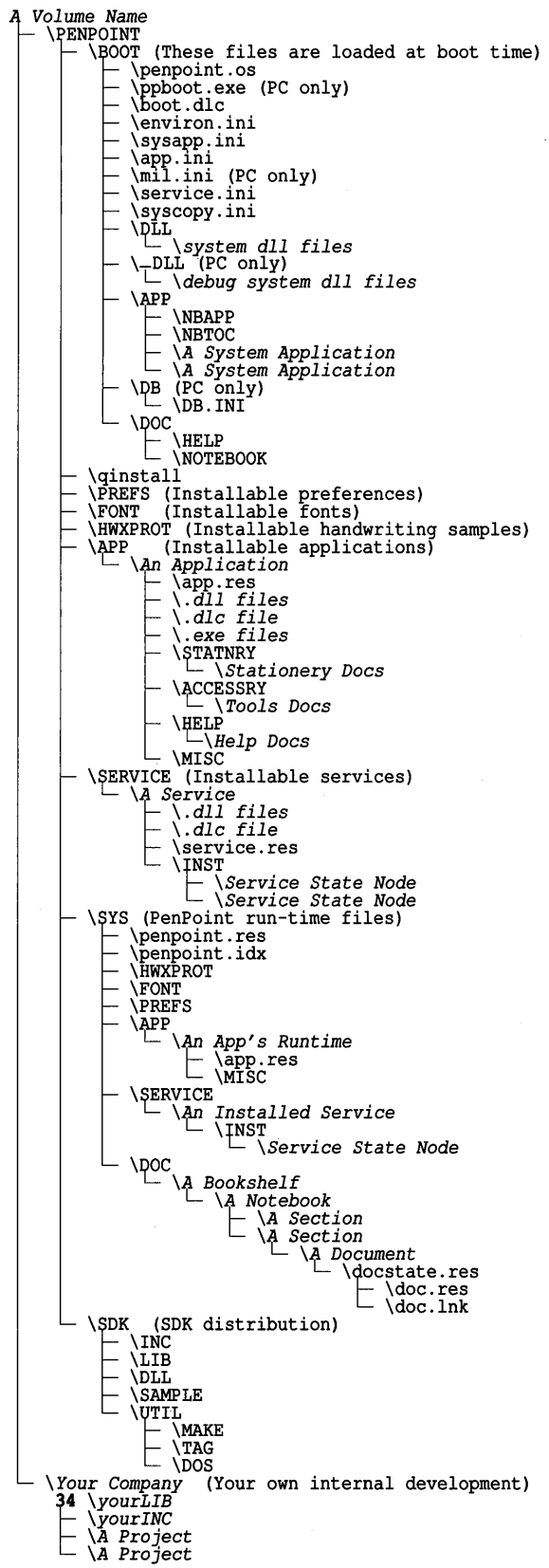
Any other directories on a PenPoint disk, outside of the \PENPOINT directory, have no structural rules. You can use these other directories to maintain your application development environment or store whatever data you choose. End-users can also use other directories to keep data. No PenPoint system software depends on structure in any other directory outside of the \PENPOINT directory.

Internally, GO uses another directory on PenPoint volumes, which allows us to maintain development efforts outside of the \PENPOINT directory. We will describe the organization of this \GO directory in later sections as a suggestion as to how you might organize a similar development environment.

The Organization 110.3

Figure 110-1 shows the overall organization of the PenPoint directory. Subsequent figures depict details of this organization. In all figures uppercase letters are used for directory names (such as \PENPOINT), lowercase letters are used for file names (such as penpoint.exe), and italic letters are used as place holders for file or directory names that are application or user dependent (such as *A Volume Name*).

Figure 110-1
PenPoint Volume Structure



General Structure 110.3.1

PenPoint volumes have this general structure:

```
\\A Volume Name
  ├─ \PENPOINT...
  └─ \Your Company...
```

As described above, the \PENPOINT directory contains files and directories for the PenPoint run-time system and the files and directories used to distribute software. It can also contain the files and directories of a running PenPoint system. Both GO and other application developers use the \PENPOINT directory to ship software to end users. Directories under \PENPOINT contain resource files, executable and DLL files, fonts, preferences, and handwriting prototypes.

The *\Your Company* directory contains the files and directories you use for your own internal development. It can include directories for each project. This directory is included in this chapter to point out a possible way to organize your own PenPoint development. The actual placement and organization of your own development directories is almost entirely up to you. However, we recommend that you do not store sources for your own development within the \PENPOINT directory (but you certainly will store your resulting applications in the \PENPOINT directory).

The PenPoint Directory 110.3.2

The \PENPOINT directory contains the files and directories used for software distribution and run-time system files. The \PENPOINT directory has the following structure. The directories with trailing ellipses (...) are described in detail in later sections.

```
\\A Volume Name
  └─ \PENPOINT
       ├─ \BOOT...
       ├─ \qinstall
       ├─ \PREFS
       ├─ \FONT
       ├─ \HWXPROT
       ├─ \APP...
       ├─ \SERVICE...
       ├─ \SYS...
       └─ \SDK...
```

The BOOT directory contains the system files used when cold-loading the PenPoint computer.

The following four directories: FONT, HWXPROT, APP, and SERVICE all contain installable items. These directories are used in distribution volumes.

The FONT directory contains installable fonts.

The HWXPROT directory contains installable handwriting prototypes.

The APP directory contains a series of installable applications. Each application is stored in a directory that contains the files needed to install an application.

The SERVICE directory contains the installable services. Each service is stored in a directory that contains the files needed to install the service.

The SYS directory contains the run-time system files used in the RAM volume.

The SDK directory contains all Software Developer's Kit (SDK) components that third-party developers and GO developers need to build an application. It includes the INC, LIB, SAMPLE, DLL, and UTIL directories.

System Distribution 110.3.3

The \PENPOINT\BOOT directory contains files and directories used to distribute and cold-load the PenPoint operating system. BOOT has this structure:

```
\BOOT (These files are loaded at boot time)
  ├─ \penpoint.os
  ├─ \ppboot.exe (PC only)
  ├─ \boot.dlc
  ├─ \environ.ini
  ├─ \sysapp.ini
  ├─ \app.ini
  ├─ \mil.ini (PC only)
  ├─ \service.ini
  ├─ \syscopy.ini
  ├─ \DLL
  │   └─ \system dll files
  ├─ \_DLL (PC only)
  │   └─ \debug system dll files
  ├─ \APP
  │   ├─ \NBAPP
  │   ├─ \NBTOC
  │   ├─ \A System Application
  │   └─ \A System Application
  ├─ \DB (PC only)
  │   └─ \db.ini
  └─ \DOC
      ├─ \HELP
      └─ \NOTEBOOK
```

PENPOINT.OS is the actual operating system.

BOOT.DLC describes the system DLL and executable files. .DLC files are described in Chapter 111, Dynamic Link Libraries. The ENVIRON.INI file contains perferences and environment variables for running PenPoint.

SYSAPP.INI is a list of system application directories to be loaded at boot time. APP.INI is an additional list of application directories to be loaded when the PenPoint computer is bootstrapped. Application developers and OEMs shouldn't have to alter the directories listed in SYSAPP.INI, unless you are removing system applications.

If you want to make an application available at boot time, you should add its directory to APP.INI. When developing applications it is a good idea to add the application to APP.INI, rather than have to go through the installer each time you boot the PenPoint computer.

SERVICE.INI contains a list of service directories from which to load services at boot time.

SYSCOPY.INI lists the files and directories to copy into the running system at boot time. This includes both source and destination specifications.

The DLL directory contains system DLL files.

The APP directory contains system application directories, which contain .EXE files for system applications. These directories include DTAPP, which contains the desktop application, and BROWSER, which contains the brower application.

Installable Entities 110.3.4

Installable (and deinstallable) entities are contained in three directories under \PENPOINT. The installer knows to look in these directories for the installable entities: fonts, handwriting prototypes, and applications. A basic version of these directories is shipped with the standard operating system distribution diskette. Additional resources (such as new fonts) can be distributed seperately.

```
\PENPOINT
  ├─ \qinstall
  ├─ \PREFS (Installable preferences)
  ├─ \FONT  (Installable fonts)
  ├─ \HWXPROT (Installable handwriting samples)
  ├─ \APP   (Installable applications)
  │    └─ \An Application...
  └─ \SERVICE (Installable services)
       └─ \A Service...
```

The QINSTALL file is only present in installation volumes. It is an optional file that directs the installer to pop up an quick installer sheet when the user connects a volume containing QINSTALL to the PenPoint computer. QINSTALL is described in greater detail later in this chapter in the section titled "Quick Install."

The PREFS directory contains installable system preferences. It always includes the standard set of preferences in the file named GENERIC.

The FONT directory contains installable fonts.

The HWXPROT directory contains handwriting prototypes. The handwriting prototypes shipped with PenPoint have been gathered from many people. End-users add further information to the HWXPROT directory when they run the Handwriting Training application; the application stores handwriting prototypes in this area.

The APP directory contains directories for installable applications and is described in the following section.

The SERVICE directory contains directories for installable services and is described after the section on installable applications.

Installable Applications 110.3.5

The \PENPOINT\APP directory contains directories for installable applications. Each application is in its own directory, named with the user-visible name of the application.

```
\APP
  └─ \An Application
       ├─ \app.res
       ├─ \.dll files
       ├─ \.dlc file
       ├─ \.exe files
       ├─ \STATNRY
       │    └─ \Stationery Docs
       ├─ \ACCESSRY
       │    └─ \Tools Docs
       ├─ \HELP
       │    └─ \Help Docs
       └─ \MISC
```

Each application directory contains:

- The application resource file (APP.RES).
- APP.INI and SERVICE.INI files that list all the other applications and services that must be loaded to run this application. When the installer finds that one of the required applications or services is not installed, it prompts the user to insert the correct distribution disk and installs that application or service.
- All the .DLL, .EXE, and .DLC files that an application will use (and that are not part of the base operating system).
- Subdirectories for stationery templates (STATNRY), help templates (HELP), and miscellaneous application files (MISC). The MISC subdirectory can contain files and directories common to all instances of an application, such as a common graphics logo.

Installable Services

110.3.6

The \PENPOINT\SERVICE directory contains directories for installable services. Each service is in its own directory, named with the user-visible name of the service.

```
\SERVICE (Installable services)
  └─ \A Service
       ├─ \.dll files
       ├─ \.dlc file
       ├─ \service.res
       └─ \INST
            ├─ \Service State Node
            └─ \Service State Node
```

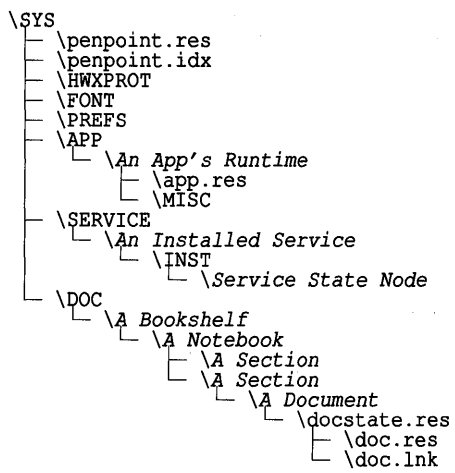
Each service directory contains:

- A SERVICE.RES file that contains resources required for this service.
- The .DLL and .DLC files that a service needs that are not part of the base operating system.
- An INIT subdirectory that contains service state nodes. These state nodes can be either:
  - Files containing preconfigured instances of the service.
  - Directories containing preconfigured instances of the service and other resource or data files.
- A MISC subdirectory that contains other information used by the service.

The Run-Time System

110.3.7

The operating system makes use of the file system at run time to maintain the dynamic state of the system. The run-time file system is also a safe storage for data across a warm boot. All run-time files are stored in \PENPOINT\SYS.



PENPOINT.RES is a resource file that contains resources for the running system.

The HWXPROT, FONT, PREFS, APP, and SERVICE directories contain the currenly installed handwriting prototypes, fonts, preferences, applications, and services.

Each installed application has a directory under the APP directory, which contains the application resource file and any other global application data. The application's instance 0 runs out of this directory.

Each installed service has a directory (under the SERVICE directory), which contains an INIT directory. The INIT directory for a particular service contains state files for the service and directories as required by the service.

Clients can get lists of these installed resources by sending a message to the well-known UIDs: **theInstalledFonts**, **theInstalledHWXProtos**, **theInstalledApps**, and **theInstalledServices**.

The DOC directory contains the current notebook (NOTEBOOK, or whatever the user names it) and its sections. A directory that contains a notebook is organized into sections; each section is a directory in the notebook directory. Each section directory contains directories for each of the documents in that section (these directories are created by **clsAppDir**).

Each document directory always contains three files (in addition to any files created by the document's application). The three files are:

- DOC.RES, which is the document's copy of the application resource file.
- DOCSTATE.RES, which is the file to which the application files the document's instance data.
- DOC.LNK, which contains a list of UUIDs used to keep track of links to other documents (such as GoTo Buttons, embedded applications, bookmarks, and so on). This file is explained in Chapter 14, The Application Class, of *Part 2: Application Framework.*

SDK Distribution 110.3.8

The \PENPOINT\SDK directory contains the libraries and include files needed to develop PenPoint applications. All of the SDK-specific information is in \PENPOINT\SDK. It has the following organization:

```
\PENPOINT
└─ \SDK  (SDK distribution)
     ├─ \INC
     ├─ \LIB
     ├─ \DLL
     ├─ \SAMPLE
     └─ \UTIL
          ├─ \MAKE
          ├─ \TAG
          └─ \DOS
```

The \PENPOINT\SDK\INC directory contains all of the header files distributed by GO in the SDK.

The \PENPOINT\SDK\LIB directory contains all the .LIB files distributed by GO in the SDK.

The \PENPOINT\SDK\DLL directory contains DLL files that are not part of the operating system, but which application developers can optionally include with their applications. For example, the NotePaper API, which is not part of the base operating system, is stored in the \PENPOINT\SDK\DLL directory.

The \PENPOINT\SDK\SAMPLE directory contains sample PenPoint applications.

The \PENPOINT\SDK\UTIL directory contains utilities to aid application developers. The MAKE subdirectory contains template make files for compiling and linking applications. The TAGS subdirectory contains tools that allow developers using the Brief, vi or emacs editors to locate `typedefs` quickly.

Your Own Internal Development 110.4

When you develop your own PenPoint application, you will probably want to maintain your files in some proximity to the \PENPOINT directories. This discussion grows from PenPoint development practices used at GO Corporation.

The organization allows you to keep your development separate from the \PENPOINT\SDK directories that you use during development and the other \PENPOINT directories that you use during testing and debugging. It also allows you to keep your applications close enough to the PENPOINT directories that you can build your applications such that your executables and DLL files can be stored directly into the \PENPOINT\APP directory.

While you do not have to structure your development in any particular way, this works well.

The *Your Company* directory has the following organization:

```
\\A Volume Name
└─ \Your Company
     ├─ \yourLIB
     ├─ \yourINC
     ├─ \A Project
     └─ \A Project
```

The *yourLIB* and *yourINC* subdirectories contain private .LIB and .H files used for your own components and applications that you use to develop system software and applications.

The individual project directories contain the files needed to build individual parts of PenPoint and applications.

Organization of Distribution Volumes 110.5

To make installation consistent and as simple as possible for end-users, PenPoint provides an application installer that performs application installation, deinstallation, deactivation, and a number of other tasks. The PenPoint Installer can automatically present an application or service for installation by reading an automatic install control file in the distribution volume.

If you use the PenPoint Installer, the files in your distribution volume must be organized according to the directories described in this chapter. This section supplements the general discussion of file organization by describing the contents of the distribution directories.

PENPOINT.DIR Files 110.5.1

File and directory names under PenPoint can be up to 32 upper and lowercase characters long and can include many special characters. However, DOS file and directory names are limited to eight uppercase characters plus a three character extension; the filename and extension can use a handful of special characters. In order to create the complex PenPoint names on DOS volumes, PenPoint stores extended information about files and directories in a file named PENPOINT.DIR. The PENPOINT.DIR file also contains file and directory attributes, which are used by PenPoint and applications.

There is one PENPOINT.DIR file per directory; each PENPOINT.DIR file contains information about the files and directories stored in that directory.

A Quick Look at STAMP 110.5.2

The STAMP utility allows you to mark a DOS file or directory with a PenPoint name. You also use STAMP to assign attributes to files or directories (you must STAMP all your application executable and DLL files to identify them as applications).

When you create long names or assign attributes to a file or directory, the PenPoint file system creates a PENPOINT.DIR file in the directory that contains the file or directory that you modified. PENPOINT.DIR contains an entry for each file that has a long name or other attributes. You can use the **GDIR** command (in \PENPOINT\SDK\UTIL\DOS) to examine the contents of the PENPOINT.DIR file.

STAMP adds or modifies information in a PENPOINT.DIR file. If the PENPOINT.DIR file does not exist, STAMP creates a new one; if an entry for the file or directory being stamped doesn't exist, STAMP creates a new entry.

The STAMP utility (and other utilities that you can use to maninpulate PENPOINT.DIR files) is documented in "DOS Utilities User's Guide" in the *PenPoint Development Tools* volume. The PENPOINT.DIR file is described in detail in *Part 7: File System* in this volume.

Application Directories 110.5.3

To create an application distribution volume, create a \PENPOINT directory in the root of a volume. Under the PENPOINT directory, create an APP directory. Under \PENPOINT\APP, create a directory for your application.

The name of this directory is the name of your application that the user sees on the screen. The directory name must be unique in the entire world of PenPoint applications. The directory name can be a PenPoint name; use the STAMP utility to name it. However, the name or an application directory cannot be longer than 28 characters; the reason for this limit is explained below.

Thus, a distribution volume for an application named "Time Management" on a volume named "Time Management Dist" would have the following structure:

```
\\Time Management Dist
   └─ \PENPOINT
        └─ \APP
             └─ \Time Management
```

We will use this example through the rest of the discussion of application directories.

Files in the Application Directory 110.5.3.1

The application directory contains:

- An APP.RES file, which contains the icons and any other resources used by your applications.
- A .DLC file (if your application uses DLLs).
- .EXE and .DLL files for your application.

When the Installer finds your application directory it first looks for a .DLC file. A .DLC file should have the same PenPoint name as the application directory, but with the extension .DLC. You need a .DLC file only when your application requires DLLs in addition to its executable file.

If the Installer doesn't find a .DLC file, it looks for an executable file. The executable file should have the same name as the application directory, but with a .EXE extension.

The maximum size of a PenPoint file or directory name is 32 characters. Because these extensions (.DLC or .EXE) add four characters to the application name, the maximum size of an application name is 28 characters.

With the files in the application directory, the PENPOINT directory has this organization:

```
\PENPOINT
  └ \APP
      └ \Time Management
          ├ \app.res
          ├ \database engine.dll
          ├ \alarm clock.dll
          ├ \Time Management.exe
          └ \Time Management.dlc
```

The TIME MANAGEMENT.DLC file contains:

```
TiManagementInc-Time Management_exe-V1(0)    Time Management.exe
TiManagementInc-database_engine_dll-V1(0)    database engine.dll
TiManagementInc-alarm_clock_dll-V1(0)        alarm clock.dll
```

All of the required executable and DLL files are in the application directory.

Stationery

110.5.3.2

To provide users with preconfigured stationery, create a directory named STATNRY under your application directory. For each stationery document that you provide, create a subdirectory in the STATNRY directory. The subdirectory should contain the file or files required by your application to store a document.

It is up to your application to understand the contents of the document subdirectory. Usually a document subdirectory contains a single APP.RES file, which contains the filed instance data for a document.

When installing your application, the installer creates a section for your application in the Stationery notebook. If your application directory contains a STATNRY directory, the installer copies the document directories and their files to your application's section in the Stationery notebook. Each document directory copied by the installer is marked with the well-known UID of your application.

If your application directory does not contain a STATNRY directory, the installer creates a section for your application in the Stationery notebook. If the stationery bit is set in the application manager metrics flags, the installer creates an empty document from your application in that directory. (For more information on application manager metrics, see *Part 2: Application Framework.*

The name of each document subdirectory in the STATNRY directory becomes the name of a document in the Stationery notebook.

Use the STAMP utility to:

- Give a PenPoint name to the document subdirectories.
- Set the stationery menu attributes of the stationery document (whether the stationery appears in the stationery menu).
- Set the NoLoad attribute for the stationery document. If NoLoad is **true**, the installer will not load the stationery document into the Stationery notebook.

When we add the STATNRY directory, the PENPOINT directory on our application distribution volume has this organization:

```
\PENPOINT
  └─ \APP
      └─ \Time Management
          ├─ \app.res
          ├─ \database engine.dll
          ├─ \alarm clock.dll
          ├─ \Time Management.exe
          ├─ \Time Management.dlc
          └─ \STATNRY
              ├─ \Personal Scheduler
              │   └─ \app.res
              └─ \WorkGroup Scheduler
                  └─ \app.res
```

When the user opens the Stationery notebook, it contains two documents belonging to the Time Management application: Personal Scheduler and WorkGroup Scheduler.

Accessories

110.5.3.3

An accessory is similar to a piece of stationery. An accessory is simply an instance of an application. Accessories appear in the Accessory notebook.

To provide accessories, create a directory named ACCESSRY under your application directory. For each accessory that you provide, create a subdirectory in the ACCESSRY directory. The subdirectory should contain the file or files required by your application to store a document.

It is up to your application to understand the contents of the document subdirectory. Usually a document subdirectory contains a single DOCSTATE.RES file, which contains the filed instance data for a document.

When installing your application, the installer creates a section for your application in the Accessory notebook. If your application directory contains an ACCESSRY directory, the installer copies the document directories and their files to your application's section in the Accessory notebook. Each document directory copied by the installer is marked with the well-known UID of your application.

If the accessory bit is set in the application manager metrics flags, the installer creates a directory for your application in the ACCESSRY directory and creates an empty document from your application in that directory. (For more information on application manager metrics, see *Part 2: Application Framework.*

The name of each document subdirectory in the ACCESSRY directory becomes the name of an accessory.

Help

110.5.3.4

To provide users with help tutorials for your application, create a directory named HELP under your application directory. For each help document that you provide, create a subdirectory in the help directory. If the installer finds a HELP directory, it creates a section for your application in the Help notebook and loads the contents of each subdirectory as documents in that section. The name of each subdirectory in the HELP directory becomes the name of a help topic in the Help notebook.

Each subdirectory can contain either:

- An APP.RES file for a PenPoint application.
- A single, specially named text file file that contains plain ASCII text or RTF text.

If the subdirectory contains a APP.RES file, it assumes that an application that can read the file will be available to PenPoint. Usually the application is MiniText, but you can provide a more sophisticated help application and store its documents in this form.

The name of each subdirectory in the HELP directory becomes the name of a help topic in the Help notebook.

If the subdirectory contains a text file, MiniText will import the text. However, the file must have one of these two names:

HELP.TXT This file contains plain ASCII text.

HELP.RTF This file contains RTF-format text.

When MiniText finds a HELP... file, it displays the file in "help" mode (that is, no menu bar, different point size, and other minor changes).

When we add the HELP directory, the PENPOINT directory on our application distribution volume has this organization:

```
\PENPOINT
  └─ \APP
       └─ \Time Management
            ├─ \app.res
            ├─ \database engine.dll
            ├─ \alarm clock.dll
            ├─ \Time Management.exe
            ├─ \Time Management.dlc
            ├─ \STATNRY
            │    ├─ \Personal Scheduler
            │    │    └─ \app.res
            │    └─ \WorkGroup Scheduler
            │         └─ \app.res
            └─ \HELP
                 ├─ \Address Book Help
                 │    └─ \address book.rtf
                 └─ \Scheduler Help
                      └─ \scheduler.rtf
```

When the user opens the Help notebook, it contains two documents belonging to the Time Management application: Address Book Help and Scheduler Help.

Application Global Data

110.5.3.5

If your application has non-resource data that it needs to access, you should create a MISC directory.

When the installer finds a MISC directory in the application distribution directory, it creates a MISC directory in your application's run-time directory, where it copies the files.

Your application should be able to determine the location of its application directory (by sending **msgAppMgrGetMetrics** to your application class). From the application directory, you can create a path to the MISC directory.

Some types of data do not fit easily into the resource model, especially those that consume a large amount of space.

When an application reads a resource, it gets a copy of the data. If the amount data is large, the application might have problems finding room to store the data.

The alternative is to store the data in a file in the MISC directory; when your application needs to access the data, you create a memory-mapped handle on the file. That way the only memory cost is in the file handle

Good examples of data you might want to put in the MISC directory is a zip code directory, a tax table, or other fixed data you want to distribute to your users. A zip code directory would be far to large and unwieldy to store as a resource, but when it is stored as a file all documents can create memory-mapped handles on the file and access the data.

When we add the MISC directory, the PENPOINT directory on our application distribution volume has this organization:

```
\PENPOINT
  └ \APP
      └ \Time Management
          ├ \app.res
          ├ \database engine.dll
          ├ \alarm clock.dll
          ├ \Time Management.exe
          ├ \Time Management.dlc
          ├ \STATNRY
          │   ├ \Personal Scheduler
          │   │   └ \app.res
          │   └ \WorkGroup Scheduler
          │       └ \app.res
          ├ \HELP
          │   ├ \Address Book Help
          │   │   └ \address book.rtf
          │   └ \Scheduler Help
          │       └ \scheduler.rtf
          └ \MISC
              └ \Zip Codes
```

All time management documents can access the zip codes stored in the MISC directory.

Service Directories

110.5.4

A service directory is quite similar to an application directory. To create a service distribution volume, create a \PENPOINT directory in the root of a volume (if one doesn't exist already). Under the PENPOINT directory, create a SERVICE directory. Under \PENPOINT\SERVICE, create a directory for your service.

The name of the service directory is the name of your service that PenPoint shows to your users. The directory name must be unique in the entire world of PenPoint services. The directory name can be a PenPoint name of up to 28 characters.

Thus, a distribution volume for an service named "CD Driver" on a volume named "CD Driver Dist" would have the following structure:

```
\\CD Driver Dist
  └ \PENPOINT
      └ \SERVICE
          └ \CD Driver
```

Files in the Service Directory 110.5.4.1

The service directory contains:

- A SERVICE.RES file.
- A .DLC file.
- DLL files for your service.
- An optional INST subdirectory.
- An optional MISC subdirectory.

When the installer finds a service directory it looks for a .DLC file. The .DLC file should have the same PenPoint name as the service directory, but with the extension .DLC.

With the files in the application directory, the PENPOINT directory has this organization:

```
\PENPOINT
└─ \SERVICE
    └─ \CD Driver
        ├─ \CD-AUDIO.dll
        │
        └─ \CD Driver.dlc
```

The CD DRIVER.DLC file contains:

```
TiManagementInc-CD_AUDIO_dll-V1(0)  CD-AUDIO.dll
TiManagementInc-CD_ROM_dll-V1(0)    CD-ROM.dll
```

All of the required executable and DLL files are in the service directory.

The INST Directory 110.5.4.2

In applications, you can provide users with preconfigured documents in the form of stationery. For services, you can provide users with preconfigured services in the form of service state nodes. These state nodes can be either:

- Files containing preconfigured instances of the service.
- Directories containing preconfigured instances of the service and other resource or data files.

To provide preconfigured services, create an INST directory in your service directory. The INST directory can contain any number of service state nodes.

When the installer finds an INST directory, it copies the contents of the directory into an INST directory for the installed service.

When we add the INST directory, the PENPOINT directory on our service distribution volume has this organization:

```
\PENPOINT
└─ \SERVICE
    └─ \CD Driver
        ├─ \CD-AUDIO.dll
        ├─ \CD-ROM.dll
        ├─ \CD Driver.dlc
        └─ \INST
            ├─ \Macintosh Format
            └─ \MS-DOS Format
```

The Quick Installer

110.5.5

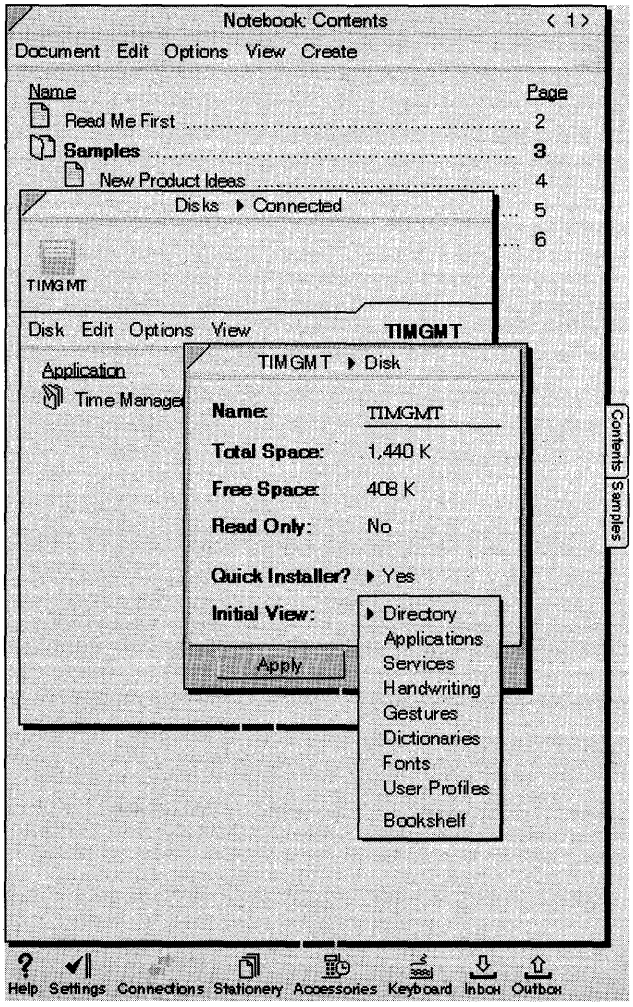
You can configure a disk volume so that PenPoint pops up an installation sheet automatically when the volume becomes available (usually when the user inserts the volume in a floppy drive).

To enable quick installation, open the Connections notebook to the disks sheet and open the disk (if it isn't open already). Tap on Disk... in the Options menu for the disk you want to modify.

Change Quick Installer? to yes, then select the Initial View, which specifies which installer is first displayed by the quick installer (Directory, Applications, Services, Handwriting, and so on).

In Figure 110-2 the disk TIMGMT is open in the Connections notebook and the user has tapped on Initial View.

Figure 110-2
Creating a Quick Install Disk



Multiple Applications and Multiple Volumes 110.5.6

A distribution volume can contain a mixture of applications and services (provided they will all fit on a single volume).

The PenPoint Installer does not currently support applications or services that span more than one volume. If you have such an application, you must control installation yourself from the application monitor (instance 0 of your application).

Upgrading 110.5.7

Currently users upgrade applications or services by deinstalling the old version and installing the new version.

Chapter 111 / Dynamic Link Libraries

A linker joins together a number of object modules to form a single executable file. This allows you to incorporate object files from many sources. It also allows you to maintain a single, shared copy of the object file, which all applications link with. However, each executable file that you create by linking object modules contains a copy of the object code; if 10 applications link with the same object file, there are 10 copies of that object file in the resulting 10 executable files. In the PenPoint computer, where memory is at a premium, this replication is wasteful and undesireable.

The solution is to create an executable file that can access a single, shared object code module only when it is required. PenPoint provides this solution by using Dynamic Link Library files (DLL files).

You create a DLL file by compling a source file with options that create a DLL file rather than an object file.

You reference a DLL file by calling a routine or referencing a class that is external to your object file. Before you link your object file, you define all DLL routines and classes in a DLL.DEF file.

For more information on the DLL.DEF file, see the *PenPoint Application Writer's Guide* and the *Microsoft Operating System/2 Programmer's Toolkit* manual.

References to DLL Files

111.1

Clients can refer to DLL files in two ways:

- A client makes a reference to a routine in the DLL file (explicit referencing).
- A client makes a reference to a class in the DLL file (implicit referencing).

A client can reference a DLL file either from within its own executable file or from within another DLL file.

Explicit references cause the linker to make a dynamic link entry in the referencing executable or DLL file. There can be circular explicit references. An explicitly referenced DLL file must be loaded when the linker entry is processed.

Implicit references must be determined by the developer, because the linker cannot make entries for them. Most of the DLL file dependencies in PenPoint are due to implicit references.

An implicitly referenced DLL file must be loaded before an object of the referenced class is created.

DLL File Issues

111.2

The PenPoint Application Monitor ensures that only one copy of a particular DLL file is loaded on the PenPoint computer. This is not as simple as you might expect because:

- PenPoint has to know which applications require which DLL files.
- If more than one version of a DLL file exists, PenPoint must determine which version or versions can be loaded.
- PenPoint must know when it can unload a DLL file because the applications that referred to it are no longer present.

In order to determine which DLL files are loaded (and avoid duplicating DLL files in memory), PenPoint needs to reliably identify DLL files. When unloading DLL files, PenPoint needs to determine whether any applications still refer to the DLL file; if the DLL file is still referenced, it should't be unloaded. You cannot guarantee that the application that caused PenPoint to load a DLL file is the only application that refers to that DLL file.

Finally, PenPoint must have a scheme that deals with different versions of the DLL files that make up both our system software and applications. This scheme needs to take versioning of classes into account as well.

This chapter discusses the mechanisms used by PenPoint to ensure that the correct DLL files are loaded. This chapter is essential to application installation because you, the application developer, are responsible for providing PenPoint with the correct information in the correct places. Without correct information, the PenPoint application installation software will not be able to install your application properly.

Identifying DLLs

111.3

Each application has its own set of DLL files, which live in the application's directory on disk. This directory must contain all non-operating system DLL files that an application needs (including third-party DLL files and company DLL files that are common to a suite of applications).

Although the application directories on disk might contain duplicate DLL files, PenPoint ensures that only one copy of a particular DLL file is installed in PenPoint computer memory (where it is shared by all applications that need it).

Each DLL file has a unique **dll-id** name. A DLL file is named by the developer that created it. Executable files are also named in this manner. The **dll-id** is given in the LIBRARY field of the DLL.DEF file that was used to build the module. The **dll-id** is a text string (up to 32 characters) of the form:

companyName-moduleName-majorVersion(minorVersion)

The dashes and parentheses are part of the syntax and are required; string parsing depends on them. The fields can contain letters, numbers, and the underscore character (_).

companyName is the name of the company that created the DLL or executable file. For example, the company name for GO Corporation is GO.

moduleName is the name of the DLL or executable file. Be sure that DLL files and executable files have different **moduleNames**. GO recommends that you call the executable file **moduleName_exe** and the DLL file **moduleName_dll**.

majorVersion is the version number of the DLL file. **minorVersion** is an optional minor version number; it is ignored by the operating system when it determines whether a DLL is already loaded in the PenPoint computer.

DLC Files

111.4

A .DLC file lists all the explicit and implicit DLL file references made by the application executable file; the .DLC file also names the application executable file itself. The .DLC file allows the operating system to preload implicit references and to locate explicit references.

Application developers must create a .DLC control file for each application that uses DLL files. If an applications has a single executable file that has the same name as the application directory, the application does not need a .DLC file.

The .DLC file must have the same name as the application directory and the executable file. For example, an application with the PenPoint name Graph It Right would be stored in the directory \PENPOINT\APP\Graph It Right; the executable file would be called Graph It Right.EXE and the .DLC file would be called Graph It Right.DLC.

Each line in a .DLC file contains a pair or names: a **dll-id** and a file system path to the corresponding DLL file or executable file. All paths are relative to the application's directory. For example, **grapher** might have the following format:

```
GO-forms_dll-V1(2)   forms.dll
GO-Grapher_exe-V1    grapher.exe
```

The operating system reads the .DLC file when it loads an application; it ensures that all the DLL files in the .DLC file are loaded before it brings in the executable file.

The operating system will use the **dll-id** to determine if a DLL file is already loaded, and not load the new DLL file if so. This rule also applies to executable files, but there will be very few cases where an executable file is already loaded.

Applications can also load optional DLL files if desired. These are DLL files that aren't part of a executable file load, such as a database engine. The developer must create a .DLC file for optional DLL files if they reference other DLL files.

Sharing DLL Files

111.5

When the application monitor loads a new application, it checks the **dll-ids** in the .DLC file against the list of currently loaded **dll-ids**. The comparison includes the company name, the DLL name, and the major version number. (It is too

dangerous to automatically run an application with a DLL file that has a different major version number.)

The application monitor does not compare minor version numbers. Different minor version numbers must be guaranteed to be compatible by the developer.

If the **dll-id**s match, the DLL has been loaded already; the operating system does not load the DLL but increments a reference count for the **dll-id**.

If the dll-ids do not match, the application monitor loads the DLL from the path specified in the .DLC file.

This scheme guarantees that an application that was written to run with a particular DLL file will always run with that DLL file.

When an application is deinstalled, the application monitor again opens the corresponding .DLC file and compares its **dll-id**s against the currently loaded **dll-id**s. If the Application Monitor finds a match, it decrements the **dll-id** reference counter. If the reference counter becomes zero, the application monitor can deinstall the DLL file.

Versions

111.6

An already loaded DLL file is used only if there is an match between **dll-id**s through the major version number.

From a developer's perspective, when you add new functionality to a DLL file, you should revise the **dll-id**'s major version number.

- If the new functionality is backwards compatible, you should upgrade the version number in the class UID.
- If the new functionality is not backwards compatible, you must create a new class ID.

DLL Processes

111.7

A DLL file can optionally contain a **DLLMain**() routine, which usually contains code to install the DLL's classes. When a DLL file is loaded, PenPoint creates a process and transfers control to the **DLLMain**(). These classes (and any other memory that the DLL file creates) are owned by the DLL file's process. A DLL process will dispatch messages, so a DLL file can also create well-known objects at init time.

The process, all memory associated with the DLL file, and all classes owned by the DLL file are destroyed when the DLL file's reference count goes to zero and it is deinstalled.

However, this utility comes at some expense; a process uses approximately 37K bytes of memory. If you structure your application so that it uses several distributed DLLs, each of which creates its own process, you can run short of memory fairly quickly.

When you create a DLL file, you have three options:

- Create a DLL file that doesn't have a **DLLMain**(), contains code for one or more classes, and which exports initialization functions for one or more classes. When your application needs a class, it calls the exported function to initialize the class. Your application uses a private well-known UID to identify the class.
- Create a DLL file that has a **DLLMain**() and contains code for more than one class. All of the classes use global well-known UIDs to identify the classes. All the classes share the same memory and process.
- Create a DLL file that has a **DLLMain**() and code for only one class. The class is identified with a global well-known UID.

Operating System DLL Files and Versions 111.8

The operating system is somewhat different from applications. The operating system is defined as those DLL files and executable files that are loaded into the machine at boot time and are always present. There can only by one version of the operating system in the machine at any time, and upgrading the operating system is done by a cold boot. Applications should be able to run on many different operating system versions. Most importantly, applications written for earlier versions of the operating system should run on later versions.

Operating system DLL files also have **dll-ids**, but these **dll-ids** have no major or minor version numbers. This is so explict references that show up in application executable or DLL files will not be affected by operating system upgrades.

The version number for operating system classes can be incremented when new functionality is introduced. However, operating system classes must be strictly backwards compatible. A new class number must be used when backwards compatibility is broken. The class manager will always search for an exact match when a class is referenced, but will accept a higher-versioned class if it can't find an exact match.

Applications can query class version on a per-class basis. We will also provide an overall version number for the operating system in the system resource file. An application can specify the minimum operating system version it will run under at installation time.

DLL Files and MAKE Files 111.9

All PenPoint DLL files that are not part of the system that is loaded at boot time (in BOOT.DLC) are distributed in \PENPOINT\SDK\DLL. The **DLL_TYPE, DISTRIBUTED**, builds a project into \PENPOINT\SDK\DLL. For example, if project Grafpapr specifies

```
DLL_TYPE = DISTRIBUTED
```

in its makefile, MAKE creates the file \PENPOINT\SDK\DLL\ GRAFPAPR\ GRAFPAPR.DLL.

Applications that dependend on a distributed .DLL file should include a `DISTRIBUTED_DLLS =` line in their makefile. This line should contain all the distributed DLL files that should be included with the app. For example:

```
DISTRIBUTED_DLLS = grafpapr\grafpapr.dll atp\flap.dll
```

If an application needs a .DLC file, the .DLC file should be part of the application project directory. The default name for a .DLC file is PROJECT_NAME.DLC. The .DLC file is copied into the application directory when the application is built.

Chapter 112 / Installation Managers

clsInstallMgr provides applications with the facilities to manage installable items. An **item** can be any sort of resource. Each type of installable item has its own **installer**.

An installer is an instance of **clsInstallMgr**, or a instance of a subclass of **clsInstallMgr**. The installer handles all common operations used to maintain installable items.

The installer application uses installers to install and deinstall several sets of items, such as applications and fonts. Fonts are a straight-forward use of the installable item manager. Applications require a much more complex use of the installable item manager.

Installer Concepts

112.1

The install manager class (**clsInstallMgr**) describes messages used by installers to install, deinstall, and maintain installable items.

Unless you are writing your own installer, you probably don't need to send or handle most **clsInstallMgr** messages. However, there is a core set of **clsInstallMgr** messages that are used by many applications. These messages are:

msgIMInstall
msgIMDeinstall
msgIMGetInstalledList
msgIMGetState
msgIMSetCurrent
msgIMGetCurrent
msgIMGetName
msgIMFind

Additionally, if your application needs to keep track of installed items, you can observe an installation manager.

clsInstallMgr also serves as the superclass for a number of specialized installers. Some types of installable items require their own installer class. These classes are subclasses of **clsInstallMgr**:

- **clsAppInstallMgr** maintains applications.
- **clsFontInstallMgr** maintains fonts.
- **clsServiceInstallMgr** maintains services.

Each of these services and their messages are described at the end of this chapter.

Installers 112.1.1

For each of the installer classes, there is a well-known instance of that class. That instance is the installer for that type of item.

The instance of **clsAppInstallMgr** is **theInstalledApps**; the instance of **clsServiceInstallMgr** is **theInstalledServices**; the instance of **clsFontInstallMgr** is **theInstalledFonts**.

Other types of items do not require specialized messages for installation. The installers for these groups are simply instances of **clsInstallMgr**. These installers are:

- **theInstalledHWXProtos**, which maintains the handwriting samples.
- **theInstalledPDicts**, which maintains the spelling dictionaries.
- **theInstalledPrefs**, which maintains the user preferences.

Additionally, the class **clsInstallMgr** also serves as a central repository of information about all installed items. If you use a subclass to maintain information about an installed item, the same information is also maintained by **clsInstallMgr**.

Installed Item Database 112.1.2

clsInstallMgr and its subclasses use the file system to keep a database of the installed items. Each item is represented by a handle on a file or directory. When PenPoint installs an installable item, it creates a directory or file in the appropriate \PENPOINT subdirectory. Application directories are stored in \PENPOINT\APP; font files are stored in \PENPOINT\FONT, and so on. The handle is the mechanism by which the install manager keeps track of the installed items.

Representing installed items with files or directories is a big win for items that are files or directories. When the item is a file or directory, the install manager's handle is a handle on that actual item. However, if an installable item is not a file, there must be an extra level of indirection.

The installers use the attributes in the file system node to store information about the item, such as the item's identifier. An item's identifier has different meanings for different items. For applications, the identifier is the application class's well-known UID; for fonts the identifier is the font ID number.

Usually the installer creates an initial set of item handles from the contents of its directory. You can override this behavior by setting the **createInitial** style bit to false; when **createInitial** is false, the installer will not creates item handles from its directory.

Controlling Items 112.1.3

clsInstallMgr provides several attributes that pertain to items, and an API for getting and setting these items.

clsInstallMgr provides an optional API to make an item current, and an API for getting and setting that attribute. An item can also be marked as being in use. The current item is considered to be in use. Items that are in use cannot be deinstalled.

A notion of whether a item differs from when it was installed is also provided. Clients should mark items as modified when they change them by sending **msgIMSetModified**. The installer will remember the time and date that the item was modified.

Clients access installable managers by an **ObjectCall()** interface. **clsInstallMgr** can accommodate simultaneous access by multiple clients if the shared style bit is set **true** (the default). This causes it to use the semaphore for all of its operations. This semaphore is available to subclasses through **msgIMGetSema**, and should be used to protect all subclass messages if multiple clients will be accommodated. **clsInstallMgr** also sets **objCapCall** on by default.

Observing Installation Managers 112.2

Usually most application developers do not need to use **clsInstallMgr** messages. However, if you want to monitor the coming and going of things such as fonts or handwriting samples, you can observe an installer.

clsInstallMgr monitors the item directory and sends notification whenever an installable item is added, removed, or when a different item becomes current. **clsInstallMgr** first sends observer messages to **self**, which allows subclasses to intercept them. If the send to **self** returns **stsOK**, **clsInstallMgr** sends the messages to observers.

A subclass of **clsInstallMgr** can prevent notification of observers by returning **stsIMNoNotify**. A subclass can turn notification generation off entirely by sending **msgIMSetNotify** to its ancestor. **msgIMSetNotify** takes a BOOLEAN value as its argument. If the value is **true**, it turns notification off.

A client can request the current notification state by sending **msgIMGetNotify** to **self**. The message takes a pointer to the BOOLEAN value that will receive the current notification state.

Clients can make themselves observers of a installation manager by sending **msgAddObserver** to that installation manager. For instance, to observe the handwriting installation manager, you would send **msgAddObserver** to **theInstalledHWX**.

Table 112-1 lists the notification messages described by **clsInstallMgr**.

Table 112-1
clsInstallMgr Notification Messages

Message	Takes	Description
msgIMNameChanged	P_IM_NOTIFY	The name of an item has changed.
msgIMCurrentChanged	P_IM_CURRENT_NOTIFY	The current item has changed.
msgIMInUseChanged	P_IM_INUSE_NOTIFY	An item's inUse attribute has changed.
msgIMModifiedChanged	P_IM_MODIFIED_NOTIFY	An item's modified attribute has changed.
msgIMInstalled	P_IM_NOTIFY	A new item was installed.
msgIMDeinstalled	P_IM_DEINSTALL_NOTIFY	An item has been deinstalled.

Handling msgIMNameChanged 112.2.1

Observers receive **msgIMNameChanged** when the name of a item has changed. The message passes a pointer to an IM_NOTIFY structure that contains:

manager The UID of the manager that sent the notification.

handle The handle on the item that changed.

Handling msgIMCurrentChanged 112.2.2

Observers receive **msgIMCurrentChanged** when another item becomes the current item. The message passes a pointer to an IM_CURRENT_NOTIFY structure that contains:

manager The UID of the manager that sent the notification.

newHandle The handle of the new current item.

oldHandle The handle of the old item.

Handling msgIMInUseChanged 112.2.3

Observers receive **msgIMInUseChanged** when a item's **inUse** attribute has changed. The message passes a pointer to an IM_INUSE_NOTIFY structure that contains:

manager The UID of the manager that sent the notification.

handle The handle on the item that changed.

inUse A BOOLEAN value that indicates the item's new **inUse** state.

Handling msgIMModifiedChanged 112.2.4

Observers receive **msgIMModifiedChanged** when an item's modified attribute has changed. The message passes a pointer to an IM_MODIFIED_NOTIFY structure that contains:

manager The UID of the manager that sent the notification.

handle The handle on the item that changed.

modified A BOOLEAN value that indicates the item's new modified state.

Handling msgIMInstalled 112.2.5

Observers receive **msgIMInstalled** when an installable item has been installed or a deactivated item was reinstalled. The message passes a pointer to an IM_NOTIFY structure, as described above in "Handling **msgIMNameChanged**."

Handling msgIMDeinstalled 112.2.6

Observers receive **msgIMDeinstalled** when an installable item has been deinstalled. The message passes a pointer to an IM_DEINSTALL_NOTIFY structure.

Using clsInstallMgr Messages 112.3

The messages defined by **clsInstallMgr** are used by installers to manipulate installed items and to get information about the installation managers. These messages are defined in INSTLMGR.H.

Table 112-2 lists the messages defined by **clsInstallMgr**.

Table 112-2
clsInstallMgr Messages

Message	Takes	Description
		Class Messages
msgNew	P_IM_NEW	Creates a new install manager.
msgNewDefaults	P_IM_NEW	Initializes the IM_NEW structure to default values.
		Instance Messages
msgIMGetStyle	P_IM_STYLE	Passes back the current style settings.
msgIMSetStyle	P_IM_STYLE	Sets the current style.
msgIMGetCurrent	P_IM_HANDLE	Passes back the current item's handle.
msgIMSetCurrent	IM_HANDLE	Sets the current item.
msgIMSetInUse	P_IM_SET_INUSE	Changes an item's in use setting.
msgIMSetModified	P_IM_SET_MODIFIED	Changes an item's modified setting.
msgIMGetName	P_IM_GET_SET_NAME	Gets the name of a item.
msgIMSetName	P_IM_GET_SET_NAME	Sets the name of a item.
msgIMGetVersion	P_IM_GET_VERSION	Gets the version string for this item.
msgIMGetList	P_LIST	Passes back a list of all the items on this install manager.
msgIMGetState	P_IM_GET_STATE	Gets the state of a item.
msgIMGetSize	P_IM_GET_SIZE	Returns the size of an item.
msgIMInstall	P_IM_INSTALL	Installs a new item.
msgIMDeinstall	P_IM_DEINSTALL	Deinstalls an item.
msgIMDup	P_IM_DUP	Creates a new item that is a duplicate of an existing one.

continued

Table 112-2 (continued)

Message	Takes	Description
msgIMUIInstall	P_IM_UI_INSTALL	Installs a new item with a user interface.
msgIMUIDeinstall	P_IM_UI_DEINSTALL	Deinstalls an item with a user interface.
msgIMUIDup	P_IM_UI_DUP	Duplicates and item with a UI.
msgIMFind	P_IM_FIND	Finds a item's handle, given its name.
msgIMGetSema	P_OS_FAST_SEMA	Gets the concurrency protection semaphore.
msgIMGetDir	P_OBJECT	Passes back a directory handle on the install manager's directory.
msgIMGetInstallerName	P_STRING	Passes back the install manager's name.
msgIMGetInstallerSingularName	P_STRING	Passes back the install manager's singular name.
msgIMGetInstallPath	P_STRING	Passes back the install base path.
msgIMGetVerifier	P_OBJECT	Passes back the current verifier object.
msgIMSetVerifier	OBJECT	Sets the current verifier object.
msgIMVerify	OBJECT	Verify the validity of an item that is being installed.
msgIMExists	P_IM_EXISTS	Verify the existance of an item that is being installed.
msgIMGetNotify	P_BOOLEAN	Returns notification generation state.
		Subclass Messages
msgIMSetNotify	BOOLEAN	Turns notification generation on or off.

Managing Installable-Item Managers 112.3.1

The following sections describe how to create and alter installable managers (instances of **clsInstallMgr**).

Creating an Installable-Item Manager 112.3.1.1

To create an installable manager, send **msgNewDefaults** and **msgNew** to **clsInstallMgr**. The message takes a pointer to an IM_NEW structure that contains an OBJECT_NEW_ONLY structure and:

style Style specifiers for the installable manager. Currently the only style is **shared**, which specifies whether the installable manager will be accessed by multiple clients. If **shared** is true (the default) **clsInstallMgr** creates a semaphore for the manager. However, semaphores are an expensive system resource; if you know that no other clients will access the installable manager, you can specify false, which does not create a semaphore.

locator A file system locator that indicates the directory that contains the items. The directory must exist before you create the installable manager object.

Getting and Setting the Style of an Installable-Item Manager 112.3.1.2

When you create an instance of **clsInstallMgr**, you can specify the installable item's style. Currently, the style only indicates whether the installable item is accessed by one or many clients. By default, the installable manager is shared, however, you can get and set the style by sending **msgIMGetStyle** and **msgIMSetStyle** to an instance of **clsInstallMgr**.

Both messages require an IM_STYLE structure that contains a single member: a BOOLEAN value (**shared**) that indicates whether the item is shared or not. If **shared** is **true**, the installable manager can be shared by more than one client.

As described earlier, when an installable manager is shared, it must create a semaphore. When you set **shared** to **false**, the semaphore is released, freeing system resources.

Getting the Item Directory 112.3.1.3

To get a directory handle of the directory observed by an installable manager, send **msgIMGetDir** to the installable manager. The only argument for the message is a pointer to the location that receives the handle.

Managing Installable Items 112.3.2

The following sections discuss how to install, deactivate, reactivate, copy, update, and delete installable items.

Installing an Installable Item 112.3.2.1

To add an installable item from an external volume to a item directory, send **msgIMInstall** to the appropriate installable manager. The message takes a pointer to an IM_INSTALL structure that contains:

locator A locator that specifies where the installable item is stored.

updateOK An IM_INSTALL_EXIST value that specifies what to do if the installable item exists already. The possible IM_INSTALL_EXIST values are:

imExistUpdate Copy a new item over an existing item.

imExistReactivate Deactivate the existing item, and activate the new item.

imExistGenError Return **stsIMAlreadyInstalled.**

imExistGenUnique Generate a different name for the new item.

imExistIncRefCount Increment the reference count of the existing item.

listAttrLabel An FS_ATTR_LABEL structure that describes the attribute list for the handle on the new item. This field is used internally by PenPoint, and should always be **null.**

listHandle A file system handle that will get the attributes. This field is used internally by PenPoint, and should always be **null.**

If the message is successful, it returns a handle on the installed item (**handle**).

Duplicating an Installed Item 112.3.2.2

To duplicate an installable item, send **msgIMDup** to the installable manager. The message takes an IM_DUP structure that specifies:

handle The handle of the item to duplicate.

pName The name of the new item. If **pName** is NULL, **clsInstallMgr** creates a unique name. If **pName** is not NULL, it must be a valid item name.

When the message completes, the structure returns the handle of the new item (**newHandle**).

If a item with **pName** exists already, the message returns **stsIMAlreadyInstalled.**

Deleting an Installable Item 112.3.2.3

To delete an installable item, send **msgIMDeinstall** to the installable manager. The item cannot be the current item. The message takes a pointer to an IM_DEINSTALL structure that specifies:

handle The UID of the item to delete.

You must use **msgIMDelete** to delete an installable item from the file system. The handle on the item node and the installable manager protect items from any other form of destruction. Messages that attempt to delete a file system node that is used by the installable manager return **stsFSNodeBusy**.

Altering Installable Item Attributes 112.3.3

The following sections describe messages that alter the attributes of individual installable items.

Getting and Setting the Current Installable Item 112.3.3.1

To make an installable item the current item, send **msgIMSetCurrent** to the installable manager. The only argument to the message is the UID of the item to make current. To clear the current item (so that no item in the item directory is current) use **objNull** as the object UID.

To get the handle of the current item, send **msgIMGetCurrent** to the installable manager. The only argument for the message is a pointer to the OBJECT location that receives the UID of the current object. If there is no current object, the message returns **objNull.**

Changing an Installable Item's Name 112.3.3.2

To change the name of an installed item, send **msgIMSetName** to the installable manager. The message takes an IM_SET_NAME structure that contains:

handle The handle of the item to be changed.

pName The new name for the item. The name must be a valid item name.

To get the current name for a item, use **msgIMGetState.**

Getting Information About an Installable Item 112.3.4

The messages in the following sections get information about installable items.

Finding an Installable Item by Name 112.3.4.1

If you know the name of an installable item but don't know its handle (its UID), you can send **msgIMFind** to the appropriate installable manager. The message takes a pointer to a IM_FIND structure that specifies the name of the item to look up (**pName**).

If the item is found, the IM_FIND structure returns the UID of the item handle (**handle**).

If the item is not found, the message returns **stsNoMatch**.

Getting a List of Items 112.3.4.2

To get a list of items (installed and deactivated) in a item directory, send **msgIMGetList** to the installable manager. The only argument for the message is a pointer to a LIST that receives the item handles. The message obtains space for the list from your default process heap. It is your responsibility to free the LIST object.

Getting the Attributes of an Installable Item 112.3.4.3

To find out the name and attribute state of an installable item, send **msgIMGetState** to the installable manager. The message takes a pointer to an IM_GET_STATE structure that specifies:

handle The handle of the item to get information on.

pName A pointer to the string that receives the name of the item. If you specify `pNull` in **pName**, the message will not return the item name.

The message uses the IM_GET_STATE structure to return:

current A BOOLEAN value that receives the indication whether the item is the current item.

modified A BOOLEAN value that receives the indication whether the item has been modified or not.

Getting the Size of an Installable Item 112.3.4.4

Before installing an item, it is a good idea to know its size so that you can determine whether there is enough room in the PenPoint computer for the item. To get the size of the item, send **msgIMGetSize** to the installable manager. The message takes a pointer to an IM_GET_SIZE structure, which contains the handle of the item (**handle**).

When the message returns, the IM_GET_SIZE structure contains the size of the item in the **size** field.

Advanced clsInstallMgr Topics 112.4

The following messages should only be used by clients that subclass **clsInstallMgr**.

Using the Semaphore 112.4.1

When an installable manager object is created with **shared** set to **true**, it uses a semaphore to synchronize client access. If you subclass **clsInstallMgr**, you will need to use the same semaphore to synchronize your access to a item directory.

Send **msgIMGetSema** to a specific installable manager to get the manager's semaphore identifier. The message takes a pointer to an OS_FAST_SEMA value that receives the semaphore identifier. Note that this is only the identifier of the semaphore; not access to the item directory.

clsInstallMgr uses the semaphore whenever it receives a message that concerns the item directory (such as **msgIMInstall**). **clsInstallMgr** requests the semaphore before it first accesses the item directory and clears it only after the last time it accesses the item directory.

When a subclass of **clsInstallMgr** must access the item directory, it should get the semaphore identifier from the installable manager. The subclass must use the **OSFastSemaRequest** to request access to the item directory and **OSFastvSemaClear** to release the semaphore.

At some time, the subclass might need to call ancestor (**clsInstallMgr**) while it holds the semaphore. When invoked by a call ancestor, **clsInstallMgr** can request the same semaphore. PenPoint grants the semaphore because the request came from the same task that is currently holding the semaphore. PenPoint maintains a count of the number of semaphore requests from the same task. When PenPoint receives **OSSemaClear**, it decrements the count.

Code Installation Manager 112.5

The code installation manager, **clsCodeInstallMgr**, is a subclass of **clsInstallMgr** that performs installation tasks common to both applications and services. The capabilities added by **clsCodeInstallMgr** are that it can:

- Install an application or service.
- Return a list of the classes of all the currently installed applications or services.
- Get the application or service class of an item handle.
- Find the item handle for a specific application or service class.

The **clsCodeInstallMgr** messages are defined in CODEMGR.H. Table 112-3 lists the messages defined by **clsCodeInstallMgr**.

Table 112-3
clsCodeInstallMgr Messages

Message	Takes	Description
msgCIMGetClassList	P_LIST	Passes back a list of the classes of the installed applications or services.
msgCIMGetClass	P_CIM_GET_CLASS	Given a handle, passes back the class.
msgCIMFindClass	P_CIM_FIND_CLASS	Returns the handle which references the specified class.
msgCIMFindProgram	P_CIM_FIND_PROGRAM	Finds a item's handle, given its program name.
msgCIMGetTerminateStatus	P_CIM_TERMINATE_VETOED	Gets termination status of last item deinstalled.
		Descendent Responsibility Messages
msgCIMLoad	P_CIM_LOAD	Installs code for the item specified.
msgCIMTerminateOK	P_CIM_TERMINATE_OK	Is this item willing to be terminated?
msgCIMTerminate	P_CIM_TERMINATE	Unconditionally terminate this item.
msgCIMTerminateVetoed	P_CIM_TERMINATE	Somebody vetoed the termination sequence.

Installing an Application or Service

112.5.1

To install an application, send **msgCIMLoad** to **theInstalledApps** or **theInstalledServices**. This message must be sent with the **ObjectSend**() macro, not **ObjectCall**(). The message takes a pointer to an CIM_LOAD structure, which contains a file handle on the item to load.

clsCodeInstallMgr does not handle **msgCIMLoad**; it is up to the classes that inherit from **clsCodeInstallMgr** (**clsAppInstallMgr** and **clsServiceInstallMgr**) to handle **msgCIMLoad**.

Application Installation Manager

112.5.2

clsAppInstallMgr is a subclass of **clsCodeInstallMgr** used to install applications. **clsAppInstallMgr** adds the ability to get or set the mask class. The mask class enables the PenPoint notebook to prompt the user when they attempt to turn to a document for which the application is no longer installed.

The **clsAppInstallMgr** messages are defined in APPIMGR.H. Table 112-4 lists the messages defined by **clsAppInstallMgr**.

Table 112-4
clsAppInstallMgr Messages

Message	Takes	Description
msgAIMGetMaskClass	P_CLASS	Passes back the mask class.
msgAIMSetMaskClass	CLASS	Sets the mask class.

If the user deinstalls an application while there are documents for that application in the PenPoint computer, the installer substitutes a mask application class in place of the application class for each document. By default, PenPoint uses the placeholder application (defined by **clsMaskApp**) as the mask application. The placeholder's only function is to respond to Application Framework activation messages by displaying a page that informs the user that the application has been deinstalled.

For more information about **clsMaskApp**, see *Part 2: Application Framework.*

PenPoint allows you to substitute your own mask application in place of the placeholder application.

Service Installation Manager 112.5.3

The service installation manager, **theInstalledServices**, maintains the installed and deinstalled services in PenPoint. **theInstalledServices** is an instance of **clsServiceInstallMgr**; **clsServiceInstallMgr** is a subclass of **clsInstallMgr**. The service installation manager differs from **clsInstallMgr** in that it must handle metrics for the service classes.

The **clsServiceInstallMgr** messages are defined in SERVIMGR.H. Table 112-5 lists the messages defined by **clsServiceInstallMgr**.

Table 112-5
clsServiceInstallMgr Messages

Message	Takes	Description
msgSIMGetMetrics	P_SIM_GET_METRICS	Gets the specified service class's metrics.

Font Installation Manager 112.6

The font installation manager, **theInstalledFonts**, maintains the installed and deinstalled fonts in PenPoint. **theInstalledFonts** is an instance of **clsFontInstallMgr**; **clsFontInstallMgr** is a subclass of **clsInstallMgr**. The font installation manager differs from **clsInstallMgr** in that it must identify fonts and maintains the notion of the system font.

Font Identification 112.6.1

Fonts are identified in four ways:

- A font file handle.
- The name of a font file.
- A short font id.
- A string (or long) font id.

A font file handle is a file handle on to the actual font file. Most of the font installation manager interface uses these handles.

The font file name is the user-visible name for the font. You can get the font file name with the messages **msgIMGetName** (which uses a handle) and **msgFIMGetNameFromId** (which uses an ID).

A short font ID is a pre-defined, 16-bit value that identifies a specific font. It is a compact, specific reference for a particular font that appears in the window system API.

A string font ID is a 4-character version of a short font ID.

You can get a list of all the font handles in the system by sending the superclass message **msgIMGetList** to **theInstalledFonts**. This list includes fonts which are deactivated. You can use the superclass message **msgIMGetActiveList** to get a list of the active fonts.

To get a pruned list of the active fonts that is appropriate for end-user display, send **msgFIMGetInstalledIDList** to **theInstalledFonts**.

clsFontInstallMgr can:

- Get a list of the short IDs of all the installed fonts.
- Get a font's short and long IDs.
- Set the font's file ID.
- Find a font handle, given a short ID.
- Return a font name, given a short ID.

clsFontInstallMgr Messages

112.6.2

The **clsFontInstallMgr** messages are defined in FONTMGR.H. Table 112-6 lists the messages defined by **clsFontInstallMgr**.

Table 112-6
clsFontInstallMgr Messages

Message	Takes	Description
msgFIMGetId	P_FIM_GET_SET_ID	Gets the short and long font IDs, given a handle.
msgFIMSetId	P_FIM_GET_SET_ID	Set the font file's ID.
msgFIMFindId	P_FIM_FIND_ID	Finds a font handle given a short ID.
msgFIMGetNameFromId	P_FIM_GET_NAME_FROM_ID	Passes back font name given an short ID.
msgFIMGetInstalledIdList	P_FIM_GET_INSTALLED_ID_LIST	Passes back a list of the short IDs of all installed fonts.

clsFontInstallMgr does not understand these superclass messages:

msgIMGetCurrent
msgIMSetCurrent
msgIMDup

clsFontInstallMgr does not send **msgIMCurrentChanged**.

Getting and Setting a Font's ID 112.6.3

If you have a font handle and want the font's short and long IDs, send **msgFIMGetId** to **theInstalledFonts**. The message takes pointer to a FIM_GET_SET_ID structure that contains the handle on the font file (**handle**).

When the message completes successfully, it returns **stsOK**, and passes back:

id An FIM_SHORT_ID value that contains the short ID.

longId An FIM_LONG_ID value that contains the long ID.

Usually you do not need to change a font's ID. This message allows third parties to create tools that edits font IDs.

To assign an ID to a font file, send **msgFIMSetId** to **theInstalledFonts**. The message takes a pointer to an FIM_GET_SET_ID structure that contains:

handle The handle of the font file to which you want to assign the new IDs.

id An FIM_SHORT_ID value that contains the new short ID. If **id** is 0, the value in the long ID is used.

longId An FIM_LONG_ID value that contains the new long ID.

Finding a Font Handle 112.6.4

If you have a font's short ID and need to know the handle on the font file, send **msgFIMFindId** to **theInstalledFonts**. The message takes a pointer to an FIM_FIND_ID structure, which contains an FIM_SHORT_ID value that specifies the font's ID (**ID**).

If the message completes successfully, it returns **stsOK**.

If the font ID is not found, it returns **stsNoMatch**.

Getting a Font Name 112.6.5

To get a font's name, given its short ID, send **msgFIMGetNameFromId** to **theInstalledFonts**. The message takes a pointer to an FIM_GET_NAME_FROM_ID structure, which contains:

id An FIM_SHORT_ID value that contains the font's short ID.

pName A pointer to the string that will receive the font's name.

If the message completes successfully, it returns **stsOK** and copies the name to the array specified by **pName**.

Getting a List of Installed Fonts 112.6.6

To get a list of the installed fonts, send **msgFIMGetInstalledIdList** to **theInstalledFonts**. The message takes a pointer to an FIM_GET_INSTALLED_ID_LIST structure that contains:

prune An FIM_PRUNE_CONTROL value that describes how the list should be pruned. The **prune** value specifies:

fimNoPruning Don't prune the list.

fimPruneDupFamilies Remove duplicates from font families.

fimPruneSymbolFonts Remove symbol fonts.

When the message completes successfully, it returns **stsOK** and passes back a list object. The list contains the short IDs of all the installed fonts. The list is pruned, according to the **prune** field, so that it is useable as a user pick list. For example, if the client specified **fimPruneDupFamilies** and both Helvetica and Helvetica Bold are in the system, only Helvetica is on this list.

You must destroy the list object when you are finished using it.

You can use the superclass message **msgIMGetList** to get a list of all the font file handles. There are handles for both installed and deactivated fonts.

Chapter 113 / The Auxiliary Notebook Manager

The auxiliary notebooks are separate notebooks defined by PenPoint™ that provide system functions. The auxiliary notebooks include the In box and Out box notebooks, the Help notebook, the Stationery notebook, the Connections notebook, the Settings notebook, and also include the keyboard and the clock.

The auxiliary notebook manager allows clients to open auxiliary notebooks and to perform other management tasks.

Topics covered in this chapter:

- The auxiliary notebooks used by the PenPoint operating system.
- The messages used to control auxiliary notebooks.
- Creating sections and documents in auxiliary notebooks.
- Deleting sections and documents from auxiliary notebooks.
- Modifying the stationery menu.

Auxiliary Notebook Concepts 113.1

There are two types of items on the PenPoint bookshelf:

- Data items, such as notebooks and documents.
- System items, such as the Settings notebook, the In box, Out box, and so on.

All system items on the Bookshelf (the auxiliary notebooks) are controlled through the auxiliary notebook manager (**theAuxNotebookMgr**), which is the only instance of **clsAuxNotebookMgr**.

The Auxiliary Notebooks 113.1.1

While using PenPoint, you have probably encountered these items at one time or another. The file AUXNBMGR.H defines tags for each of these auxiliary notebooks. Table 113-1 lists these tags and their purpose.

Table 113-1
Auxiliary Notebooks

Symbol	Auxiliary Notebook
anmSettingsNotebook	The Settings UI. Used to configure PenPoint settings.
anmHelpNotebook	The Help notebook. Used to access help on topics.
anmStationeryNotebook	The Stationery notebook. Used to store stationery.
anmInboxNotebook	The In box notebook. Used to import and store arriving documents.
anmOutboxNotebook	The Out box notebook. Used to queue and output documents.
anmAccessories	The accessories. Used for central storage of accessories and other documents.

Some of these "auxiliary notebooks" are not notebooks at all. They actually are instances of specialized applications. The auxiliary notebooks that actually behave like notebooks are: the In box, Out box, Stationery, and Help notebooks.

Auxiliary Notebooks and the File System 113.1.2

For each auxiliary notebook, there is a directory in \PENPOINT\SYS\DOC that contains the documents (and, if supported, sections) in that notebook. For example, the Help notebook contains directories for each installed application. When the user installs an application, the installer:

1. Creates a directory for that application in the Help notebook directory.
2. Uses **clsAuxNotebookMgr** messages to create a section in the Help notebook.
3. Copies the help templates from the HELP directory to the new section.

While it is important to understand the relationship between the auxiliary notebooks and the file system, clients should not access the auxiliary notebooks through the file system. Rather, clients should send messages to **theAuxNotebookMgr** to manipulate the auxiliary notebooks. This allows PenPoint to change the file-system name or location of these notebooks at any time in the future.

Back Up Considerations 113.1.3

Auxiliary notebooks contain documents that are maintained by PenPoint system software. These notebooks provide their own mechanisms to back up their data. If you are writing a backup program for PenPoint, do not back up documents in the auxiliary notebooks.

Auxiliary Notebook Manager Messages 113.2

The messages and defines for **clsAuxNotebookMgr** are defined in the file AUXNBMGR.H. Table 113-2 lists the messages defined by **clsAuxNotebookMgr**.

Table 113-2
Auxiliary Notebook Manager Messages

Message	Takes	Description
		General Messages
msgANMOpenNotebook	P_ANM_OPEN_NOTEBOOK	Activate and optionally open an auxiliary notebook.
msgANMGetNotebookPath	P_ANM_GET_NOTEBOOK_PATH	Returns the base path of one of the auxiliary notebooks.
		Notebook Specific Messages
msgANMCreateSect	P_ANM_CREATE_SECT	Create a section in one of the auxiliary notebooks.
msgANMCreateDoc	P_ANM_CREATE_DOC	Create a document in one of the auxiliary notebooks.
msgANMMoveInDoc	P_ANM_MOVE_COPY_DOC	Move a document into an auxiliary notebook.
msgANMCopyInDoc	P_ANM_MOVE_COPY_DOC	Copy a document into an auxiliary notebook.
msgANMDelete	P_ANM_DELETE	Delete a section or document in one of the auxiliary notebooks.
msgANMDeleteAll	P_ANM_DELETE_ALL	Delete all the nodes that are identified by 'ID'.
msgANMGetNotebookUUID	P_ANM_GET_NOTEBOOK_UUID	Returns the UUID of one of the auxiliary notebooks.

Generalized Auxiliary Notebook Manager Messages 113.3

Clients can use the following three messages (**msgANMOpenNotebook**, **msgANMGetNotebookPath**, and **msgANMSystemInited**) with all auxiliary notebooks.

Opening an Auxiliary Notebook 113.3.1

When you open an auxiliary notebook, it is displayed on the screen—much like opening a document causes it to be displayed on screen.

To open an auxiliary notebook send **msgANMOpenNotebook** to **theAuxNotebookMgr**. The only argument for the message is an ANM_AUX_NOTEBOOK value that specifies the notebook to open.

Getting the Path to an Auxiliary Notebook 113.3.2

All auxiliary notebooks are stored in the directory \PENPOINT\SYS\DTMGR. To get the complete path to an auxiliary notebook, send **msgANMGetNotebookPath** to **theAuxNotebookMgr**. The message take a pointer to an ANM_GET_NOTEBOOK_ PATH structure that contains:

notebook An ANM_AUX_NOTEBOOK value that specifies the notebook for which you want the path.

pLocator A pointer to the buffer to receive the path name. If the notebook does not exist, the message **pLocator** is set to **pNull** and the message returns **stsOK**.

Specialized Auxiliary Notebook Manager Messages 113.4

The messages described here apply only to the Help notebook, In box, Out box, and the accessories.

Creating Auxiliary Notebook Sections 113.4.1

To create a section in the Help notebook or In box and Out box notebooks, send **msgANMCreateSect** to **theAuxNotebookMgr**. The message takes a pointer to an ANM_CREATE_SECT structure, which contains:

notebook An ANM_AUX_NOTEBOOK value that specifies the notebook in which to create the section.

sectClass The class of the section.

pPath A pointer to a path that indicates the location of the new section in the auxiliary notebook. You can get the path to an auxiliary notebook by sending **msgANMGetNotebookPath** to **theAuxNotebookMgr**. If the pointer is **null**, the message creates the section in the top level of the notebook.

pName A pointer to a string that contains the name of the new section.

sequence A sequence number that identifies where to insert the section. The new section is inserted in front of the document originally identified by the sequence number.

pBookmarkLabel A pointer to a string that contains the bookmark label for the section. If the pointer is **null**, no book mark is created.

exist An ANM_EXIST_BEHAVIOR value that specifies what to do if the section exists or doesn't exist.

pDestPath A pointer to the string that receives the path to the created section. If this pointer is **null**, the message won't return the path.

id A U32 value used to identify contents of the section. When the installer deinstalls an application, it uses this identifier to locate and remove all related entries in the Stationery notebook, Help notebook, and so on.

If the message completes successfully, it returns **stsOK**.

You cannot send **msgANMCreateSect** to accessories.

Creating Auxiliary Notebook Documents 113.4.2

To create a document in the Help notebook, In box, Out box, or accessories, send **msgANMCreateDoc** to **theAuxNotebookMgr**. The message takes a pointer to an ANM_CREATE_DOC structure, which contains:

notebook An ANM_AUX_NOTEBOOK value that specifies the notebook in which to create the document.

docClass The class of the document.

pPath A pointer to a path that indicates the location of the new document in the auxiliary notebook. You can get the path to an auxiliary notebook by sending **msgANMGetNotebookPath** to **theAuxNotebookMgr**. If the pointer is **null**, the message creates the document in the top level of the notebook.

pName A pointer to a string that contains the name of the new document.

sequence A sequence number that identifies where to insert the section. The new document is inserted in front of the document originally identified by the sequence number.

pBookmarkLabel A pointer to a string that contains the bookmark label for the document. If the pointer is **null**, no book mark is created.

exist An ANM_EXIST_BEHAVIOR value that specifies what to do if the document exists or doesn't exist.

putInMenu A BOOLEAN value that specifies whether a stationery document should be listed in the stationery menu.

pDestPath A pointer to the string that receives the path to the document. If this pointer is **null**, the message won't return the path.

id A U32 value used to identify contents of the document. When the installer deinstalls an application, it uses this identifier to locate and remove all related entries in the Stationery notebook, Help notebook, and so on.

If the message completes successfully, it returns **stsOK**.

Moving and Copying Documents to an Auxiliary Notebook 113.4.3

To move or copy documents into the Help notebook, In box, Out box, or accessories, send **msgANMMoveInDoc** or **msgANMCopyInDoc** to **theAuxNotebookMgr**. Both messages take a pointer to an ANM_MOVE_COPY_DOC structure that contains:

notebook An ANM_AUX_NOTEBOOK value that specifies the notebook that will contain the document.

source A locator to the document that will be moved or copied.

pPath A path to the destination of the document within the auxiliary notebook. The path is relative to the auxiliary notebook's directory (which is a subdirectory of \PENPOINT\SYS\DTMGR). If you specify **pNull**, the document is moved or copied to the top level of the notebook.

defaultClass A class UID for the document if it isn't already stamped with a class.

sequence A sequence number that identifies where to insert the document. The document is inserted in front of the document originally identified by the sequence number.

pBookmarkLabel A pointer to a string that contains the bookmark label for the document. If the pointer is **null**, no book mark is created.

exist An ANM_EXIST_BEHAVIOR value that specifies what to do if the document exists or doesn't exist.

forceInMenu A BOOLEAN value that specifies whether a stationery document should be listed in the stationery menu, regardless of any local attributes.

pDestPath A pointer to the string that receives the path to the created document. If this pointer is **null**, the message won't return the path.

id A U32 value used to identify contents of the document. When the installer deinstalls an application, it uses this identifier to locate and remove all related entries in the Stationery notebook, Help notebook, and so on.

Deleting an Auxiliary Notebook Section or Document 113.4.4

To delete a section or document from the Help notebook, In box, Out box, or accessories, send **msgANMDelete** to **theAuxNotebookMgr**. The message takes a pointer to an ANM_DELETE structure that contains:

notebook An ANM_AUX_NOTEBOOK value that specifies the notebook that contains the section or document to delete.

pPath The path to the section or document to delete.

To delete all nodes that have a specific application ID, send **msgANMDeleteAll** to **theAuxNotebookMgr**. The message takes a pointer to an ANM_DELETE_ALL structure that contains:

notebook An ANM_AUX_NOTEBOOK value that specifies the notebook that contains the documents to be deleted.

id A U32 value that identifies the application.

Modifying the Stationery Menu 113.5

clsAuxNotebookMgr defines two messages that clients can use to add and remove documents from the stationery menu.

Adding a Document to the Stationery Menu 113.5.1

To add a document that is in the Stationery notebook to the stationery menu, send **msgANMAddToStationeryMenu** to **theAuxNotebookMgr**. The message takes a pointer to an ANM_MENU_ADD_REMOVE structure that contains the directory index of document to add to the menu (**document**).

Removing a Document to the Stationery Menu 113.5.2

To remove a document from the stationery menu, send **msgANMRemoveFrom-StationeryMenu** to **theAuxNotebookMgr**. The message takes a pointer to an ANM_MENU_ADD_REMOVE structure, as described above in **msgANMAddToStationeryMenu**.

Chapter 114 / The System Class

The system class, **clsSystem**, provides information about the running PenPoint™ operating system. This chapter discusses these topics:

- The PenPoint booting sequence.
- The file system paths.
- The system messages.

Concepts 114.1

clsSystem manages PenPoint booting. There is only one instance of **clsSystem**, which has the well-known identifier **theSystem**. All clients send **clsSystem** messages to **theSystem**.

Booting Sequence 114.1.1

After the PenPoint machine interface layer (MIL) is loaded, **clsSystem** manages booting the PenPoint operating system. The SYS_BOOT_PROGRESS enum defines symbols for completion of each of the major steps in the boot sequence. Table 114-1 lists these enums in the correct boot sequence.

Table 114-1
Boot Sequence Symbols

Symbol	Meaning
sysKernelComplete	The PenPoint kernel is loaded.
sysSystemDllsComplete	The system DLLs listed in BOOT.DLC are loaded.
sysSystemAppsInstalled	The system applications listed in SYSAPP.INI are loaded.
sysInitialAppInstalled	The initial application (the Bookshelf) is installed.
sysBookshelfItemsCreated	The items on the Bookshelf notebooks are created.
sysServicesInstalled	The services listed in SERVICE.INI are installed.
sysAppsInstalled	The applications listed in APP.INI are installed.
sysInitialAppRunning	The initial application is running.
sysBootComplete	Booting is complete.

The initial application is the bookshelf application. Note that the items that appear on the bookshelf are not placed in the bookshelf until the bookshelf application is running (**sysInitialAppRunning**).

Your application or service might want to perform specific actions as soon as it is installed. However, if it depends on another component that is loaded later in the boot sequence, it can use **theSystem** to find out when booting has reached a particular step.

File System Paths

114.1.2

As part of managing booting, **clsSystem** defines a number of constants for file system paths to frequently used locations. Rather than adding your own string literals to your applications, you should use these constants.

For example, if you want to create a string that identifies where PenPoint applications live, do not use:

```
strcpy(pFoo, "PENPOINT\\APP");
```

Instead, you should use:

```
strcpy(pFoo, sysBaseDir "\\" sysInstallableAppDir);
```

Table 114-2 lists the file system path constants and their meanings.

Table 114-2
File System Path Constants

Constant	Definition
	Base PenPoint Directory
sysBaseDir	PENPOINT
	Locations Under sysBaseDir
sysInstallableFontDir	FONT
sysInstallablePrefDir	PREFS
sysInstallableHWXProtDir	HWXPROT
sysInstallableGestureDir	GESTURE
sysInstallablePDictDir	PDICT
sysInstallableAppDir	APP
sysInstallableServiceDir	SERVICE
sysBootDir	BOOT
sysQuickInstall	QINSTALL
sysRuntimeRootDir	SYS
	Locations Under sysRuntimeRootDir
sysSysAppFile	SYSAPP.INI
sysAppFile	APP.INI
sysSysServiceFile	SYSSERV.INI
sysServiceFile	SERVICE.INI
sysCopyFile	SYSCOPY.INI
sysResFile	PENPOINT.RES
sysMILResFile	MIL.RES
sysLiveRoot	Bookshelf
sysLoaderDir	LOADER
	Default Initial App (in PENPOINT\BOOT\APP)
sysDefaultInitialApp	Bookshelf

Just as a reminder, you can use **theBootVolume** to identify the volume from which the PenPoint operating system was booted. You can use **theSelectedVolume** to identify the volume that contains the PenPoint run-time information.

The System Messages 114.2

Table 114-3 lists the messages defined by **clsSystem** in the file SYSTEM.H.

Table 114-3
clsSystem Messages

Message	Takes	Description
msgSysGetBootState	P_SYS_BOOT_STATE	Passes back the current booting stage.
		System Directory Messages
msgSysGetRuntimeRoot	P_OBJECT	Passes back a dir handle onto the root of the Penpoint runtime area.
msgSysGetLiveRoot	P_SYS_GET_LIVE_ROOT	Passes back an appDir handle onto the root of a volume's live document area.
msgSysIsHandleLive	P_SYS_IS_HANDLE_LIVE	Determines if a filesystem handle is within the live document area.
msgSysCreateLiveRoot	P_SYS_CREATE_LIVE_ROOT	Create a new live root on a volume.
		System Information Messages
msgSysGetVersion	P_U16	Passes back the system version number.
msgSysGetSecurityObject	P_OBJECT	Gets the current security object.
msgSysSetSecurityObject	P_SYS_SET_SECURITY_OBJECT	Sets the current security object.
msgSysGetCorrectiveServiceLevel	P_STRING	Gets the corrective service level.
msgSysSetCorrectiveServiceLevel	P_STRING	Sets the corrective service level.
		Notification Messages
msgSysBootStateChanged	P_SYS_BOOT_STATE	The system has reached another stage of booting.

Boot Progress Messages 114.2.1

There are two ways your application can find out the progress of system booting:

- It can make itself an observer of **theSystem**. When the boot state changes, it will receive **msgBootStateChanged**.
- It can send **msgSysGetBootState** to **theSystem** to find out the current stage.

Both messages pass a pointer to a SYS_BOOT_STATE structure, which contains:

booted A BOOLEAN value that indicates whether booting has completed (**true**) or not (**false**).

progress A SYS_BOOT_PROGRESS value (described above) that indicates the current boot stage.

type A SYS_BOOT_TYPE value that indicates the boot type. There are two types of boots: cold-boot (**sysColdBoot**) and warm-boot (**sysWarmBoot**). When booting on a PC, the boot type will be

sysColdBoot; when booting tablet hardware, the boot type will always be **sysWarmBoot**.

initialAppClass A UID that indicates the class of the initial application.

System Directory Messages

114.2.2

As described in Chapter 110, PenPoint defines specific directories for many of its system files. **clsSystem** defines several messages that allow you to access these files and directories.

You can send **msgSysGetRuntimeRoot** to **theSystem** to get a directory handle on the root of the PenPoint runtime area.

If a PenPoint volume has a bookshelf (in \PENPOINT\SYS\DOC), this is said to be the "live" area for documents on the volume. You can use **msgSysGetLiveRoot** to access the live area on a volume. The live area can be on any PenPoint volume. To find out if a handle is on a file or directory within the live area, send **msgSysIsHandleLive** to **theSystem**.

Part 13 / Writing PenPoint Services

Chapter 115 / Introduction

This manual describes how to write services for the PenPoint™ operating system. PenPoint services are separately installable, non-application DLLs that provide system extensions such as database engines, e-mail backends, and PenPoint device drivers.

Intended Audience 115.1

This manual is written for people who are designing and implementing PenPoint services.

Writing a service requires a good knowledge of PenPoint, its object-oriented design, and its message passing mechanism.

We expect that you are familiar with the PenPoint operating system and object-oriented programming concepts, proficient in the C programming language, and—if you are writing a device drive—that you have some familiarity with hardware interfaces or data communications protocols.

Layout of This Manual 115.2

This chapter, Chapter 115, provides an overview to services, describes the intended audience for this manual, describes the organization of the manual, and provides pointers to other sources of information.

Chapter 116, Service Concepts, describes the concepts that you need to know before writing a service, but doesn't describe how to implement these concepts.

Chapter 117, Programming Services, describes the actions that your service must take in response to a message.

Chapter 118, Distributing Your Service, describes how to organize your service so that it works correctly with the installer architecture.

Chapter 119, Test Service Examples, provides listings of the sample services that are distributed in \PENPOINT\SDK\SAMPLE.

Other Sources of Information 115.3

Chapter 94, Using Services, in *Part 10: Connectivity* describes services from the client's point of view. To write an application that uses or tests your service, you will need to understand this information.

If you are writing a device driver, you will need documentation for the device with which you intend to communicate.

Chapter 116 / Service Concepts

This section discusses the concepts that you need to know before writing a service. Chapter 117 describes how to implement these concepts.

Service Manager Architecture

The PenPoint service architecture enables the PenPoint™ operating system to manage installable and deinstallable non-application facilities. The need for a service manager architecture was dictated by two conflicting needs in the PenPoint operating system:

- PenPoint does not depend on a disk being available, so memory is usually limited.
- PenPoint machines are portable and may require device drivers for several different devices (for example, different locations might have different printers).

If memory is tight, users probably only want to load the services that they need. If the user goes to an office that has a different printer, the PenPoint service architecture allows the user to deinstall the current printer driver and load the printer driver for the new device.

The service manager:

- Manages non-application facilities.
- Allows arbitrary categories of services.
- Manages finding, binding, and opening services.
- Provides notification for addition, removal, connection, and disconnection of services.
- Gracefully handles the case where a requested service is not available.

Generally, services:

- Provide installable and deinstallable, non-application system extensions.
- Can target other services to form chains.
- Do not require their target to be present when they are created (delayed binding).
- Can have owners.

Applications, Components, and Services 116.2

There are three types of programs that you might write for the PenPoint operating system: applications, components, and services.

Applications 116.2.1

Application are PenPoint classes that inherit from **clsApp**. Generally, applications:

- Provide the interface through which users interact with the system.
- Provide some computational work.
- Use services and components to perform more sophisticated tasks.
- Respond to the PenPoint Application Framework messages.

Components 116.2.2

Components are DLLs that provide specific application capabilities. Components can be seen as building blocks that developers can use to add functionality to their application.

Components can provide a user interface (but don't have to). Components do not inherit from **clsApp**. Typical examples of components are:

- **clsTextView**
- **clsMiniNote.**

Services 116.2.3

PenPoint **services** are installable, non-application DLLs that provide system extensions. Services inherit from **clsService**. While components can be used by any number of users, most services require controlled access; the access to services is controlled by the service managers.

The philosophy behind the services architecture is that no part of PenPoint should expect any particular hardware to be present. Other system extensions provided by services are:

- Database engines
- E-mail backends
- Installable file systems.

Not all services provide a user interface. Services also do not respond to the PenPoint Application Framework messages.

Services in PenPoint 116.3

PenPoint uses services to provide system extensions. This section outlines the various services provided by PenPoint. You can use these services and their organization to model how your services relate to PenPoint. You can also use these services to model how your services present their user interface (do they have an option card? do they require a configuration accessory?).

MIL Services 116.3.1

PenPoint MIL services perform the functions usually performed by device drivers in other operating systems. The MIL services handle requests to communicate directly with ports. (Not all services are directly connected to devices; services can be chained to act like a protocol stack.)

The MIL services that communicate directly with device ports are usually loaded at boot time (depending on the configuration of the machine). Two examples of port MIL services are:

Serial Port Controls the serial port or ports.

Parallel Port Controls the parallel port or ports.

Other services and MIL services that communicate directly with optional devices can be loaded at boot time or can be installed by the user. Two examples of non-port services are:

DotMatrix Handles dot-matrix printer requests from a printer window device and communicates printer commands through a parallel port.

Modem Handles modem requests from applications and communicates AT commands through the serial port.

Other Services 116.3.2

Other types of services in PenPoint are the DOS and Macintosh file systems and the replaceable shape matcher.

Classes Used by Services 116.4

When developing a service, you must know about three classes:

clsService The service class.

clsInstallMgr The install manager class.

clsServiceManager The service manager class, which inherits from **clsInstallMgr**.

The Service Class and Service Instances 116.4.1

A service class implements the functions for a particular type of device or function. For each device or function configured in a running PenPoint system, there is an instance of a service class.

An instance of a service can be created:

- By the service's **DLLMain** at install time.
- By the service installer at install time from pre-configured instance state data.
- Dynamically at the user's request (through a user interface, such as the Printers).

Each service class is a subclass of **clsService** and is implemented as a separate DLL.

A service instance receives messages from its service manager and, when opened, from its opener. Most of the messages sent by the service manager are defined by **clsService**. The service instance does little work with these messages, but passes them up to its superclass, **clsService**.

We will refer many times to the superclass; unless otherwise noted, it means **clsService**.

The service instance does most of its work when receiving requests from its openers. A service instance usually interracts with its openers by handling messages from the openers. However, the service can also tell its openers the entry points to specific procedural interfaces (if any). This allows openers to access time-critical services without the overhead of object calls.

The Service Manager Class

116.4.2

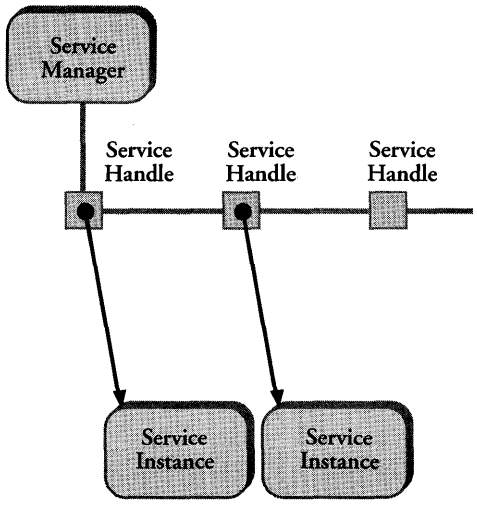
A service manager maintains a list of instances that share the same minimum API. There can be instances of different serice subclasses on the same service managers. Each service instance must belong to at least one service manager; service instances can be listed on more than one service manager.

When a client wants to use a service, the client communicates with the service manager that has the needed service on its list. Service instances can be on more than one service manager list.

Service managers are instances of **clsServiceManager**. Most service managers are created by the PenPoint operating system at boot time.

Figure 116-1 shows a service manager and its service instances.

Figure 116-1
Services and a Service Manager



When writing a client that uses services, you use the messages defined by **clsServiceManager** to find, express interest in, and open a service instance. Clients can observe individual services, or can observe a service manager.

The Service Installation Manager Class 116.4.3

The service installation manager handles installation and deinstallation of service classes. For each installed service, the service installation manager creates and manages a service directory in the RAM file system.

There is only one service installation manager in the system, **theInstalledServices**, which is an instance of **clsServiceInstallMgr**.

When getting information about installed services, you use messages defined by **clsServiceInstallMgr** and its ancestor, **clsInstallMgr**.

Open Service Object Class 116.4.4

When a client opens a service, the service manager passes back a service instance UID to the client. The client then communicates with the service by sending messages to the UID.

While most services allow only one opener per service instance, some services allow more than one client to access the same service instance. When designing multiple-access services, you (the service developer) must decide whether the service should give the UID of the service instance to each opener or if the service should give a separate, placeholder UID to each opener.

But where do you get these UIDs? PenPoint provides a class, the open service object class (**clsOpenServiceObject**), that you can subclass. When a client opens your service, you create an instance of the subclass and give the UID of the subclass back to the client. **clsOpenServiceObject** inherits from **clsStream**.

The advantage of giving separate UIDs to each opener is that your service can use the open service object subclass to maintain the state of each of the openers individually.

Service Overview: Installation to Use 116.5

There are four parts to the life cycle of a service:

- Installing the service class.
- Creating a service instance.
- Accessing the service instance.
- Responding to service messages.

This section presents an overview of a service, beginning with service installation to the service responding to client messages.

Installing a Service Class 116.5.1

There are three ways that service classes can be installed:

- By a cold-boot of an SDK version of PenPoint (the service is listed in the SERVICE.INI file).
- By the quick installer (the volume specifies quick install from the services; requires some user interaction).

- By the user (the user installs a service from the Connections notebook or the Settings notebook).

When installation is initiated, **theInstalledServices** finds the service on disk, copies the service DLL files into the loader data base, and copies non-executable files to the RAM file system.

theInstalledServices then calls the service's **DLLMain()** routine, which creates the service class by subclassing **clsService**. The **DLLMain()** routine also creates any other classes required by the service.

Creating Service Instances 116.5.2

Once the **DLLMain** routine creates the service class, a client can send **msgNew** to the service class to create a service instance. The arguments to **msgNew** for a service include a list of service managers that will manage this service instance and a target for the service instance (if any).

Usually the service class does little with **msgNew**, but passes it to its superclass. **clsService** creates the new service instance and adds the instance to the lists maintained by the specified service managers.

Depending on the service flags, **clsService** can also bind the service instance to its target when it is created.

If a service has a fixed number of service instances, the service can create its own instances from its **DLLMain()** routine. Otherwise, the service should provide some application or accessory through which users can create and destroy instances of a service, rename service instances, or specify or change the target of a service. (Service targets are explained later in this chapter.)

Using a Service Instance 116.5.3

When the service instance appears on one or more service manager lists, a client can locate, bind to, and then open the service instance:

1. The client finds the service instance by sending **msgIMFind** to the appropriate service manager, specifying the name of the service instance. **msgIMFind** passes back a handle on the service instance.
2. The client binds to the service handle by sending **msgSMBind** to the service manager. This makes the client an observer of the service instance.
3. The client sends **msgSMSetOwner** to the service manager. This allows the client to access exclusive-access services.
4. The client sends **msgSMOpenDefaults** to the service manager, so that the service instance can provide default values for the open **pArgs** (if any).
5. The client opens the service instance by sending **msgSMOpen** to the service manager. If the open is successful, the service manager passes back the UID of the service instance or the open service handle. A client should open a service instance only when it is ready to send or receive data.

6 The client uses the service instance to perform some action. Usually this consists of sending **msgStreamRead** or **msgStreamWrite** to the service instance.

7 The client should close the service instance (by sending **msgSMClose** to the service manager) as soon as it has finished sending or receiving data.

8 Finally, the client unbinds from the service instance by sending **msgSMUnbind** to the service manager. The client must close the service before unbinding from it.

Chapter 94, Using Services, in *Part 10: Connectivity* describes these steps in much greater detail.

Responding to Service Messages

116.5.4

For some messages that a client sends to a service manager, the service manager sends a corresponding message to the appropriate service instance. Most of these messages inform the service instance that a request was made and allow the service instance (or its superclass) to veto the request or provide some information.

When the client sends **msgSMBind** to the service manager, the service manager sends **msgSvcBindRequested** to the service instance; when the client sends **msgSMOpen** to the service manager, the service manager sends **msgSvcOpenRequested** to the service instance, and so on.

When the service instance receives **msgSvcOpenRequested**, it must allow **clsService** to handle the message, then, if the service instance allows multiple openers, it creates an instance of its open handle class and passes that UID to the client.

When a client has opened a service instance, it sends messages directly to the service instance to perform some work. The service class can define methods for messages created by its ancestors (such as **msgStreamRead** and **msgStreamWrite**) or it can define methods for its own messages.

Services and the File System

116.6

Much of the file system information is similar to that described in *Part 12: Installation API*.

Each service has its own directory. The name of the service directory is the name of the service. In installation volumes, service directories are in the \PENPOINT\SERVICE directory. In a running system, service directories are in the \PENPOINT\SYS\SERVICE directory.

Each service instance is represented by a file system node. The node is usually a file, but can be a directory if the service desires. A service uses its file system node to save its state information. For example, a service that uses the serial port can save the baud rate and other serial communication parameters.

When a service is installed and instances of the service are created, its service manager creates a file system handle on the node for the service. Each service manager maintains a list of open file system handles for the service nodes it is responsible for.

The service instance nodes live in a subdirectory of the \PENPOINT\SYS\SERVICE\INST.

Services on Distribution or Boot Disks

116.6.1

The service directory must contain at least one .DLL or .DLC file.

In a distribution or boot volume, service directories are in the \PENPOINT\SERVICE directory. A service directory can contain the following files, as shown in the directory hierarchy below:

- One or more service DLL files.
- A .DLC file (if there is more than one DLL file) that lists the DLLs required by this service.
- An optional INIT.DLL file that is loaded, run, and unloaded during service installation.
- An optional service resource file, SERVICE.RES, which is similar to an application's APP.RES file.
- An optional MISC directory (similar to an application's MISC directory), which can contain static data files that are common to all service instances.
- An optional INST directory, which contains one or more **service state nodes** (a node is either a file or a directory) containing instance data for saved service instances. The service install manager uses this data to create pre-configured service instances when the service is installed.
- An optional SERVICE.INI file that specifies additional services that must be installed when this service is installed.
- An optional APP.INI file that specifies applications that must be installed when this service is installed.

```
\\Distribution Volume
  └─ \PENPOINT
       └─ \SERVICE
            ├─ \Service Directory
            │    ├─ \.dll files
            │    ├─ \.dlc file
            │    ├─ \init.dll
            │    ├─ \service.res
            │    ├─ \MISC
            │    │    └─ \Static Data Files
            │    ├─ \INST
            │    │    ├─ \Service State Node
            │    │    └─ \Service State Node
            │    ├─ \APP.INI
            │    └─ \SERVICE.INI
            └─ \Service Directory
```

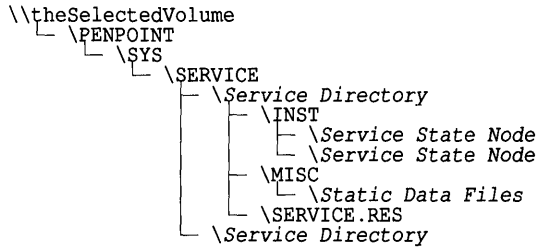
If there is only one DLL file and no .DLC file, the DLL file must have the same name as the service (with a .DLL extension). For example, the FLAP service directory contains FLAP.DLL.

If there is more than one DLL file, the .DLC file must have the same name as the service (with a .DLC extension). For example, the PCL service directory contains PCL.DLC (along with PCL.DLL, OBXSERV.DLL, CLSBND.DLL, and CLSPRN.DLL).

Services in theSelectedVolume 116.6.2

When a service is installed, its service directory is created in \PENPOINT\SYS\SERVICE. The service directory contains:

- An INST directory that contains one or more **service state nodes** (a node is either a file or a directory). Each service state node contains instance data for a specific service instance.
- An optional MISC directory that contains static data files common to all instances of the service.
- The optional SERVICE.RES file that contains the service's UI components, quick help resources, and other read-only resources.



Services in File System at Run Time 116.6.3

When **clsService** creates a new instance of a service class, it creates a **service state node** (either a file or a directory) in the \INST directory of the service's directory (that is, in \PENPOINT\SYS\SERVICE\MyService\INST). The service instance uses this state node to store any state that needs to survive a warm boot. There is no explicit save and restore sequence for services. A service must update its state node whenever its state changes.

Exclusive and Multiple Access Services 116.7

Exclusive access services allow only one client to access their instances at a time; **multiple access** services can be accessed by more than one client at a time. Exclusive access services usually represent a physical device, such as a serial port or a printer. Multiple access services usually represent an abstract entity that allows simultaneous access, such as a network or a database.

Exclusive Access Services 116.7.1

There are two ways of specifying that a service instance has exclusive access:

- A service instance can allow only one opener at a time (specified by a flag).
- A service instance can be opened only by its owner.

Each service instance has an owner field. This field can be NULL, meaning the service has no owner. Each service instance also has a flag that, when **true**, specifies that only the owner can open the service.

When a client wants to become the owner of a service instance (or when a third-party wants to change the owner of a service), it sends **msgSMSetOwner** to a service manager for the service instance. The service manager then negotiates with

the current owner, the new owner, and the service itself to ensure that all are prepared to change ownership. The protocol for changing ownership is explained in Chapter 117.

Multiple Access Services 116.7.2

There are two different types of multiple access services:

- Shared services, where each opener of a service instance receives the UID of the service instance; all openers send requests to the same UID.
- Multiuser services, where each opener of a service instance receives the UID of a unique open service object; each opener sends its requests to the UID of its own open service object.

Any client that has the UID of a shared service can send messages to the service instance at any time, even while the service is handling another request. You must use semaphores to protect access, where necessary.

Multiuser services provide a convenient place to store caller-specific state. When a client opens a multiuser service, **clsService** sends **msgNew** to a a subclass of **clsOpenServiceObject** (the subclass was created by the service class when it was installed). When a client closes a multi-user service, **clsService** sends **msgDestroy** to the open service object.

Targeting and Chaining Services 116.8

Service instances can bind and open other service instances or targets.

When the service instance is first created, the default behavior is to attempt to bind to its target.

When a client opens a service, a style bit in the service's metrics can tell the service to automatically open its target.

When a service becomes a client to its target all client observer notifications and ownership messages from the target are also sent to the client service. Information about ownership is also propogated down the target chain.

Services that communicate directly with the hardware do not have a target.

Service Connection 116.9

Services support the notion of knowing whether they are connected or not. When a device is connected to a port, the service can communicate with the device. Each service has a state bit that indicates whether itis connected or not.

Some services are able to detect when a connection is made or is broken; other services cannot detect connections. The service writer specifies whether a service can detect connections when creating a service instance. As a third alternative the service writer can tell the service to take on the connection state of its target. Usually services that deal directly with a hardware interface specify auto-detect or non-auto-detect; all other services follow their target's connection state.

The connection state is important to services that have been enabled. To relieve the user of having to turn to the Out box notebook and check **Enabled** everytime the PenPoint computer is attached to a printer, the user can leave **Enabled** checked all the time for an auto-detecting device. A good example is a printer on a TOPS network: when the PenPoint computer is connected to the TOPS network, the service detects that a connection has been made and starts to send data to the port.

Similarly, if connection is broken, an auto-detecting service will be able to stop its current action and prompt the user to reestablish the connection or cancel the operation.

Most hardware services can detect whether their hardware is connected or disconnected. Each service has a state bit which says whether it is connected or not. When the hardware changes connection state, the service sends a notification message to itself. This notification message then notifies all clients that are bound to that service.

Non-hardware services automatically change their connection state when their targets change connection state. Thus, connection state propagates up from the hardware to all services that are bound to that hardware.

A hardware service can also decide that it cannot detect hardware connect. In this case the service is always marked connected.

Chapter 117 / Programming Services

This chapter describes the code that you must write to implement a service.

Object-Oriented Architecture 117.1

Before you write a PenPoint™ service, you must be familiar with the object oriented design of PenPoint. It would help if you have written an application or component for PenPoint already, particularly one that uses the service manager to access a service.

The object oriented design of PenPoint requires a service to be a subclass of **clsService**. **clsService** provides methods for most messages that your service will receive from a service manager. Your service handles many **clsService** messages by calling ancestor.

A client uses a service manager to bind to and open an instance of your service. Once the client has opened your service instance the client sends messages directly to your service, and your service begins to perform its work.

Design Decisions 117.2

Chapter 116 described the concepts of services and their organization. In describing the service concepts, the chapter presented many options that are available with PenPoint services. When you design your service, you must answer these questions:

- Is the service an exclusive or multiple access service?
- If the service allows multiple accessors, is the service shared (all clients use the same UID) or is it multiuser (clients use an instance of an open service object class)?
- Is the service targeted? If not, is it a hardware service?
- What kind of state data will the server need? Should the state node be a file or should it be a directory?
- What does the user need to do to create instances of your service?
- Which service manager will manage your service, or do you need to create a new service manager?

Using the Template Services 117.3

To make the job of writing a service easier, GO provides two template services, **clsTestSvc** and **clsMilSvc**, which you can modify to implement your own service. The files used to implement **clsTestSvc** are in the directory \PENPOINT\SDK\SAMPLE\TESTSVC; the files for **clsMilSvc** are in \PENPOINT\SDK\SAMPLE\MILSVC.

If you are writing a multiple access, multi-user service, GO also provides a template open service object class, **clsTestOpenObject**, which is a subclass of **clsOpenServiceObject**. The files for this class (OPENOBJ.H and OPENOBJ.C) are in the \PENPOINT\SDK\SAMPLE\TESTSVC directory.

The rest of this chapter uses the sample service files for many of its examples; you should have them available to you while you read. If you do not have the sample service files, please contact GO Developer Technical Support.

Service Installation

117.4

An application class runs in the process O for that application; a service class runs in the **DLLMain()** for that service.

When your service is installed, the service installer locates your service's directory and looks in the directory for a DLL or .DLC file with the same name.

To create your **DLLMain()**, you start with the INIT.C file in TESTSVC.

```
STATUS EXPORTED DllMain(void)
{
    TEST_SVC_NEW        testSvcNew;
    STATUS              s;

    // Install classes.
    StsRet(TstsvcSymbolsInit(), s);
    StsRet(ClsTestServiceInit(), s);
    StsRet(ClsTestOpenObjectInit(), s);  // Only needed if multi-user.

    // Let system know about our service and set global service
    // characteristics. THIS IS REQUIRED!
    StsRet(InitService(pNull,           // Always pNull.
                       clsTestService,  // Service class.
                       false,           // Autocreate instances? Set to false
                                        //  if all instances are statically
                                        //  created in DLLMain();
                       0,               // Global service type. This would be
                                        //  set to a tag if you are using type
                                        //  categorization (ie. printers, e-mail)
                       svcPopupOptions, // Flags. Or-in options.
                       0,               // Reserved. Always set to 0.
                       0), s);          // Reserved. Always set to 0.

    // Create any static service instances. YOU MUST SET autoCreate in
    // InitService() TO FALSE IF YOU DO THIS! If you know exactly how many
    // service instances there will be, this is where you should create them.
    // Alternatively, they can be dynamically created elsewhere, after
    // DLLMain() runs. Beware of process ownership issues if you create
    // services dynamically. You must ensure that the process which owns
    // the dynamically created service instance will be around for the
    // lifetime of the service instance!
    ObjCallWarn(msgNewDefaults, clsTestService, &testSvcNew);
    testSvcNew.svc.pServiceName = "Testing, testing...";  // Name of this instance
    testSvcNew.svc.target.svc.manager = theTransportHandlers; // Target svc manager
    strcpy(testSvcNew.svc.target.svc.pName, "Netware"); // Target name
    ObjCallRet(msgNew, clsTestService, &testSvcNew, s);

    return stsOK;
} // DllMain
```

The following sections describe issues to consider while coding your **DLLMain()** function.

Calling Your Service Initialization Routines 117.4.1

The first step of **DLLMain**() is to install your service class and any other classes required by your service.

```
// Install classes.
StsRet(TstsvcSymbolsInit(), s);
StsRet(ClsTestServiceInit(), s);
StsRet(ClsTestOpenObjectInit(), s);  // Only needed if multi-user.
```

The template service calls two initialization routines:

ClsTestServiceInit() Initializes and installs your service class.

ClsTestOpenObjectInit() (optional) Initializes and installs your class for open service objects.

You can add other initialization routines for other classes that you require. The following sections describe the routines for the service class and the open service object class in detail.

Initializing Your Service Class 117.4.1.1

As with an application or component, you must create your class by sending **msgNew** to **clsClass**.

```
/*****************************************************************************
    ClsTestServiceInit

    Install our class.
*****************************************************************************/
STATUS FAR PASCAL ClsTestServiceInit(void)
{
    STATUS                  s;
    CLASS_NEW               new;

    // Create the service class.
    ObjCallWarn(msgNewDefaults, clsClass, &new);
    new.object.uid          = clsTestService;
    new.cls.pMsg            = clsTestServiceTable;
    new.cls.ancestor        = clsService;
    new.cls.size            = SizeOf(INSTANCE_DATA);
    new.cls.newArgsSize     = SizeOf(TEST_SVC_NEW);
    ObjCallRet(msgNew, clsClass, &new, s);

    return s;

} // ClsTestServiceInit
```

The **ClsTestServiceInit** function:

- Sends **msgNewDefaults** to **clsClass**.
- Sets the service's well-known UID, message table UID, ancestor, and size of data.
- Sends **msgNew** to **clsClass**.

If necessary, the **ClsTestServiceInit**() function could also initialize any data used by the service.

Initializing an Open Service Object Class 117.4.1.2

If a service allows multiple openers, there are two ways to give clients an identifier for the service, by giving all openers the same UID (called a shared service) or by giving each opener an instance of an open service object class (called a multi-user service).

Multiuser services provide a convenient place to store caller-specific state.

If you implement a multiuser service, you must create your own open service object class by subclassing **clsOpenServiceObject**. The template service creates its open service object class by calling **ClsTestOpenObjectInit**(), which is defined in OPENOBJ.C.

```
/******************************************************************************
    ClsTestOpenObjectInit

    Install our class.
******************************************************************************/
STATUS FAR PASCAL ClsTestOpenObjectInit(void)
{
    STATUS                  s;
    CLASS_NEW               new;

    // Create the service class.
    ObjCallWarn(msgNewDefaults, clsClass, &new);
    new.object.uid          = clsTestOpenObject;
    new.cls.pMsg            = clsTestOpenObjectTable;
    new.cls.ancestor        = clsOpenServiceObject;
    new.cls.size            = SizeOf(INSTANCE_DATA);
    new.cls.newArgsSize     = SizeOf(TEST_OPEN_OBJECT_NEW);
    ObjCallRet(msgNew, clsClass, &new, s);

    return s;

} // ClsTestOpenObjectInit
```

Calling Other Class Initialization Routines 117.4.2

If your application requires private classes in addition to the service class itself, you should call their initialization routines soon after creating your service class (to make your initialization procedure orderly, if for no other reason).

Calling InitService 117.4.3

InitService informs **theInstalledServices** about the service and sets global service characteristics. Other than creating the service class, sending **msgSvcClassInitService** is one of the most important functions in a service's **DLLMain**(). **msgSvcClassInitService** takes a pointer to an SVC_INIT_SERVICE structure that contains:

autoCreate A BOOLEAN value that specifies whether the service manager should automatically create an instance for each state node at installation and warm boots. If this parameter is **true**, **InitService** locates the service state nodes in the service's INST directory and creates instances of the service from the nodes.

serviceType A U32 that contains the service type (defined in SVCTYPES.H). This is usually 0.

initServiceFlags A set of flags that specify how the installer should treat this service. You can specify more than one flag by ORing flags. The flags are:

svcNoShow Don't show this service in the installer. If this flag is set, the user can't configure or deinstall the service.

svcPopupOptions Automatically pop up the global service option card when this service is installed. If the service is being reactivated, the option card will not be displayed.

svcNoLoadInstances When the service is installed, don't copy in the state files from the INST directory.

svcCreatePrivateServiceMgr Create a private service manager for instances of this class. All instances of this class will automatically be added to the private service manager. See SVC_CLASS_METRICS for UID of the private service manager.

svcFullEnvironment Generate a complete process environment in the **DLLMain()** process. In PenPoint 1.0, this means creating **theProcessResList**. Also, a service resource file handle will be created even if the service resource file is empty. A complete process environment takes up significant memory. Only turn this bit on if you need it.

This is the **InitService** call from INIT.C for the template service.

```
STATUS EXPORTED DLLMain(void)
{
    SVC_INIT_SERVICE    initService;
    STATUS              s;
    StsRet(ClsTestServiceInit(), s);
    memset(initService.spare, 0, sizeof(initService.spare));
    initService.autoCreate = true;
    initService.serviceType = 0;
    initService.initServiceFlags = 0;
    ObjCallRet(msgSvcClassInitService, clsTestService, &initService, s);
    return stsOK;
} // DllMain
```

Static and Dynamic Service Instances

117.4.4

If you know exactly how many service instances there will be, you should create them soon after calling **InitService** (by sending **msgNewDefaults** and **msgNew** to your service class, described below). If you create static service instances, the **InitService** flag **autoCreate** must be **false**.

Alternatively, you can create service instances dynamically after **DLLMain()** runs. However, you must beware of process ownership issues if you create services dynamically. You must ensure that the process that owns the dynamically created service instance will be around for the lifetime of the service instance.

This is the template service code for creating a static service instance:

```
ObjCallWarn(msgNewDefaults, clsTestService, &testSvcNew);
testSvcNew.svc.pServiceName = "Testing, testing...";  // Name of this instance
testSvcNew.svc.target.svc.manager = theTransportHandlers; // Target svc manager
strcpy(testSvcNew.svc.target.svc.pName, "Netware"); // Target name
ObjCallRet(msgNew, clsTestService, &testSvcNew, s);
```

If you don't know how many instances of your service will be created, you must create them dynamically. You must ensure that the process owner of the service instance remains alive for the life of the service instance; if the process owner is destroyed, the service instance is also destroyed.

Creating Service Instances

117.4.5

You create new instances of your service by sending **msgNewDefaults** and **msgNew** (or **msgObjectNew**) to your service class. Because your service class inherits from **clsService**, the _NEW structure that your service class takes must include the SVC_NEW_ONLY structure, which is defined by **clsService**. SVC_NEW_ONLY contains eight arguments:

target An SVC_TARGET structure that specifies the initial target instance for this service instance. The SVC_TARGET structure contains:

target.manager The UID of the target's manager object. If the service is a MIL service for a hardware device, set this field to **objNull**.

target.pName A pointer to a string that contains the name of the target service instance.

pServiceName The name of this service instance. This is the name of the service state node for this instance and is the name that the user sees.

style A SVC_STYLE structure that specifies the attributes of the service instance. The possible values for **style** are:

waitForTarget Specifies that the service will wait until its target appears. When the target appears the service will attempt to bind to it. If you do not specify **waitForTarget** and the specified target doesn't exist, **msgNew** will fail.

exclusiveOpen Specifies that only one client is allowed to open the service instance at a time.

autoOwnTarget Specifies that the service instance should attempt to set itself as the owner of its target when it receives **msgSvcChangeOwnerRequested**.

autoOpen Specifies that the service instance should open and close its target when the service instance is opened and closed.

autoMsgPass Specifies that all messages not used by the service should be passed to its target.

checkOwner Specifies that a client must own this service instance before it can open it.

autoOption Specifies that **clsService** should forward all option sheet messages to the target of this service instance.

connectStyle Specifies whether the service instance can detect hardware connections (**svcAutoDetect**) or cannot detect connections (**svcNoAutoDetect**), or whether it should follow the connection state of its target (**svcFollowTarget**).

openClass Specifies the open service object class for multiple access, multi-user services that pass back a UID from **msgSMOpen**. If there is no open service object class, you must specify **objNull**.

handleClass The handle class used to access the service state node. If the service state node is a file, you should specify **clsFileHandle**; if the service state node is a directory, you should specify **clsDirHandle**.

fsNew An FS_NEW structure that contains **msgNew** arguments for the handle class specified in **handleClass**. The structure must be initialized if the **handleClass** is anything other than **clsFileHandle**.

fsNewExtra An array of 25 U32 values that you can use to pass extra **fsNew** data.

pManagerList A pointer to an array of service manager UIDs that will administer this service instance. **clsService** adds the service instance to each service manager. A service instance can be administered by more than one service manager.

numManagers The number of managers in the **pManagerList** array.

Services and Tasks 117.4.6

Just like any other object, a service instance is owned by some task. However, because **objCapCall** is always **true** for service instances, all service instances must be callable from outside the owning task. This affects two aspects of services:

- Where the service instance stores its data.
- Which task owns the service instance.

Service Data 117.4.6.1

Service instances must never store data in a local heap; they should either store data in their instance data or in global heaps. (See the *PenPoint Architectural Reference, Part 1: Class Manager* for more information on instance data and storage.)

Owning Task 117.4.6.2

The service's owning task must remain active for the life of the service instance.

If you create service instances in **DLLMain()** (either static service instance or dynamically from saved state nodes), the service instance is owned by the task executing the **DLLMain()** (the main task of the service). A service's main task remains active until the service is deactivated or deinstalled.

However, if a service instance is created by a transient user interface task such as a document or a tool, the service instance will become invalid when the user turns away from the document or closes the tool. You have two alternatives:

- Keep the creating task around for the lifetime of the service instance.
- Use **msgObjectNew**, rather than **msgNew**, to create the service instance.

msgObjectNew creates an object in the context of the object to which the message is sent. You must use **ObjectSend**(), not **ObjectCall**(), to send **msgObjectNew** and any pointers in the **pArgs** for **msgObjectNew** must point to global memory.

We suggest that you send **msgObjectNew** to the resource file handle for the service class (because the resource file handle is owned by the service's main task). Your creating task can find the resource file handle by sending **msgSIMGetMetrics** to **theInstalledServices**, specifying the service class in its **pArgs**. The message passes back the handle in **metrics.resFile**. Send **msgObjectNew** to this handle.

You can't send **msgObjectNew** to the service class object itself, because the class object is owned by **clsClass**.

Deinstalling Services

117.5

Deinstallation of services is a two-phase process.

In the first phase, the installer sends **msgSvcClassTerminateOK** to the service class being deinstalled. The service class immediately passes the message to its superclass, which sends **msgSvcDeinstallRequested** to all instances of the service. To approve the deinstallation, a service instance returns **stsOK**; any return value other than **stsOK** is a veto. If the call ancestor returns **stsOK**, the service class determines whether it can allow the termination. Again, to veto the termination, the service class returns a value other than **stsOK**.

If any instances veto the termination, the installer sends **msgSvcClassTerminateVetoed** to the service class. The service class passes the message to its superclass, which sends **msgSvcDeinstallVetoed** to all instances of the service. This message lets them know that the termination will not happen.

If all service instances and the service class approved the termination, the installer sends **msgSvcClassTerminate** to the service class. Again, the service class passes the message to its superclass, which sends **msgDestroy** to all instances of the service.

Finally, when the call ancestor for **msgSvcClassTerminate** returns, the service installer destroys the service class.

Messages Sent to Your Service Class

117.6

This section describes the messages that your service class must handle. In addition to **msgNewDefaults** and **msgNew**, **clsService** defines a number of class messages that relate to termination negotiation, service home information, and loading service instances. Usually a service will pass these messages to its superclass without any further action.

Handling msgNewDefaults 117.6.1

When a client sends **msgNewDefaults** to your service class, you should first route the message to your ancestor, **clsService** (usually this is done in the method table, see METHOD.TBL in the TESTSVC directory). This code fragment shows how **clsService** handles **msgNewDefaults**:

```
pArgs->svc.style.waitForTarget = true;  // Almost always true.
pArgs->svc.style.exclusiveOpen = false; // Exclusive open service?
pArgs->svc.style.autoOwnTarget = true;  // Usually true if exclusive open.
pArgs->svc.style.autoOpen = false;      // Usually true if exclusive open.
pArgs->svc.style.autoMsgPass = false;   // Usually false.
pArgs->svc.style.checkOwner = false;    // True if exclusive open and you
                                        //  want clients to use owner stuff.
pArgs->svc.style.autoOption = false;    // Usually true if your service
                                        //  does option sheets.
pArgs->svc.style.connectStyle = svcFollowTarget; // Only change this if you
                                        //  don't have a target.
pArgs->svc.handleClass = clsFileHandle; // Change this if you want your
                                        //  state handle to be something
                                        //  other than a file handle.
```

The defaults provided by **clsService** are general; when your service handles **msgNewDefaults** you should specify the style flags and the service manager or managers for the service.

If a subclass wants to change the **handleClass**, **fsNew**, or **fsNewExtra** parameters, it must also send **msgNewDefaults** to the handle class after it sends **msgNewDefaults** to its ancestor (most services will not need to do this):

```
ObjCallWarn(msgNewDefaults, pArgs->svc.handleClass; &(pArgs->svc.fsNew));
pArgs->svc.fsNew.fs.exist = fsExistOpen | fsNoExistCreate;
```

Handling msgNew 117.6.2

As with **msgNewDefaults**, you should route **msgNew** to your ancestor (**clsService**). If you look at METHOD.TBL in the TESTSVC directory, you will see that the method table for **clsTestService** doesn't even list **msgNew**. Because there is no entry for **msgNew**, the class manager automatically routes the message to the class's ancestor.

Handling msgSvcClassTerminateOK 117.6.3

When the installer deinstalls a service, it sends **msgSvcClassTerminateOK** to the service instances class. The service class must call ancestor first, which allows **clsService** to send **msgSvcDeinstallRequested** to all service instances.

If all of the service instances return **stsOK**, the call ancestor returns **stsOK** to the service class. Then it is up to the service class to approve the termination. If any of the instances return a value other than **stsOK**, the call ancestor returns that status value and the service class should return with that status value.

msgSvcClassTerminateOK passes a pointer to an OBJECT. This value contains nothing, but if a service instance vetoes the termination, the superclass will return

the UID of the instance in the OBJECT. Typically, if your service class vetoes the termination, it should store its own UID in this location.

Handling msgSvcClassTerminateVetoed 117.6.4

When a service instance or the service class vetoes the termination, the installer sends **msgSvcClassTerminateVetoed** to the service class. The service class immediately passes the message to its superclass. **clsService** sends **msgSvcDeinstallVetoed** to all instances of the service class.

The message passes a pointer to an SVC_TERMINATE_VETOED structure, which contains two arguments:

vetoer Specifies the object that vetoed the deinstallation.

status Specifies the status value that the **vetoer** used.

Handling msgSvcClassTerminate 117.6.5

If the request to deinstall the service was not vetoed, the installer sends **msgSvcClassTerminate** to the service class. The service class passes the message to its superclass. **clsService** then sends **msgDestroy** to all instances of the service class.

There are no arguments for this message.

Handling msgFree 117.6.6

When you receive **msgFree**, you should save any stateful objects, free all objects that you created, then call ancestor. The method table defined in TESTSVC\METHOD.TBL specifies **objCallAncestorAfter** for **msgFree**.

You shouldn't delete the service instance state node as part of **msgFree**. If you received **msgFree** as part of a service deactivation, the service instance should be able to restore itself from its state node.

This is a code fragment from TESTSVC.C:

```
/******************************************************************************
    TestSvcFree

    Free any resources that this service created. Don't delete the state file
    or free the state file handle!
******************************************************************************/
MsgHandlerWithTypes(TestSvcFree, P_ARGS, P_INSTANCE_DATA)
{
    MsgHandlerParametersNoWarning;
    return stsOK;

}   // TestSvcFree
```

Handling msgSvcClassLoadInstance 117.6.7

If an application needs to load a service state instance at a time other than initialization or warm-boot, it can send **msgSvcClassLoadInstance** to the service class.

The message passes a pointer to an SVC_LOAD_INSTANCE structure, containing an FS_LOCATOR (**source**), which indicates the location of the service state node.

clsService copies the state node specified by **source** to the INST directory for the service and starts an instance of the service stored in the state node (much like warm-boot or service installation). If a service instance with the name of the state node exists already, **clsService** first removes the existing service instance.

Usually subclasses of **clsService** do not process this message, unless they need to change the behavior when the service instance exists already.

Messages Sent by Service Managers 117.7

Before a client opens a service instance and has direct access to the service, the client must communicate with the service instance through its service managers. The client uses messages defined in **clsSvcManager** to get service information about the service, attempt to change owner, or attempt to change the target of the service.

When the service manager receives one of the **clsSvcManager** messages, it sends a corresponding **clsService** message to the service instance.

The next three sections describe the **clsService** messages and how you handle them. The first section describes messages for which you perform some action and then pass to clsService. The second section describes messages that **clsService** uses to either inform your service of an event or ask for confirmation. The third section lists the messages that you do not need to handle; you just allow **clsService** to handle these messages.

Service Manager Requests for Information 117.7.1

Although **clsService** does most of the work, you must be prepared to do some work for the messages listed in Table 117-1.

Table 117-1
clsService Information Messages

Message	Takes	Description
msgFree	OBJECT	Frees the service instance.
msgSvcGetFunctions	P_SVC_GET_FUNCTIONS	Passes back a pointer to a table of function entry points.
msgSvcGetMetrics	P_SVC_GET_SET_METRICS	Passes back the current configuration metrics.
msgSvcSetMetrics	P_SVC_GET_SET_METRICS	Sets the configuration metrics.

Handling msgSvcGetMetrics 117.7.1.1

Clients use **msgSvcGetMetrics** to get metrics from your service instance. **msgSvcGetMetrics** passes a pointer to an SVC_GET_SET_METRICS structure, which the service instance uses to send back metrics information. The structure contains two arguments:

pMetrics A pointer to a buffer intended to hold the metrics for this service instance.

len A U16 value that specifies the size of the buffer specified in **pMetrics**.

Clients usually send **msgSvcGetMetrics** twice. The first time, the client specifies a zero length for the size of the metrics buffer (**len**); the service instance passes back only the size of its metrics. The client then sends **msgSvcGetMetrics** again, this time specifying the **len** value that it received in the first call. The service instance writes its metric information to the buffer specified by the client.

If your service has metrics that clients can access, it must be prepared to handle **msgSvcGetMetrics**. Because clients might file this information, you should also incorporate some form of version identification into your metrics.

This example shows how a typical service responds to **msgSvcGetMetrics**:

```
/************************************************************************
    SvcDemoGetMetrics

    Get service's metrics.
************************************************************************/
STATUS LOCAL SvcDemoGetMetrics(
    OBJECT              self,
    P_ARGS              pArgs,
    P_INSTANCE_DATA     pInst)
{
    P_SVC_GET_SET_METRICS   pSvcMetrics;
    pSvcMetrics = (P_SVC_GET_SET_METRICS)pArgs;
    if (pSvcMetrics->len == 0)
    {
        pSvcMetrics->len = sizeof(DEMO_METRICS);
        return stsOK;
    }
    else
    {
        if (pSvcMetrics->len < sizeof(DEMO_METRICS))
        {
            return stsFailed;
        }
        *((P_DEMO_METRICS)(pSvcMetrics->pMetrics)) = pInst->demoMetrics;
        return stsOK;
    }
}
```

Handling msgSvcSetMetrics 117.7.1.2

Clients use **msgSvcSetMetrics** to set your service instance's metrics. **msgSvcSetMetrics** passes a pointer to an SVC_GET_SET_METRICS structure, which contains two arguments:

pMetrics A pointer to a buffer that contains the new metrics data.

len A U16 value that specifies the size of the buffer specified in **pMetrics**.

If your service has client-writable instance data, you must respond to this message. Because clients might attempt to restore data that has been filed for a time, you must have some form of version checking.

This example shows how a service can respond to **msgSvcSetMetrics**:

```
/*****************************************************************************
    SvcModemSetMetrics

    Set modems metrics.
*****************************************************************************/
STATUS LOCAL SvcModemSetMetrics(
    OBJECT              self,
    P_ARGS              pArgs,
    P_INSTANCE_DATA     pInst)
{
    P_MODEM_METRICS         pMdmMetrics;
    P_SVC_GET_SET_METRICS   pSvcMetrics;
    STATUS                  s;
    pSvcMetrics = (P_SVC_GET_SET_METRICS)pArgs;
    pMdmMetrics = (P_MODEM_METRICS)pSvcMetrics->pMetrics;
    if (pSvcMetrics->len < sizeof(MODEM_METRICS))
    {
        return stsFailed;
    }
    StsRet(ModemRestoreModem(pInst, self), s);
    pInst->modemMetrics.mdmFAXResolution = pMdmMetrics->mdmFAXResolution;
    pInst->modemMetrics.mdmFAXEncoding = pMdmMetrics->mdmFAXEncoding;
    pInst->modemMetrics.mdmFAXLineWidth = pMdmMetrics->mdmFAXLineWidth;
    pInst->modemMetrics.mdmFAXMaxBaudRate = pMdmMetrics->mdmFAXMaxBaudRate;
    return stsOK;
}
```

Messages from Service Managers 117.7.2

The service instance receives the messages listed in Table 117-2 from the service manager when it has received a request from a client. Usually the messages ask the service instance for permission to continue.

When you receive most of these messages, you must pass the message to **clsService**; if **clsService** doesn't veto the request, you can determine if you should allow the request.

Table 117-2
clsService Notification Messages

Message	Takes	Description
msgSvcBindRequested	P_SVC_BIND	Client asked to bind to this service.
msgSvcUnbindRequested	P_SVC_BIND	Client asked to unbind from this service.
msgSvcOpenDefaultsRequested	P_SVC_OPEN_CLOSE	Client wants open pArgs initialized.
msgSvcOpenRequested	P_SVC_OPEN_CLOSE	Client asked to open this service.
msgSvcCloseRequested	P_SVC_OPEN_CLOSE	Client asked to close this service.
msgSvcQueryLockRequested	pNull	Client asked to QueryLock this service.
msgSvcQueryUnlockRequested	pNull	Client asked to QueryUnlock this service.
msgSvcDeinstallRequested	pNull	Client asked to destroy this service instance.
msgSvcDeinstallVetoed	P_SVC_DEINSTALL_VETOED	Deinstallation process was vetoed.
msgSvcSaveRequested	P_FS_FLAT_LOCATOR	Client asked to save this instance to external media.

continued

Table 117-2 (continued)

Message	Takes	Description
msgSvcOwnerReleaseRequested	P_SVC_OWNED_NOTIFY	Is it OK to remove you as the owner of a service?
msgSvcOwnerAcquireRequested	P_SVC_OWNED_NOTIFY	Is it OK to make you the new owner of a service?
msgSvcOwnerAcquired	P_SVC_OWNED_NOTIFY	You are now the new owner of a service.
msgSvcOwnerReleased	P_SVC_OWNED_NOTIFY	You are no longer the owner of a service.
msgSvcChangeOwnerRequested	P_SVC_OWNED_NOTIFY	Owner change request message.
msgSvcClientDestroyedEarly	OBJECT	An client was destroyed while it had a service open.

Handling msgSvcBindRequested

117.7.2.1

When the service manager receives **msgSMBind** from a client, it sends **msgSvcBindRequested** to the specified service instance. This offers the service instance the chance to veto the bind request.

The message passes a pointer to an SVC_BIND structure, which contains two arguments:

caller The UID of the object making the request.

manager The UID of the service manager through which the **caller** is making the request.

You must always pass this message to **clsService**. By default, **clsService** returns **stsOK**.

When **clsService** returns the message, you can do one of two actions:

- Refuse the bind by returning **stsFailed**.
- Accept the bind by returning **stsOK**.

If you return **stsOK**, the service manager adds the client to the observer list for your service's handle.

Handling msgSvcUnbindRequested

117.7.2.2

When a client sends **msgSMUnbind** to the service manager, the service manager notifies the specified service instance by sending it **msgSvcUnbindRequested**. This offers the service instance the opportunity to veto the request.

The message passes the service a pointer to an SVC_BIND structure, described above in **msgSvcBindRequested**.

You must always pass this message to **clsService**. Usually you do not need to do any further handling for this message, simply return the status returned by **clsService**.

If you return **stsOK**, the service manager removes the client from the observer list for your service instance.

Handling msgSvcOpenRequested 117.7.2.3

When a client sends **msgSMOpen** to the service manager, the service manager sends **msgSvcOpenRequested** to the specified service instance. The message passes a pointer to an SVC_OPEN_CLOSE structure, which contains four arguments:

caller The UID of the client that made the request.

manager The UID of the service manager that took the request.

pArgs A pointer to a buffer that contains service-specific open arguments. If your service requires additional arguments, the client can pass its arguments using this structure. The client can also ask your service to provide defaults for these arguments by sending **msgSMOpenDefaults** to the service manager, which then sends **msgSvcOpenDefaultsRequested** to your service instance.

service An OBJECT element in which you can store the UID of an open service object, if any.

You must pass this message to **clsService**. **clsService** handles most of the checks specified by the service flags:

- Is the service locked?
- If **checkOwner** is TRUE, is the opener the owner?
- If **exclusiveOpen** is TRUE, does any other client have this service open?

clsService also determines whether the service class is currently being deinstalled. If **openClass** is not null, **clsService** creates a new instance of the open class. If **autoOpen** is **true**, **clsService** opens the service's target.

If your service instance needs to refuse the open request, it can return **stsFailed**.

If your service instance accepts the open request, it should return **stsOK**. If you return **stsOK**, the service manager adds the client to the list of clients that have your service instance open. You or other clients can get the list of openers on a service by sending **msgSMOpenList** to the service manager.

Handling msgSvcOpenDefaultsRequested 117.7.2.4

Before a client sends **msgSMOpen** to a service manager, it must request the default **pArgs** for **msgSMOpen** by sending **msgSMOpenDefaults** to the service manager, specifying the service instance. When the service manager receives **msgSMOpenDefaults**, it sends **msgSvcOpenDefaultsRequested** to your service instance. The message passes a pointer to an P_SVC_OPEN_CLOSE structure, as described in **msgSvcOpenRequested**.

If your service instance can provide defaults for any of its open arguments, it should add its defaults to the structure indicated by **pArgs**.

If your service is a multiple access, multi-user service, you do not have to do anything more for this message other than send it to your superclass. **clsService** which sends **msgNewDefaults** to your open service object class (indicated by **metrics.openClass**). (The METHOD.TBL file in the TESTSVC directory does not

specify an ancestor call for **msgSvcOpenDefaultsRequested**; if you use an open service object class, you must remember to modify its method table entry.)

If your service is a single access service, provide the defaults and return; **clsService** does not have a method for this message, so your service does not have to call its ancestor.

```
/************************************************************************
    TestSvcOpenDefaultsRequested

    A client wants to get the defaults for the pArgs field of his open
    structure.

    The client sent msgSMOpenDefaults to a service manager.
************************************************************************/
MSG_HANDLER TestSvcOpenDefaultsRequested(
    const   MESSAGE                 msg,
    const   OBJECT                  self,
    const   P_SVC_OPEN_CLOSE        pArgs,
    const   CONTEXT                 context,
    const   P_INSTANCE_DATA         pInst)
{
    msg; self; pArgs; context; pInst;

    // If you are a multi-user service (openClass <> objNull) then
    // you probably don't need to handle this message. Superclass behavior
    // is to send msgNewDefaults to your openClass.
    // Single-user services that support the concept of a defaulted open
    // pArgs should initialize pArgs->pArgs here.

    return stsOK;

} // TestSvcOpenDefaultsRequested
```

Handling msgSvcCloseRequested

117.7.2.5

When a client sends **msgSMClosed** to a service manager, the service manager sends **msgSvcCloseRequested** to the specified service instance. The message passes a pointer to an SVC_OPEN_CLOSE structure, as described above in **msgSvcOpenRequested**.

This message informs the service that a particular object no longer has it open. The service manager removes the service instance from its open list before sending this message.

The service instance cannot veto this request, however, it should perform any necessary cleanup and then pass the message to its superclass.

```
/************************************************************************
    TestSvcCloseRequested
    A client is finished interacting with the service.
    The client sent msgSMClose to a service manager.
************************************************************************/
MSG_HANDLER TestSvcCloseRequested(
    const   MESSAGE                 msg,
    const   OBJECT                  self,
    const   P_SVC_OPEN_CLOSE        pArgs,
    const   CONTEXT                 context,
    const   P_INSTANCE_DATA         pInst)
{
    msg; self; pArgs; context; pInst;
```

```
    // If this is a multi-user service then clsService will automatically
    // send msgDestroy the openClass instance created at open time.
    // pArgs->pArgs becomes the pArgs for the msgDestroy.

    // If this is a single-user service you might need to update instance
    // data state at this time.

    return stsOK;

} // TestSvcCloseRequested
```

Handling msgSvcQueryLockRequested

117.7.2.6

Query locking is for advanced users only.

So that clients can access a service without opening it, clients can send **msgSMQueryLock** to a service manager, specifying a service instance to lock. When a client sends **msgSMQueryLock** to a service manager, the service manager sends **msgSvcQueryLockRequested** to the specified service instance. The message has no arguments.

If your service instance receives **msgSvcQueryLockRequested**, it must pass the message to its superclass.

A client cannot read and write data using a service instance while it has a query lock; the client must open the service to do so.

If **exclusiveOpen** is **true**, a query lock counts as an open. If a client has a service instance open and **exclusiveOpen** is **true**, another client cannot access the service instance. If a client has a query lock on the service instance and **exclusiveOpen** is **true**, it has exclusive access to that service instance.

Handling msgSvcQueryUnlockRequested

117.7.2.7

To release a query lock, a client sends **msgSMQueryUnlock** to the service manager. The service manager then sends **msgSvcQueryUnlockRequested** to the specified service instance. The message has no arguments.

If your service instance receives **msgSvcQueryUnlockRequested**, it must pass the message to its superclass.

Handling msgSvcDeinstallRequested

117.7.2.8

When **theInstalledServices** deinstalls a service or when a service application needs to destroy a service instance, it sends **msgIMDeinstall** to a service manager for each instance of the service. The service manager checks whether the service instance is in use. If the service instance is in use, the service manager refuses the message with **stsFailed**.

If the service instance is not in use, the service manager sends **msgSvcDeinstallRequested** to the specified service instance. The message has no arguments.

If your service instance receives **msgSvcDeinstallRequested**, it should perform any clean up that it needs and returns **stsOK**. A service instance does not have to pass this message to the superclass, but if it does pass **msgSvcDeinstallRequested**, it must also pass **msgSvcDeinstallVetoed** to the superclass.

If all instances of the service return **stsOK**, **theInstalledServices** sends **msgFree** to each instance. A service instance cannot veto **msgFree**. **msgFree** causes the service instance to be removed from all service managers. Between returning **stsOK** and receiving **msgFree**, the service instance must not accept any new clients.

Handling msgSvcDeinstallVetoed

117.7.2.9

If any instance vetos the deinstallation, **theInstalledServices** sends **msgSvcDeinstallVetoed** to each service that received **msgSvcDeinstallRequested**. The message passes no arguments.

When your service instance receives **msgSvcDeinstallVetoed**, it can accept new clients.

If you passed **msgSvcDeinstallRequested** to the superclass, you must also pass **msgSvcDeinstallVetoed** to the superclass.

Handling msgSvcSaveRequested

117.7.2.10

When a client sends **msgSMSave** to a service manager and specifies this service, or when the entire service is being saved to home, the service manager sends **msgSvcSaveRequested** to your service instance. The message passes a pointer to an FS_FLAT_LOCATOR structure, which specifies the parent directory in which this service instance should be saved.

Your service instance should make sure that your state file is up to date and then send this message to the superclass. **clsService** saves the state file and the current target. If a node with the same name as the service instance already exists, **clsService** overwrites the destination. If the **pArgs** is **pNull**, the service instance is saved to its home. The service instance's home is in the INST directory in the home directory of the service class.

Alternatively, your service instance could save its state data and anything else, and not pass the message to the superclass.

Handling msgSvcClientDestroyedEarly

117.7.2.11

If a client terminates while it is bound to a service instance, has a service instance open, or owns a service instance, **msgSvcClientDestroyedEarly** is sent to the service instance. Service instances that maintain per-client state must handle this message and perform their own cleanup.

The message passes the UID of the client that was destroyed.

You must pass this message to your superclass. **clsService** cleans up the service instance by sending **msgSMUnbind**, **msgSMClose** and **msgSMSetOwner** to **self** as appropriate.

Change Ownership Protocol Messages 117.7.3

When a client sends **msgSMChangeOwner** to a service manager, the service manager negotiates with the current owner of the service instance, the new owner of the service instance, and the service instance itself. Note that the client that sends **msgSMChangeOwner** does not have to be one of the owners; it can be a separate application, such as Printers, which tells the current owners of a device to change.

The negotiation occurs in this sequence:

1. The service manager sends **msgSvcOwnerAcquireRequested** to the new owner. The new owner can veto the change by returning anything other than **stsOK** or **stsNotUnderstood**. If the new owner vetoes the change, **msgSMChangeOwner** returns with a failure status.
2. The service manager sends **msgSvcOwnerReleaseRequested** to the current owner. The old owner can veto the change by returning anything other than **stsOK** or **stsNotUnderstood**. If the old owner vetoes the change, **msgSMChangeOwner** returns with a failure status.
3. If the current owner approves the change and it has the service instance open, it must close the service instance before returning **stsOK**.
4. The service manager checks to see if the service instance is still open. If it is, the service manager abandons the change owner operation by returning **stsSvcInUse**.
5. The service manager sends **msgSvcChangeOwnerRequested** to the service instance. This informs the service instance that its owner is about to change, and allows the service instance to veto the change (by returning a status other than **stsOK** or **stsNotUnderstood**). If the service instance vetoes the change, **msgSMChangeOwner** returns with a failure status.
6. The service manager sends **msgSMOwnerChanged** to all clients that are bound to the service instance and to all clients that are observing the service manager that lists this service.
7. The service manager sends **msgSvcOwnerReleased** to the old owner.
8. The service manager sends **msgSvcOwnerAcquired** to the new owner.

Clients can also use **msgSMSetOwnerNoVeto**, which is like **msgSMSetOwner**, but it does give the current and new owners the chance to veto the change (it doesn't send **msgSvcReleaseRequested** to the current owner and **msgSvcAcquireRequested** to the new owner).

Handling msgSvcOwnerReleaseRequested 117.7.3.1

When a service manager receives a **msgSMChangeOwner**, it sends a **msgSvc-OwnerReleaseRequested** to the client that currently owns the service instance. The messageasks the client if it is willing to relinquish ownership of a specific service

instance. The message passes a pointer to an SVC_OWNED_NOTIFY structure, which contains:

ownedService The UID of the service instance whose owner is changing.

oldOwner The UID of the current owner.

newOwner The UID of the new owner.

When you receive this message, you must pass it to your superclass. If **clsService** vetoes the request (by returning a status other than **stsOK** or **stsNotUnderstood**), you should return with that status.

If you want to release ownership of the service instance, return **stsOK**. If you need to remain the owner of the service instance, return any status other than **stsOK** or **stsNotUnderstood**.

Handling msgSvcOwnerAcquireRequested

117.7.3.2

If the current owner of the service instance does not veto **msgSvcOwnerRelease-Requested**, the service manager sends **msgSvcOwnerAcquireRequested** to the client that is proposed as the new owner. This message asks the client if it is willing to take ownership of the service instance. The message passes a pointer to an SVC_OWNED_NOTIFY structure, as described above in **msgSvcOwner-ReleaseRequested**.

When you receive this message, you must pass it to your superclass. If **clsService** vetoes the request (by returning a status other than **stsOK** or **stsNotUnderstood**), you should return with that status.

If you want to take ownership of the service instance, return **stsOK**. If you don't want to become the owner of the service instance, return any status other than **stsOK** or **stsNotUnderstood**.

Handling msgSvcChangeOwnerRequested

117.7.3.3

If the owner of the service instance does not veto **msgSvcOwnerAcquireRequested**, the service manager sends **msgSvcChangeOwnerRequested** to the service instance. This message informs the service instance you that its owner owner is about to change and allows it to veto the change. The message takes a pointer to an SVC_OWNED_NOTIFIED structure, which contains three arguments:

ownedService The UID of the service instance whose owner is changing. This should be self.

oldOwner The UID of the current owner.

newOwner The UID of the new owner.

If you want to allow the ownership change, return **stsOK**. If you don't want to allow the change, return any status other than **stsOK** or **stsNotUnderstood**.

If you don't veto the request, you must pass this message to your superclass. If **clsService** vetos the request (by returning a status other than **stsOK** or **stsNotUnderstood**), you should return with that status.

Handling msgSvcOwnerReleased 117.7.3.4

When a client is no longer the owner of a service instance, a service manager sends **msgSvcOwnerReleased** to the client. The message takes a pointer to an SVC_OWNED_NOTIFY structure, as described above in **msgSvcChange-OwnerRequested**.

You must send this message to your superclass.

If you need to preserve any owned state information for the service instance while you own it, you should get it now (with **msgSvcGetMetrics**) and save it in your state file.

You can manipulate the service as its owner until you return; the ownership change actually takes place when you return from this message.

Handling msgSvcOwnerAcquired 117.7.3.5

When a client becomes the owner of a service instance, a service manager sends **msgSvcOwnerAcquired** to the client. The message takes a pointer to an SVC_OWNED_NOTIFY structure, as described above in **msgSvcChangeOwner-Requested**.

You must send this message to your superclass.

You can manipulate the service as its owner as soon as you receive this message.

If you need to restore any saved state information for the service instance, you should do it here (usually with **msgSvcSetMetrics**).

Messages Handled By clsService 117.7.4

Your service instance should not handle the messages listed in Table 117-3; they should be handled by **clsService** only.

Table 117-3
clsService Responsibility Messages

Message	Takes	Description
msgSvcGetStyle	P_SVC_STYLE	Returns current style settings.
msgSvcSetStyle	P_SVC_STYLE	Changes style settings.
msgSvcAutoDetectingHardware	P_BOOLEAN	Is the hardware that this service ultimately talks to auto-detecting?
msgSvcGetHandle	P_OBJECT	Returns a handle to the service's state node.
msgSvcOpenTarget	P_SVC_OPEN_TARGET	Attain access to the target service for data transfer.
msgSvcCloseTarget	P_SVC_OPEN_CLOSE_TARGET	Give up data transfer access to the target service.
msgSvcGetTarget	P_SVC_GET_TARGET	Returns current target.
msgSvcSetTarget	P_SVC_SET_TARGET	Change the target.
msgSvcAddToManager	P_SVC_ADD_TO_MANAGER	Add this service instance to a service manager.
msgSvcRemoveFromManager	P_SVC_REMOVE_FROM_MANAGER	Removes this service instance from a service manager.
msgSvcGetConnected	P_SVC_GET_SET_CONNECTED	Gets the connected state of this service.

continued

Table 117-3 (continued)

Message	Takes	Description
msgSvcSetConnected	P_SVC_GET_SET_CONNECTED	Sets connection state of self.
msgSvcGetModified	P_SVC_GET_SET_MODIFIED	Gets the modified state of this service.
msgSvcSetModified	P_SVC_GET_SET_MODIFIED	Sets modified state of self.
msgSvcGetMyOwner	P_OBJECT	Gets the current owner of this service, if any.
msgSvcGetOwned	P_OBJECT	Gets the service that is owned by this service, if any.
msgSvcGetName	P_SVC_GET_NAME	Gets the name of this service instance.
msgSvcGetClassMetrics	P_SVC_CLASS_METRICS	Gets metrics for the service class that controls this instance.
msgSvcPropagateMsg	P_OBJ_NOTIFY_OBSERVERS	Propagates a service-specific message.
msgSvcGetBindList	P_SVC_GET_LIST	Gets a list of all the callers that have bound to this service.
msgSvcGetOpenList	P_SVC_GET_LIST	Gets a list of all the callers that have opened this service.
msgSvcGetOpenObjectList	P_SVC_GET_LIST	Gets a list of the open objects which were returned for each open.
msgSvcGetManagerList	P_SVC_GET_LIST	Gets a list of all the service managers that this service is on.
msgSvcGetManagerHandleList	P_SVC_GET_LIST	Gets a list of the svc mgr handles that this service is represented by.
msgSvcGetDependentAppList	P_SVC_GET_LIST	Gets a list of theInstalledApps handles for all dependent apps.
msgSvcGetDependentServiceList	P_SVC_GET_LIST	Gets a list of theInstalledServices handles for all dependent services.

Messages Sent to Open Services 117.8

Once a client has opened a service, the client sends messages directly to the service instance. These messages tell the service to perform its functions.

Some services require clients to use the **clsStream** messages to send or receive data from the service (remember that **clsService** inherits from **clsStream**). Other services cannot use the **clsStream** messages. These services must define their own messages in their header file and METHOD.TBL file.

In either case, the service class must define methods for the messages from clients.

Open Service Objects 117.9

If you are writing a multiple access, multi-user service, you must create a class that can provide UIDs to each of the service openers. You must do this by creating a subclass of **clsOpenServiceObject** when you initialize your service class. When you create your service instances, the arguments to **msgNew** specify the open service object class that your service uses.

The section "Initializing an Open Service Object Class" describes how to initialize the open service object class and gives an example showing how to subclass **clsOpenServiceObject**.

To the client, the behavior of exclusive- and multiple-access services is no different. The client sends **msgSMOpen** to a service manager; if the service is available, the service manager passes back a service UID in the service field of the SM_OPEN_CLOSE structure. The client does not know whether the service is multiple access or exclusive access, nor should it have to know.

clsService Does Most of the Work 117.9.1

When you use a subclass of **clsOpenServiceObject** in a service, **clsService** actually performs most of the work for you.

When your service passes **msgSvcOpenDefaultsRequested** to your superclass, **clsService** determines that you have a open service object class, allocates a _NEW structure for the class, and initializes the _NEW structure by sending **msgNewDefaults** to the open service object class.

Later, when your service passes **msgSvcOpenRequested** to your superclass, **clsService** creates an instance of your open service object class by sending it **msgNew**. **clsService** then passes back the UID of the new open service object to the opener.

Because **clsService** creates the open service object in response to a client opening a specific service instance, the open service object is said to be associated with a service instance.

What clsOpenServiceObject Does 117.9.2

Like **clsService**, **clsOpenServiceObject** is a subclass of **clsStream**. Openers of the service send messages to the open service object. The open service object performs some local handling, and forwards all **clsService** messages to the service instance with which it is associated.

clsOpenServiceObject defines a single message, **msgOSOGetServiceInstance**, which allows its subclasses to get the UID of the service instance with which the open service object is associated.

Subclassing clsOpenServiceObject 117.9.3

Your open service object class performs front end work for your service and maintains per-client state for the service. For instance, an open service object class might maintain the client's current position in a database service; another open service object class might maintain the client's session information for a network service.

It is hard to specify exactly where to draw the line between what the open service object class does, and what the service does. You must determine what is most efficient for your particular service.

When **clsService** creates the open service object, it creates it in the context of the opener's process. The open service object is local to the client; only the client can call the open service object. If performance is not an issue, the service can use **ObjectSend** to pass messages to the open service object; if performance is an issue, the open service object can make itself callable by the service.

Because the open service object is local to the client, it can use **OSProcessHeap()** to allocate its data structures. On the other hand, services must never use **OSProcessHeap()** to allocate data structures.

Chapter 118 / Distributing Your Services

This chapter describes what you must do to make your service available to the user to install. It also describes what the user must do to install your service.

What You Must Do 118.1

So that a user can install your service correctly, you must use the PenPoint file organization correctly.

The PenPoint file organization for services was described in Chapter 116. As a review, your distribution disk should have this structure:

```
\\Distribution Volume
  └─ \PENPOINT
       └─ \SERVICE
            └─ \Service Directory
                 ├─ \.dll files
                 ├─ \.dlc file
                 ├─ \INIT.DLL
                 ├─ \SERVICE.RES
                 ├─ \MISC
                 │    └─ \Static Data Files
                 ├─ \INST
                 │    ├─ \Service State Node
                 │    └─ \Service State Node
                 ├─ \APP.INI
                 └─ \SERVICE.INI
```

Providing Preconfigured Instances 118.1.1

Where appropriate, you should provide preconfigured instances of your service.

The best way to save a preconfigured instance is to run PenPoint with the B 800 debugger flag set. This flag allows you to view the file system for the running PenPoint system in the Connections notebook.

Create the instance, then open the system disk to \PENPOINT\SYS\SERVICE\Your Service\INST and copy the appropriate service state node to \PENPOINT\SERVICE\Your Service\INST.

Providing Demo Apps 118.1.2

If your service will be used programmatically, provide a demo application that shows how to access your service.

It is probably not a good idea to place the demo application source files in the \PENPOINT directory. Rather, create a directory in the root of your distribution volume, and store the source files there.

What ever you do, make sure you tell your potential clients where to find the source.

What the User Must Do 118.2

When users obtain your service, they need to know the following information:

- How to install your service.
- How to use your service.
- What additional files (such as utilities or service instances) you shipped with your service.

Of course, the best way to provide this information is to document it. Tech Note #8 from GO Developer Technical Support recommends some procedures for documenting PenPoint applications. Most of this information will be directly applicable to services.

Chapter 119 / Test Service Examples

This chapter describes the example services in TESTSVC, BASICSVC, and MILSVC.

- TESTSVC is a general service that you can use it as a template from which to build most services.
- BASICSVC is a simple service that performs the minimum work that a service needs to do.
- MILSVC is provides the foundations for a device driver service that uses the PenPoint machine interface layer (MIL).

TESTSVC

The following sections list the files used to build TESTSVC. These files are also in the directory \PENPOINT\SDK\SAMPLE\TESTSVC. The sections are:

METHOD.TBL

TESTSVC.H

TESTSVC.C

OPENOBJ.H

OPENOBJ.C

METHOD.TBL

```
/*****************************************************************************
  File: method.tbl

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     $Revision:   1.19  $
     $Date:   31 Jan 1992 08:40:34  $

 Contains the method tables for the Test Service.

 Note: The method table for clsTestService has two handlers for each
 of these four methods: msgOptionAddCards, msgOptionProvideCardWin,
 msgOptionRefreshCard, and msgOptionApplyCard. One handler is what we
 typically think of as a message handler -- it handles messages sent to
 instances of a class. The other one is slightly different. It handles
 messages sent to the class itself.

 You specify that a handler is for messages sent to a class by OR'ing in
 objClassMessage with objCallAncestorBefore, After, and so on.

 You declare a class's message handler in the normal way. However, remember
 that self is a class, and that pInst does not point to the instance data
 of any of its instances. Instead, it points to some random chunk of
 memory. So, do not look at the instance data in a class's message handler.
 With services, the msgOption<...> messages are sent to the service class
 if the user draws a check mark over the service in the Installer, and
 when the user initially installs the service if svcPopupOptions is
 or-ed in to the InitService() flags. For more information, please see
 the comment titled "5. Advanced Features" in the service.h public include
 file.
*****************************************************************************/
#include <option.h>
#include <testsvc.h>
#include <openobj.h>

MSG_INFO clsTestServiceMethods [] = {
        msgNewDefaults,       "TestSvcNewDefaults",    objCallAncestorBefore,
        msgInit,      "TestSvcNew",       objCallAncestorBefore,
        msgFree,      "TestSvcFree",      objCallAncestorAfter,
        msgSvcGetMetrics,     "TestSvcGetMetrics",     0,
        msgSvcSetMetrics,     "TestSvcSetMetrics",     0,
        msgSvcOpenRequested,     "TestSvcOpenRequested", objCallAncestorBefore,
        msgSvcOpenDefaultsRequested, "TestSvcOpenDefaultsRequested",
objCallAncestorBefore,
        msgSvcCloseRequested,    "TestSvcCloseRequested",objCallAncestorBefore,
      msgOptionAddCards,  "TestSvcAddCards",  objCallAncestorAfter,
      msgOptionProvideCardWin,"TestSvcProvideCardWin",objCallAncestorAfter,
      msgOptionRefreshCard,    "TestSvcRefreshCard",    objCallAncestorAfter,
      msgOptionApplyCard, "TestSvcApplyCard",      objCallAncestorAfter,
      msgOptionAddCards,  "TestSvcClassAddCards", objClassMessage,
      msgOptionProvideCardWin,"TestSvcClassProvideCardWin", objClassMessage,
      msgOptionRefreshCard,    "TestSvcClassRefreshCard", objClassMessage,
      msgOptionApplyCard, "TestSvcClassApplyCard", objClassMessage,
      msgSvcClassTerminate,    "TestSvcTerminate",
                  objClassMessage | objCallAncestorAfter,
      0
};

MSG_INFO clsTestOpenObjectMethods [] = {
        msgNewDefaults,   "TestOpenObjectNewDefaults",objCallAncestorBefore,
        msgInit,      "TestOpenObjectNew",     objCallAncestorBefore,
        msgFree,  "TestOpenObjectFree",    objCallAncestorAfter,
      0
};

CLASS_INFO classInfo[] = {
      "clsTestServiceTable",  clsTestServiceMethods,  0,
      "clsTestOpenObjectTable", clsTestOpenObjectMethods, 0,
      0
};
```

TESTSVC.H

```
/*****************************************************************************
 File: testsvc.h

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 $Revision:   1.18  $
     $Date:   31 Jan 1992 08:40:20  $

 This file contains the API definition for clsTestService.
 clsTestService inherits from clsService.

*****************************************************************************/
#ifndef TEST_SERVICE_INCLUDED
#define TEST_SERVICE_INCLUDED

#ifndef SERVICE_INCLUDED
#include <service.h>
#endif

/* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 *                  Common #defines and typedefs                           *
 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * */

/****  Class Option Tags  ****/
#define  tagTestSvcOptionCard               MakeTag(clsTestService, 10)
#define  tagTestSvcGlobalOptionCard         MakeTag(clsTestService, 11)

/****  Quick Help Tags  ****/
#define hlpTestSvcOptionCard                MakeTag(clsTestService, 20)
#define hlpTestSvcGlobalOptionCard       MakeTag(clsTestService, 21)

/* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 *                             Messages                                    *
 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * */

/*****************************************************************************
 msgNew                    takes P_TEST_SVC_NEW, returns STATUS
     category: class message
     Creates a new test service instance.
*/
typedef struct TEST_SVC_NEW_ONLY {
    U32                     unused1;
    U32                     unused2;
    U32                     unused3;
} TEST_SVC_NEW_ONLY, *P_TEST_SVC_NEW_ONLY;

#define testServiceNewFields \
    serviceNewFields         \
    TEST_SVC_NEW_ONLY       testSvc;

typedef struct TEST_SVC_NEW {
    testServiceNewFields
} TEST_SVC_NEW, *P_TEST_SVC_NEW;


/*****************************************************************************
 msgNewDefaults                takes P_TEST_SVC_NEW, returns STATUS
     category: class message
     Set defaults:

*/


                        /* Your messages here! */


#endif  // TEST_SERVICE_INCLUDED
```

TESTSVC.C

```
/*****************************************************************************
 File: testsvc.c

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 $Revision:   1.22  $
     $Date:   31 Jan 1992 08:40:14  $

 This file contains the class definition and methods for clsTestService.

 This is a cannonical service, designed to give service writers a head
 start. Stubs for the messages that are typically subclassed by a service
```

```
 are provided. Note that not every subclass-responsibility message is
 given; only those that are most often used. For example, a handler for
 msgSvcBindRequested isn't provided since it is very rarely subclassed.

 Notes:

 Remember that service instances have capCall turned on. This means that
 they can be called from a process besides their owning process. If it is
 possible for more than one caller to access the same service instance
 simultaneously, think through the concurrency issues! You might have to
 use semaphores to protect areas which can't handle being called
 simultaneously by multiple folks.
*****************************************************************************/
#include <string.h>
#include <stdlib.h>
#include <debug.h>
#include <list.h>
#include <fs.h>
#include <os.h>
#include <osheap.h>
#include <opttable.h>
#include <option.h>
#include <servmgr.h>
#include <method.h>

#include <testsvc.h>


// TKTables for instance and class option cards.
static TK_TABLE_ENTRY optionCard[] = {
     {"Instance Option1:",0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, clsButton},
     {"Instance Option2:",0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, clsButton},
     {pNull}
};

static TK_TABLE_ENTRY globalOptionCard[] = {
     {"Global Option1:",0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, clsButton},
     {"Global Option2:",0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, clsButton},
     {pNull}
};

// The service manager(s) we should be put on.
static UID    managers = {thePrinterDevices};

typedef struct INSTANCE_DATA {
     U32                 unused1;
     U32                 unused2;
} INSTANCE_DATA, *P_INSTANCE_DATA;
```

```
/*****************************************************************************
     TestSvcNewDefaults

     Set defaults. This is where the service characterstics that are common
     to all instances of your service subclasses are specified.
*****************************************************************************/
MsgHandlerWithTypes(TestSvcNewDefaults, P_TEST_SVC_NEW, P_INSTANCE_DATA)
{
     MsgHandlerParametersNoWarning;

     // These are the default values from clsService.
     pArgs->svc.style.exclusiveOpen = false; // Exclusive open service?
     pArgs->svc.style.autoOption = false;    // Set to true to pass option
                                             //  sheet messages to your target.

     pArgs->svc.handleClass = clsFileHandle; // Change this if you want your
                                             //  state handle to be something
                                             //  other than a file handle.
     // The next two lines are only needed if you change svc.handleClass.
     ObjCallWarn(msgNewDefaults, pArgs->svc.handleClass, &(pArgs->svc.fsNew));
     pArgs->svc.fsNew.fs.exist = fsExistOpen | fsNoExistCreate;

     // Service managers that this instance should go on. Often statically
     // defined, as in this example. See managers definition above.
     pArgs->svc.pManagerList = &managers;
     pArgs->svc.numManagers = 1;

     // The setting of openClass determines whether the service instance
     // object is passed back on open (openClass = objNull), or a new
     // instance of the openClass is created and passed
     // back (openClass = clsYourOpenObject). openObject classes should
     // be subclasses of clsOpenServiceObject.
     pArgs->svc.style.openClass = objNull;

     return stsOK;

} // TestSvcNewDefaults


/*****************************************************************************
     TestSvcNew

     Create a new Test Service.

     1. Set up your instance data.
     2. Deal with your state file. Your state file will either contain stuff
        (if you are being recreated due to a warm boot or having been copied
        in from disk) or be empty (if this is the first time). You must call
        ancestor before dealing with your state file.
```

```
     Notes:

     If autoCreate in msgSvcClassInitService was true then the system will
     send msgNewDefaults and msgNew for each state file it finds.
*****************************************************************************/
MsgHandlerWithTypes(TestSvcNew, P_TEST_SVC_NEW, P_INSTANCE_DATA)
{
     INSTANCE_DATA                  inst;
     OBJECT                         stateHandle;
     STATUS                         s;

     MsgHandlerParametersNoWarning;

     inst.unused1 = 0;
     inst.unused2 = 0;

     // Get my state file.
     ObjCallJmp(msgSvcGetHandle, self, &stateHandle, s, objectWrite);

     // Is it empty? Initialize it. Is it full? Update instance data if
     // appropriate.

     s = stsOK;

objectWrite:
     StsWarn(ObjectWrite(self, ctx, &inst));

     return s;

} // TestSvcNew


/*****************************************************************************
     TestSvcFree

     Free any resources that this service created. Don't delete the state file
     or free the state file handle!
*****************************************************************************/
MsgHandlerWithTypes(TestSvcFree, P_ARGS, P_INSTANCE_DATA)
{
     MsgHandlerParametersNoWarning;

     return stsOK;

}    // TestSvcFree


/*****************************************************************************
     TestSvcGetMetrics

     If this service supports client accessable metrics then this message
     must be handled. Be sure to include some form of version identification
     with the metrics.
*****************************************************************************/
MsgHandlerWithTypes(TestSvcGetMetrics, P_SVC_GET_SET_METRICS, P_INSTANCE_DATA)
{
     MsgHandlerParametersNoWarning;

     if (pArgs->len == 0) {
//       pArgs->len = myMetricsLength;
     } else {
         // Copy out my metrics to pArgs->pMetrics.
     }
     return stsOK;

} // TestSvcGetMetrics


/*****************************************************************************
     TestSvcSetMetrics

     If this service supports client accessable metrics then this message
     must be handled. Be able to handle old versions of the metrics...
*****************************************************************************/
MsgHandlerWithTypes(TestSvcSetMetrics, P_SVC_GET_SET_METRICS, P_INSTANCE_DATA)
{
     MsgHandlerParametersNoWarning;

     return stsOK;

} // TestSvcSetMetrics


/*****************************************************************************
     TestSvcOpenDefaultsRequested

     A client wants to get the defaults for the pArgs field of his open
     structure.

     The client sent msgSMOpenDefaults to a service manager.
*****************************************************************************/
MsgHandlerWithTypes(TestSvcOpenDefaultsRequested, P_SVC_OPEN_CLOSE,
P_INSTANCE_DATA)
{
     MsgHandlerParametersNoWarning;

     // If you are a multi-user service (openClass <> objNull) then
     // you probably don't need to handle this message. Superclass behavior
     // is to send msgNewDefaults to your openClass.

     // Single-user services that support the concept of a defaulted open
     // pArgs should initialize pArgs->pArgs here.
```

```
    return stsOK;

} // TestSvcOpenDefaultsRequested


/*****************************************************************************
    TestSvcOpenRequested

 A client wants interact directly with the service, typically to move data.

 The client sent msgSMOpen to a service manager.
*****************************************************************************/
MsgHandlerWithTypes(TestSvcOpenRequested, P_SVC_OPEN_CLOSE, P_INSTANCE_DATA)
{
//  SVC_OPEN_CLOSE_TARGET       openTarget;
//  SVC_GET_TARGET              getTarget;
//  STATUS                      s;

    MsgHandlerParametersNoWarning;

    // If this is a multi-user service then clsService will automatically
    // create an instance of the openClass you specified in
    // msgNewDefaults. You might want to specify or modify the open
    // request's pArgs (pArgs->pArgs). These become the pArgs for the msgNew
    // to your openClass, and is how you can communicate with your
    // openClass.

    // If this is a single-user service you might need to update instance
    // data state at this time. Note that you don't have handle checking for
    // exclusive access; clsService does this all for you.

    // If auto-open is false, this service will probably want to open its
    // target.
//  openTarget.pArgs = ...;
//  ObjCallRet(msgSvcOpenTarget, self, &openTarget, s);

    // Get the actual target object.
//  ObjCallRet(msgSvcGetTarget, self, &getTarget, s);

    // Send some messages to my target.
//  ObjCallRet(msgBlahBlah, getTarget.targetService, &blah, s);

    return stsOK;

} // TestSvcOpenRequested


/*****************************************************************************
    TestSvcCloseRequested

    A client is finished interacting with the service.

    The client sent msgSMClose to a service manager.
*****************************************************************************/
MsgHandlerWithTypes(TestSvcCloseRequested, P_SVC_OPEN_CLOSE, P_INSTANCE_DATA)
{
//  SVC_OPEN_CLOSE_TARGET       closeTarget;
//  STATUS                      s;

    MsgHandlerParametersNoWarning;

    // If this is a multi-user service then clsService will automatically
    // send msgDestroy the openClass instance created at open time.
    // pArgs->pArgs becomes the pArgs for the msgDestroy.

    // If this is a single-user service you might need to update instance
    // data state at this time.

    // If auto-open is false, this service will probably want to close its
    // target.
//  closeTarget.pArgs = ...;
//  ObjCallRet(msgSvcCloseTarget, self, &closeTarget, s);

    return stsOK;

} // TestSvcCloseRequested


/*****************************************************************************
    TestSvcAddCards

 Add service instance option cards. This routine should be used if this
 service provides options cards for its instances.
*****************************************************************************/
MsgHandlerWithTypes(TestSvcAddCards, P_OPTION_TAG, P_INSTANCE_DATA)
{
    OPTION_CARD                 optCard;
    STATUS                      s;

    MsgHandlerParametersNoWarning;

    optCard.tag = tagTestSvcOptionCard;
    optCard.pName = "Testing, testing, testing...";
    optCard.win = objNull;
    optCard.client = self;
    ObjCallRet(msgOptionAddCard, pArgs->option, &optCard, s);

    return stsOK;

}   // TestSvcAddCards


/*****************************************************************************
    TestSvcProvideCardWin
```

```
 Provide service instance option cards. This routine should be used if this
 service provides options cards for its instances.
*****************************************************************************/
MsgHandlerWithTypes(TestSvcProvideCardWin, P_OPTION_CARD, P_INSTANCE_DATA)
{
    OPTION_TABLE_NEW            optTable;
    STATUS                      s;

    MsgHandlerParametersNoWarning;

    if (pArgs->tag == tagTestSvcOptionCard) {
        ObjCallWarn(msgNewDefaults, clsOptionTable, &optTable);
        optTable.win.flags.style |= wsShrinkWrapWidth | wsShrinkWrapHeight;
        optTable.gWin.helpId = hlpTestSvcOptionCard;
        optTable.tkTable.pEntries = optionCard;
        ObjCallRet(msgNew, clsOptionTable, &optTable, s);
        pArgs->win = optTable.object.uid;
    }

    return stsOK;

}   // TestSvcProvideCardWin


/*****************************************************************************
    TestSvcRefreshCard

 Refresh the instance option cards.
*****************************************************************************/
MsgHandlerWithTypes(TestSvcRefreshCard, P_OPTION_CARD, P_INSTANCE_DATA)
{
    MsgHandlerParametersNoWarning;

    if (pArgs->tag != tagTestSvcOptionCard) {
        return stsOK;
    }

    // Refresh our card(s) here.

    return stsOK;

}   // TestSvcRefreshCard


/*****************************************************************************
    TestSvcApplyCard

 Apply the instance option cards.
*****************************************************************************/
MsgHandlerWithTypes(TestSvcApplyCard, P_OPTION_CARD, P_INSTANCE_DATA)
{
    MsgHandlerParametersNoWarning;

    if (pArgs->tag != tagTestSvcOptionCard) {
        return stsOK;
    }

    // Apply our card(s) here.

    return stsOK;

}   // TestSvcApplyCard


/***************************** Class Messages *****************************/


/*****************************************************************************
    TestSvcTerminate

    Perform any operations required when the entire service is being
    deinstalled. Note that all instances have already been destroyed.
*****************************************************************************/
MsgHandlerArgType(TestSvcTerminate, P_ARGS)
{
    MsgHandlerParametersNoWarning;

    return stsOK;

}   // TestSvcTerminate


/*****************************************************************************
    TestSvcClassAddCards

 Add global service option cards. These cards are popped up when the user
 checks on this service in the installer, and when the user initially
 installs the service if svcPopupOptions is or-ed in to the InitService()
 flags.
*****************************************************************************/
MsgHandlerArgType(TestSvcClassAddCards, P_OPTION_CARD)
{
    OPTION_CARD                 optCard;
    STATUS                      s;

    MsgHandlerParametersNoWarning;

    optCard.tag = tagTestSvcGlobalOptionCard;
    optCard.pName = "Global Options";
    optCard.win = objNull;
    optCard.client = self;
    ObjCallRet(msgOptionAddCard, pArgs->option, &optCard, s);

    return stsOK;
```

```
}     // TestSvcClassAddCards


/************************************************************************
     TestSvcClassProvideCardWin

 Provide the win for our cards.
************************************************************************/
MsgHandlerArgType(TestSvcClassProvideCardWin, P_OPTION_CARD)
{
     OPTION_TABLE_NEW               optTable;
     STATUS                         s;

     MsgHandlerParametersNoWarning;

     if (pArgs->tag == tagTestSvcGlobalOptionCard) {
         ObjCallWarn(msgNewDefaults, clsOptionTable, &optTable);
         optTable.win.flags.style |= wsShrinkWrapWidth | wsShrinkWrapHeight;
         optTable.gWin.helpId = hlpTestSvcGlobalOptionCard;
         optTable.tkTable.pEntries = globalOptionCard;
         ObjCallRet(msgNew, clsOptionTable, &optTable, s);
         pArgs->win = optTable.object.uid;
     }

     return stsOK;

}     // TestSvcClassProvideCardWin


/************************************************************************
     TestSvcClassRefreshCard

 Refresh the global option cards.
************************************************************************/
MsgHandlerArgType(TestSvcClassRefreshCard, P_OPTION_CARD)
{
     MsgHandlerParametersNoWarning;

     if (pArgs->tag != tagTestSvcGlobalOptionCard) {
         return stsOK;
     }

     // Refresh our global option card(s) here...

     return stsOK;

}     // TestSvcClassRefreshCard


/************************************************************************
     TestSvcClassApplyCard

 Apply the global option cards.
************************************************************************/
MsgHandlerArgType(TestSvcClassApplyCard, P_OPTION_CARD)
{
     MsgHandlerParametersNoWarning;

     if (pArgs->tag != tagTestSvcGlobalOptionCard) {
         return stsOK;
     }

     // Apply our global option cards here...

     return stsOK;

}     // TestSvcClassApplyCard


/************************************************************************
     ClsTestServiceInit

     Install our class.
************************************************************************/
STATUS PASCAL ClsTestServiceInit(void)
{
     STATUS                    s;
     CLASS_NEW                 new;

     // Create the service class.
     ObjCallWarn(msgNewDefaults, clsClass, &new);
     new.object.uid            = clsTestService;
     new.cls.pMsg              = clsTestServiceTable;
     new.cls.ancestor          = clsService;
     new.cls.size              = SizeOf(INSTANCE_DATA);
     new.cls.newArgsSize       = SizeOf(TEST_SVC_NEW);
     ObjCallRet(msgNew, clsClass, &new, s);

     return s;

} // ClsTestServiceInit

// STATUS PASCAL ClsTestOpenObjectInit(void); // Only needed if multi-user.


/************************************************************************
     DLLMain()

     Install our service. This routine is called once when the service is
     first installed on PenPoint.
************************************************************************/
STATUS EXPORTED DLLMain(void)
{
     SVC_INIT_SERVICE    initService;
```

```
    SVC_NEW             svcNew;
    STATUS              s;

    // Install classes.
    StsRet(ClsTestServiceInit(), s);
//  StsRet(ClsTestOpenObjectInit(), s);  // Only needed if multi-user service.

    // Let system know about our service and set global service
    // characteristics. THIS IS REQUIRED!
    memset(initService.spare, 0, sizeof(initService.spare));
    initService.autoCreate = false;
    initService.serviceType = 0;
    initService.initServiceFlags = svcPopupOptions; // Flags. Or-in options.
    ObjCallRet(msgSvcClassInitService, clsTestService, &initService, s);

    // Create any static service instances. Set autoCreate above to false
    // if you do this. If you know exactly how many service instances
    // there will be, this is where you should create them.
    // Alternatively, they can be dynamically created elsewhere, after
    // DLLMain() runs. Beware of process ownership issues if you create
    // services dynamically. You must ensure that the process which owns
    // the dynamically created service instance will be around for the
    // lifetime of the service instance!
    ObjCallWarn(msgNewDefaults, clsTestService, &svcNew);
    svcNew.svc.pServiceName = "Test Instance";  // Name of this instance
    svcNew.svc.target.manager = theTransportHandlers; // Target svc manager
    strcpy(svcNew.svc.target.pName, "Netware"); // Target name
    ObjCallRet(msgNew, clsTestService, &svcNew, s);

    return stsOK;

} // DllMain
```

OPENOBJ.H

```
/*****************************************************************************
 File: openobj.h

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 $Revision:   1.19  $
     $Date:   31 Jan 1992 12:20:16  $

 This file contains the API definition for clsTestOpenObject.
 clsTestOpenObject inherits from clsOpenServiceObject.
 Provides a template for a multi-user service's open object class.

*****************************************************************************/
#ifndef OPENOBJ_INCLUDED
#define OPENOBJ_INCLUDED

#ifndef OPENSERV_INCLUDED
#include <openserv.h>
#endif

/* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 *                  Common #defines and typedefs                           *
 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * */


/* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 *                              Messages                                   *
 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * */

/*****************************************************************************
 msgNew                      takes P_TEST_OPEN_OBJECT_NEW, returns STATUS
     category: class message
     Creates a new test open object instance.
*/

typedef struct TEST_OPEN_OBJECT_NEW_ONLY {
    U32                     unused1;
    U32                     unused2;
    U32                     unused3;
} TEST_OPEN_OBJECT_NEW_ONLY, *P_TEST_OPEN_OBJECT_NEW_ONLY;

#define testOpenObjectNewFields  \
     openServiceObjectNewFields      \
    TEST_OPEN_OBJECT_NEW_ONLY       testOpenObject;

typedef struct TEST_OPEN_OBJECT_NEW {
    testOpenObjectNewFields
} TEST_OPEN_OBJECT_NEW, *P_TEST_OPEN_OBJECT_NEW;


/*****************************************************************************
 msgNewDefaults              takes P_TEST_OPEN_OBJECT_NEW, returns STATUS
     category: class message
     Set defaults:

*/

                        /* Your messages here! */

#endif  // OPENOBJ_INCLUDED
```

OPENOBJ.C

```
/*****************************************************************************
 File: openobj.c

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 $Revision:   1.18  $
     $Date:   31 Jan 1992 08:40:30  $

 This file contains the class definition and methods for clsTestOpenObject.

 This is a stub for and open service Object class. This class is only used
 for mult-user services that wish to pass a new uid to each opener.

 Notes:

 There's really not a whole lot to the default behavior for this class.
 Basically just put your stuff here.
*****************************************************************************/
#include <string.h>
#include <stdlib.h>
#include <debug.h>
#include <list.h>
#include <fs.h>
#include <os.h>
#include <osheap.h>
#include <servmgr.h>
#include <method.h>

#include <openobj.h>

typedef struct INSTANCE_DATA {
     U32                unused1;
     U32                unused2;
} INSTANCE_DATA, *P_INSTANCE_DATA;


/*****************************************************************************
     TestOpenObjectNewDefaults

*****************************************************************************/
MsgHandlerWithTypes(TestOpenObjectNewDefaults, P_TEST_OPEN_OBJECT_NEW,
P_INSTANCE_DATA)
{
     MsgHandlerParametersNoWarning;

     return stsOK;

} // TestOpenObjectNewDefaults


/*****************************************************************************
     TestOpenObjectNew

*****************************************************************************/
MsgHandlerWithTypes(TestOpenObjectNew, P_TEST_OPEN_OBJECT_NEW,
P_INSTANCE_DATA)
{
     INSTANCE_DATA                  inst;
     STATUS                         s;

     MsgHandlerParametersNoWarning;

     s = stsOK;

     StsWarn(ObjectWrite(self, ctx, &inst));

     return s;

} // TestOpenObjectNew


/*****************************************************************************
     TestOpenObjectFree

*****************************************************************************/
MsgHandlerWithTypes(TestOpenObjectFree, P_ARGS, P_INSTANCE_DATA)
{
     MsgHandlerParametersNoWarning;

     return stsOK;

}    // TestOpenObjectFree


/*****************************************************************************
     ClsTestOpenObjectInit

     Install our class.
*****************************************************************************/
STATUS PASCAL ClsTestOpenObjectInit(void)
{
     STATUS                 s;
```

```
    CLASS_NEW               new;

    // Create the service class.
    ObjCallWarn(msgNewDefaults, clsClass, &new);
    new.object.uid          = clsTestOpenObject;
    new.cls.pMsg            = clsTestOpenObjectTable;
    new.cls.ancestor        = clsOpenServiceObject;
    new.cls.size            = SizeOf(INSTANCE_DATA);
    new.cls.newArgsSize     = SizeOf(TEST_OPEN_OBJECT_NEW);
    ObjCallRet(msgNew, clsClass, &new, s);

    return s;

} // ClsTestOpenObjectInit
```

BASICSVC

The following sections list the files used to build BASICSVC. These files are also in the directory \PENPOINT\SDK\SAMPLE\BASICSVC. The sections are:

METHOD.TBL

BASICSVC.H

BASICSVC.C

METHOD.TBL

```
/*****************************************************************************
  File: method.tbl

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     $Revision:   1.3  $
     $Date:   31 Jan 1992 08:05:22  $

  Contains the method tables for clsBasicService.
*****************************************************************************/
#include <service.h>

MSG_INFO clsBasicServiceMethods [] = {
        msgNewDefaults,      "BasicSvcNewDefaults",  objCallAncestorBefore,
     0
};

CLASS_INFO classInfo[] = {
     "clsBasicServiceTable", clsBasicServiceMethods, 0,
     0
};
```

BASICSVC.H

```
/*****************************************************************************
 File: basicsvc.h

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 $Revision:   1.3  $
     $Date:   31 Jan 1992 08:05:18  $

 This file contains sample code for a minimal service, clsBasicService.

 This is the absolute minimum required to make a service. Add your methods
 to this framework.
*****************************************************************************/
#ifndef BASICSVC_INCLUDED
#define BASICSVC_INCLUDED

#ifndef SERVICE_INCLUDED
#include <service.h>
#endif

/* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 *                                Messages                                 *
 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * */


        /* Your messages here! */


#endif  // BASICSVC_INCLUDED
```

BASICSVC.C

```
/******************************************************************************
 File: basicsvc.c

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 $Revision:   1.3  $
     $Date:   31 Jan 1992 08:05:24  $

 This file contains sample code for a minimal service, clsBasicService.

 This is the absolute minimum required to make a service. Add your methods
 to this framework.
******************************************************************************/
#include <string.h>
#include <stdlib.h>
#include <debug.h>
#include <method.h>

#ifndef BASICSVC_INCLUDED
#include <basicsvc.h>
#endif

// Service managers to put instances on. SUBSTITUTE YOUR SERVICE MGR HERE!
static UID managers = {theSerialDevices};

STATUS PASCAL ClsBasicServiceInit(void);

STATUS EXPORTED DllMain(void)
{
     SVC_INIT_SERVICE    initService;
     SVC_NEW             svcNew;
     STATUS              s;

     // Install class.
     StsRet(ClsBasicServiceInit(), s);

     // Let the system know about our service.
     memset(initService.spare, 0, sizeof(initService.spare));
     initService.autoCreate = false;
     initService.serviceType = 0;
     initService.initServiceFlags = 0; // Flags. Or-in options.
     ObjCallRet(msgSvcClassInitService, clsBasicService, &initService, s);

     // Create an instance.
     ObjCallWarn(msgNewDefaults, clsBasicService, &svcNew);
     svcNew.svc.pServiceName = "Basic Instance";  // Name of this instance.
     ObjCallRet(msgNew, clsBasicService, &svcNew, s);

     return stsOK;

} // DllMain


/******************************************************************************
     BasicSvcNewDefaults

     Set defaults. This is where the service characterstics that are common
     to all instances of your service subclasses are specified.
******************************************************************************/
MsgHandlerWithTypes(BasicSvcNewDefaults, P_SVC_NEW, P_IDATA)
{
     MsgHandlerParametersNoWarning;

     // What service manager(s) should instances go on?
     pArgs->svc.numManagers = 1;
     pArgs->svc.pManagerList = &managers;

     // What are the exclusivity requirements for this service?
     pArgs->svc.style.exclusiveOpen = true;

     return stsOK;

} // BasicSvcNewDefaults


/******************************************************************************
     ClsBasicServiceInit

     Install our class.
******************************************************************************/
STATUS PASCAL ClsBasicServiceInit(void)
{
     STATUS              s;
     CLASS_NEW           new;

     // Create the service class.
     ObjCallWarn(msgNewDefaults, clsClass, &new);
     new.object.uid      = clsBasicService;  // SUBSTITUTE YOUR CLASS HERE!
     new.cls.pMsg        = clsBasicServiceTable;
     new.cls.ancestor    = clsService;
     new.cls.size        = 0;
     new.cls.newArgsSize = SizeOf(SVC_NEW);
```

```
    ObjCallRet(msgNew, clsClass, &new, s);

    return s;

} // ClsBasicServiceInit
```

MILSVC

The following sections list the files used to build MILSVC. These files are also in the directory \PENPOINT\SDK\SAMPLE\MILSVC. The sections are:

METHOD.TBL

MILSVC.H

MILSVC.C

MILSVC0.H

MILSVC0.C

METHOD.TBL

```
/*****************************************************************************
  File: method.tbl

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     $Revision:   1.16  $
         $Date:   13 Mar 1992 16:37:10  $

  method.tbl contain the method tables for class clsTestMILService.
*****************************************************************************/

//
//    Include files
//
#include <clsmgr.h>
#include <stream.h>
#include <milserv.h>
#include <milsvc.h>
#include <milsvc0.h>

MSG_INFO clsTestMILSvcServiceMethods[] =
{
     msgNewDefaults,                "TestMILSvcNewDefaults",
                                                    objCallAncestorBefore,

     msgInit,                       "TestMILSvcNew",    objCallAncestorBefore,
     msgFree,                       "TestMILSvcFree",   objCallAncestorAfter,

     msgSvcGetMetrics,              "TestMILSvcGetSvcMetrics",          0,
     msgSvcSetMetrics,              "TestMILSvcSetSvcMetrics",          0,

     msgSvcOpenRequested,           "TestMILSvcOpen",   objCallAncestorBefore,
     msgSvcQueryLockRequested,      "TestMILSvcOpen",   objCallAncestorBefore,
     msgSvcCloseRequested,          "TestMILSvcClose",  objCallAncestorBefore,
     msgSvcQueryUnlockRequested,    "TestMILSvcClose",  objCallAncestorBefore,

     msgTestMILSvcInitialize,       "TestMILSvcHWInitialize",           0,
     msgTestMILSvcStatus,           "TestMILSvcGetHWStatus",            0,
     msgTestMILSvcAutoLineFeedOn,   "TestMILSvcAutoLineFeedOn",         0,
     msgTestMILSvcAutoLineFeedOff,  "TestMILSvcAutoLineFeedOff",        0,
     msgTestMILSvcGetTimeDelays,    "TestMILSvcGetTimeDelays",          0,
     msgTestMILSvcSetTimeDelays,    "TestMILSvcSetTimeDelays",          0,
     msgTestMILSvcCancelPrint,      "TestMILSvcCancelPrintBuffer",      0,
     msgFSFlush,                    "TestMILSvcFlush",                  0,
     msgStreamWrite,                "TestMILSvcPrintBuffer",            0,
     msgMILSvcAreYouConnected,      "TestMILSvcAreYouConnected",        0,

     msgMILSvcConnectionStateResolved,
                                    "TestMILSvcConnectionStateResolved",
                                                    objCallAncestorAfter,

     msgMILSvcStartConnectionProcessing,
                                    "TestMILSvcPenpointBooted",         0,

     msgMILSvcPowerOff,             "TestMILSvcPowerOff",               0,
     msgTestMILSvcDoConnection,     "TestMILSvcDoConnection",           0,
     0
};


CLASS_INFO classInfo[] =
{
     "clsTestMILSvcServiceTable",   clsTestMILSvcServiceMethods,        0,
     0
};
```

MILSVC.H

```
/*****************************************************************************
 File: milsvc.h

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 $Revision:   1.16  $
     $Date:   12 Mar 1992 12:32:32  $

 This file contains the API definition for clsTestMILService.
 clsTestMILService inherits from clsMILService.

 This mil service provides the interface between the parallel printer
 mil device and the rest of Penpoint. This interface allows for the
 configuring of the parallel printer mil device and for printing using
 the parallel printer mil device. The pport mil service will typically
 only be accessed by printer drivers since they are responsible for
 rendering an image for printing.

 You access this mil service by using the standard service access techniques.
 These techniques are discribed in servmgr.h.
 The pport mil service is a member of the 'theParallelDevices' and
 'thePrinterDevices' service managers.

*****************************************************************************/

#ifndef MILSVC_INCLUDED
#define MILSVC_INCLUDED

#ifndef GO_INCLUDED
#include <go.h>
#endif

#ifndef CLSMGR_INCLUDED
#include <clsmgr.h>
#endif

#ifndef MIL_SERVICE_INCLUDED
#include <milserv.h>
#endif

/* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 *              Common #defines and typedefs                               *
 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * */

typedef OBJECT           TEST_MIL_SVC, *P_TEST_MIL_SVC;


#define stsTestMILSvcBusy         MakeStatus(clsTestMILService, 1)
#define stsTestMILSvcOutOfPaper   MakeStatus(clsTestMILService, 2)
#define stsTestMILSvcOffLine      MakeStatus(clsTestMILService, 3)
#define stsTestMILSvcNoPrinter    MakeStatus(clsTestMILService, 4)
#define stsTestMILSvcPrinterErr   MakeStatus(clsTestMILService, 5)



typedef struct TEST_MIL_SVC_METRICS
{
     U16     version;            // version number of test mil service
     U16     devFlags;           // device flags (none defined)
     U16     unitFlags;          // unit flags (see dvparall.h)
     U32     initDelay;          // time in microSeconds init signal
                                 // is applied to printer
     U32     interruptTimeOut;   // the printer should be ready to accept
                                 // another character within this time
                                 // period (in milliseconds)
} TEST_MIL_SVC_METRICS, *P_TEST_MIL_SVC_METRICS;


/* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 *                  Parallel Port Class Messages                           *
 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * */

/*****************************************************************************
 msgTestMILSvcStatus takes P_TEST_MIL_SVC_STATUS, returns STATUS
     returns the current hardware status of the printer.

     'testMILSvcStatus' is the contents of the parallel port status register.

*/

#define msgTestMILSvcStatus              MakeMsg(clsTestMILService, 3)

#define testMILSvcStsBusy            flag7   // printer is busy
#define testMILSvcStsAcknowledge     flag6   // printer acknowledged char.
#define testMILSvcStsEndOfPaper          flag5   // printer out of paper
#define testMILSvcStsSelected        flag4   // printer on line
#define testMIlSvcStsIOError         flag3   // printer error occurred
#define testMILSvcStsInterruptHappened   flag2   // printer interrupt occurred

typedef struct TEST_MIL_SVC_STATUS
{
     U16 testMILSvcStatus;
```

```
} TEST_MIL_SVC_STATUS, *P_TEST_MIL_SVC_STATUS;

/*****************************************************************************
 msgTestMILSvcInitialize takes P_NULL, returns STATUS
     initializes the printer.

     The printer is initialized by asserting the control
     line "Initialize" to the printer for initDelay microseconds.

*/

#define msgTestMILSvcInitialize          MakeMsg(clsTestMILService, 4)

/*****************************************************************************
 msgTestMILSvcAutoLineFeedOn takes P_NULL, returns STATUS
     inserts a line feed after each carriage return.

     The auto line feed signal to the printer is set active.

*/

#define msgTestMILSvcAutoLineFeedOn      MakeMsg(clsTestMILService, 5)

/*****************************************************************************
 msgTestMILSvcAutoLineFeedOff takes P_NULL, returns STATUS
     disables inserting a line feed after each carriage return.

     The auto line feed signal to the printer is set inactive.

*/

#define msgTestMILSvcAutoLineFeedOff MakeMsg(clsTestMILService, 6)

/*****************************************************************************
 msgTestMILSvcGetTimeDelays  takes P_TEST_MIL_SVC_TIME_DELAYS, returns STATUS
     gets the initialization and interrupt time out intervals.

     The initialization time period is the time the initialization pulse
     is asserted to the printer in microseconds. The interrupt time out
     interval is the maximum time the printer will assert busy before being
     ready to accept another character in milliseconds.

*/

#define msgTestMILSvcGetTimeDelays       MakeMsg(clsTestMILService, 7)

typedef struct TEST_MIL_SVC_TIME_DELAYS
{
     U32 initDelay;                  // initialization delay
     U32 interruptTimeOut;           // interrupt time out

} TEST_MIL_SVC_TIME_DELAYS, *P_TEST_MIL_SVC_TIME_DELAYS;

/*****************************************************************************
 msgTestMILSvcSetTimeDelays  takes P_TEST_MIL_SVC_TIME_DELAYS, returns STATUS
     sets the initialization and interrupt time out intervals.

     Neither value can be zero. It's best to get the present
     values before changing the time intervals.

*/

#define msgTestMILSvcSetTimeDelays       MakeMsg(clsTestMILService, 8)

/*****************************************************************************
 msgTestMILSvcCancelPrint takes P_NULL, returns STATUS
     cancels the printing of the buffer currently being printed.

*/

#define msgTestMILSvcCancelPrint     MakeMsg(clsTestMILService, 9)

/*****************************************************************************
 msgNew  takes P_TEST_MIL_SVC_NEW, returns STATUS
     creates a new test mil service object.

*/

#define testMILSvcNewFields      \
     milServiceNewFields

typedef struct TEST_MIL_SVC_NEW {
     testMILSvcNewFields
} TEST_MIL_SVC_NEW, *P_TEST_MIL_SVC_NEW;


STATUS EXPORTED ClsTestMILSvcInit(void);

#endif   // MILSVC_INCLUDED
```

MILSVC.C

```
/*****************************************************************************
 File: milsvc.c

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```

```
 $Revision:   1.21  $
     $Date:   30 Mar 1992 15:07:36  $

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 THE USE OR INABILITY TO USE THIS SAMPLE CODE.

 This file contains the class definition and methods for clsTestMILService.
*****************************************************************************/

#include <go.h>
#include <clsmgr.h>
#include <system.h>
#include <os.h>
#include <ospriv.h>
#include <debug.h>
#include <milserv.h>
#include <stream.h>
#include <string.h>
#include <list.h>
#include <servmgr.h>

#include <dvparall.h>

#include <method.h>
#include <milsvc.h>
#include <milsvc0.h>


/*****************************************************************************
     This service is to be placed on the service managers listed.
*****************************************************************************/

static const UID  logicalParallelPorts[] = { theParallelDevices,
                                             thePrinterDevices };

/*****************************************************************************
     The following routines provide the entry points to the ring 0
     portion of test mil service. First a prototype of the ring 0
     function is given then the actual transition occurs by calling
     OSSupervisorCall using the function in the prototype as the
     function to call in the ring 0 code. In the ring 0 linker
     definition file the function defined with a leading 'X' is
     aliased with the actual function in the ring 0 code without
     the 'X'.
*****************************************************************************/

STATUS EXPORTED XTestMILSvcGetReqBlocks(P_INSTANCE_DATA pInst);

STATUS EXPORTED TestMILSvcGetReqBlocks(P_INSTANCE_DATA pInst)
{
     return (STATUS)(OSSupervisorCall(XTestMILSvcGetReqBlocks, &pInst, 1));
}


STATUS EXPORTED XTestMILSvcInitialize(P_INSTANCE_DATA pInst);

STATUS EXPORTED TestMILSvcInitialize(P_INSTANCE_DATA pInst)
{
     return (STATUS)(OSSupervisorCall(XTestMILSvcInitialize, &pInst, 1));
}


STATUS EXPORTED XTestMILSvcGetMetrics(P_TEST_MIL_SVC_METRICS pMetrics,
                                      P_INSTANCE_DATA pInst);

STATUS EXPORTED TestMILSvcGetMetrics(P_TEST_MIL_SVC_METRICS pMetrics,
                                      P_INSTANCE_DATA pInst)
{
     Unused(pInst);
     return (STATUS)(OSSupervisorCall(XTestMILSvcGetMetrics, &pMetrics, 2));
}


STATUS EXPORTED XTestMILSvcSetMetrics(P_TEST_MIL_SVC_METRICS pMetrics,
                                      P_INSTANCE_DATA pInst);

STATUS EXPORTED TestMILSvcSetMetrics(P_TEST_MIL_SVC_METRICS pMetrics,
                                      P_INSTANCE_DATA pInst)
{
     Unused(pInst);
     return (STATUS)(OSSupervisorCall(XTestMILSvcSetMetrics, &pMetrics, 2));
}


STATUS EXPORTED XTestMILSvcPrint(P_STREAM_READ_WRITE pStream,
                                 P_INSTANCE_DATA pInst);

STATUS EXPORTED TestMILSvcPrint(P_STREAM_READ_WRITE pStream,
                                 P_INSTANCE_DATA pInst)
{
     Unused(pInst);
     return (STATUS)(OSSupervisorCall(XTestMILSvcPrint, &pStream, 2));
}


STATUS EXPORTED XTestMILSvcGetStatus(P_TEST_MIL_SVC_STATUS pTestMILSvcStatus,
                                      P_INSTANCE_DATA pInst);
```

```
STATUS EXPORTED TestMILSvcGetStatus(P_TEST_MIL_SVC_STATUS pTestMILSvcStatus,
                                    P_INSTANCE_DATA pInst)
{
     Unused(pInst);
     return (STATUS)(OSSupervisorCall(XTestMILSvcGetStatus,
                                      &pTestMILSvcStatus,
                                      2));
}


STATUS EXPORTED XTestMILSvcSetInterrupt(P_INSTANCE_DATA pInst);

STATUS EXPORTED TestMILSvcSetInterrupt(P_INSTANCE_DATA pInst)
{
     return (STATUS)(OSSupervisorCall(XTestMILSvcSetInterrupt,
                                      &pInst,
                                      1));
}


STATUS EXPORTED XTestMILSvc0Destroy(P_INSTANCE_DATA pInst);

STATUS EXPORTED TestMILSvc0Destroy(P_INSTANCE_DATA pInst)
{
     return (STATUS)(OSSupervisorCall(XTestMILSvc0Destroy, &pInst, 1));
}


STATUS EXPORTED XTestMILSvcCancelPrint(P_INSTANCE_DATA pInst);

STATUS EXPORTED TestMILSvcCancelPrint(P_INSTANCE_DATA pInst)
{
     return (STATUS)(OSSupervisorCall(XTestMILSvcCancelPrint, &pInst, 1));
}


STATUS EXPORTED XTestMILSvcStartConnectionDetection(P_INSTANCE_DATA pInst);

STATUS EXPORTED TestMILSvcStartConnectionDetection(P_INSTANCE_DATA pInst)
{
     return (STATUS)(OSSupervisorCall(XTestMILSvcStartConnectionDetection,
                                      &pInst,
                                      1));
}


STATUS EXPORTED XTestMILSvcStopConnectionDetection(P_INSTANCE_DATA pInst);

STATUS EXPORTED TestMILSvcStopConnectionDetection(P_INSTANCE_DATA pInst)
{
     return (STATUS)(OSSupervisorCall(XTestMILSvcStopConnectionDetection,
                                      &pInst,
                                      1));
}


/*****************************************************************************
     void LOCAL TestMILSvcSwitchForConnection(P_INSTANCE_DATA pInst)

     This routine sends the message msgTestMILSvcDoConnection, a private
     message, to self in process context. See msgTestMILSvcDoConnection
     for more details.
*****************************************************************************/

void LOCAL TestMILSvcSwitchForConnectionDetection(P_INSTANCE_DATA pInst)
{
     OS_TASK_ID      taskId;


     ObjectCall(msgOwner, pInst->self, &taskId);
     ObjectSendTask(msgTestMILSvcDoConnection,
                    pInst->self,
                    &taskId,
                    SizeOf(OS_TASK_ID),
                    taskId);

}    // TestMILSvcSwitchForConnectionDetection


/*****************************************************************************
     MsgHandlerWithTypes(TestMILSvcDoConnection, P_ARGS, P_INSTANCE_DATA)

     This routine handles the message msgTestMILSvcDoConnection, a private
     message. This message was self sent to change process to testMILSvc's
     original process context. This process keeps the continuous mil
     request from terminating when the process whose context the service
     set connected message was sent. We don't know if a sub-task will be
     created for the continuous request. We don't need to do this for
     terminating connection detection.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcDoConnection, P_ARGS, P_INSTANCE_DATA)
{
     P_INSTANCE_DATA pInst;


     MsgHandlerParametersNoWarning;

     pInst = *(P_INSTANCE_DATA *)pData;
     return TestMILSvcStartConnectionDetection(pInst);

} // TestMILSvcDoConnection
```

```
/************************************************************************
     MsgHandlerWithTypes(TestMILSvcPenpointBooted, P_ARGS, P_INSTANCE_DATA)

     This routine handles the message msgMILSvcConnectionProcessing.
     This message is received when the PenPoint operating system is fully
     booted. We wait to start connection processing until the system is
     booted and all services are running. When a connection is detected,
     all services will have a chance to respond to the queries of the
     conflict group manager.
************************************************************************/

MsgHandlerWithTypes(TestMILSvcPenpointBooted, P_ARGS, P_INSTANCE_DATA)
{
     P_INSTANCE_DATA     pInst;


     MsgHandlerParametersNoWarning;


     pInst = *(P_INSTANCE_DATA *)pData;

     // Start connection detection if we have auto detecting hardware
     if (pInst->connectStyle == svcAutoDetect)
     {
         pInst->connected = false;
         /* Start connection detection */
         TestMILSvcSwitchForConnectionDetection(pInst);
     }
     return stsOK;

}    /* TestMILSvcPenpointBooted */


/************************************************************************
     MsgHandlerWithTypes(TestMILSvcNewDefaults,
                         P_TEST_MIL_SVC_NEW,
                         P_INSTANCE_DATA)

     This routine handles the message msgNewDefaults. The routine sets
     default parameters for msgNew. All style bits for mil service are
     set/cleared. Some may be default values.
************************************************************************/

MsgHandlerWithTypes(TestMILSvcNewDefaults, P_TEST_MIL_SVC_NEW,
P_INSTANCE_DATA)
{

     MsgHandlerParametersNoWarning;

     /*
      * Since a mil service targets a mil device not another
      * service, any style bit dealing with a target should be
      * false. These bits are 'waitForTarget', 'autoOwnTarget',
      * 'autoOpen', 'autoMsgPass', and 'autoOption'.
      *
      * Since our mil service can only be openned by one client,
      * 'exclusiveOpen' and 'checkOwner' style bits should be true.
      */
     pArgs->svc.style.waitForTarget      =   false;
    pArgs->svc.style.exclusiveOpen      =   true;
     pArgs->svc.style.autoOwnTarget      =   false;
    pArgs->svc.style.autoOpen           =   false;
     pArgs->svc.style.autoMsgPass        =   false;
     pArgs->svc.style.checkOwner         =   true;
     pArgs->svc.style.autoOption         =   false;
     pArgs->svc.style.openClass          =   objNull;

     /*
      * Indicate which service managers we're to be placed on
      */
     pArgs->svc.numManagers              =   SizeOf(logicalParallelPorts) /
                                             SizeOf(UID);
    pArgs->svc.pManagerList             =   logicalParallelPorts;

     return stsOK;

}    /* TestMILSvcNewDefaults */


/************************************************************************
     BOOLEAN LOCAL IsAnybodyConnected(P_INSTANCE_DATA pInst)

     This routine scans the conflict group we're in checking if a
     mil service in the conflict group is connected.
************************************************************************/

BOOLEAN LOCAL IsAnybodyConnected(P_INSTANCE_DATA pInst)
{
     LIST_ENTRY              le;
     OBJECT                  list;
     U16                     n;
     SM_QUERY_LOCK           query;
     STATUS                  s;
     SVC_GET_SET_CONNECTED   serviceConnected;


     // Create a list of mil services in our conflict group
     ObjCallRet(msgIMGetList, pInst->conflictGroup, &list, s);

     // Get the number of mil services in our conflict group
     ObjectCall(msgListNumItems, list, &n);

     // Query each mil service in our group
     for (le.position = 0; le.position < n; le.position++)
```

```
    {
        // Get the next mil service in our group
        ObjCallWarn(msgListGetItem, list, &le);
        query.handle = (OBJECT)le.item;
        ObjCallWarn(msgSMQuery, pInst->conflictGroup, &query);

        // Get the connected state of the mil service
        ObjCallWarn(msgSvcGetConnected, query.service, &serviceConnected);
        if (serviceConnected.connected != false)
        {
            // if connected - we're done
            break;
        }
    }
    // Destroy list
    ObjCallWarn(msgDestroy, list, pNull);

    // return connected state
    return serviceConnected.connected;

}    /* IsAnybodyConnected */

/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcNew, P_TEST_MIL_SVC_NEW, P_INSTANCE_DATA)

    This routine handles the message msgInit. This routine creates a
    new testMILSvc object. 'msgMILSvcGetDevice' is called to obtain the
    mil device we are to use for printing. Connection detection is
    not started until the PenPoint is booted. A check is provided
    here in case we're loaded after the system is booted. In which
    case, we start connection detection only if no other mil service
    in our conflict group is in the connected state. It's normal for
    all mil services other than the mil service being connected to
    terminate their connection detection functions when the service
    is connected.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcNew, P_TEST_MIL_SVC_NEW, P_INSTANCE_DATA)
{
    MIL_SVC_DEVICE              device;
    OBJECT                      myself;
    P_INSTANCE_DATA             pInst;
    TEST_MIL_SVC_TIME_DELAYS    timeDelays;
    STATUS                      s;
    SYS_BOOT_STATE              sysBootState;


    MsgHandlerParametersNoWarning;


    /* Create self. */

    // Save who we are
    myself = pArgs->object.uid;

    // Get mil device we are to use
    ObjCallRet(msgMILSvcGetDevice, myself, &device, s);

    Dbg(DebugF("TEST_MIL_SVC: creating instance for logicalId %d: unit %d",
                                            device.logicalId, device.unit);)

    // Allocate our instance data
    StsRet(OSHeapBlockAlloc(osProcessSharedHeapId,
                            SizeOf(INSTANCE_DATA),
                            &pInst), s);

    // Store pointer to our instance data
    ObjectWrite(myself, ctx, &pInst);

    // Initialize our instance data
    memset(pInst, 0, SizeOf(INSTANCE_DATA));

    // Save who we are and who our mil device is
    pInst->self = myself;
    pInst->logicalId = device.logicalId;
    pInst->conflictGroup = device.conflictGroup;
    pInst->unit = device.unit;

    // Get whether we can detect connection
    pInst->connectStyle = pArgs->svc.style.connectStyle;

    // Initialize print in progress, connected and open flag
    pInst->printInProgress = false;
    pInst->connected = false;
    pInst->open = false;

    // Allocate necessary ring 0 memory
    StsRet(TestMILSvcGetReqBlocks(pInst), s);

    // Enable interrupt
    StsRet(TestMILSvcSetInterrupt(pInst), s);

    // Initialize parallel printer device timeouts
    timeDelays.initDelay = 500000;
    timeDelays.interruptTimeOut = 30000;
    ObjCallRet(msgTestMILSvcSetTimeDelays, self, &timeDelays, s);
    StsRet(TestMILSvcGetMetrics(&(pInst->testMILSvcMetrics), pInst), s);

    // Get the booted state of the system
    ObjCallRet(msgSysGetBootState, theSystem, &sysBootState, s);

    // Don't start if we don't have auto connecting hardware
    if (pInst->connectStyle == svcAutoDetect)
    {
```

```
        // If the system is booted and no other mil service is connected
        // start connection detection
        if (sysBootState.booted != false && IsAnybodyConnected(pInst) == false)
        {
            TestMILSvcSwitchForConnectionDetection(pInst);
        }
    }
    return s;

}  /* TestMILSvcNew */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcFree, P_ARGS, P_INSTANCE_DATA)

    This routine handles the message msgFree. This routine destroys
    a testMILSvc object. We destroy ourself by terminating connection
    detection and freeing all system resources we've allocated.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcFree, P_ARGS, P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;
    STATUS              s;

    MsgHandlerParametersNoWarning;

    pInst = *(P_INSTANCE_DATA *)pData;

    if (pInst != 0)
    {
        StsRet(TestMILSvcStopConnectionDetection(pInst), s);
        StsRet(TestMILSvc0Destroy(pInst), s);
        StsRet(OSHeapBlockFree(pInst), s);
    }

    return stsOK;

}  /* TestMILSvcFree  */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcGetSvcMetrics,
                        P_SVC_GET_SET_METRICS,
                        P_INSTANCE_DATA)

    This routine handles the message msgSvcGetMetrics. This routine
    gets the parallel printer port metrics.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcGetSvcMetrics,
                    P_SVC_GET_SET_METRICS,
                    P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;


    // Get pointer to our instance data
    pInst = *(P_INSTANCE_DATA *)pData;

    /*
     * If the len field of the metrics structure passed in is zero
     * return the size of data area needed to store the metrics;
     * otherwise, if  the length field equals the size of the
     * metrics, return the metrics.
     */
    if (pArgs->len == 0)
    {
        return pArgs->len = SizeOf(TEST_MIL_SVC_METRICS);
    }
    else if (pArgs->len != SizeOf(TEST_MIL_SVC_METRICS))
    {
        return stsBadParam;
    }
    else
    {
        memcpy(pArgs->pMetrics,
               &(pInst->testMILSvcMetrics),
               SizeOf(TEST_MIL_SVC_METRICS));
    }

}    /* TestMILSvcGetMetrics */

/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcSetSvcMetrics,
                        P_SVC_GET_SET_METRICS,
                        P_INSTANCE_DATA)

    This routine handles the message msgSvcSetMetrics. This routine
    sets the parallel printer port metrics.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcSetSvcMetrics,
                    P_SVC_GET_SET_METRICS,
                    P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;


    pInst = *(P_INSTANCE_DATA *)pData;
```

```
    // Only set the metrics if the size of the data area is correct
    if (pArgs->len != SizeOf(TEST_MIL_SVC_METRICS))
    {
        return stsBadParam;
    }
    // Call the ring 0 code to set the mil device metrics
    return TestMILSvcSetMetrics(pArgs->pMetrics, pInst);

}    /* TestMILSvcSetMetrics */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcOpen, P_ARGS, P_INSTANCE_DATA)

    This routine handles the message msgSvcOpenRequested/
    msgQueryLockRequested. Either of these messages is received when
    a client wishes to open our mil service. We save our open state
    since when we receive messages from our client they don't go through
    the service open checks.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcOpen, P_ARGS, P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;


    pInst = *(P_INSTANCE_DATA *)pData;

    pInst->open = true;

    return stsOK;

}    /* TestMILSvcOpen */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcClose, P_ARGS, P_INSTANCE_DATA)

    This routine handles the message msgSvcCloseRequested/
    msgSvcQueryUnlockRequested. Either of these messages is received
    when a client wishes to close our mil service.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcClose, P_ARGS, P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;

    pInst = *(P_INSTANCE_DATA *)pData;

    pInst->open = false;

    return stsOK;

}    /* TestMILSvcClose */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcHWInitialize, P_ARGS, P_INSTANCE_DATA)

    This routine handles the message msgTestMILSvcHWInitialize. This routine
    initializes the printer attached by toggling the initialize signal to
    the printer.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcHWInitialize, P_ARGS, P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;


    pInst = *(P_INSTANCE_DATA *)pData;

    // Ignore if printer is not connected or we are not open
    if (pInst->connected == false || pInst->open == false)
    {
        return stsFailed;
    }
    // Must call the mil device from ring 0
    return TestMILSvcInitialize(pInst);

}    /* TestMILSvcHWInitialize */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcGetHWStatus, P_TEST_MIL_SVC_STATUS,
P_INSTANCE_DATA)

    This routine handles the message msgTestMILSvcGetStatus. The routine
    gets the contents of the parallel port status register.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcGetHWStatus, P_TEST_MIL_SVC_STATUS,
P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;


    pInst = *(P_INSTANCE_DATA *)pData;
```

```
    // Must call the mil device from ring 0
    return TestMILSvcGetStatus(pArgs, pInst);

}   /* TestMILSvcGetHWStatus */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcAutoLineFeedOn, P_ARGS, P_INSTANCE_DATA)

    This routine handles the message msgTestMILSvcAutoLineFeedOn. The routine
    sets the auto line feed signal to the printer active.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcAutoLineFeedOn, P_ARGS, P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;


    pInst = *(P_INSTANCE_DATA *)pData;

    // Set the auto line feed flag in our metrics
    pInst->testMILSvcMetrics.unitFlags |= parallelAutoLineFeed;

    // Set the auto line feed flag in the mil devices parameters
    return TestMILSvcSetMetrics(&(pInst->testMILSvcMetrics), pInst);

}   /* TestMILSvcAutoLineFeedOn */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcAutoLineFeedOff, P_ARGS, P_INSTANCE_DATA)

    This routine handles the message msgTestMILSvcAutoLineFeedOn. The routine
    sets the auto line feed signal to the printer active.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcAutoLineFeedOff, P_ARGS, P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;


    pInst = *(P_INSTANCE_DATA *)pData;

    // Clear the auto line feed flag in our metrics
    pInst->testMILSvcMetrics.unitFlags &= ~parallelAutoLineFeed;

    // Clear the auto line feed flag in the mil devices parameters
    return TestMILSvcSetMetrics(&(pInst->testMILSvcMetrics), pInst);

}   /* TestMILSvcAutoLineFeedOff */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcGetTimeDelays,
                        P_TEST_MIL_SVC_TIME_DELAYS,
                        P_INSTANCE_DATA)

    This routine handles the message msgTestMILSvcGetTimeDelays. This routine
    gets the time delays used by the mil device. 'initDelay' is the width
    in microseconds of the initialization pulse used to hardware initialize
    the printer. 'interruptTimeOut' is the time in milliseconds to wait
    for an interrupt to occur after writing a character to the printer.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcGetTimeDelays, P_TEST_MIL_SVC_TIME_DELAYS,
P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;


    pInst = *(P_INSTANCE_DATA *)pData;

    // Return the time periods from our metrics
    pArgs->initDelay = pInst->testMILSvcMetrics.initDelay;
    pArgs->interruptTimeOut = pInst->testMILSvcMetrics.interruptTimeOut;

    return stsOK;

}   /* TestMILSvcGetTimeDelays */

/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcSetTimeDelays,
                        P_TEST_MIL_SVC_TIME_DELAYS,
                        P_INSTANCE_DATA)

    This routine handles the message msgTestMILSvcSetTimeDelays. This routine
    sets the time delays used by the mil device. 'initDelay' is the width
    in microseconds of the initialization pulse used to hardware initialize
    the printer. 'interruptTimeOut' is the time in milliseconds to wait
    for an interrupt to occur after writing a character to the printer.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcSetTimeDelays, P_TEST_MIL_SVC_TIME_DELAYS,
P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;
```

```
    pInst = *(P_INSTANCE_DATA *)pData;

    // Neither time period can be zero
    if (pArgs->initDelay == 0 || pArgs->interruptTimeOut == 0)
    {
        return stsBadParam;
    }
    else
    {
        // Set our metrics to the new values
        pInst->testMILSvcMetrics.initDelay =    pArgs->initDelay;
        pInst->testMILSvcMetrics.interruptTimeOut = pArgs->interruptTimeOut;

        // Tell the mil device of the new values
        return TestMILSvcSetMetrics(&(pInst->testMILSvcMetrics), pInst);
    }

}    /* TestMILSvcSetTimeDelays */

/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcCancelPrintBuffer, P_ARGS, P_INSTANCE_DATA)

    This routine handles the message msgTestMILSvcCancelPrintBuffer. The
    routine cancels the printing of the buffer currently being printed.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcCancelPrintBuffer, P_ARGS, P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;


    pInst = *(P_INSTANCE_DATA *)pData;

    // Transition to ring 0 to do the work
    return TestMILSvcCancelPrint(pInst);

}    /* TestMILSvcCancelPrintBuffer */

/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcFlush, P_ARGS, P_INSTANCE_DATA)

    This routine handles the message msgFSFlush. This routine allows
    a client to send a flush to our mil service without causing an error.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcFlush, P_ARGS, P_INSTANCE_DATA)
{
    MsgHandlerParametersNoWarning;

    // So stdio can use this without warnings being generated
    return stsOK;

}    /* TestMILSvcFlush */

/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcPrintBuffer, P_ARGS, P_INSTANCE_DATA)

    This routine handles the message msgStreamWrite. The routine causes
    a clients buffer to be sent to the printer connected. An error is
    returned and the buffer is not printed if we are not open and no
    printer is connected.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcPrintBuffer, P_ARGS, P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;


    pInst = *(P_INSTANCE_DATA *)pData;

    // Return error if not connected or openned
    if (pInst->connected == false || pInst->open == false)
    {
        return stsFailed;
    }

    // Must call mil device from ring 0
    return TestMILSvcPrint((P_STREAM_READ_WRITE)pArgs, pInst);

}    /* TestMILSvcPrintBuffer */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcAreYouConnected,
                        P_MIL_SVC_ARE_YOU_CONNECTED,
                        P_INSTANCE_DATA)

    This routine handles the message msgMILSvcAreYouConnected. The
    message is sent by our conflict group manager when a mil service
    in our conflict group reports connected. More than one mil
    service can report connected. The valid responses are msYES,
    msMaybe, or msNO. 'msYES' indicates we are certain our device is
    connected. 'msMaybe' indicates something is connected, but we are
    not sure if it is our device. 'msMaybe' can also indicate we don't
    know if anything is connected. 'msNO' indicates our device is not
    connected. The mil device for the printer can determine absolutely
    if a printer is connected.
*****************************************************************************/
```

```
MsgHandlerWithTypes(TestMILSvcAreYouConnected,
                    P_MIL_SVC_ARE_YOU_CONNECTED,
                    P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;

    pInst = *(P_INSTANCE_DATA *)pData;

    /*
     *  Answer maybe if we can't determine
     *  if anything is connected. If only one
     *  other mil service indicates it is connected
     *  with msYes, then that mil service will get
     *  the connection. If more than one mil service
     *  indicates it is connected with msYes or msMaybe,
     *  then a dialog box will be displayed with all the
     *  mil services indicating connected. The user
     *  then selects which mil service will actually be
     *  connected. If we're the only mil service indicating
     *  connected with msMaybe, then we will be connected by
     *  default.
     */
    if (pInst->connectStyle == svcNoAutoDetect)
    {
        *pArgs = msMaybe;
    }
    else if (pInst->connected == false)
    {
        Dbg(Debugf("TEST_MIL_SVC: responding to 'msgMILSvcAreConnected'"
                   " with msNo");)
        *pArgs = msNo;
    }
    else
    {
        Dbg(Debugf("TEST_MIL_SVC: responding to 'msgMILSvcAreConnected'"
                   " with msYes");)
        *pArgs = msYes;
    }
    return stsOK;

}   /* TestMILSvcAreYouConnected */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcConnectionStateResolved, P_ARGS,
P_INSTANCE_DATA)

    This routine handles the messge msgMILSvcConnectionStateResolved.
    This message is sent by our conflict manager when a mil service's
    connection state changes. This message indicates which mil service
    on the conflict group is being set connected. The logical id
    of the corresponding mil device is used to indicate who received the
    connection. A logical id of maxU16 indicates a mil service was
    disconnected. When another mil service receives connection, we
    should terminate our connection detection function to prevent our
    connection function from interferring with the operation of the
    other mil service and mil device. We restart our connection
    detection function when the other mil service is disconnected.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcConnectionStateResolved, P_ARGS,
P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;

    MsgHandlerParametersNoWarning;

    pInst = *(P_INSTANCE_DATA *)pData;

    /*
     * Start our connection detection function if
     * no other mil service is connected, if our
     * mil device can detect connection, and if
     * our connection detection function is not
     * already started.
     *
     * Terminate our connection detection function
     * if another mil service in our conflict group
     * is connected and if we have a connection
     * detection function started.
     *
     * Otherwise if we are connected, perform any
     * initialization operations.
     */
    if ((U16)pArgs == maxU16)
    {
        if (pInst->connectStyle == svcAutoDetect && pInst->pRBConnect == 0)
        {
            TestMILSvcSwitchForConnectionDetection(pInst);
        }
    }
    else if ((U16)pArgs != pInst->logicalId)
    {
        if (pInst->connectStyle == svcAutoDetect && pInst->pRBConnect != 0)
        {
            TestMILSvcStopConnectionDetection(pInst);
            pInst->pRBConnect = 0;
        }
```

```
    }
    else if ((U16)pArgs == pInst->logicalId)
    {
    }
    return stsOK;

}    /* TestMILSvcConnectionStateResolved */


/*****************************************************************************
    MsgHandlerWithTypes(TestMILSvcPowerOff, P_ARGS, P_INSTANCE_DATA)

    This message handles the message msgMILSvcPowerOff. This messge
    is received when the power to the tablet is about to be shut off.
    We perform any clean up operations here. There is a corresponding
    message, msgMILSvcPowerOn, which can be handled when power is
    applied. At which time, we can perform any operations necessary
    when power is applied. When power is shut off we want to cancel
    printing if a buffer is currently being printed.
*****************************************************************************/

MsgHandlerWithTypes(TestMILSvcPowerOff, P_ARGS, P_INSTANCE_DATA)
{
    P_INSTANCE_DATA     pInst;


    MsgHandlerParametersNoWarning;


    pInst = *(P_INSTANCE_DATA *)pData;
    return TestMILSvcCancelPrint(pInst);

}    /* TestMILSvcPowerOff */


/*****************************************************************************
    ClsTestMILServiceInit(void)

    Install the class.
*****************************************************************************/
STATUS EXPORTED ClsTestMILServiceInit(void)
{
    CLASS_NEW       classNew;
    STATUS          s;


    /* Create the class. */

    ObjCallWarn(msgNewDefaults, clsClass, &classNew);

    classNew.object.cap         |= objCapCall;
    classNew.object.uid          = clsMILParallelPortDevice;
    classNew.cls.pMsg            = clsTestMILSvcServiceTable;
    classNew.cls.ancestor        = clsMILService;
    classNew.cls.size            = SizeOf(INSTANCE_DATA);
    classNew.cls.newArgsSize     = SizeOf(TEST_MIL_SVC_NEW);

    ObjCallRet(msgNew, clsClass, &classNew, s);

    return (stsOK);

}    /* ClsTestMILServiceInit */


/*****************************************************************************
    DLLMain

    Initialize milsvc.dll

*****************************************************************************/

STATUS EXPORTED DLLMain(void)
{
    STATUS              s;
    SVC_INIT_SERVICE    initService;


    // Install classes
    StsRet(ClsTestMILServiceInit(), s);

    // Let system know about our service
    // and set global service characteristics
    memset(initService.spare, 0, sizeof(initService.spare));
    initService.autoCreate = true;
    initService.serviceType = 0;
    initService.initServiceFlags = svcNoShow;
    ObjCallRet(msgSvcClassInitService,
               clsMILParallelPortDevice,
               &initService,
               s);

    return stsOK;

}    /* DLLMain */
```

MILSVC0.H

```
/*****************************************************************************
 File: milsvc0.h

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```

```
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 $Revision:   1.1  $
     $Date:   13 Mar 1992 16:37:18  $

 This file contains the private interface definition for clsTestMILService.
 clsTestMILService is a subclass of clsMILService.
*****************************************************************************/
#ifndef MILSVC0_INCLUDED
#define MILSVC0_INCLUDED

#ifndef GO_INCLUDED
#include <go.h>
#endif

#ifndef MILSVC_INCLUDED
#include <milsvc.h>
#endif


/* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 *                  Private Parallel Port Class Messages                   *
 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * */

/*****************************************************************************
 msgTestMILSvcStatus takes P_NULL, returns STATUS
     starts connection detection.

     We switch to our process context to start connection detection.
     We don't need to do this when connection detection is terminated.

*/

#define msgTestMILSvcDoConnection     MakeMsg(clsTestMILService, 100)


/*
 *    Instance Data
 */

typedef struct INSTANCE_DATA
{
     // Who we are
     OBJECT                  self;               // our instance
     U16                     logicalId;          // mil device logical id
     U16                     unit;               // mil device unit number
     UID                     conflictGroup;      // conflict group we're on
     U16                     connectStyle;       // is connection detection
                                                 // supported

     // Our state information
     TEST_MIL_SVC_METRICS    testMILSvcMetrics;  // our metrics
     BOOLEAN                 open;               // are we open for business
     BOOLEAN                 connected;          // are we connected
     BOOLEAN                 printInProgress;    // are we in mil printing

     // Request blocks
     P_MIL_REQUEST_BLOCK     pRBMisc;            // used for single stage req.
     P_MIL_REQUEST_BLOCK     pRBPrint;           // used for printing
     P_MIL_REQUEST_BLOCK     pRBConnect;         // used for connection

     // Pointer to ring 0 buffer for printing
     P_U8                    printBuffer;
} INSTANCE_DATA, *P_INSTANCE_DATA;

#endif
```

MILSVC0.C

```
/*****************************************************************************
 File: milsvc0.c

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 $Revision:   1.0  $
     $Date:   12 Mar 1992 12:33:00  $

 This file contains the ring 0 code for clsTestMILService.
*****************************************************************************/

#include <clsmgr.h>
#include <debug.h>
#include <list.h>
#include <servmgr.h>
#include <service.h>
#include <stream.h>
#include <drvmil.h>
#include <os.h>
```

```
#include <string.h>
#include <dvparall.h>
#include <milsvc.h>
#include <milsvc0.h>


/*****************************************************************************
     pRBInit, pRBPrn, pRBSet, pRBStatus, and pRBAttach

     Shorthand version of corresponding variable on right

     pRBInit   -- used in printer initialization routine
     pRBPrn    -- used in print routine
     pRBSet    -- used in get/set device parameters routines
     pRBStatus -- used in the get printer status routine
     pRBAttach -- used in the printer attachment routines
*****************************************************************************/

#define  pRBInit     ((P_MIL_RB_PUB_PARALLEL_INIT_PRINTER)(pInst->pRBMisc))
#define pRBPrn       ((P_MIL_RB_PUB_PARALLEL_WRITE)(pInst->pRBPrint))
#define pRBSet       ((P_MIL_RB_PUB_PARALLEL_DEVICE_PARAMETERS)(pInst->pRBMisc))
#define pRBStatus ((P_MIL_RB_PUB_PARALLEL_DEVICE_PARAMETERS)(pInst->pRBMisc))
#define pRBAttach ((P_MIL_RB_PUB_BASE_ATTACHMENT_CONT)(pInst->pRBConnect))


/*****************************************************************************
     STATUS EXPORTED0 TestMILSvcGetReqBlocks(P_INSTANCE_DATA pInst)

     Allocates ring0 system resources.
*****************************************************************************/

STATUS EXPORTED0 TestMILSvcGetReqBlocks(P_INSTANCE_DATA pInst)
{
     STATUS  s;


     /*
      * Our instance data is used by the attachment callback
      * procedure. Locking it in memory insures that it will
      * be in memory when we need it. We aren't required to do
      * this since the attachment routine is a timed not an interrupt
      * function. Otherwise page faults can occur to bring pages
      * swapped to disk back into memory.
      */
     OSMemLock(pInst, SizeOf(INSTANCE_DATA));

     // Allocate a request block for all the single stage mil requests
     StsRet(DrvMILRequestBlockCreate(pInst->logicalId,
                                     (PP_UNKNOWN)(&(pInst->pRBMisc))), s);

     // Allocate a request to perform printing
     StsRet(DrvMILRequestBlockCreate(pInst->logicalId,
                                     (PP_UNKNOWN)(&(pInst->pRBPrint))), s);

     // Initialize the unit field in the request block to our unit number
     pInst->pRBPrint->unit = pInst->unit;
     pInst->pRBMisc->unit = pInst->unit;

     /*
      * Allocate a 512 byte buffer (size arbitrary).
      * This buffer must be allocated/locked such that it
      * in memory at all times. The printing mil request
      * is a stage on interrupt function; therefore, the
      * buffer to be printed must be in memory at all times.
      * A page fault to bring in a non-memory resident page
      * cannot occur within an interrupt routine.
      */
     StsRet(OSHeapBlockAlloc(osProcessSharedHeapId, 512,
                                                &(pInst->printBuffer)), s);
//   OSMemLock(pInst->printBuffer, 512);

     return stsOK;

}    // TestMILSvcGetReqBlocks


/*****************************************************************************
     STATUS EXPORTED0 TestMILSvc0Destroy(P_INSTANCE_DATA pInst)

     Free all ring 0 resources used by this service
*****************************************************************************/

STATUS EXPORTED0 TestMILSvc0Destroy(P_INSTANCE_DATA  pInst)
{
     BOOLEAN     enable;
     LIST        conflictGroupItems;
     STATUS      s;
     U16         numConflictItems;

     // Unlock memory used by this service
     OSMemUnlock(pInst, SizeOf(INSTANCE_DATA));

     // Free request blocks
     StsRet(DrvMILRequestBlockFree((P_UNKNOWN)(pInst->pRBMisc)), s);
     StsRet(DrvMILRequestBlockFree((P_UNKNOWN)(pInst->pRBPrint)), s);

     // Free our print buffer
     if (pInst->printBuffer != 0)
     {
//        OSMemUnlock(pInst->printBuffer, 512);
          StsRet(OSHeapBlockFree(pInst->printBuffer), s);
     }

     // If we are the last mil service on our
```

```
    // conflict group, disable our interrupt.
    ObjCallRet(msgIMGetList, pInst->conflictGroup, &conflictGroupItems, s);
    ObjCallRet(msgListNumItems, conflictGroupItems, &numConflictItems, s);
    if (numConflictItems == 1)
    {
        enable = false;
        OSIntMask(pInst->pRBMisc->logicalId, &enable);
    }
    return ObjectCall(msgDestroy, conflictGroupItems, pNull);

}   /* TestMILSvc0Destroy */


/*****************************************************************************
    STATUS EXPORTED TestMILSvcSetInterrupt(P_INSTANCE_DATA pInst)

    Enables parallel port interrupt
*****************************************************************************/

STATUS EXPORTED0 TestMILSvcSetInterrupt(P_INSTANCE_DATA pInst)
{
    BOOLEAN     enable;

    enable = true;
    return OSIntMask(pInst->pRBMisc->logicalId, &enable);

}   /* TestMILSvcSetInterrupt */


/*****************************************************************************
    void EXPORTED0 TestMILSvcAttachmentCallBack(P_MIL_COMMON_DATA pCommonData,
                        P_MIL_RB_PUB_BASE_ATTACHMENT_CONT     pRB)

    The connection detection call back routine. This routine is called
    by the mil connection detection function whenever a printer is
    attached or detached.
*****************************************************************************/

void EXPORTED0 TestMILSvcAttachmentCallBack(P_MIL_COMMON_DATA     pCommonData,
                                    P_MIL_RB_PUB_BASE_ATTACHMENT_CONT    pRB)
{
    P_INSTANCE_DATA         pInst;
    SVC_GET_SET_CONNECTED   svcGetSetConnected;


    Unused(pCommonData);


    // Get our instance data pointer from the request block
    pInst = (P_INSTANCE_DATA)(pRB->callerDataU32A);

    if (pRB->event == milDevAttachedEvent)
    {
        // We're attached
        pInst->connected = true;
        Dbg(Debugf("TEST_MIL_SVC0: printer connected to device %d", pRB->logicalId)
    }
    else if (pRB->event == milDevDetachedEvent)
    {
        // We're detached
        pInst->connected = false;
        Dbg(Debugf("TEST_MIL_SVC0: printer not connected to device %d",
pRB->logicalId);)
    }

    // Send message to ourself indicating new connection state
    svcGetSetConnected.connected = pInst->connected;
    ObjectPost(msgSvcSetConnected, pInst->self, &svcGetSetConnected,
                                            SizeOf(SVC_GET_SET_CONNECTED));

}   /* TestMILSvcAttachmentCallBack */


/*****************************************************************************
    STATUS EXPORTED0 TestMILSvcStartConnectionDetection(P_INSTANCE_DATA pInst)

    Start the parallel mil devices connection function. The connection
    function is a continuous staged on time function. When the connection
    function runs, it checks for a printer connected to the parallel port.
    When a printer is attached or detached, the attachment call back
    procedure is called with the attachment state.
*****************************************************************************/

STATUS EXPORTED0 TestMILSvcStartConnectionDetection(P_INSTANCE_DATA pInst)
{
    STATUS  s;

    // Initially indicate we are disconnected
    pInst->connected = false;

    /*
     * Allocate a request block for the attachment function
     * We allocate the request block here since the cancel
     * request frees the request block
     */
    StsRet(DrvMILRequestBlockCreate(pInst->logicalId,
                                    (PP_UNKNOWN)(&(pInst->pRBConnect))), s);

    /* Fill in the appropriate fields of the request block
     *      our unit number
     *      function code for attachment
     *      user data (our instance data)
     *      the call back function to use
     */
```

```
    pRBAttach->unit = pInst->unit;
    pRBAttach->functionCode = milBaseAttachmentCont;
    pRBAttach->callerDataU32A = (U32)pInst;
    pRBAttach->pAsyncEventFunc =
                        (P_MIL_ASYNC_EVENT_FUNC)TestMILSvcAttachmentCallBack;

    // Start the attachment function
    return DrvMILRequest(pInst->pRBConnect);

}   /* TestMILSvcStartConnectionDetection */


/*****************************************************************************
    STATUS EXPORTED0 TestMILSvcStopConnectionDetection(P_INSTANCE_DATA pInst)

    Terminates the connection detection mil request.
*****************************************************************************/

STATUS EXPORTED0 TestMILSvcStopConnectionDetection(P_INSTANCE_DATA pInst)
{
    return DrvMILCancelRequest(pInst->pRBConnect);

}   /* TestMILSvcStopConnectionDetection */


/*****************************************************************************
    STATUS EXPORTED0 TestMILSvcGetMetrics(P_TEST_MIL_SVC_METRICS       pArgs,
                                P_INSTANCE_DATA     pInst)

    Get the mil device parameters portion of testMILSvc metrics
*****************************************************************************/

STATUS EXPORTED0 TestMILSvcGetMetrics(P_TEST_MIL_SVC_METRICS pArgs,
                                P_INSTANCE_DATA pInst)
{
    STATUS  s;

    /*
     * You must reset the request block before
     * reusing an existing request block.
     */
    DrvMILRequestBlockReset(pInst->pRBMisc);

    // Request the device parameters from the parallel port mil device
    pRBSet->functionCode = milParallelGetDevParameters;
    StsRet(DrvMILRequest(pInst->pRBMisc), s);

    // Copy parameters to metrics structure
    pArgs->devFlags = pRBSet->parallelDevParms.parallelDevFlags;
    pArgs->unitFlags = pRBSet->parallelUnitParms.parallelUnitFlags;
    pArgs->initDelay = pRBSet->parallelTimeIntervals.initDelay;
    pArgs->interruptTimeOut = pRBSet->parallelTimeIntervals.interruptTimeOut;
    return stsOK;

}   /* TestMILSvcGetMetrics */


/*****************************************************************************
    STATUS EXPORTED0 TestMILSvcSetMetrics(P_TEST_MIL_SVC_METRICS       pArgs,
                                P_INSTANCE_DATA     pInst)

    Set the mil device parameters from the testMILSvc metrics
*****************************************************************************/

STATUS EXPORTED0 TestMILSvcSetMetrics(P_TEST_MIL_SVC_METRICS pArgs,
                                P_INSTANCE_DATA pInst)
{
    STATUS          s;


    // interrupt time out and init delay cannot be zero
    if (pArgs->interruptTimeOut == 0 || pArgs->initDelay == 0)
    {
        return stsBadParam;
    }
    else
    {
        /*
         * You must reset the request block before
         * reusing an existing request block.
         */
        DrvMILRequestBlockReset(pInst->pRBMisc);

        // Fill in the proper fields in the request block
        pRBSet->functionCode = milParallelSetDevParameters;
        pRBSet->parallelDevParms.parallelDevFlags = pArgs->devFlags;
        pRBSet->parallelUnitParms.parallelUnitFlags = pArgs->unitFlags;
        pRBSet->parallelTimeIntervals.initDelay = pArgs->initDelay;
        pRBSet->parallelTimeIntervals.interruptTimeOut =
                                            pArgs->interruptTimeOut;

        // Perform the request to set the parameters
        if ((s = DrvMILRequest(pInst->pRBMisc)) == stsOK)
        {
            // If successful copy new metrics to instance data
            memcpy(&(pInst->testMILSvcMetrics), pArgs,
                                            SizeOf(TEST_MIL_SVC_METRICS));
        }
        else
        {
            // Otherwise get old metrics from mil device
            TestMILSvcGetMetrics(&(pInst->testMILSvcMetrics), pInst);
        }
        return s;
```

```
    }
}   /* TestMILSvcSetMetrics */


/*****************************************************************************
    STATUS EXPORTED TestMILSvcInitialize(P_INSTANCE_DATA pInst)

    Have the parallel printer mil device initialize the printer by
    asserting the initialize hardware signal to the printer. The
    initialize signal is asserted for initDelay microseconds.
*****************************************************************************/

STATUS EXPORTED0 TestMILSvcInitialize(P_INSTANCE_DATA pInst)
{
    /*
     * You must reset the request block before
     * reusing an existing request block.
     */
    DrvMILRequestBlockReset(pInst->pRBMisc);

    // Indicate what function is requested and call the mil
    pRBInit->functionCode = milParallelInitPrinter;
    DrvMILRequest(pInst->pRBMisc);

    return (pInst->pRBMisc)->status;

}   /* TestMILSvcInitialize */


/*****************************************************************************
    STATUS EXPORTED0 TestMILSvcGetStatus(P_TEST_MIL_SVC_STATUS   portStatus,
                                         P_INSTANCE_DATA     pInst)

    Get the status of the printer connected to the parallel port. All
    parallel printer functions return the printer status. We use the
    get device function since it gets the status without affecting
    the printer. The get printer status returns the contents of the
    parallel port status register.
*****************************************************************************/

STATUS EXPORTED0 TestMILSvcGetStatus(P_TEST_MIL_SVC_STATUS         portStatus,
                                     P_INSTANCE_DATA     pInst)
{
    STATUS  s;

    /*
     * You must reset the request block before
     * reusing an existing request block.
     */
    DrvMILRequestBlockReset(pInst->pRBMisc);

    // Indicate what function is requested and call the mil
    pRBStatus->functionCode = milParallelGetDevParameters;
    StsRet(DrvMILRequest(pInst->pRBMisc), s);

    // Get the printer status from the request block
    portStatus->testMILSvcStatus = pRBStatus->parallelUnitParms.parallelStatus;
    return stsOK;

}   /* TestMILSvcGetStatus */


#ifdef DEBUG

/*****************************************************************************
    The following functions are not necessary for printing. They are
    included to display the buffer contents when the buffer is not
    printed. Only present in debug version.
*****************************************************************************/

U8 LOCAL HexToAscii(U8 num)
{
    U8  ascii;

    ascii = num + '0';
    if (ascii > '9')
    {
        ascii = (num - 10) + 'a';
    }
    return ascii;

}   /* HexToAscii */

#define HighU4(x)     (((x) >> 4) & 0x0f)
#define LowU4(x)      ((x) & 0x0f)


void LOCAL DisplayBuffer(P_U8 pBuffer, U16 bufferSize)
{
    U16     count;
    U16     i;
    U8      outbuf[81];

    for (count = 0, i = 0; count < bufferSize; count++)
    {
        outbuf[i++] = HexToAscii(HighU4(pBuffer[count]));
        outbuf[i++] = HexToAscii(LowU4(pBuffer[count]));
        outbuf[i++] = ' ';
        if (i > 77)
        {
            outbuf[i] = '\0';
            Debugf(outbuf);
            i = 0;
        }
```

```
    }
    if (i)
    {
        outbuf[i] = '\0';
        Debugf(outbuf);
    }

}    /* DisplayBuffer */

#endif


/*****************************************************************************
    STATUS EXPORTED0 TestMILSvcPrint(P_STREAM_READ_WRITE    pStream,
                                     P_INSTANCE_DATA     pInst)

    Sends the contents of the buffer specified in the pStream structure
    to the printer to be printed. The buffer is copied to our local
    buffer before printing. It is copied to our buffer to insure that
    the data is available when the interrupt routine is executed.
*****************************************************************************/

STATUS EXPORTED0 TestMILSvcPrint(P_STREAM_READ_WRITE pStream,
                                 P_INSTANCE_DATA     pInst)
{
    U16     count;
    U16     i, j;


    Dbg(Debugf("TEST_MIL_SVC0: Printing");)

    // initialize the count we have printed variable to zero
    count = 0;
    do
    {
        /*
         * copy 512 bytes of the client buffer
         * or the entire client buffer to our
         * local buffer
         */
        j = count;
        for (i = 0; i < 512 && j < pStream->numBytes; i++, j++)
        {
            pInst->printBuffer[i] = ((P_U8)(pStream->pBuf))[j];
        }

        /*
         * You must reset the request block before
         * reusing an existing request block.
         */
        DrvMILRequestBlockReset(pInst->pRBPrint);

        /*
         * Initialize request block parameters
         *      function to perform
         *      pointer to our buffer
         *      indicate we are giving
         *          the mil device a pointer
         *          to a buffer
         *      the size of the buffer
         */
        pRBPrn->functionCode = milParallelWrite;
        pRBPrn->data.pBuffer = pInst->printBuffer;
        pRBPrn->dataIsBuffer = false;
        pRBPrn->bufferSize = i;

        // indicate we are inside the mil request
        pInst->printInProgress = true;

        // call the mil
        StsWarn(DrvMILRequest(pInst->pRBPrint));

        // has the printing been cancelled?
        if (pInst->printInProgress == false)
        {
            // yes - exit
            break;
        }

        // indicate we are not in the mil
        pInst->printInProgress = false;

        // update count of total characters printed
        count += pRBPrn->countPrinted;

        // continue until an error or the entire buffer is printed
    } while (pRBPrn->countPrinted == pRBPrn->bufferSize &&
                                                 count < pStream->numBytes);

    // indicate number of characters printed
    pStream->count = count;

#ifdef   DEBUG
    // if an error occurred display buffer being printed
    if (pRBPrn->status != stsOK)
    {
        Debugf("count printed is %d -- count requested %d",
                pRBPrn->countPrinted,
                pRBPrn->bufferSize);

        Dbg(DisplayBuffer(pInst->printBuffer, pRBPrn->bufferSize);)

        Debugf("pStream->count is %d -- pStream->numBytes is %d",
                pStream->count,
```

```
                pStream->numBytes);
    }
#endif

    return pRBPrn->status;

}    /* TestMILSvcPrint */


/*****************************************************************************
    STATUS EXPORTED0 TestMILSvcCancelPrint(P_INSTANCE_DATA pInst)

    Cancel print request.
*****************************************************************************/

STATUS EXPORTED0 TestMILSvcCancelPrint(P_INSTANCE_DATA pInst)
{
    STATUS  s;

    // If print mil reques in progress, cancel request
    if (pInst->printInProgress != false)
    {
        // call mil with request block to be cancelled
        StsRet(DrvMILCancelRequest(pInst->pRBPrint), s);

        // indicate request has been cancelled
        pInst->printInProgress = false;
    }
    return stsOK;

}    /* TestMILSvcCancelPrint */
```

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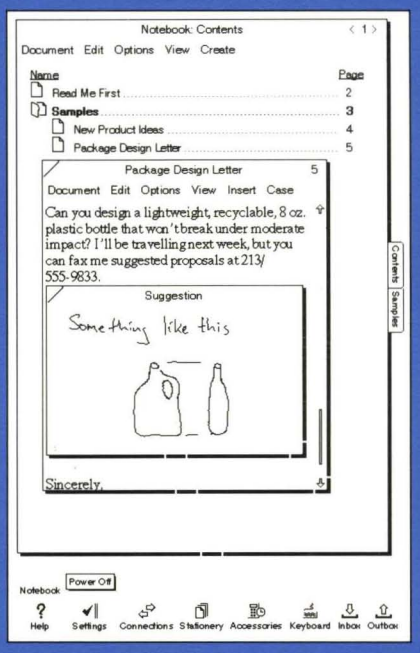

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