Palm OS® Platform Developer Guide

Software and Hardware

Rev. E

November 22, 2006

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Date	Revision	Description of Changes
2004 - 2005	A	Documents prior to document revisioning.
May 15, 2006	B	Revisions for Treo™ 700p smartphone.
June 29, 2006	C	Revisions for Multimedia features.
November 20, 2006	D	Revisions for Treo™ 700p smartphone Rest of World carrier release.
November 22, 2006	E	Revisions for Treo™ 680 smartphone.

Contents

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What’s New

This section provides an overview of new features and product developments that have been implemented since the last revision of this guide.

Overall, the current revision of this document (Rev. E) reflects updates to features and specifications for the Treo™ 680 smartphone.

Specifically, the following items have been added or updated in the current revision of the *Palm OS Developer Guide*:

- Added product overview and hardware specifications for the Treo 680 smartphone to **Chapter 2**.
- Added information on audio pause and resume functionality for Treo 680 smartphones in **Section 4.3.1.2.3 on page 77**.
- Documented a new error condition used in the HTTP Library in **Section 5.3.3 on page 96**.
- Documented changes in the updated Phone Application 3.0 for Treo 680 smartphones and basic information on Telephony APIs in **Chapter 7**.
- Added information on memory partitioning and button mapping for Treo 680 smartphones in **Chapter 9**.
- Added information on support for overlapping gadgets in Treo 680 smartphones to **Section 13.2.2 on page 261**.
- Added information on a known issue with streaming on the Treo 700p smartphone in **Section 4.5.1 on page 83**.

What’s new in Treo™ 680 smartphones

The Treo 680 smartphone is a new ergonomic hardware design that is slightly smaller than the Treo 650 or Treo 700p smartphones. The Treo 680 is an EDGE-enabled GSM radio that runs Palm OS 5.4.9. New hardware features include:

- A smaller removable 1200 mAh battery.
- The first Palm OS-based Treo smartphone that features an internal antenna.
- The SD card slot placement is on the side of the device.
- New color form factors, including Arctic, Copper, Graphite, and Crimson.
- Power/sync over Multi-connector, USB “trickle charge”, or AC adapter (108-132 VAC/60Hz).

For complete hardware specifications, see **Chapter 2**.

In Treo 680 smartphone software updates, the Phone Application 3.0 includes a new interface that integrates the Main, Dial Pad, Favorites, Contacts, and Call Log views. The impact on developers is minimal, but a few changes are noted in **Chapter 7**.

What’s new in Treo™ 700p ROW smartphones

The Treo 700p smartphone ROW release is for specified carriers only. For the current list of carriers included in the Treo 700p ROW release, visit the Palm Developer website at **http://pluggedin.palm.com** and navigate to the Treo 700p device page.

The Treo 700p ROW release includes the Bluetooth 1.2 patch. The Bluetooth 1.2 patch resolves car-kit compatibility issues, which caused the Bluetooth (ACL) connection between the Treo 700p smartphone and the car-kit to drop.

The Treo 700p ROW release supports the following languages:

- English
- Spanish

As a CDMA Rest of World release, the Treo 700p smartphone ROW does not include MMS. For more information, see **Section 2.1 on page 17**.

What’s new in Treo™ 700p smartphones

The Treo 700p smartphone is the first Treo CDMA smartphone that has the ability to connect to 1xRTT/EvDO networks. The Treo 700p includes NVFS on Palm OS 5.4.9, a new memory architecture with 64 MB NOR Flash memory stacked on the processor, and 64 MB NAND Flash.

For more information on the Treo 700p memory architecture, see **Section 9.8 on page 144**.

Other changes include:

- An updated button mapping scheme. For more information, see **Section 9.9.8.3 on page 165**.
- Class detection for serial peripherals. For more information, see **Chapter 14**.
- Changes to the Network Preferences panel, described in **Section 5.1.3 on page 87**.
- Power/sync over Multi-connector, USB “trickle charge”, or AC adapter (108-132 VAC/60Hz).

CHAPTER 1

1. Overview

This chapter introduces the Palm OS® Platform Software Development Kit (SDK). It discusses how this guide is organized, how to get started developing for Palm OS-based devices, the contents of the SDK and how to use it, and where to find more information and resources.

1.1 How this guide is organized

This guide contains an overview of products that use the Palm OS, including Treo™ smartphones, LifeDrive™ mobile managers, and Palm®, Tungsten™, and Zire™ handhelds. This guide also includes hardware specifications for each device and a feature matrix that identifies the software features available on each device.

The libraries discussed in this guide are organized by general category, such as Multimedia Libraries and Application Libraries.

In addition to the discussion of the libraries, this guide contains debugging information for troubleshooting problems on the various devices, as well as style conventions for how certain features should be used. It also includes coding examples and specific references to more information in the *Palm OS Platform API Guide*.

1.2 Getting started

With its focus on the mobile user, Palm OS was designed from the beginning for mobile computing, and provides a flexible, easy-to-use, and compatible development platform.

Leading the mobile computing revolution since the introduction of the first Palm Pilot in 1996, Palm OS provides the largest selection of mobile software in the world. Palm OS platform gives users the ability to control all of their mobile information, communication, and entertainment needs, no matter where their lives take them.

The following sections contain information on how to begin developing applications for Palm OS-based devices.

1.2.1 Join the PalmSource® developer program

To download the latest Core Palm OS SDK from PalmSource, you will first need to register for PalmSource's Palm OS developer program at the following URL:

http://www.palmsource.com/developers/

1.2.2 Download the PalmSource® Palm OS SDK

The PalmSource SDK includes headers files, documentation, and samples necessary to begin application development.

IMPORTANT: PalmSource's Palm OS SDK does not include a build environment, nor does it include any device differentiations from Palm, Inc.

Next, from **www.palmos.com/dev/tools/core.html**:

1. Download and install the Palm OS Garnet SDK (68K) R3.
2. Download and install the latest version of the Palm OS 68K API SDK, which is an update to the Garnet SDK.

For more information and getting started tips on the Palm OS platform, see **http://www.palmos.com/dev/start/**.

1.2.3 Acquire a development environment

To develop applications for Palm OS-based devices, you will need to acquire one or more of the following development environments:

- **Palm OS Developer Suite -** The Palm OS Developer Suite from PalmSource runs under Microsoft Windows and is based on Eclipse, so most of its code runs in the Java Virtual Machine (JVM). The Palm OS Developer Suite allows developers to build both Protein applications (all ARM-native code) for Palm OS Cobalt, and 68K applications for all versions of the Palm OS currently shipping. First, register for the PalmSource developer program, then download the Palm OS Developer Suite from PalmSource at the following URL:

  http://www.palmos.com/dev/tools/dev_suite.html

- **CodeWarrior Development Studio for Palm OS Platform -** Metrowerks CodeWarrior, available for Windows and Mac OS, is a complete programming tool for the Palm OS platform. CodeWarrior is available at the following URL:

  http://www.freescale.com/webapp/sps/site/homepage.jsp?nodeId=012726

- **PRC-Tools -** PRC-Tools is a freeware complete compiler tool for building Palm OS applications in C or C++. PRC-Tools includes GNU packages, GCC, binutils, GDB, and other post-linker tools. A link to PRC-Tool resources can be found at the following URL:

  http://www.palmos.com/dev/tools/gcc/

1.2.4 Join the Palm® Developer program

For registered members of the Palm Developer program, the Palm Developer website provides access to the Palm OS SDK, documentation, Frequently Asked Questions, and other resources, such as developer forums.

For more information on the program, visit the following URL:

http://pluggedin.palm.com

1.2.5 Download the Palm OS Platform SDK

The latest Palm OS Platform SDK from Palm, Inc. is available for download from the Palm Developer website at **http://pluggedin.palm.com**.

IMPORTANT: Before using Palm, Inc.'s Palm OS SDK, you must download the current PalmSource® SDK from **www.palmos.com/dev/tools/core.html** which is discussed in **Section 1.2.2 on page 14**.

The Palm, Inc. Palm OS SDK includes:

- **Header Files -** Palm-specific header files are required in addition to the header files provided by the PalmSource SDK. Header files are generally updated with each product launch.
- **Documentation:**
  - **Palm OS Platform Developer Guide -** The *Palm OS Platform Developer Guide* (this document) is the comprehensive guide to software and hardware development for all Palm devices on the Palm OS platform. The *Developer Guide* is generally updated for each major product launch.
  - **API Guide -** In the past, detailed documentation on API functions and structures was included in the *Developer Guide*. Complete API documentation is now generated directly from Palm source code and presented in a separate document. Refer to the *Palm OS Platform API Guide* either in compressed HTML format (.chm) or HTML format available on the Palm Developer website.The *API Guide* is updated for each SDK build.
  - **Frequently Asked Questions** - The Palm Developer website includes an archive or Frequently Asked Questions with answers from Palm engineers. FAQs are updated on an ongoing basis.
  - **Application Notes -** When relevant, Application Notes on specific developer issues are generated between SDK releases and *Developer Guide* revisions. Therefore, they are generally the most up to date source of information.
- **Sample Code -** The Sample Code section of the Palm OS Platform SDK is used to illustrate concepts and API usage, allowing developers to grasp basic and complicated ideas quickly.
- **Debugging Tools and Utilities -** Debugging tools and utilities provided in the Palm OS SDK include:
  - PalmDebugger
  - PPP Tracer
  - TraceViewer
  - MemoryInfo
  - DebugPrefs.c.

For more information on Debugging, see **Chapter 12**.

- **Simulators/Emulators -** A simulator is provided for each individual product at the Palm Developer website on that product's page. (Palm OS platform-specific simulators are provided by PalmSource, but they do not include any of Palm's device differentiations.) Generally, simulators are not updated, but new simulators are made available with each maintenance release.

The Palm OS Platform SDK is updated with every product launch or announcement. The SDK is versioned using the following X.Y.Z method:

- X is incremented if a major change/addition occurs.
- Y is incremented when a new product is released or announced.
- Z is incremented when a change is made to the SDK that does not warrant an X or a Y change.

1.3 Additional documentation and resources

User Manuals, support information, and other documentation on Palm OS-based devices can be found at the Palm Customer Service and Support website, **http://www.palm.com/us/support/**.

CHAPTER 2

2. Product Line Overview

This chapter provides an overview of Treo™ smartphones, Tungsten™ handhelds, Zire™ handhelds, and the LifeDrive™ mobile manager, as well as a high-level description of the features available in each product line. A hardware features table illustrates the hardware and electrical specifications of each model, and a software features table illustrates the specific features and APIs that apply to each device.

2.1 Treo™ smartphone product line

The Treo by Palm is a family of compact smartphones that integrates a mobile phone, wireless data applications such as messaging and web browsing, and a Palm OS® organizer. Treo smartphones are available in two radio versions, GSM and CDMA, with the following specifications.

1. **GSM** - Treo 600, Treo 650, and Treo 680 smartphones features a quad-band GSM/GPRS/EDGE world radio on the following frequencies:
   - 850 MHz (NA band)
   - 900 MHz (EU/Asia band)
   - 1800 MHz (EU/Asia band)
   - 1900 MHz (NA band)
2. **CDMA**
   - Treo 600 and Treo 650 smartphones features a dual-band CDMA/1xRTT nationwide radio on the following frequencies:
     - 800 MHz (Cellular band)
     - 1900 MHz (PCS band)
   - Treo 700p smartphones features a dual-band CDMA2000/1xRTT/EvDO nationwide radio on the following frequencies:
     - 800 MHz (Cellular band)
     - 1900 MHz (PCS band)

One of the key differentiators of the Palm OS-based Treo smartphone is the integration of the main applications and the user interface, which makes applications easy to use. Most applications are common to both versions of the Treo smartphone, GSM and CDMA, and they include:

- Phone application
- SMS messaging
  - GSM - SMS messages can be received and sent
  - CDMA - SMS services may or may not be offered and supported by the operator

- MMS
  - GSM - All GSM phones include MMS
  - CDMA - Only Sprint and Verizon phones include MMS - Rest of World (ROW) release phones do not include MMS
- Proxyless Blazer® web browser supporting direct download of ring tones, applications, and documents
- Photo capture application
- Email applications are available, but the type of application varies by operator
- Palm OS® organizer applications, such as Calendar, Contacts, Tasks, and Memos
- Music playback capability on the Treo 650, Treo 680, and Treo 700p smartphone
- A high-resolution screen on the Treo 650, Treo 680, and Treo 700p smartphone
- Streaming Audio and Video applications on the Treo 680 and Treo 700p smartphone
- Bluetooth 1.2 patch for Treo 700p ROW smartphones, which resolves car-kit compatibility issues that caused the Bluetooth (ACL) connection between the Treo 700p smartphone and the car-kit to drop.

NOTE: Some applications are applicable only to the GSM or CDMA version. Treo smartphones might also be configured differently depending on the operator.

2.1.1 What's not supported by Treo™ smartphones

Treo smartphones use Palm OS version 5.x. However, as each licensee can choose to implement only certain features of the OS as it applies to its product, Palm implements certain features and not others.

Treo smartphones do not support:

- INet library

  Palm has never supported the INet library, contained in the header file `INetMgr.h`, or ported it to Palm products.
- `Lz77Mgr.h` header file
- `SmsLib.h` header file

  Treo smartphones have their own SMS library. The Treo SMS library supports the Exchange Manager.
- Telephony Manager

  Treo smartphones have their own Phone library. The telephony header files `TelephonyMgr.h`, `TelephonyMgrTypes.h`, and `TelephonyMgrUI.h` are not supported in the Palm OS.
- Fax services are not supported by Treo smartphones.
- The Treo 650, Treo 680, and Treo 700p smartphones do not include the zLib that was included in the Treo 600 smartphone. A version of this library can be found at: **www.copera.com/zlib-armlet/**.

For a complete list of Palm libraries compatible with Palm OS-based Treo smartphones, see **Section 2.7 on page 27**.

2.2 Tungsten™ handheld product line

Devices in the Tungsten product line are designed to target the power business user. Tungsten handhelds provide easy, reliable access to business data, as well as seamless integration with the desktop business environment. Tungsten handhelds provide a large, easy-to-read display, compatibility with the most popular business applications, a large amount of storage (which is not lost when battery power is depleted), and powerful organization and search functions. Some models of Tungsten handhelds also enable the user to mount the handhelds as a drive on a compatible PC.

2.2.1 What's not supported by Tungsten™ handhelds

Tungsten handhelds use Palm OS version 5.x. However, as each licensee can choose to implement only certain features of the OS as it applies to its product, Palm implements certain features and not others.

Tungsten handhelds do not support:

- INet library

  Palm has never supported or ported the INet library, contained in the header file `INetMgr.h`, to its products.

- `Lz77Mgr.h` header file

For a complete list of Palm libraries compatible with Tungsten handhelds, see **Section 2.7 on page 27**.

2.3 Zire™ handheld product line

Devices in the Zire product line are designed to target the consumer who wants an easy-to-use handheld that is ready out of the box and useful in both a personal and business environment. Zire handhelds leverage MP3 capability, a color screen, and expandibility to appeal to casual technology users interested in value, as well as savvy young technology users interested in style and the latest functionality.

2.3.1 What's not supported by Zire™ handhelds

Zire handhelds use Palm OS version 5.x. However, as each licensee can choose to implement only certain features of the OS as it applies to its product, Palm implements certain features and not others.

Here is a list of what Zire handhelds do not support:

- INet library

  Palm has never supported or ported the INet library, contained in the header file `INetMgr.h`, to its products.

- `Lz77Mgr.h` header file

For a complete list of Palm libraries compatible with Zire handhelds, see **Section 2.7 on page 27**.

2.4 LifeDrive™ mobile manager

The new LifeDrive mobile manager lets users keep track of schedules, business and personal contacts, to-do lists, and even Microsoft Office and multimedia files. LifeDrive mobile manager also offers a 4GB hard drive that lets users carry files and hours of music, photos, and videos. Users can transfer information in real time between the device and their computer and, on a Windows computer, select which files and folders to synchronize. Users can import photos and videos from a digital camera's memory card, or connect wirelessly to a Wi-Fi network.

LifeDrive mobile manager is the first Palm device to use a hard drive for memory (storage). LifeDrive mobile manager's hard drive changes some of the basic assumptions that Palm OS applications typically make about the speed of various operations. Not only does it use DBCache (introduced in NVFS devices), but developers should also consider the following performance issues:

- If the drive is automatically turned off (after ten seconds of inactivity, meaning no active writes or reads to/from the drive), the system stalls for one or two seconds while the drive spins up again.
- Whenever the heads of the drive are over the platters, the hard drive is susceptible to damage from drops. The heads are over the platters during every read and write operation and remain there until there have been about two seconds of no read/write activity.

2.4.1 What's not supported by LifeDrive™ mobile managers

LifeDrive mobile managers use Palm OS version 5.x. However, as each licensee can choose to implement only certain features of the OS as it applies to its product, Palm implements certain features and not others.

Here is a list of what LifeDrive handhelds do not support:

- INet library

  Palm has never supported or ported the INet library, contained in the header file `INetMgr.h`, to its products.
- `Lz77Mgr.h` header file

For a complete list of Palm libraries compatible with LifeDrive mobile managers, see **Section 2.7 on page 27**.

2.5 Hardware feature matrix

2.5.1 Treo™ smartphone hardware features

Feature	Treo 600	Treo 650	Treo 680	Treo 700p
Processor				
Type	TI OMAP 310 ARM	Intel XScale PXA270 ARM	Intel XScale PXA270 ARM	Intel XScale PXA270 ARM
Speed	144MHz	312MHz	312MHz	312MHz
Memory				
RAM	32MB	32MB	64MB	32MB
NAND Flash User Store	N/A	32MB	64MB	64MB
Battery				
Type	Rechargeable Lithium Ion	Rechargeable Lithium Ion	Rechargeable Lithium Ion	Rechargeable Lithium Ion
mAh	1800	1900	1200	1800
Standby or use time	up to 300 hours	GSM/GPRS - up to 300 hours CDMA - up to 336 hours	up to 300 hours	up to 300 hours
Talk time	up to 6 hours	up to 6 hours	up to 4 hours	up to 4.5 hours
Removable	No	Yes	Yes	Yes
Form factor				
Size	4.41" x 2.36" x .87" without antenna	4.41" x 2.36" x .87" without antenna	4.4" x 2.3" x .8" internal antenna	4.4" x 2.3" x .9" without antenna
5-way button	Yes	Yes	Yes	Yes
Grafitti	None	None	None	None
Keyboard	Built-in QWERTY keyboard	Built-in QWERTY keyboard	Built-in QWERTY keyboard	Built-in QWERTY keyboard
Color	Silver	Silver	Arctic, Copper, Graphite, Crimson	Silver/Black

Feature	**Treo 600**	**Treo 650**	**Treo 680**	**Treo 700p**
Display				
Resolution	160 x 160 pixels	320 x 320 pixels	320 x 320 pixels	320 x 320 pixels
Density	16-bit (65,536 colors)	16-bit (65,536 colors)	16-bit (65,536 colors)	16-bit (65,536 colors)
Wireless				
	CDMA or GSM/GPRS	CDMA/1xRTT or GSM/GPRS/ EDGE, Bluetooth® 1.1	Quad-band GSM/GPRS/EDGE (850/900/1800/1900) Bluetooth® 1.2	CDMA/1xRTT/EvDO Bluetooth® - Sprint and Verizon, Bluetooth® 1.2 - Rest of World*, Bluetooth® 1.2 with patch
Camera				
	VGA (640 x 480) 0.3 mega-pixels	VGA (640 x 480) 0.3 mega-pixels	VGA (640 x 480) 0.3 mega-pixels	1.3 mega-pixels (1280 x 1024)
Interface Connector				
	Treo 600 smartphone connector (USB, serial without flow control)	Multi-connector (USB, serial without flow control)	Multi-connector (USB, serial without flow control)	Multi-connector (USB, serial without flow control)

* For the current list of carriers included in the Treo 700p ROW release, visit the Palm Developer website at **http://pluggedin.palm.com** and navigate to the Treo 700p device page.

2.5.2 Palm® handheld and LifeDrive™ mobile manager hardware features

Feature	Palm T|X handheld	LifeDrive mobile manager	Tungsten T5	Tungsten E	Tungsten E2	Tungsten C
Processor						
Type	Intel Xscale PXA270 ARM	Intel Xscale PXA270 ARM	Intel XScale PXA270 ARM	TI OMAP 311 ARM	Intel XScale PXA255 ARM	Intel XScale PXA255 ARM
Speed	312MHz	416MHz	312MHz	126MHz	200MHz	400MHz
Memory						
RAM	32MB SDRAM + 128MB NAND Flash	32MB + 3.85GB hard drive	256MB	32MB	32MB	64MB
ROM	12MB (masked)	16MB	32MB	8MB	8MB (masked)	16MB
Battery						
Type	Rechargeable Lithium Ion	Rechargeable Lithium Ion	Rechargeable Lithium Ion	Rechargeable Lithium Ion	Rechargeable Lithium Ion	Rechargeable Lithium Ion
mAh	1300	1660	1020	800	1020	1500
Standby or use time	N/A	N/A	48 days	21 days	48 days	30 days
Talk time	N/A	N/A	N/A	N/A	N/A	N/A
Removable	No	No	No	No	No	No
Form factor						
Size	4.76" x 3.08" x .61" without flipcover	4.76" x 2.87" x 7.4"	4.5" x 3" x .5" without flipcover	4.5" x 3.1" x .5"	4.5" x 3.1" x .59" without flipcover	4.0" x 3.07" x .65"
5-way button	Yes	Yes	Yes	Yes	Yes	Yes
Grafitti	Dynamic	Dynamic	Dynamic	Yes	Yes	None
Keyboard	None	None	None	None	None	Built-in QWERTY keyboard
Display						
Resolution	320 x 480	320 x 480	320 x 480 pixels	320 x 320 pixels	320 x 320 pixels	320 x 320 pixels
Density	16-bit (65,536 colors)	16-bit (65,536 colors)	16-bit (65,536 colors)	16-bit (65,536 colors)	16-bit (65,536 colors)	16-bit (65,536 colors)
Wireless						
	802.11b (WPA2 enabled) Bluetooth®	Wi-Fi (802.11b), Bluetooth® 1.1	Bluetooth®	None	Bluetooth®	Wi-Fi (802.11)

Feature	Palm T|X handheld	LifeDrive mobile manager	Tungsten T5	Tungsten E	Tungsten E2	Tungsten C
Camera						
	None	None	None	None	None	None
Interface Connector						
	Multi-connector (USB, serial without flow control)	Multi-connector (USB, serial without flow control)	Multi-connector (USB, serial without flow control)	Standard Mini-USB	Multi-connector (serial without flow control)	Universal Connector (USB, serial with flow control)

2.5.3 Palm® Z22 organizer and Zire™ handhelds hardware features

Feature	**Palm Z22**	**Zire 31**	**Zire 72**
Processor			
Type	Samsung S3C2410A ARM	Intel XScale PXA255 ARM	Intel XScale PXA270 ARM
Speed	200MHz	200MHz	312MHz
Memory			
RAM	16MB SDRAM + 32MB NAND Flash	16MB	32MB
ROM	6MB ROM	4MB	8MB
Battery			
Type	Rechargeable Lithium Ion	Rechargeable Lithium Ion	Recharge-able Lithium Ion
mAh	720	900	950
Standby or use time	14 days	48 days	29 days
Talk time	N/A	N/A	N/A
Removable	No	No	No
Form factor			
Size	2.7" x 4.06" x 0.6"	4.4" x 2.9" x .6"	4.6" x 2.95" x .67"
5-way button	Yes	Yes	Yes
Grafitti	Yes	Yes	Yes
Keyboard	None	None	None
Display			
Resolution	160x160 pixels	160x160 pixels	320 x 320 pixels
Density	16-bit (65,536 colors) 12-bit actual	16-bit (65,536 colors)	16-bit (65,536 colors)
Wireless			
	None	None	Bluetooth®
Camera			
	None	None	Photo: 1280 x 960 Video: 320 x 240
Interface Connector			
	Standard Mini-USB	Standard Mini-USB	Standard Mini-USB

2.6 SDIO support

An SDIO (SD Input/Output) card extends the functionality of devices with SD card slots. SDIO cards support different data transfer modes, including SPI, SD 1-bit, and SD 4-bit modes.

Many SDIO cards are labelled "low speed" or "full speed."

- If an SDIO card is a low-speed card, then it is required to support only the SPI and 1-bit data transfer modes.
- If an SDIO card supports full-speed data transfer, then all three data modes (SPI, SD 1-bit, and SD 4-bit) are supported.

The following table lists the transfer modes of SDIO cards that are compatible with Palm devices.

Device	SPI	SD 1-bit	SD 4-bit
Palm T|X handheld	-	●	●
Palm Z22 organizer	-	-	-
LifeDrive mobile manager	-	●	●
Treo 600 smartphone	-	●	-
Treo 650 smartphone	-	●	●
Treo 680 smartphone	-	●	●
Treo 700p smartphone	-	●	●
Tungsten C handheld	●	●	-
Tungsten E handheld	●	●	●
Tungsten E2 handheld	-	●	-
Tungsten T5 handheld	-	●	●
Zire handheld	-	-	-
Zire 31 handheld	-	●	-
Zire 71 handheld	●	●	●
Zire 72 handheld	●	●	●

For information on developing SDIO applications for Palm devices, see **Chapter 11**.

[1]

[1] In this and the following tables, a bullet (●) indicates that the feature is available on that device.

2.7 Software compatibility specifications (Palm libraries)

Software	Palm T|X handheld	Palm Z22 organizer	LifeDrive mobile manager	Treo 600	Treo 650	Treo 680	Treo 700p	Tungsten T5	Tungsten E	Tungsten E2	Tungsten C	Zire 31	Zire 72
Palm OS	5.4.9	5.4.9	5.4.8	5.2.1	5.4	5.4.9	5.4.9	5.4	5.2.1	5.4.7	5.2.1	5.2.8	5.2.8
Multimedia													
Ring Tones	-	-	-	●	●	●	●	-	-	-	-	-	-
Sound and Voice Recording	●	-	●	●	●	●	●	●	-	-	●	-	●
Camera	-	-	-	●	●	●	●	-	-	-	-	-	●
Photos	●	●	●	●	●	●	●	●	●	●	-	●	●
Video	●	-	●	-	-	●	●	●	-	-	-	-	●
Codec Plug-in Manager	●	-	●	-	●	●	●	●	-	●	-	-	●
Data communications													
Network preferences	-	-	-	●	●	●	●	-	-	-	-	-	-
HTTP	●	-	●	●	●	●	●	●	-	●	-	-	-
Wi-Fi	●	-	●	-	-	-	-	-	-	-	●	-	-
NetMaster	-	-	-	●	●	●	●	-	-	-	-	-	-
HTML Library	●	-	●	-	●	●	●	-	-	-	-	-	-
Telephony													
Telephony	-	-	-	●	●	●	●	-	-	-	-	-	-
SMS	-	-	-	●	●	●	●	-	-	-	-	-	-

Software	Palm T|X handheld	Palm Z22 organizer	LifeDrive mobile manager	Treo 600	Treo 650	Treo 680	Treo 700p	Tungsten T5	Tungsten E	Tungsten E2	Tungsten C	Zire 31	Zire 72
System extensions													
Transparency	-	-	-	●	●	●	●	-	-	-	-	-	-
File Browser API	-	-	●	-	-	●	-	●	-	-	-	-	-
Smart Text Engine	-	-	●	●	●	●	●	-	-	-	-	-	-
REM sleep	●	-	-	●	●	●	●	-	-	-	-	-	-
MMS helper functions	-	-	-	●	●	●	●	-	-	-	-	-	-
NVFS	●	●	●	-	●	●	●	●	-	●	-	-	-
Handspring® extensions	-	-	-	●	●	●	●	-	-	-	-	-	-
Keyguard	-	-	-	●	●	●	●	-	-	-	-	-	-
Option and shift	-	-	-	●	●	●	●	-	-	-	-	-	-
Tips and tutorial	●	●	●	●	●	●	●	●	-	●	-	-	-
Full-screen writing	●	●	●	-	-	-	-	●	-	●	-	●	●
Applications													
Web browser	●	-	●	●	●	●	●	●	-	●	-	-	-
VersaMail®	●	-	●	-	●	●	●	●	-	●	-	-	-

2.8 sysExternalConnectorAttachEvent and sysExternalConnectorDetachEvent notifications

The `sysExternalConnectorAttachEvent` and `sysExternalConnectorDetatchEvent` notifications are used with the Palm Multi-connector. For more information, see **Chapter 14**.

	Power notification 0x0008	**Serial notification 0x0040**	**USB notification 0x0010**
Tungsten T5 handheld	●	●	●
Tungsten E2 handheld	●	●	●
LifeDrive mobile manager	●	●	●
Treo 650 smartphone	-	-	-
Treo 680 smartphone	●	●	●
Treo 700p smartphone	●	●	●

2.9 kPmConnectorClass Notifications

The `kPmConnectorClass` notifications are used by LifeDrive mobile managers to detect accessories.

	Audio With Headset 0x05	**Audio No headset 0x00**	**Carkit 0x01**	**Generic Serial 0x03**
LifeDrive mobile manager	-	●	●	●

2.10 Optimizing your application for Palm® NVFS devices

Available on:

- LifeDrive™ mobile manager
- Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5, Tungsten™ E2, and Palm® T|X handhelds
- Palm® Z22 organizer

Before the introduction of the Non-Volatile File System (NVFS), data on a Palm device was stored in "volatile" memory that required a constant stream of low power to maintain data. If a device’s battery became completely drained, data would be lost until a HotSync operation restored it from a PC.

Beginning with the Treo 650 smartphone and the Tungsten T5 handheld, Palm devices use "non-volatile" memory, which means that they don't need power to store data. A device’s battery can be completely drained, or swapped out, and data will remain in the device.

Applications and data may take up more space on NVFS devices than devices with traditional “volatile” memory. For this reason, developing applications for NVFS devices may require some additional work to avoid performance issues.

For information on the NVFS API, see **Section 9.8 on page 144**.

2.10.1 Speeding up actual performance

Applications on NVFS devices reside on the hard drive and must be read from the hard drive at first launch to ensure that they are loaded into DBCache in SDRAM. Therefore, there is more disk traffic the first time an application is launched after a reset.

When developing applications for any NVFS device, please consider the following methods of optimization:

- Do not use `PrefSetPreferences` and `PrefSetAppPreferences` to store data.

  Many applications use preferences to indiscriminately store application data. On a RAM-based system, this has little overhead, but on NVFS-based systems it has significant overhead.

  Use features and feature pointers rather than preferences to store data that does not need to be preserved across a soft reset.

  It is better to make a single `PrefSet` call with all of your changes (at `StopApplication` for instance) than multiple `PrefSet` calls.

  Note that a `PrefSet` call will not generate NVFS traffic if the set preference is exactly the same as the existing preference. However, if you are using buffers, make sure they are zeroed so that changing garbage data at the end of the buffer will not cause spurious writes.

  These techniques also apply to the Connection Manager and the Exchange Manager.

- Use cache instead of rereading from a file.

  In many instances, applications constantly reread the same information from NVFS files (especially if they use the Media libraries). If your application is reading from a database, that will already be cached in the DBCache, but if you are using raw file data on a read-only basis, consider using a cache in either feature memory or using a FileStream.

  In particular, opening and closing the media library is a time-consuming (2-3 seconds) task. To avoid the cost of continually opening the media library, open the library, generate the bitmaps you will need (such as backgrounds), and cache those bitmaps to feature memory or temporary databases.

- Improve memory management.

  Using a feature pointer instead of a normal memory pointer has significant overhead if you are doing many writes because `DmWrite` is much slower than a normal memory access.

  Using a temporary database (or filestream) to store data can really slow things down because every `DmWrite` must be written to the backing store when the database closes. This is useful when you need to preserve your temporary data across resets and application launches, but can be a performance drain.

  If you are caching a small amount of data (<0.5MB), use heap-based pointers from `MemPtrNew`. If you need to cache a larger amount of data (>0.5MB), use `FtrPtrNew`.

- Use `DmWrite`, `FileWrite`, and `VFSFileWrite` only when necessary.

  Written data must be automatically saved to the disk, so it can become costly if you write little bits of data at a time. Your application will perform better if you make fewer larger writes rather than many small writes.

  For more information on developing applications for NVFS devices, see **Section 9.8.3 on page 151**.

2.10.2 Speeding up perceived performance

- One of the things that users report in terms of performance is that the screen goes white or flickers while applications are loading or doing other significant work.

  Use `WinScreenLock/WinScreenUnlock` to freeze the UI on the screen while you are doing background processing that might make the screen flicker. This is also useful to reduce the appearance of a slow redraw time since you can redraw everything and then put it on the real display in one go.

- Process data at `sysAppLaunchCmdReset` time.

  Much of the time spent by applications launching for the first time after a reset is in recreating default databases. To save time, you may create default databases at `sysAppLaunchCmdReset` time instead of at `sysAppLaunchCmdNormalLaunch` time. That way, much of the initial application launch times are buried within the longer reset time (which already has UI).

- Keep the event loop running.

  Slow UI is due in part to the fact that almost all of our libraries and applications are single-threaded. When a long blocking operation is initiated, the event loop (which updates all UI) doesn't run. This means that user input is ignored until the blocking operation is completed.

- Display "*Please wait"* dialogs.

  There are circumstances where you cannot avoid a lengthy delay (connecting to a network service, etc.). Instead of having a non-responsive UI or blank screen, use shell applications to pop up a "*Please wait"* dialog or do a `WinScreenLock()` while an application with many code resources or a lot of startup processing is loading. This shell can be as simple as being in the first code segment, typically running at `sysAppLaunchCmdNormalLaunch` in `PilotMain`. Consider using a pop up a message or progress indicator so the user doesn't think they have crashed or hung while the rest of the application processing is running. Obviously, this is a solution of last resort after exhausting other avenues to speed up an application.

PART I

Features and Libraries

This part of the guide details the software libraries available in the Palm OS® SDK.

CHAPTER 3

3. PIM Database Structures

This chapter details the changes in the personal information manager (PIM) database structures available in the PIM SDK, as of Palm OS version 5.4 R3 and later.

3.1 The PIM SDK

The PIM SDK includes the latest information on PIM databases and structures, including header files, documentation, and sample code. It must be downloaded separately from the latest Palm OS SDK from **http://pluggedin.palm.com**.

IMPORTANT: Header files in the PIM SDK are not meant to be used as they are. The purpose of distributing the PIM SDK is to illustrate the changes in the database structures since the previous version, and explain how to use the new fields.

3.2 Overview

Personal information management (PIM) applications are the core feature of Palm mobile devices. Users rely on PIM applications to store and access their personal data to perform business and personal tasks. Since late 2004, existing PIM applications (Address Book, Datebook, ToDo, and Memo) have been enhanced to add new fields in the database. These changes were made by creating new PIM applications with different creator IDs (Contacts, Calendar, Tasks, and Memos). So the current PIM applications include both the old and new creator IDs.

This section will explain the changes to the PIM application database structures and code samples in the PIM SDK since Palm OS version 5.4 R3.

To build applications that access the PIM databases, such as Contacts, Calendars, Tasks, and Memos, refer to the header files and documentation included with the PIM SDK.

The PIM code samples that are distributed with the SDK are a reference on how to access the databases and how to get and set data outside the PIM applications. With the introduction of the new database fields, some of the functions in the source code of the code samples must be changed to adapt to the new structures. The purpose of the sections on specific code samples is to identify and document these changes.

3.3 PIM database structures

IMPORTANT: Applications should always use the APIs, and not access database fields directly. PIM application database structures may change in the future, and if your application accesses fields directly, it may break.

The content of the legacy PIM databases is accessible through a compatibility layer that simulates the old databases. This layer assumes that PalmSource's format is respected. For this reason, using different content such as an encrypted blob, will cause a device to crash.

The following tables include the old and new creator IDs for the PIM applications, as well as the types for applications, databases, and the compatibility layer:

Legacy		**New**	
Application	**Creator ID**	**Application**	**Creator ID**
Address Book	`'addr'`	Contacts	`'PAdd'`
Datebook	`'date'`	Calendar	`'PDat'`
Todo	`'todo'`	Tasks	`'PTod'`
Memo	`'memo'`	Memos	`'PMem'`
		Compatibility Layer	`'pdmE'`

Item	**Type**
Applications	`'appl'`
Dababases	`'DATA'`
Compatability Layer	`'aexo'`

Legacy PIM databases exist on the device, but they are empty when not accessed. Records are created on the fly when an application reads or writes to the databases. For this reason, the legacy structures have some impact on performance, especially when a large number of records are present. For example, you may see a performance issue when `AddressDB` is opened, because data is copied from the legacy `ContactsDB-PAdd`, and records are created in the new `AddressDB`.

If your application will provide a different PIM interface, first make sure the new PIM applications and the compatibility layer exist on the device. Where the new enhanced databases are available, use them instead of the legacy databases in your application.

Another change in the database structures is the use of binary large objects (blobs). A blob is a collection of binary data stored as a single item in a database, such as multimedia files like images, video, or sound. In the old PIM database structures, blobs followed at the end of records. With the new PIM database structures, blobs are now part of the record structure and are easier to access. Blobs are available for use by developers, and follow the format of creator ID, size, and data.

NOTE: The data of a blob can contain anything as long as it does not exceed 1K in size.

Blobs use the following database structure:

```
typedef struct
{
   UInt32 creatorID;
   UInt16 size;
   void * content;
} BlobType;
```

For more specific information on the structures of the enhanced PIM databases, see the header files in the PIM SDK.

3.3.1 Contacts

This section describes the changes in the database structures for the Contacts application since Palm OS version 5.4 R3. It also illustrates the changes that must be made to use the code samples for packing and unpacking records.

The enhancements to the database structures for the Contacts application are shown here:

```
typedef struct
{
   AddrOptionsType        options;
   Char *                 fields[addrNumStringFields];
   BirthdayInfo           birthdayInfo;          // NEW
   AddressDBPictureInfo   pictureInfo;           // NEW
      Release2BlobType    rel2blobInfo;          // NEW
   UInt16                 numBlobs;              // NEW
   BlobType               blobs[apptMaxBlobs];   // NEW

} AddrDBRecordType;
```

Two structures have been added to the Birthday and Picture fields in the database: `birthdayInfo` and `pictureInfo`. As the result of these additions, the number of fields was also increased from `addressFieldsCount` in the old `AddressDB.h` to `addrNumStringFields` in the `AddressDB.h` included in the PIM SDK.

rel2blobInfo is also new, and uses the following type:

```
typedef struct
{
   UInt16               dirty;
   BirthdayInfo         anniversaryInfo;
   ToneIdentifier       ringtoneInfo;

} Release2BlobType;
```

For more specific information on the new database structures, refer to the header files in the PIM SDK.

To adapt to the changes in the Contacts database structures, the record pack and unpack functions in the code samples must be modified as well. These changes are described in the following sections.

3.3.1.1 Contacts - Packing Records code sample

```
void PrvAddrDBPack(AddrDBRecordPtr s, void * recordP)
{
   Int32 offset;
   AddrDBRecordFlags flags;
   Int16 index;
   PrvAddrPackedDBRecord* d = 0;
   UInt16 len;
   void * srcP;
   UInt8 companyFieldOffset;
   UInt16 blobCount = 0;
   UInt16 size = 0;

   flags.allBits = 0;
   flags.allBits2 = 0;

   DmWrite(recordP, (Int32)&d->options, &s->options, sizeof(s->options));
   offset = (Int32)&d->firstField;

   for (index = firstAddressField; index < addrNumStringFields; index++)
   {
      if (s->fields[index] != NULL)
      {
         if ((s->fields[index][0] != '\0') || (index == note))
         {
            srcP = s->fields[index];
            len = StrLen((Char*)srcP) + 1;
            DmWrite(recordP, offset, srcP, len);
            offset += len;
            SetBitMacro(flags, index);
         }
      }
   }

   len = sizeof(DateType);
```

```
if(s->birthdayInfo.birthdayDate.month && s->birthdayInfo.birthdayDate.day)
{
   DmWrite(recordP, offset, &(s->birthdayInfo.birthdayDate), len);
   offset += len;
   SetBitMacro(flags, birthdayDate);

   len = sizeof(AddressDBBirthdayFlags);
   DmWrite(recordP, offset, &(s->birthdayInfo.birthdayMask), len);
   offset += len;
   SetBitMacro(flags, birthdayMask);

   if(s->birthdayInfo.birthdayMask.alarm)
   {
      len = sizeof(UInt8);
      DmWrite(recordP, offset, &(s->birthdayInfo.birthdayPreset), len);
      offset += len;
      SetBitMacro(flags, birthdayPreset);
   }
}

if(s->pictureInfo.pictureSize && s->pictureInfo.pictureData)
{
   UInt32 blobId = addrPictureBlobId;
   UInt16 blobSize = 0;

   len = sizeof(blobId);
   DmWrite(recordP, offset, &blobId, len);
   offset += len;

   len = sizeof(blobSize);
   blobSize = s->pictureInfo.pictureSize + sizeof(s->pictureInfo.pictureDirty);
   DmWrite(recordP, offset, &blobSize, len);
   offset += len;

   len = sizeof(s->pictureInfo.pictureDirty);
   DmWrite(recordP, offset, &(s->pictureInfo.pictureDirty), len);
   offset += len;

   DmWrite(recordP, offset, (s->pictureInfo.pictureData),
      s->pictureInfo.pictureSize);
   offset += s->pictureInfo.pictureSize;

   blobCount++;
}

if( (s->rel2blobInfo.anniversaryInfo.birthdayDate.month
     && s->rel2blobInfo.anniversaryInfo.birthdayDate.day)
     || s->rel2blobInfo.ringtoneInfo.id )
{
   UInt32 blobId = addrRelease2BlobId;
   UInt16 blobSize = 0;

   len = sizeof(blobId);
   DmWrite(recordP, offset, &blobId, len);
   offset += len;

   len = sizeof(blobSize);
```

```
      blobSize = sizeof(ToneIdentifier) + sizeof(BirthdayInfo);
      DmWrite(recordP, offset, &blobSize, len);
      offset += len;

      DmWrite(recordP, offset, &(s->rel2blobInfo.anniversaryInfo), blobSize);
      offset += len;

      blobCount++;
   }

   ErrNonFatalDisplayIf(blobCount + s->numBlobs > apptMaxBlobs, "Too many blobs");
   for (index = 0; index < s->numBlobs; index++)
   {
      size = sizeof(s->blobs[index].creatorID);
      DmWrite(recordP, offset, &(s->blobs[index].creatorID), size);
      offset += size;
      size = sizeof(s->blobs[index].size);
      DmWrite(recordP, offset, &(s->blobs[index].size), size);
      offset += size;
      DmWrite(recordP, offset, s->blobs[index].content, s->blobs[index].size);
      offset += s->blobs[index].size;
   }

   ErrNonFatalDisplayIf(offset > MemHandleSize(MemPtrRecoverHandle(recordP)),
        "Not enough room for packed record");

   DmWrite(recordP, (Int32)&d->flags.allBits, &flags.allBits, sizeof(flags.allBits));
   DmWrite(recordP, (Int32)&d->flags.allBits2, &flags.allBits2,
sizeof(flags.allBits2));

   if (s->fields[company] == NULL)
      companyFieldOffset = 0;
   else
     {
      index = 1;
      if (s->fields[name] != NULL)
         index += StrLen(s->fields[name]) + 1;
      if (s->fields[firstName] != NULL)
         index += StrLen(s->fields[firstName]) + 1;
      companyFieldOffset = (UInt8) index;
   }
   DmWrite(recordP, (Int32)(&d->companyFieldOffset), &companyFieldOffset,
sizeof(companyFieldOffset));
}
```

3.3.1.2 Contacts - Unpacking Records code sample

```
void PrvAddrDBUnpack(PrvAddrPackedDBRecord *src, AddrDBRecordPtr dest)
{
   Int16 index;
   AddrDBRecordFlagsflags;
   Char * p;
   UInt16 recordSize = 0;
   Char * blobStart;
   Char * blobEnd;
   UInt32 blobId;
   UInt16 blobSize;

   MemMove(&(dest->options), &(src->options), sizeof(AddrOptionsType));

   MemMove(&flags, &(src->flags), sizeof(AddrDBRecordFlags));
   p = &src->firstField;

   for (index = firstAddressField; index < addrNumStringFields; index++)
   {
      if (GetBitMacro(flags, index) != 0)
      {
         dest->fields[index] = p;
         p += StrLen(p) + 1;
      }
      else
         dest->fields[index] = NULL;
   }

   MemSet(&(dest->birthdayInfo), sizeof(BirthdayInfo), 0 );

   if(GetBitMacro(flags, birthdayDate))
   {
      MemMove(&(dest->birthdayInfo.birthdayDate), p, sizeof(DateType));
      p+= sizeof(DateType);
   }

   if(GetBitMacro(flags, birthdayMask))
   {
      MemMove(&(dest->birthdayInfo.birthdayMask), p, sizeof(AddressDBBirthdayFlags));
      p+= sizeof(AddressDBBirthdayFlags);
   }

   if(GetBitMacro(flags, birthdayPreset))
   {
      dest->birthdayInfo.birthdayPreset = *((UInt8*)p);
      p+= sizeof(UInt8);
   }

   dest->pictureInfo.pictureDirty = 0;
   dest->pictureInfo.pictureSize = 0;
   dest->pictureInfo.pictureData = NULL;
   dest->numBlobs = 0;

   MemSet(&(dest->rel2blobInfo), sizeof(Release2BlobType), 0 );
   dest->numBlobs = 0;
```

```
blobStart = p;
recordSize = MemPtrSize(src);

while (blobStart < (Char *)src + recordSize)
{
   p = blobStart;

   ErrNonFatalDisplayIf((Char *)src + recordSize - blobStart <= sizeof (blobId) +
      sizeof (blobSize),"Invalid blob encountered");

   MemMove(&blobId, p, sizeof (blobId));
   p += sizeof (blobId);

   MemMove(&blobSize, p, sizeof (blobSize));
   p += sizeof (blobSize);

   blobEnd = p + blobSize;

   switch (blobId)
   {
      case addrPictureBlobId:
      {
         UInt16  pictureDirtySize;

         pictureDirtySize = sizeof(dest->pictureInfo.pictureDirty);

         dest->pictureInfo.pictureSize = blobSize - pictureDirtySize;

         MemMove(&(dest->pictureInfo.pictureDirty), p, pictureDirtySize);

         p+= pictureDirtySize;

         if(dest->pictureInfo.pictureSize)
            dest->pictureInfo.pictureData = p;

         p+= dest->pictureInfo.pictureSize;
         break;
      }

      case addrRelease2BlobId:
      {
         MemMove(&dest->rel2blobInfo.anniversaryInfo, p, sizeof(BirthdayInfo));

         p += sizeof(BirthdayInfo);

         MemMove(&dest->rel2blobInfo.ringtoneInfo, p, sizeof(ToneIdentifier));

         p += sizeof(ToneIdentifier);
         break;
      }


      default:
      {
         ErrNonFatalDisplayIf(dest->numBlobs >= apptMaxBlobs, "Too many blobs");
```

```
            dest->blobs[dest->numBlobs].creatorID = blobId;
            dest->blobs[dest->numBlobs].size = blobSize;
            dest->blobs[dest->numBlobs].content = p;

            dest->numBlobs++;
            p = blobEnd;
            break;
         }
      }

      ErrNonFatalDisplayIf(p != blobEnd, "Blob size does not agree with contents");

      blobStart = blobEnd;
   }

   ErrNonFatalDisplayIf(blobStart != (Char *)src + recordSize,
   "Last blob not aligned with end of record - don't let fields edit records
directly!");
}
```

3.3.2 Calendar

This section describes the changes in the database structures for the Calendar application since Palm OS version 5.4 R3. It also illustrates the changes that must be made to use the code samples for packing, unpacking, and sorting records.

The enhanced database structures for the Calendar application are shown here:

```
typedef struct
{
   ApptDateTimeType       *when;
   AlarmInfoType          *alarm;
   RepeatInfoType         *repeat;
   ExceptionsListType     *exceptions;
   char                   *description;
   char                   *note;
   char                   *location;             // NEW
   ApptTimeZoneType       timeZone;              // NEW
   ApptMeetingInfo        meetingInfo;           // NEW
   UInt16                 numBlobs;              // NEW
   BlobType               blobs[apptMaxBlobs];   // NEW
} ApptDBRecordType;
```

In addition to the inclusion of blobs in the record, new data such as `location`, `timeZone`, and `meetingInfo` are also introduced to the Calendar database structure.

- The `location` string provides information about the venue of the appointment.
- The `ApptTimeZoneType` structure enables the use of a time zone feature when setting up appointments. This controls Daylight Saving Time start and end dates.
- The `ApptMeetingInfo` structure contains information about whether a meeting is accepted or declined, number of attendees, etc.

It is important to note that the `timeZone` and `meetingInfo` structures are stored as blobs in the database with blob IDs `dateTimeZoneBlobId` and `dateMeetingBlobId` respectively. However, they are not counted towards the maximum number of blobs allowed (`apptMaxBlobs`).

3.3.2.1 Calendar - Packing Records code sample

```
static void ApptPack(ApptDBRecordPtr s, ApptPackedDBRecordPtr d)
{
   ApptDBRecord        Flagsflags;
   UInt16              size;
   ApptDateTimeType    when;
   UInt16              len;
   UInt16              index;
   UInt32              offset = 0;
   UInt32              offsetForSize;
   UInt32              blobId;
   UInt16              blobSize;
   UInt16              blobCount = 0;

   *(UInt8 *)&flags = 0;

   offset = 0;

   when = *s->when;
   if (when.endTime.hours == hoursPerDay)
      when.endTime.hours = 0; // Never store hours = 24 in database.

   DmWrite(d, offset, &when, sizeof(ApptDateTimeType));
   offset += sizeof (ApptDateTimeType) + sizeof (ApptDBRecordFlags);

   if (s->alarm != NULL)
   {
      DmWrite(d, offset, s->alarm, sizeof(AlarmInfoType));
      offset += sizeof (AlarmInfoType);
      flags.alarm = 1;
   }

   if (s->repeat != NULL)
   {
      DmWrite(d, offset, s->repeat, sizeof(RepeatInfoType));
      offset += sizeof (RepeatInfoType);
      flags.repeat = 1;
   }

   if (s->exceptions != NULL)
   {
      size = sizeof (UInt16) + (s->exceptions->numExceptions * sizeof (DateType));
      DmWrite(d, offset, s->exceptions, size);
      offset += size;
      flags.exceptions = 1;
   }

   if (s->description != NULL)
   {
      size = StrLen(s->description) + 1;
      DmWrite(d, offset, s->description, size);
      offset += size;
      flags.description = 1;
   }

   if (s->note != NULL)
```

```
{
   size = StrLen(s->note) + 1;
   DmWrite(d, offset, s->note, size);
   offset += size;
   flags.note = 1;
}

if (s->location != NULL)
{
   size = StrLen(s->location) + 1;
   DmWrite(d, offset, s->location, size);
   offset += size;
   flags.location = 1;
}

DmWrite(d, sizeof(ApptDateTimeType), &flags, sizeof(flags));

// Include a time zone blob if needed.
if (s->timeZone.name[0] != chrNull)
{
   blobId = dateTimeZoneBlobId;

   // Write the 4 byte blob ID.
   len = sizeof(blobId);
   DmWrite(d, offset, &blobId, len);
   offset += len;

   // Don't write the size yet, but remember where it goes.
   offsetForSize = offset;
   offset += sizeof(blobSize);

   // Write the blob content.
   DmWrite(d, offset, &s->timeZone.uTC, sizeof(s->timeZone.uTC));
   offset += sizeof(s->timeZone.uTC);

   DmWrite(d, offset, &s->timeZone.dSTStart, sizeof(s->timeZone.dSTStart));
   offset += sizeof(s->timeZone.dSTStart);

   DmWrite(d, offset, &s->timeZone.dSTEnd, sizeof(s->timeZone.dSTEnd));
   offset += sizeof(s->timeZone.dSTEnd);

   DmWrite(d, offset, &s->timeZone.dSTAdjustmentInMinutes,
      sizeof(s->timeZone.dSTAdjustmentInMinutes));
   offset += sizeof(s->timeZone.dSTAdjustmentInMinutes);

   DmWrite(d, offset, &s->timeZone.country, sizeof(s->timeZone.country));
   offset += sizeof(s->timeZone.country);

   DmWrite(d, offset, (UInt8 *)&s->timeZone.name - 1 /*custom flag*/, sizeof(UInt8));
   offset += sizeof(UInt8); /*custom flag*/

   ErrNonFatalDisplayIf(StrLen(s->timeZone.name) > apptMaxTimeZoneNameLen - 1,
      "Time zone name too long");

   DmWrite(d, offset, s->timeZone.name, StrLen(s->timeZone.name) + 1);
   offset += StrLen(s->timeZone.name) + 1;
```

```
      // Now go back and fill in the blob size.
      blobSize = offset - offsetForSize - sizeof(blobSize);
      DmWrite(d, offsetForSize, &blobSize, sizeof(blobSize));
      blobCount++;
   }


   // Include a meeting blob if needed, have any attendees or set the appt status to
   // something other than default
   if (s->meetingInfo.numAttendees != 0 || s->meetingInfo.apptStatus)
   {
      blobId = dateMeetingBlobId;

      // Write the 4 byte blob ID.
      len = sizeof(blobId);
      DmWrite(d, offset, &blobId, len);
      offset += len;

      // Don't write the size yet, but remember where it goes.
      offsetForSize = offset;
      offset += sizeof(blobSize);

      // Write the blob content.
      DmWrite(d, offset, &s->meetingInfo.meetingStatus,
         sizeof(s->meetingInfo.meetingStatus));
      offset += sizeof(s->meetingInfo.meetingStatus);

      DmWrite(d, offset, &s->meetingInfo.apptStatus, sizeof(s->meetingInfo.apptStatus));
      offset += sizeof(s->meetingInfo.apptStatus);

      DmWrite(d, offset, &s->meetingInfo.numAttendees,
         sizeof(s->meetingInfo.numAttendees));
      offset += sizeof(s->meetingInfo.numAttendees);

      for (index = 0; index < s->meetingInfo.numAttendees; index++)
      {
         DmWrite(d, offset, &s->meetingInfo.attendees[index].role,
            sizeof(s->meetingInfo.attendees[index].role));
         offset += sizeof(s->meetingInfo.attendees[index].role);

         DmWrite(d, offset, s->meetingInfo.attendees[index].name,
            StrLen(s->meetingInfo.attendees[index].name) + 1);
         offset += StrLen(s->meetingInfo.attendees[index].name) + 1;

         DmWrite(d, offset, s->meetingInfo.attendees[index].email,
            StrLen(s->meetingInfo.attendees[index].email) + 1);
         offset += StrLen(s->meetingInfo.attendees[index].email) + 1;
      }

      // Now go back and fill in the blob size.
      blobSize = offset - offsetForSize - sizeof(blobSize);
      DmWrite(d, offsetForSize, &blobSize, sizeof(blobSize));
      blobCount++;
   }

   // Include any other blobs we don't understand.
   ErrNonFatalDisplayIf(blobCount + s->numBlobs > apptMaxBlobs, "Too many blobs");
```

```
    for (index = 0; index < s->numBlobs; index++)
    {
        size = sizeof(s->blobs[index].creatorID);
        DmWrite(d, offset, &(s->blobs[index].creatorID), size);
        offset += size;
        size = sizeof(s->blobs[index].size);
        DmWrite(d, offset, &(s->blobs[index].size), size);
        offset += size;
        DmWrite(d, offset, s->blobs[index].content, s->blobs[index].size);
        offset += s->blobs[index].size;
    }

    ErrNonFatalDisplayIf(offset > MemHandleSize(MemPtrRecoverHandle(d)),
        "Not enough room for packed record");

    ErrNonFatalDisplayIf(offset < MemHandleSize(MemPtrRecoverHandle(d)),
        "Too much room for packed record");
}
```

3.3.2.2 Calendar - Unpacking Record code sample

```
static void ApptUnpack(ApptPackedDBRecordPtr src, ApptDBRecordPtr dest)
{
    ApptDBRecordFlags flags;
    Char *p;
    Char *blobStart;
    Char *blobEnd;
    UInt16 recordSize;
    UInt32 blobId;
    UInt16 blobSize;
    UInt16 index;
    flags = src->flags;
    p = &src->firstField;

    recordSize = MemPtrSize(src);
    dest->when = (ApptDateTimeType *) src;

    ErrNonFatalDisplayIf(dest->when->endTime.hours == hoursPerDay,
        "Hours = 24 found in database");

    if (flags.alarm)
    {
        dest->alarm = (AlarmInfoType *) p;
        p += sizeof (AlarmInfoType);
    }
    else
        dest->alarm = NULL;


    if (flags.repeat)
    {
        dest->repeat = (RepeatInfoType *) p;
        p += sizeof (RepeatInfoType);
    }
    else
        dest->repeat = NULL;
```

```
if (flags.exceptions)
{
   dest->exceptions = (ExceptionsListType *) p;
   p += sizeof (UInt16) +
       (((ExceptionsListType *) p)->numExceptions * sizeof (DateType));
}
else
   dest->exceptions = NULL;

if (flags.description)
{
   dest->description = p;
   p += StrLen(p) + 1;
}
else
   dest->description = NULL;


if (flags.note)
{
   dest->note = p;
   p += StrLen(p) + 1;
}
else
   dest->note = NULL;

if (flags.location)
{
   dest->location = p;
   p += StrLen(p) + 1;
}
else
   dest->location = NULL;

// There may also be blob data on the end of the record.
// First set everything as if there were no blobs.

// This indicates that there is no time zone info for this meeting.
dest->timeZone.name[0] = chrNull;

dest->meetingInfo.meetingStatus = unansweredMeeting;
dest->meetingInfo.apptStatus = showAsBusy;

// This indicates that it is not a meeting.
dest->meetingInfo.numAttendees = 0;

dest->numBlobs = 0; // Start by assuming no blobs we don't understand.


// Then iterate through the blobs, ignoring any we don't understand.
blobStart = p;// First blob starts where last non-blob data ends.
while (blobStart < (Char *)src + recordSize)
{
   p = blobStart;
```

```
// If a field is using edit in place to directly edit a database record at
// the time this routine is called, or if the device was reset while an
// edit in place was in progress, the record can be left with junk data on
// the end. FldCompactText would clean up this junk, but it either wasn't
// called or simply hasn't yet been called. We will attempt to parse this
// junk data as blobs, but more than likely these blobs will appear to be
// invalid. On release builds we want to recover gracefully from this
// situation by ignoring the junk data.

if ((Char *)src + recordSize - blobStart <= sizeof (blobId) + sizeof (blobSize))
{
   ErrNonFatalDisplay("Blob goes beyond end of record - don't let fields edit
   records directly!");
   return;
}

MemMove(&blobId, p, sizeof (blobId));
p += sizeof (blobId);
MemMove(&blobSize, p, sizeof (blobSize));
p += sizeof (blobSize);

// Blob size excludes space to store ID and size of blob.
blobEnd = p + blobSize;

if (blobEnd > (Char *)src + recordSize)
{
ErrNonFatalDisplay("Blob goes beyond end of record - don't let fields
edit records directly!");
   return;
}

switch (blobId)
{
   case dateTimeZoneBlobId:

      ErrNonFatalDisplayIf(dest->timeZone.name[0] != chrNull,
         "Duplicate time zone blob");

      MemMove(&dest->timeZone.uTC, p, sizeof (dest->timeZone.uTC));
      p += sizeof (dest->timeZone.uTC);

      MemMove(&dest->timeZone.dSTStart, p, sizeof (dest->timeZone.dSTStart));
      p += sizeof (dest->timeZone.dSTStart);

      MemMove(&dest->timeZone.dSTEnd, p, sizeof (dest->timeZone.dSTEnd));
      p += sizeof (dest->timeZone.dSTEnd);

      MemMove(&dest->timeZone.dSTAdjustmentInMinutes, p,
         sizeof (dest->timeZone.dSTAdjustmentInMinutes));
      p += sizeof (dest->timeZone.dSTAdjustmentInMinutes);

      MemMove(&dest->timeZone.country, p, sizeof (dest->timeZone.country));
      p += sizeof (dest->timeZone.country);

      MemMove((Char *)&dest->timeZone.name - 1 /*custom flag*/, p,
         sizeof (UInt8));
      p += sizeof (UInt8);
```

```
            ErrNonFatalDisplayIf(StrLen(p) > apptMaxTimeZoneNameLen - 1,
               "Time zone name too long");
            StrCopy(dest->timeZone.name, p);
            p += StrLen(dest->timeZone.name) + 1;

            break;

         case dateMeetingBlobId:
            ErrNonFatalDisplayIf(dest->meetingInfo.numAttendees != 0,
               "Duplicate meeting blob");

            MemMove(&dest->meetingInfo.meetingStatus, p,
               sizeof (dest->meetingInfo.meetingStatus));
            p += sizeof (dest->meetingInfo.meetingStatus);

            MemMove(&dest->meetingInfo.apptStatus, p,
               sizeof (dest->meetingInfo.apptStatus));
            p += sizeof (dest->meetingInfo.apptStatus);

            MemMove(&dest->meetingInfo.numAttendees, p,
               sizeof (dest->meetingInfo.numAttendees));
            p += sizeof (dest->meetingInfo.numAttendees);

            for (index = 0; index < dest->meetingInfo.numAttendees; index++)
            {
               MemMove(&dest->meetingInfo.attendees[index].role, p,
                  sizeof(dest->meetingInfo.attendees[index].role));
               p += sizeof(dest->meetingInfo.attendees[index].role);

               dest->meetingInfo.attendees[index].name = p;
               p += StrLen(dest->meetingInfo.attendees[index].name) + 1;

               dest->meetingInfo.attendees[index].email = p;
               p += StrLen(dest->meetingInfo.attendees[index].email) + 1;

               dest->meetingInfo.attendees[index].AttendeePos = index;
            }
            break;

         default:
         {
            ErrNonFatalDisplayIf (dest->numBlobs >= apptMaxBlobs,"Too many blobs");

            dest->blobs[dest->numBlobs].creatorID = blobId;
            dest->blobs[dest->numBlobs].size = blobSize;
            dest->blobs[dest->numBlobs].content = p;
            dest->numBlobs++;
            p = blobEnd;
            break;
         }
      }

      ErrNonFatalDisplayIf(p != blobEnd, "Blob size does not agree with contents");
      blobStart = blobEnd;// Next blob starts where last blob ends.
   }

   ErrNonFatalDisplayIf(blobStart != (Char *)src + recordSize, "Last blob not aligned with
   end of record - don't let fields edit records directly!");

   ErrNonFatalDisplayIf(ApptPackedSize(dest) != recordSize, "Blob size mismatch");
}
```

3.3.2.3 Calendar - Sorting Records code sample

With the changes to the PIM application database structures, the Calendar application has implemented a stricter sort order, which improves efficiency. The new sort function works in the following way:

- Repeating items are sorted before non-repeating items in the database.
- Repeating items are sorted by their end date (oldest to newest).
- In the case where two items have the same repeat end date, the application compares start times.

```
static Int16 ApptComparePackedRecords (ApptPackedDBRecordPtr r1, ApptPackedDBRecordPtr
r2,
   Int16 extra, SortRecordInfoPtr info1, SortRecordInfoPtr info2, MemHandle appInfoH)
{
#pragma unused (extra, info1, info2, appInfoH)

   Int16 result;

   if ((r1->flags.repeat) || (r2->flags.repeat))
   {
      if ((r1->flags.repeat) && (r2->flags.repeat))
      {
         // In the past, two repeating events were considered equal. Now we
         // sort them by their end date in order to more efficiently iterate
         // over the repeating events on a given date or date range. First
         // step is to find the repeat info in each of the records so we can
         // compare their end dates. No end date is represented as -1, which
         // will sort last, as desired.

         result = DateCompare (ApptGetRepeatInfo(r1)->repeatEndDate,
            ApptGetRepeatInfo(r2)->repeatEndDate);

         if (result == 0)

         // Two events than end on the same date are sorted by their
         // start time. We don't in fact rely on this, but might in
         // the future.
         result = TimeCompare (r1->when.startTime, r2->when.startTime);
      }

      else if (r1->flags.repeat)
         result = -1;
      else
         result = 1;
   }
   else
   {
      result = DateCompare (r1->when.date, r2->when.date);
      if (result == 0)
         result = TimeCompare (r1->when.startTime, r2->when.startTime);
   }
   return result;
}
```

3.3.3 Tasks

This section describes changes in the database structures for the Tasks application since Palm OS version 5.4 R3. It also illustrates the changes that must be made to use the code samples for updating records.

The enhanced database structures for the Tasks application are shown here:

```
typedef struct {
   ToDoDBDataFlags     dataFlags;       // NEW
   UInt16              recordFlags;     // NEW
   UInt16              priority;        // NEW
   char                optionalData[];  // NEW
} ToDoDBRecord;
```

In the enhanced ToDo (Tasks) application, in addition to due date, priority and description, each task is given its own completion date, alarm time, note, and recurrence information. These fields are stored in the variable length container that is pointed by `optionalData` in the structure. You may retrieve the fields based on the flag and by adjusting the offset.

As new data is added or deleted, the order of data or the offsets must be adjusted to reflect the changes. For example, if the task previously had a due date, `optionalData + 0(zero)` pointed to the due date and `optionalData + sizeof(DateType)` pointed to the completion date (if applicable). When the due date is removed, the data for completion date is moved forward and `optionalData + 0(zero)` will now point to it.

3.3.3.1 Tasks - Updating Record code sample

```
Err ToDoChangeRecord(DmOpenRef dbP, UInt16 *index, UInt16 filter, UInt16 subFilter,
   ToDoRecordFieldType changedField, const void * data)
{
   Char *              c;
   MemHandle           recordH = 0;
   ToDoDBRecordPtr     src;
   UInt32              offset;
   ToDoDBDataFlags     newFlags;
   Err                 err;
   Int16               cLen;
   UInt16              attr;
   UInt16              curSize;
   UInt16              newSize;
   UInt16              descriptionOffset;
   UInt16              newIndex;
   UInt16              priority;
   UInt16              recordFlags;

   // Get the record which we are going to change
   recordH = DmQueryRecord(dbP, *index);
   src = MemHandleLock (recordH);

   newFlags = src->dataFlags;



   // If the record is being changed such that its sort position will
   // change, move the record to its new sort position.
   if ((changedField == toDoRecordFieldCategory) ||
      (changedField == toDoRecordFieldPriority) ||
      (changedField == toDoRecordFieldDueDate)  ||
      (changedField == toDoRecordFieldCompletionDate) )
   {
      SortRecordInfoTypesortInfo;
      MemHandle tempRecH = 0;
      ToDoDBRecordPtrtempRecP;
      UInt32    tempRecSize;
      DateType  srcDueDate, srcCompletionDate;
      Boolean   newHasDueDate, newHasCompletionDate;

      MemSet( &sortInfo, sizeof( sortInfo ), 0 );
      DmRecordInfo( dbP, *index, &attr, NULL, NULL );
      sortInfo.attributes = attr;

      // we don't bother adding alarm info to the temporary new record,
      // since it doesn't matter to sorting.
      if ( toDoRecordFieldDueDate == changedField )
      {
         newHasDueDate = (toDoNoDueDate != *( UInt16 * ) data);
      }
      else
      {
         newHasDueDate = src->dataFlags.dueDate;
      }
```

```
if ( toDoRecordFieldCompletionDate == changedField )
{
   newHasCompletionDate = (toDoNoCompletionDate != *( UInt16 * ) data);
}
else
{
   newHasCompletionDate = src->dataFlags.completionDate;
}

tempRecSize = sizeDBRecord;
if ( newHasDueDate )
{
   tempRecSize += sizeof( DateType );
}
if ( newHasCompletionDate )
{
   tempRecSize += sizeof( DateType );
}
if ( src->dataFlags.repeat )
{
   tempRecSize += sizeof( ToDoRepeatInfoType );
}

tempRecH = MemHandleNew( tempRecSize );
if ( !tempRecH )
{
   goto exit;
}

tempRecP = ( ToDoDBRecordPtr ) MemHandleLock( tempRecH );
MemSet( tempRecP, tempRecSize, 0 );

// set data flags before the direct data manipulation below
tempRecP->dataFlags.dueDate= newHasDueDate;
tempRecP->dataFlags.completionDate= newHasCompletionDate;
tempRecP->dataFlags.repeat= src->dataFlags.repeat;

if ( tempRecP->dataFlags.repeat && src->dataFlags.repeat )
{
   MemMove(ToDoDBRecordGetFieldPointer(tempRecP, toDoRecordFieldRepeat ),
      ToDoDBRecordGetFieldPointer(src, toDoRecordFieldRepeat ),
      sizeof( ToDoRepeatInfoType ) );
}

if ( src->dataFlags.dueDate )
{
   srcDueDate = *(DateType *)ToDoDBRecordGetFieldPointer(src,
      toDoRecordFieldDueDate );
}
else
{
   DateToInt( srcDueDate ) = toDoNoDueDate;
}

if ( src->dataFlags.completionDate )
{
   srcCompletionDate = *( DateType * ) ToDoDBRecordGetFieldPointer( src,
        toDoRecordFieldCompletionDate );
}
else
{
    DateToInt( srcCompletionDate ) = toDoNoCompletionDate;
}

if ( changedField == toDoRecordFieldCategory )
{
    tempRecP->priority= src->priority;
    if ( newHasDueDate )
    {
        *( DateType * ) ToDoDBRecordGetFieldPointer( tempRecP,
            toDoRecordFieldDueDate ) = srcDueDate;
    }
    if ( newHasCompletionDate )
    {
        *( DateType * ) ToDoDBRecordGetFieldPointer( tempRecP,
            toDoRecordFieldCompletionDate ) = srcCompletionDate;
    }
    sortInfo.attributes = *( UInt16 * ) data;
}
else if ( changedField == toDoRecordFieldPriority )
{
    tempRecP->priority= *( UInt16 * ) data;
    if ( newHasDueDate )
    {
        *( DateType * ) ToDoDBRecordGetFieldPointer( tempRecP,
            toDoRecordFieldDueDate ) = srcDueDate;
    }
    if ( newHasCompletionDate )
    {
        *( DateType * ) ToDoDBRecordGetFieldPointer( tempRecP,
            toDoRecordFieldCompletionDate ) = srcCompletionDate;
    }
    sortInfo.attributes = attr;
}
else if ( changedField == toDoRecordFieldDueDate )
{
    tempRecP->priority= src->priority;
    if ( newHasDueDate )
    {
        *( DateType * ) ToDoDBRecordGetFieldPointer( tempRecP,
            toDoRecordFieldDueDate ) = *(( DatePtr ) data);
    }
    if ( newHasCompletionDate )
    {
        *( DateType * ) ToDoDBRecordGetFieldPointer( tempRecP,
            toDoRecordFieldCompletionDate ) = srcCompletionDate;
    }
    sortInfo.attributes = attr;
}
else if ( changedField == toDoRecordFieldCompletionDate )
{
    tempRecP->priority= src->priority;
    if ( newHasDueDate )
    {
         *( DateType * ) ToDoDBRecordGetFieldPointer( tempRecP,
            toDoRecordFieldDueDate ) = srcDueDate;
      }
      if ( newHasCompletionDate )
      {
         *( DateType * ) ToDoDBRecordGetFieldPointer( tempRecP,
            toDoRecordFieldCompletionDate ) = *(( DatePtr )
                                                                        data);
      }
      sortInfo.attributes = attr;
   }

   newIndex = ToDoFindSortPosition( dbP, tempRecP, &sortInfo, filter, subFilter );
   DmMoveRecord( dbP, *index, newIndex );

   if ( newIndex > *index )
   {
      newIndex--;
   }

   *index = newIndex;

   MemHandleUnlock( tempRecH );
   MemHandleFree( tempRecH );
}

if ( changedField == toDoRecordFieldCategory )
{
   attr = (attr & ~dmRecAttrCategoryMask) | *( UInt16 * ) data;

   DmSetRecordInfo( dbP, newIndex, &attr, NULL );

   goto exit;
}

if ( changedField == toDoRecordFieldPriority )
{
   priority = *( UInt16 * ) data;

   DmWrite( src, OffsetOf( ToDoDBRecord, priority ), &priority, sizeof( UInt16 ) );

   goto exit;
}


if ( changedField == toDoRecordFieldComplete )
{
   recordFlags = src->recordFlags;

   if ( *( UInt16 * ) data )
   {
      recordFlags |= TODO_RECORD_FLAG_COMPLETE;
   }
   else
   {
      recordFlags &= ~TODO_RECORD_FLAG_COMPLETE;
   }
```

```
    DmWrite(src, OffsetOf( ToDoDBRecord, recordFlags), &recordFlags, sizeof(UInt16));

    goto exit;
}

if ( toDoRecordFieldDueDate == changedField )
{
    MemPtrUnlock( src );

    if ( toDoNoDueDate == *( UInt16 * ) data )
    {
        ToDoDBRecordClearDueDate( dbP, *index );
    }
    else
    {
        ToDoDBRecordSetDueDate( dbP, *index, ( DateType * ) data );
    }

    goto exitNoUnlock;
}

if ( toDoRecordFieldCompletionDate == changedField )
{
    MemPtrUnlock( src );

    if ( toDoNoCompletionDate == *( UInt16 * ) data )
    {
        ToDoDBRecordClearCompletionDate( dbP, *index );
    }
    else
    {
        ToDoDBRecordSetCompletionDate( dbP, *index, ( DateType * ) data );
    }

    goto exitNoUnlock;
}

if ( toDoRecordFieldAlarm == changedField )
{
    MemPtrUnlock( src );

    ToDoDBRecordSetAlarmInfo( dbP, *index, ( ToDoAlarmInfoType * ) data );

    goto exitNoUnlock;
}

if ( toDoRecordFieldRepeat == changedField )
{
    goto exit;
}
```

```
// Calculate the size of the changed record. First,
// find the size of the data used from the old record.
newSize =sizeof( ToDoDBDataFlags ) + // dataFlags
       sizeof( UInt16 ) +            // recordFlags
       sizeof( UInt16 );             // priority

offset = OffsetOf( ToDoDBRecord, optionalData );
c = ( char * ) &src->optionalData;

if ( src->dataFlags.dueDate )
{
   newSize += sizeof( DateType );
}

if ( src->dataFlags.completionDate )
{
   newSize += sizeof( DateType );
}

if ( src->dataFlags.alarm )
{
   newSize += sizeof( ToDoAlarmInfoType );
}

if ( src->dataFlags.repeat )
{
   newSize += sizeof( ToDoRepeatInfoType );
}

descriptionOffset = newSize;

// Now, add in the size of the new data
newSize += StrLen( ( Char * ) data ) + 1;

// Now, add in the size of whichever of the description and note will
// remain unchanged.
c = ( Char * ) src + descriptionOffset;
cLen = StrLen( c ) + 1;

if ( changedField != toDoRecordFieldDescription )
{
   newSize += cLen;
}

if ( changedField != toDoRecordFieldNote )
{
   c += cLen;
   newSize += StrLen( c ) + 1;
}

// Change the description field.
if ( changedField == toDoRecordFieldDescription )
{
   newFlags.description = (0 != StrLen( ( Char * ) data ));

   if ( newFlags.description != src->dataFlags.description )
   {
         DmWrite( src, OffsetOf( ToDoDBRecord, dataFlags ), &newFlags,
            sizeof( ToDoDBDataFlags ) );
      }

      // If the new description is longer, expand the record.
      curSize = MemPtrSize( src );
      if ( newSize > curSize )
      {
         MemPtrUnlock( src );
         err = MemHandleResize( recordH, newSize );
         if ( err )
         {
            return err;
         }

         src = MemHandleLock( recordH );
      }

      // Move the note field.

      // Calculate new offset of note field
      offset = descriptionOffset + StrLen( ( Char * ) data ) + 1;

      // Point c at current note field
      c = ( Char * ) src + descriptionOffset;
      c += StrLen( c ) + 1;

      DmWrite( src, offset, c, StrLen( c ) + 1 );

      // Write the new description field.
      offset = descriptionOffset;
      DmStrCopy( src, offset, ( Char * ) data );

      // If the new description is shorter, shrink the record.
      if ( newSize < curSize )
      {
         MemHandleResize( recordH, newSize );
      }

      goto exit;
   }

   // Change the note field
   if ( changedField == toDoRecordFieldNote )
   {
      newFlags.note = (0 != StrLen( ( Char * ) data ));

      if ( newFlags.note != src->dataFlags.note )
      {
         DmWrite( src, OffsetOf( ToDoDBRecord, dataFlags ), &newFlags,
            sizeof( ToDoDBDataFlags ) );
      }

      c = ( Char * ) src + descriptionOffset;
      offset = descriptionOffset + StrLen( c ) + 1;

      MemPtrUnlock( src );
      err = MemHandleResize( recordH, newSize );
      if ( err )
      {
         return err;
      }

      src = MemHandleLock( recordH );

      DmStrCopy( src, offset, data );

      goto exit;
   }

exit:
   MemPtrUnlock( src );

exitNoUnlock:

#if ERROR_CHECK_LEVEL == ERROR_CHECK_FULL
   ECToDoDBValidate( dbP );
#endif

   return 0;
}
```

3.3.4 Memos

There are no changes to the structure of the database for the Memo application, except for the name and creator ID, as described in **Section 3.3 on page 36**.

3.3.5 Known issues

3.3.5.1 Record remainders

When an application opens a legacy PIM database, it is filled with records that are copied from the new databases. Then, when the legacy database is closed, data is removed, but 1-byte records are left behind.

3.3.5.2 DmDeleteRecord causes devices to crash

An NVFS bug exists where when `DmDeleteRecord` is called after `DmAttachRecord`, a device will crash. This will cause a problem if an application is currently modifying the old PIM databases and relies on the compatibility layer to remove that record from the new databases.

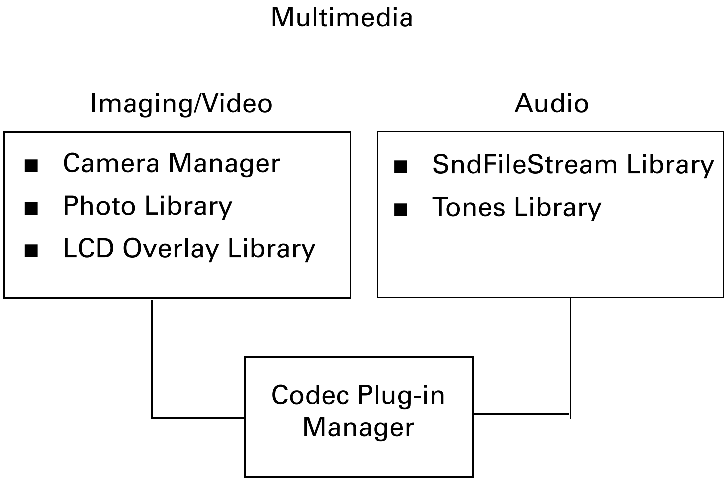
To work around this issue, make sure your application looks for the unique ID of the record and deletes the record from the new database directly. The unique ID of the record in both old and new databases should be the same.

CHAPTER 4

4. Multimedia

This chapter details the multimedia features and libraries available in the Palm OS® SDK. Palm OS devices feature imaging, video, and audio multimedia capabilities.

This chapter begins with a detailed description of the Codec Plug-in Manager, which is used to register and provide codecs for multimedia features where necessary. Other components used to provide each feature are illustrated in the diagram below.



4.1 Codec Plug-in Manager

Available on:

- LifeDrive™ mobile manager
- Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5, Tungsten™ E2, and Palm® T|X handhelds
- Zire™ 72 handhelds

The Codec Plug-in Manager unifies codecs available for Palm devices and provides a standardized way to access and load codecs.

The Codec Plug-in Manager is declared in the header file `palmOnePalmCodecPluginMgr.h`, while the method that codecs use to handle individual formats is declared in the header file `palmOneCodecFormat.h`. Each media format is denoted by a four-byte string (for example, `JPEG`).

Because there are many separate formats handled by the Codec Plug-in Manager, and new formats may be added later as new codecs are written or released, the particulars of handling specific formats are beyond the scope of this chapter. A complete list of the codec media formats currently available exists in the `palmOneCodecFormat.h` section of the *Palm OS Platform API Guide*.

For examples of how to handle specific formats, refer to the Sample Code section of the Palm OS SDK.

4.1.1 Codec Plug-in Manager Overview

At each bootup, the Codec Plug-in Manager searches for codec plug-ins first in RAM, then in the system image. It recognizes codecs by the PRC type `'CdPl'` and loads all codecs into memory, regardless of whether they will be used or not.

Each PRC of type `'CdPl'` is then queried for the format pair it supports. A format pair consists of two parts:

1. The input format
2. The output format that will come out of the codec

For example, an MPEG4 codec (decoder) supports MPEG4 ->YUV, so its format pair is [MPEG4, YUV]. The expected input is MPEG4, and the output format is YUV.

A single PRC can contain multiple codecs and support multiple format pairs.

IMPORTANT: Major codecs such as **JPEG**, **GIF**, or **MP3** should each be implemented as single PRCs.

For each codec plug-in, there can be more than one codec. These codecs may also have the exact same input and output formats. For this reason, every format pair has an additional parameter associated with it, called a Codec ID. This codec ID parameter is used to differentiate between the different codecs in a codec plug-in. In most cases, one codec plug-in only contains one codec, so you can set the Codec ID parameter to 0 `(palmNULLCodecID)`.

For more information on Codec IDs, see **Section 4.1.3 on page 66**.

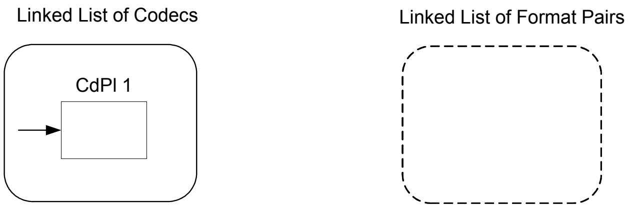
The Codec Plug-in Manager creates and manages two linked lists:

1. **A linked list of codecs -** Includes codec plug-ins, or `'CdPl'`s, where each codec is added to the front of this list upon discovery.
2. **A linked list of format pairs -** Includes format pairs, where each pair is added to the beginning of this list upon discovery, and each format pair has a reference to a codec plug-in in the linked list of codecs

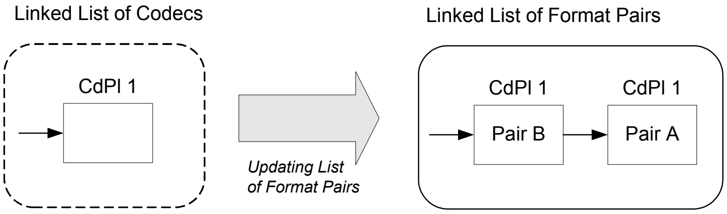
The following diagram is an example of the process.

NOTE: In this diagram, items with solid lines indicate which of the two linked lists is being acted upon at the time of the change. Items with dashed lines indicate that this list is *not* being acted upon.

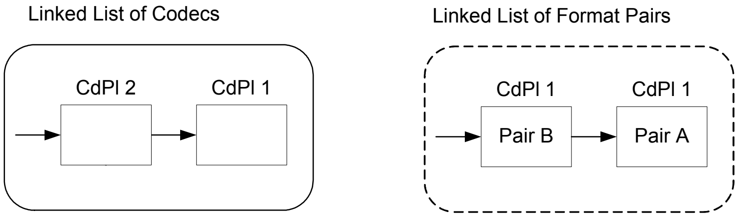
1. At bootup, the Codec Plug-in Manager looks for codecs, and finds first codec plug-in, `'CdPl' 1`:



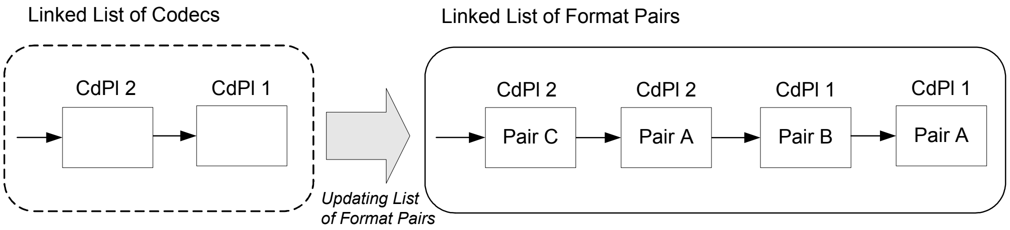
2. The Codec Plug-in Manager then queries `'CdPl' 1` for the format pairs it supports. In this example, `'CdPl' 1` supports two pairs, “Pair A” and “Pair B”:



3. Next, the Codec Plug-in Manager finds another codec plug-in, `'CdPl' 2`. (Notice that `'CdPl' 2` is placed in front of `'CdPl' 1` in the linked list.)



4. The Codec Plug-in Manager then queries `'CdPl' 2` for the format pairs that it supports. `'CdPl' 2` supports two pairs, “Pair A” and “Pair C”.



When the Codec Plug-in Manager receives a request for a codec plug-in that supports a particular format pair, the Codec Plug-in Manager will traverse the linked list of format pairs to see if the requested format pair is supported. The Codec Plug-in Manager will then return the codec that corresponds to the *first* format pair that matches what it’s looking for. This means that a codec loaded later *always* has a higher priority than a codec loaded earlier.

As shown in the previous diagram example, when an application asks the Codec Plug-in Manager for a codec that supports the format pair “Pair A”, the Codec Plug-in Manager will traverse the linked list of format pairs and find format pair “Pair A” as the second element, and return `'CdPl' 2`. It is important to note in this example that Codec Plug-in Manager will always return `'CdPl' 2`, because it was loaded last and is therefore the first one in the format pairs linked list, even though there is another codec that supports the format pair “Pair A” in the same list.

To override this codec priority, use a codec’s Creator and Codec ID to create a codec session with a specific codec by calling `CodecMgrCreateSessionByID ()`.

4.1.2 Codec Wrapping

For the Codec Plug-in Manager to recognize a codec, the codec must be “wrapped”. This means that each codec must be type `'CdPl'`, and must have the correct structure for the format pairs it supports. A codec that is wrapped will be registered with as a codec that can be used by applications when calling the Codec Plug-in Manager.

If you are developing a codec plug-in for the Codec Plug-in Manager, you must follow the function numbers in the order specifically illustrated in the following table. Currently, only 12 functions are supported (0-11, as shown in the following table).

To use the function name, call it the same way you would call a function that is in a 68K shared library.

Function Number	Function
0	CodecOpen
1	CodecClose
2	CodecSleep
3	CodecWake
4	CodecLibAPIVersion
5	CodecEnumerateSupportedFormats
6	CodecCreateSession
7	CodecResetSession
8	CodecExitSession
9	CodecGetMaxDestBufferSize
10	CodecEncodeDecode
11	CodecCustomControl

4.1.3 Codec Plug-in Manager process

To use the Codec Plug-in Manager, an application must determine if the input/output format of the codec is supported. Optionally, it can also specify which particular codec to use.

The Codec Plug-in Manager selects a particular codec based on four criteria:

1. **Input format -** The format of the data input to the codec.
2. **Output format -** The format of the data output from the codec.
3. **PRC Creator ID -** The creator ID of the PRC containing the desired codec on the device. This is optional; you can have the Codec Plug-in Manager select an appropriate codec based on the input and output formats.

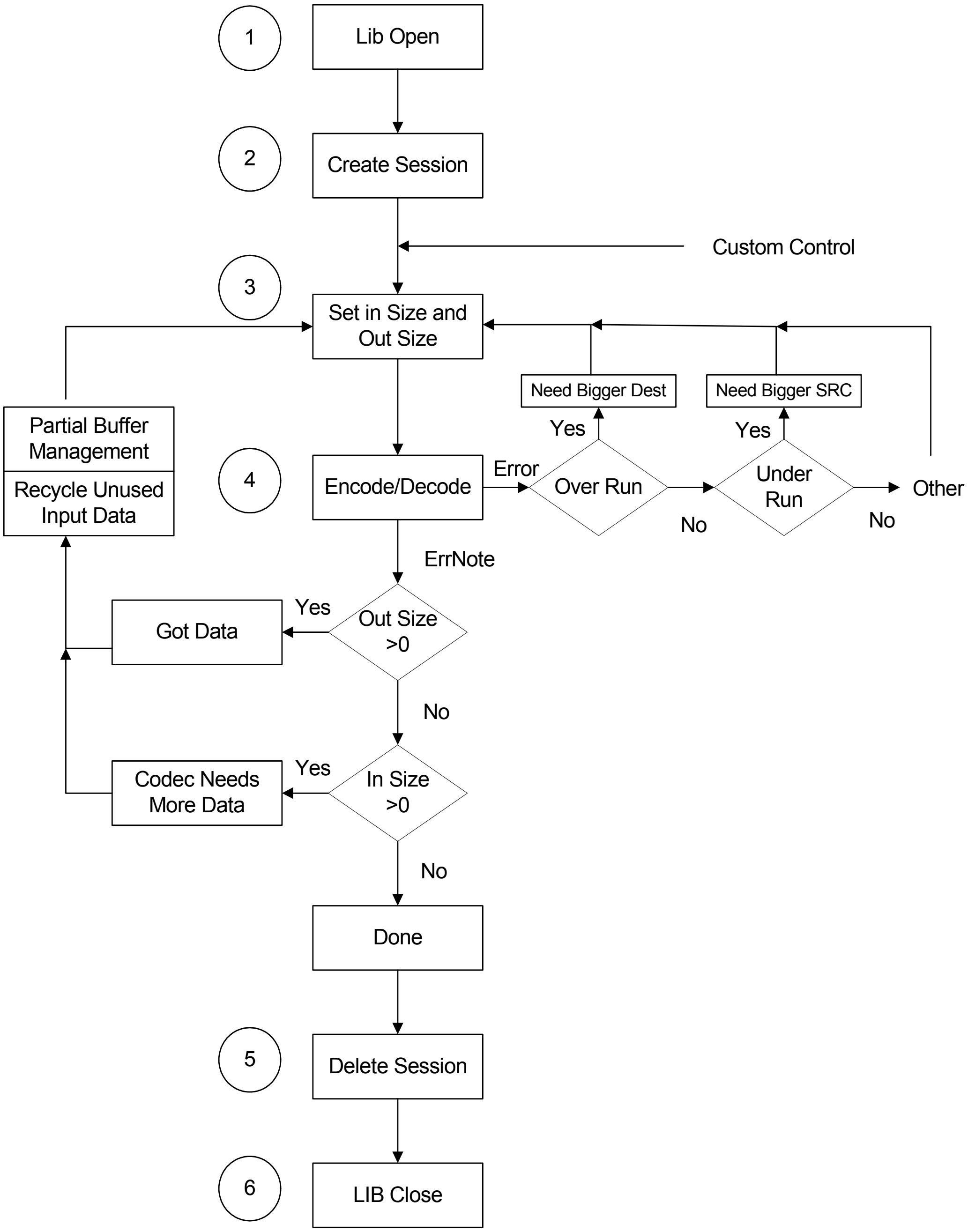
IMPORTANT: PRC Creator IDs are unique and must be registered with PalmSource.

4. **Codec ID -** The unique ID of the codec. This is provided because a PRC file can contain multiple codecs that have the same input and output formats. Again, this is optional; you can have the Codec Plug-in Manager select an appropriate codec based on the input and output formats.

Once an application has selected a codec, it must go through the following steps, which are illustrated in the diagram on the next page:

1. Open the library.
2. Create a session with the Codec Plug-in Manager.
3. Specify the input and output formats and, optionally, which particular codecs to use.
4. Start decoding or encoding.
5. Delete the session once the decoding or encoding is complete.
6. Close the library.

The following diagram shows the process flow of a typical Codec Plug-in Manager session.



4.1.4 Media codec formats supported by device

The following table details the codecs that are supported for imaging, video, and audio features on Palm OS devices.

Feature	Technology				Product									
	Codec	Description	Encoder	Decoder	Zire		Tungsten				Treo			
					22	72	T5	E2	T|X	LifeDrive	6XX CDMA	6XX GSM	680 GSM	700p
Imaging	BMP	Windows bitmap	-	●	-	●	●	●	●	●	●	●	●	●
	GIF	Graphics interchange format	-	●	-	●	●	●	●	●	●	●	●	●
	JPEG	standard image compression algorithm	●	●	-	●	●	●	●	●	●	●	●	●
	TIFF	Still image bitmaps stored in tagged fields	-	●	-	●	●	●	●	●	●	●	●	●
Video	H263	Provisional ITU-T standard	●	●	-	●	●	●	●	●	●	●	●	●
	MJPEG	JPEG encoding for moving images	-	●	-	●	●	●	●	●	●	●	●	●
	MPEG4	Extension of MPEG1 and MPEG2 compression	-	●	-	●	●	●	●	●	●	●	●	●
			●		-	●	-	-	-	●	●	-	-	●
Audio	ADPCM	ADPCM decoder	-	●	-	●	●	●	●	●	●	●	●	●
	AMR	AMR-NB	●	●	-	-	-	-	-	-	-	●	●	●
		3GPP AMR/AMR2/GSM AMR	●	-	-	-	-	-	-	-	-	●	●	●
	MP3	Audio Level 3 (MP3)	-	●	-	●	●	●	●	●	●	●	●	●
	QCELP	QCELP 13K encoder library following the standard TIA/EIA IS733	●	●	-	-	-	-	-	-	●		●	●

4.1.5 For more information

The Codec Plug-in Manager header files include:

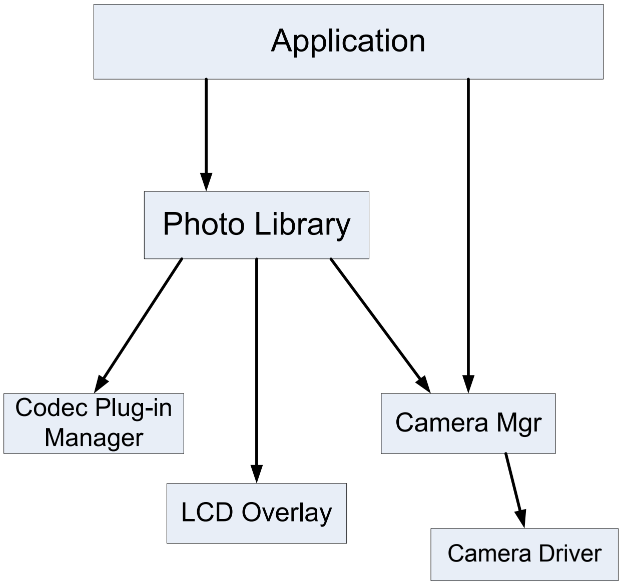
- `palmOneCodecPluginMgr.h`
- `palmOneCodecPluginMgrCommon.h`
- `palmOneCodecFormat.h`

For more detailed information on the Codec Plug-in Manager, refer to the *Palm OS Platform API Guide* at the Palm Developer website.

Also, refer to the Sample Code section of the Palm OS SDK for coding examples.

4.2 Imaging

On Palm Treo™ smartphones and handhelds that include cameras, an application must work with several software components to provide imaging functionality, including the Photo Library, Camera Manager, Codec Plug-in Manager, LCD Overlay, and Camera Drivers, as shown in the following diagram.



4.2.1 Photo Library

Available on:

- LifeDrive™ mobile manager
- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5, Tungsten™ E, Tungsten™ E2, and Palm® T|X handhelds
- Zire™ 31 and Zire™ 32 handhelds
- Palm® Z22 organizer

The Photo Library includes two basic categories of functionality:

1. Capturing images and video with a camera attached to device
2. Storing images and video
3. Manipulating images

The Photo Library uses the LCD Overlay to preview what the camera is scanning. The Photo Library itself provides the camera user interface, but uses the Camera Manager to capture photos. For more information, see **Section 4.2.2 on page 71**.

When storing and manipulating images, the Photo Library provides the ability to select images, open, close and save images, get image information, scale, crop and rotate images, and delete images.

There are three versions of the Photo Library: version 1, version 2, and version 3. In general, structures, function names, and things that ends in “V2” are available only in version 2 and above. Items that ends in “V3” are available only in version 3. Exceptions are noted where appropriate.

Use `PalmPhotoLibGetVersion()` to check the version of the library that exists on the device.

The Photo Library is declared in the header file `palmOnePhoto.h`.

4.2.1.1 Coding Examples

The following code is an example of how to use the Photo Library to capture images:

```
MemSet(&cParam, sizeof(PalmPhotoCaptureParamV2), 0);

//saving to memory (versus SD card, for example)
cParam.fileLocation.fileLocationType = palmPhotoMemoryLocation;

cParam.fileLocation.file.MemoryFile.bufferSize = 0;
cParam.fileLocation.file.MemoryFile.bufferP = NULL;
cParam.imageInfo.width = width;
cParam.imageInfo.height = height;
cParam.imageInfo.bitsPerPixel = 16;

//specifying RGB565 file format (versus JPEG, for example)
cParam.imageInfo.fileFormat = palmPhotoRGB565FileFormat;

//capturing picture
imageH = PalmPhotoCaptureImageV2(photoLibRefNum, &cParam );
```

The following code is an example of how to use the Photo Library to select images:

```
SelectionParam.albumID = PALM_PHOTO_ALBUM_ALL;
SelectionParam.offset = 0;
SelectionParam.selectionCount = 3;
SelectionParam.filterCallback = NULL;
SelectionParam.userDataP = NULL;
SelectionParam.selectedImages.imageCount= 0;
PalmPhotoSelectDlg(photoLibRef, &SelectionParam, palmPhotoDlgSelection, true);
```

For more coding examples, refer to the Sample Code section of the Palm OS SDK.

4.2.1.2 For more information

The Photo Library header files include:

- `PalmPhoto.h`
- `palmOnePhoto.h`
- `palmOnePhotoCommon.h`

Photo Utility header files include:

- `PalmPhotoUtilProt.h`
- `PalmPhotoUtilTypesProt.h`

For more detailed information on the Photo Library and Photo Utility header files, refer to the *Palm OS Platform API Guide* at the Palm Developer website.

Also, refer to the Sample Code section of the Palm OS SDK for coding examples.

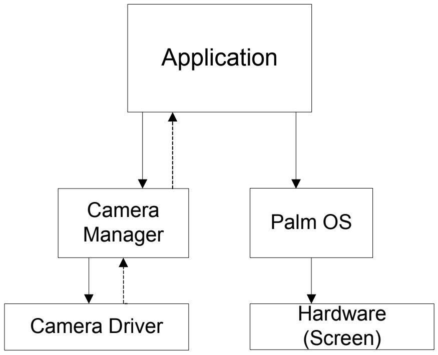
4.2.2 LCD Overlay

Available on:

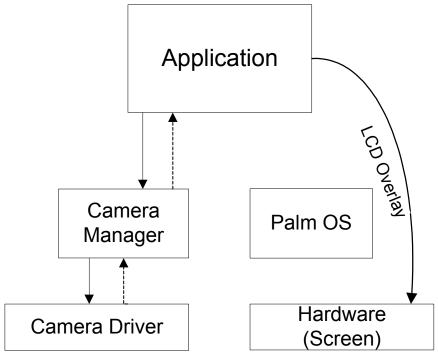
- Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Zire™ 72 handhelds

On devices with a camera, the LCD Overlay allows users to preview what the camera is scanning. The LCD Overlay is declared in the header files `palmOneLcdOverlay.h` and `palmOneLcdOverlayCommon.h`.

Without the LCD Overlay, applications would have to negotiate the Palm OS software layer to access the hardware screen buffer, which might impact performance. In order to preview what the camera is scanning, the LCD Overlay allows applications to access the screen buffer directly by bypassing the Palm OS layer of software, as shown in the following diagrams:



Without LCD Overlay



With LCD Overlay

The LCD Overlay uses the YUV color model. For this reason, it is easy for a decoder to use. Please note that although decoders usually separate three individual buffers for Y, U, and V color definitions, the LCD Overlay only expects one pointer.

4.2.2.1 External dialogs

External dialogs are pop-up windows used by applications to notify the user that an action is taking place. Examples include battery level notifications, volume level graphics, or SMS message dialogs.

Only the LCD Overlay is aware of what is being rendered on the screen when it has control of the screen. (The LCD Overlay is beyond control of the Windows Manager.) For this reason, applications must handle external dialog pop-ups whenever necessary.

On Treo 700p smartphones and later, two notifications have been created to allow applications to handle external dialogs:

- `#define sysNotifyExternalDialogOpenedEvent` is sent when an external dialog is about to be displayed.
- `#define sysNotifyExternalDialogClosedEvent` is sent when an external dialog is about to be closed.

The following use case will describe how to use these notifications.

Assume that an application called PlayerX is currently playing video as the active application. Another application called LauncherY wants to display a mini-LauncherY external dialog when the Side key is pressed.

Since it is not possible for PlayerX to know that it should pause the video while the mini-LauncherY dialog is being displayed, LauncherY should broadcast `sysNotifyExternalDialogOpenedEvent` before it tries to draw an external dialog, then broadcast `sysNotifyExternalDialogClosedEvent` when it is finished displaying the dialog.

PlayerX should register for both notifications and keep track of how many external dialogs are currently open. If PlayerX is playing video when it receives `sysNotifyExternalDialogOpenedEvent`, then it should pause the video until all external dialogs are closed.

4.2.2.2 For more information

The LCD Overlay header files include:

- `palmOneLcdOverlay.h`
- `palmOneLcdOverlayCommon.h`

For more detailed information on the LCD Overlay header files, refer to the *Palm OS Platform API Guide* at the Palm Developer website.

Also, refer to the Sample Code section of the Palm OS SDK for coding examples.

4.2.3 Camera Manager

Available on:

- Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Zire™ 72 handhelds

This section provides reference information for the Camera Manager. You can use the functions in this library to turn the camera on, control the settings, and to allow an application to capture and preview images and video.

The Camera Manager is declared in the header files `palmOneCameraCommon.h` and `palmOneCamera.h`.

IMPORTANT: For information on a known issue with Camera Manager and streaming on Treo 700p smartphones, see **Section 4.5.1 on page 83**.

If the device includes a camera slider, such as the Zire 72 handheld, camera slider notification information is declared in the header file `PalmCameraSlider.h`. For more information on the camera slider, see **Section 4.2.3.3 on page 75**.

There are three versions of the Camera Manager: Version 1, Version 2, and Version 3. Version 2 has several features in addition to those in Version 1. Version 3 includes minor changes to Version 2, such as additional image formats. The differences are noted throughout this section.

NOTE: The Camera Library is currently still supported for the Treo 600 smartphones. In the future, however, the Camera Manager should be used instead.

4.2.3.1 Using the Camera Manager

Depending on the hardware available on a particular device, Camera Manager settings and functionality may or may not be available. For this reason, you should always use the `CamLibControl` query commands to check for the features and settings that are available. For more information, see the information on `CamLibControl` in the *API Guide*.

Programmatically, you will know if a camera is available on a device if the Camera Manager is present.

The Camera Manager is more difficult to use than the Photo Library, but it does provide options to control settings for photographic contrast, exposure, sharpness, and light.

When using the Camera Manager, an application must implement many steps manually. For example, to display a preview window on the screen, the application must communicate with the camera driver and manually place the image data on the screen.

Also, keep the following points in mind when using Camera Manager:

- The Camera Manager always returns bitmap data.
- The Camera Manager communicates directly with the camera driver.

- The Camera Manager does not use the Codec Plug-in Manager.
- The Camera Manager can be used to capture images manually, but there is no user interface.

To use the Camera Manager to capture images, an application should use the following steps:

1. Open the Camera library.
2. Turn the camera on.
3. Proceed with camera functionality, such as turning on image preview, adjusting settings, and so forth.

4.2.3.2 Resources required for camera functionality

The following requirements are necessary to take advantage of camera functionality:

- To preview images, capture images, and display the camera configuration dialog box, the device must support 16-bit color-depth mode. The camera configuration dialog box may or may not be present on a particular device.
- Depending on the available camera hardware, images can be previewed in resolution sizes listed in the following table:

Format	Size	Memory	Use
SXGA	1280 x 1024	2.6MB	images
SXGA	1280 x 960	2.4MB	images
VGA	640 x 480	600KB	images
QVGA	320 x 240	150KB	images/video
QQVGA	160 x 120	37.5KB	images/video
QCIF	176 x 144	50KB	images/video
CIF	352 x 288	198KB	images/video

NOTE: Video is not available in Camera Manager V1. The QCIF and CIF formats are not available in Camera Manager V1 or V2.

For a matrix of available image formats by device, see **Section 4.1.4 on page 68**.

4.2.3.3 Using the Camera Slider on Zire™ 72 handhelds

The Zire 72 handheld includes a camera slider that opens to reveal a camera shutter button and camera lens. Camera slider notification information is declared in the header file `PalmCameraSlider.h` for the Zire 72 handheld.

Applications for the Zire 72 should check for the presence of a camera slider, register for camera slider notifications, and then turn the camera on if the slider is open or if no slider is present. Typically, an application should follow this general workflow:

1. Open the Camera library.
2. Check to see if a camera slider is present.
3. If a camera slider is present:
   - Register for camera slider notifications.
   - Check to see if the slider is open.
4. Turn the camera on.
5. Proceed with camera functionality, such as turning on image preview, adjusting settings, and so forth.

4.2.3.4 For more information

The Camera Manager header files include:

- `palmOneCamera.h`
- `palmOneCameraSlider.h`
- `palmOneCameraCommon.h`

For more detailed information on the Camera Manager header files, refer to the *Palm OS Platform API Guide* at the Palm Developer website.

Also, refer to the Sample Code section of the Palm OS SDK for coding examples.

4.3 Audio

4.3.1 Voice recording and sound libraries

Available on:

- LifeDrive™ mobile manager
- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5, Tungsten™ C, and Palm® T|X handhelds
- Zire™ 72 handhelds

4.3.1.1 Palm® OS Sound Manager library

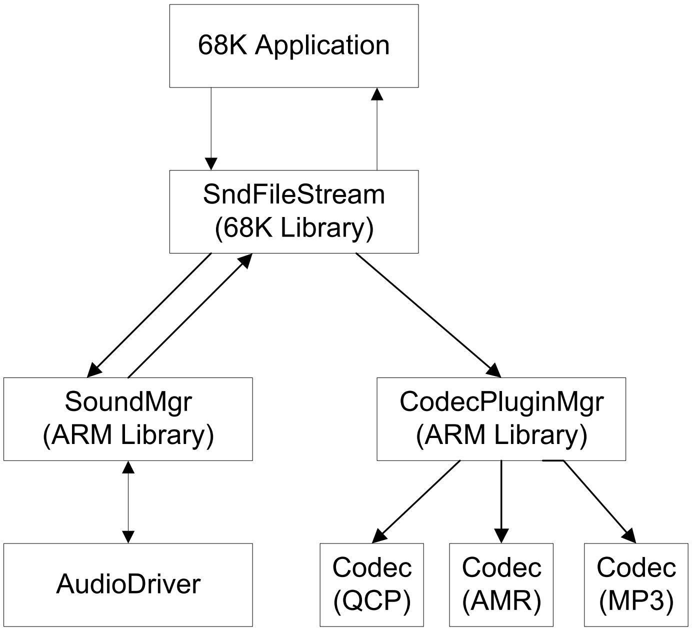
In general, use the Palm OS Sound Manager Library `HsSoundLib` to control voice recording and sounds, create audio streams, and support audio stream playback. This Library supports both synchronous and asynchronous mode.

4.3.1.2 Sound File Stream library (SndFileStream)

`SndFileStream`, a 68k shared library, is used mostly by audio applications to play and record audio files in different formats by managing the Sound Manager and the Codec Plug-in Manager. It provides support for formats including AMR, WAV, QCELP, and MP3. `SndFileStream` also provides support for recording and playing audio from files.

`SndFileStream` is declared in the header file `palmOneSndFileStream.h`.

The following diagram details how an application can use `SndFileStream` to work with other components to play and record audio.



4.3.1.2.1 Audio Playback

In an audio playback application, `SndFileStream` parses the audio header information in the audio file that is being played. This header file includes:

- File format
- Sample rate
- Duration
- Meta data

`SndFileStream` then uses the parsed info to create an audio stream through Sound Manager. Depending on the audio format, it also creates a decoding session through the Codec Plug-in Manager. Next, `SndFileStream` manages reading bitstreams from the audio file, passing the bitstream data to the codec, and passing the decoded audio samples to the Sound Manager to play.

For the Treo 700p smartphone, there are APIs that help retain audio sync. For more information, please refer to the *API Guide*, or see the `HsSoundLib.h` header file.

4.3.1.2.2 Audio Recording

In an audio recording application, there is no header file to parse. Instead, the application is responsible for passing information to `SndFileStream`. `SndFileStream` must then go through the following steps:

1. Generate a header file.
2. Write the header to the recording file (before writing any recording data to that file).
3. Create an audio stream through the Sound Manager.
4. Create an encoding session through the Codec Plug-in Manager.
5. Get raw Pulse Code Modulation (PCM) audio data from Sound Manager.
6. Pass raw data to the codec to encode.
7. Write the encoded bitstream data to the recording file.

4.3.1.2.3 Audio Pause and Resume

For Treo 680 smartphones and later, audio pause and resume functionality has been added to the `HsSoundLib.h` header file. To access these features, use the calls `PmSndStreamPause` and `PmSndStreamResume`.

4.3.1.3 For more information

The voice recording and sound header files include:

- `HsSoundLib.h`
- `palmOneSndFileStream.h`

For more detailed information on the voice recording and sound header files, refer to the *Palm OS Platform API Guide* at the Palm Developer website.

Also, refer to the Sample Code section of the Palm OS SDK for coding examples.

4.3.2 Tones library

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

The Tones library is used to manage the two phone ring tone databases, the "MIDI Ring Tone DB" and the "Palm OS Tone DB". The `TonesLib.h` header file, which is provided with the Palm SDK, contains all the public information referenced in this section, including constants, structure definitions, and function prototypes.

Use the Tones library to create personalized ring tones. Supported formats include:

- AMR
- MIDI
- MP3
- QCELP
- WAV

NOTE: MIDI ringtones are limited to 64 KB in size. Other types do not have this limit.

The Tones library uses the Codec Plug-in Manager to provide codecs. Codecs then convert between audio formats.

4.3.2.1 Ring tone databases

Two ring tone databases are accessed by the Tones library, the "MIDI Ring Tone DB" and the "Palm OS Tone DB."

- The MIDI Ring Tone database contains all MIDI data for ring tones, and is accessed directly by the Tones library. This database is used for backwards compatibility.
- The Palm OS Tone database is used for WAV, AMR, QCELP, and MP3 file types. It contains only the names of the tones stored as file streams. This database is specific to alert tones.

Each record in the MIDI Ring Tone database should contain one MIDI sound, using a Format 0 Standard MIDI File (SMF). For more information on the database format, see the Sound Manager reference information in the *Palm OS Reference Guide* and the Sound section of the *Palm OS Companion Guide* available at **www.palmos.com/dev/support/docs/**.

The following table contains the details of the system MIDI Ring Tone database.

Feature	Description
Database name	`#define TonesDBName 'MIDI Ring Tones'`
Database type	`smfr`

Creator code	`#define hsFileCMultiChannelRingToneDB`
	`MCnl`

In order for the system to recognize a new ring tone, the tone must be installed in the database using an alarm management tool. If you are creating ring tone management applications, you may want to keep a separate database of archived ring tones.

We recommend that you use the attributes listed in the following table for such a database.

Feature	Description
Database type	smfr
Creator code	HSsf

You can use standard Palm OS database calls to install the sound records into this database from their own application. To do this, typically, you would create a MIDI sound database, install it on the smartphone, and then use an alarm management program to copy the sounds into the MIDI Ring Tone database.

4.3.2.1.1 Restoring the Ring Tone databases

The MIDI Ring Tone and Palm OS Tone databases are stored in RAM in order to allow applications to add and delete ring tones. The OS also includes a copy of this database frozen in the system image. The database is copied to RAM after a hard reset or if the database has been deleted from RAM.

To restore original ring tones, simply delete the database.

If ring tones are lost due to a hard reset, you may use HotSync to replace the data.

4.3.2.1.2 Ring tone tools

Treo smartphones use standard Palm OS MIDI files for ring tones, and all popular third-party tools for creating Palm OS system sounds can be used to create ring tones.

4.3.2.1.3 Example code for creating and adding ring tones

To add a new ring tone programmatically to the Tones library using a single interface, use the `TonesLibToneCreate()` and `TonesLibToneWrite()`, and `TonesLibToneClose()` functions, as shown in the example code below:

```
Err TonesLibToneCreate (UInt16 refNum, UInt32* streamP, ToneType toneType,
      CharPtr toneName, Boolean protectedTone);

TonesLibToneWrite(ref,stream,soundBuf,bufSize);

Err TonesLibToneClose (UInt16 refNum, UInt32 stream);
```

In this example, the `TonesLibToneCreate()` function includes the following parameters:

- `refNum` - The reference to the Tones library, which is already open.
- `streamP` - This parameter is returned to the caller and should be used during the calls to `TonesLibToneWrite()` and `TonesLibToneClose()`.

- toneType - This is the format of the tone, which may be:
  - toneTypeMIDI
  - toneTypeWAV
  - toneTypeQCELP
  - toneTypeAMR
  - toneTypeMP3
- toneName - This is a string limited to 31 characters.
- protectedTone - This parameter instructs the Tone library to enforce forward lock on the created ringtone.

The TonesLibToneClose() function includes these parameters:

- refNum - The reference to the Tones library, which is already open.
- streamP - This parameter identifies which stream is being closed. It is the value that was returned from TonesLibToneCreate(), which will be returned to the caller, and should be used during subsequent calls to TonesLibToneWrite().

In this example, the TonesLibToneCreate() function accepts a toneType parameter. If the toneType parameter is set to toneTypeMIDI, the tone is created and TonesLibToneClose() internally calls TonesLibAddMidiTone.

Otherwise, TonesLibAddMidiTone can be called separately, as shown in the code snippet below:

```
TonesLibAddMidiTone(ref,midiTone,''Yes'',false);
```

NOTE: The TonesLibToneWrite() function can be called repeatedly (in a loop, for example) and the data will be appended to the open stream. This way, the caller does not need to buffer an entire audio file before calling TonesLibToneWrite().

In the next code example, the application scans the SD card for MIDI, WAV, or MP3 files and allows them to be added to the Tones library.

```
static Err PrvAddToneToTonesLib(UInt16 vfsVolume, UInt16 toneType, Char *fileName,
Char *path, Char *storeNameP)
{
       Err err = errNone;
       Char fullPath[512];
       FileRef fileRef = NULL;
       UInt32 newTone = 0;
       UInt8 *dataP = (UInt8*)MemPtrNew(4096);
       UInt32 numBytesRead;
       UInt16 tonesLibRefNum = sysInvalidRefNum;

       if(!dataP) goto Done;

       // Load TonesLib
       err = SysLibFind(tonesLibName, &tonesLibRefNum);
       if (err)
          err = SysLibLoad(tonesLibType, tonesLibCreator, &tonesLibRefNum);

       if(err) goto Done;

       // Create full path
       StrCopy(fullPath, path);
       StrCat(fullPath, fileName);

       // Open the file
       err = VFSFileOpen(vfsVolume, fullPath, vfsModeRead, &fileRef);
       if(err) goto Done;

       // Create tone
       err = TonesLibToneCreate(tonesLibRefNum, &newTone, toneType, storeNameP, false);
       if(err) goto Done;

       // Write the tone
       while(!err)
       {
          err = VFSFileRead(fileRef, 4096, dataP, &numBytesRead);
          if(numBytesRead == 0) break;

          err = TonesLibToneWrite(tonesLibRefNum, newTone, dataP, numBytesRead);
       }

Done:
   if(dataP) MemPtrFree(dataP);
   if(fileRef) VFSFileClose(fileRef);
   if(newTone) TonesLibToneClose(tonesLibRefNum, newTone);

   return err;
}
```

4.3.2.2 For more information

The Tones library header files include:

- `TonesLib.h`

For more detailed information on the Tones library header files, refer to the *Palm OS Platform API Guide* at the Palm Developer website.

Also, refer to the Sample Code section of the Palm OS SDK for coding examples.

4.4 Video playback

Palm devices do not currently provide a framework for video playback. This section is not meant to be a tutorial on creating a video playback application. It is only a guideline for what an application would need to do to provide such functionality.

To provide video playback, an application must work with Photo Library, Camera Manager, the LCD Overlay, and the Codec Plug-in Manager by performing the following tasks:

1. Parse the video file for video and audio content.
   - Determine the kinds of tracks that are to be played: video, audio and/or both.
   - Determine the track formats.
   - Determine the target resolution.
2. Query the Codec Plug-in Manager for the necessary codec(s).
3. Split (demultiplex) the original content file into separate audio and video streams.
4. Create a Codec Plug-in Manager session for each codec you will use. (For example, one for audio and one for video.)
5. Call `CodecMgrEncodeDecode` for every data packet for the audio and video streams.
6. Scale the resolution of the video.
7. Manage synching video and audio together.
   - For audio, the sampling rate tells you how much data must be played back. Use the provided time stamps (the reference clock).
   - For video, a timestamp is provided, but only the audio timestamp is usually used as a reference.
8. Send the decoded and scaled content to the screen and speaker for playback.

4.5 Streaming

Available on:

- Treo™ 680 and Treo™ 700p smartphones

Streaming audio and video is available for Treo 680 and Treo 700p smartphones.

For more information on streaming specific to the Blazer® 4.5 web browser, see the following sections:

- **Section 10.1.3.2 on page 198**
- **Section 10.1.3.4 on page 202**
- **Section 13.1.4.4 on page 246**.

4.5.1 Known issue

In the Treo 700p smartphone, the following API does not work with streaming, and is a known issue:

```
CamLibControl([LibRefNum], kCamLibCtrlStreamStart, [&StreamType]);
```

In this API, the key parameter is the second parameter, which controls the camera. The first and third parameters, surrounded by brackets, may be customized.

For streaming, the second parameter is `kCamLibCtrlStreamStart`. When you use this API call with this parameter to stream in the Treo 700p smartphone, the call will fail, although `CamLibControl` will still return `0`. Returning `0` indicates that the function is successful, even though it failed. The camera will not be turned on.

Currently, there is no workaround. For more information on streaming with your application, refer to the Streaming code example in **Section 10.1.3.4 on page 202**.

CHAPTER 5

5. Data Communications

This chapter details the data communication features and APIs available in the Palm OS® SDK.

5.1 NetPref Library API

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

This section provides detailed information about the NetPref Library API.

The NetPref Library was created to provide better support for the GSM/GPRS and CDMA/1XRTT network parameters, dynamic UI flags, Home/Roaming network configurations, CCSM database utilization, synchronization with IOTA-provisioned settings, and configuration of fallback services required by the features of the Treo smartphone. The network database access was redesigned by moving database and record access operations from the Network panel into the NetPref Library.

5.1.1 Loading the library

The NetPref Library is designed as a Palm OS shared library. The NetPref Library should be loaded for use and unloaded after use by a client application. Link the NetPref Library when you need it and then unlink it when you have finished.
The system does not load the NetPref Library at reset or start-up time and leave it permanently installed, as is done with some other libraries. This method helps avoid some HotSync® conflicts, such as an attempt to install over a protected database.

For examples of linking and unlinking, refer to `NetPrefUtilNetPrefLibLink` and `NetPrefUtilNetPrefLibUnlink` as defined in the `NetPrefUtils` package.

The following code sample demonstrates how to link the NetPref Library based on the `NetPrefUtil` package.

```
extern Boolean
NetPrefUtilNetPrefLibLink (NetPrefUtilNetPrefLibType* netPrefLibP)
{
   Boolean           isSuccessful = false;
   Err               err = 0;
   UInt16            refNum = 0;
   NetPrefContextTypeTag* cxtP = NULL;

ErrNonFatalDisplayIf (!netPrefLibP, "null arg");
  ErrNonFatalDisplayIf (netPrefLibP->linkSignature
               == netPrefUtilNetPrefLinkSignature,
               "NetPref lib already linked");
   err = SysLibLoad (netPrefLibTypeID, netPrefLibCreatorID,
                      &refNum);
   if (err)
      {
      ErrNonFatalDisplay ("failed to load NetPrefLib");
      goto Exit;
      }
   err = NetPrefLibOpen (refNum, &cxtP);
   if (err)
      {
      ErrNonFatalDisplay ("failed to open NetPrefLib");
      goto Exit;
      }
   // "Construct" the NetPref lib "instance"
   isSuccessful = true;
Exit:
   if (err)
      {
      if (refNum != 0)
         SysLibRemove (refNum);
      MemSet (netPrefLibP, sizeof(*netPrefLibP), 0);
      }
   return (isSuccessful);
} // NetPrefUtilNetPrefLibLink
```

5.1.2 NetPref Library information

The following table shows the attributes of the NetPref Library and related information. For more detail, see the *Palm OS Platform API Guide*.

Description	Attribute
Creator ID	`HsNP`
Type ID	`libr`
Library database name	`NetPrefLibrary`
Library name	`HsNetPrefLibrary.lib`

Header files	`NetPrefUtils.h`
	`NetPrefLibrary.h`
	`NetPrefLibTypes.h`
	`NetPrefLibErrors.h`
	`NetPrefLibTarget.h`
	`NetPrefLibFieldInfoTable.h`

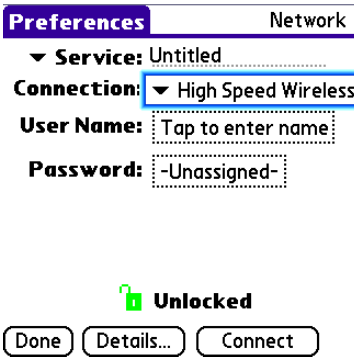
5.1.3 NetPref panel

The Network Preference panel has been modified to provide support to the various Treo smartphone features that are not possible by using the original Palm OS software (3.5 and 5.x) Network Preference panel implementation. Changes include parameters specific to GSM/GPRS and CDMA/1-X (Simple-IP & Mobile-IP), IOTA support, CCSM table support, and various UI features such as hiding certain fields and locking certain services.

In other changes, the network database record format was extended in a backward-compatible way, and the network database access logic was separated into the NetPref Library. The Network Preferences panel as well as other system components, such as NetMaster library, the IOTA application, and network profile creator, uses the NetPref Library to read, write, create, duplicate, and delete network service profiles.

In addition, the configuration of NetLib was redesigned to dynamically perform during each network login instead of doing so only when a user selects a service. This dynamic configuration implementation was moved from the Network panel to the NetMaster library, which is described later in this section. This change permits support for dynamic network configuration based on location, such as Home versus Roaming, executing GPRS and One-X specific functions during login, and implementing the service fallback feature.

The following are examples of Preference Panel displays.



Preferences Network

▾ **Service:** Untitled

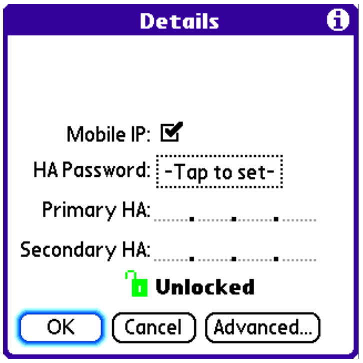
Connection: ▾ High Speed Wireless

User Name: Tap to enter name

Password: -Unassigned-

Unlocked

Done | Details... | Connect



Details

Mobile IP: ☑

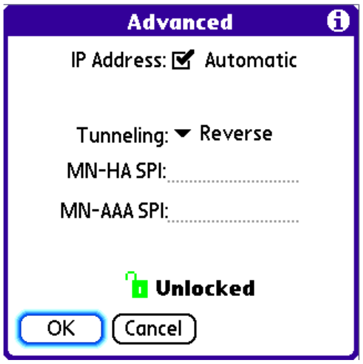
HA Password: -Tap to set-

Primary HA: . . .

Secondary HA: . . .

Unlocked

OK | Cancel | Advanced...



Advanced

IP Address: ☑ Automatic

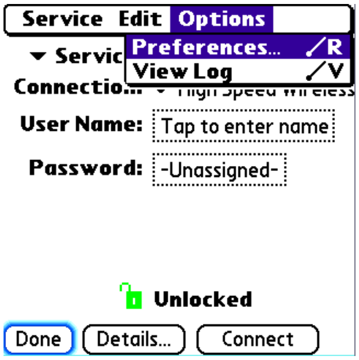
Tunneling: ▾ Reverse

MN-HA SPI:

MN-AAA SPI:

Unlocked

OK | Cancel



Service Edit Options

Preferences... ⁄R

View Log ⁄V

▾ **Servic**

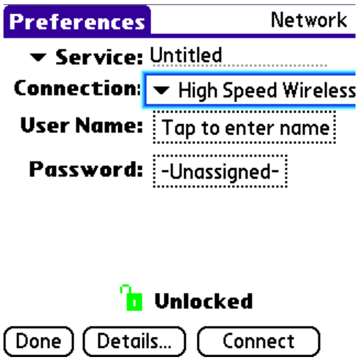
Connectio... ▾ High Speed Wireless

User Name: Tap to enter name

Password: -Unassigned-

Unlocked

Done | Details... | Connect



Preferences Network

▾ **Service:** Untitled

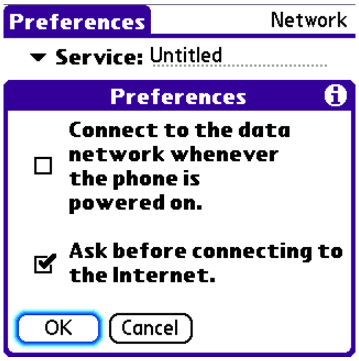
Connection: ▾ High Speed Wireless

User Name: Tap to enter name

Password: -Unassigned-

Unlocked

Done | Details... | Connect



Preferences Network

▾ **Service:** Untitled

Preferences

□ **Connect to the data network whenever the phone is powered on.**

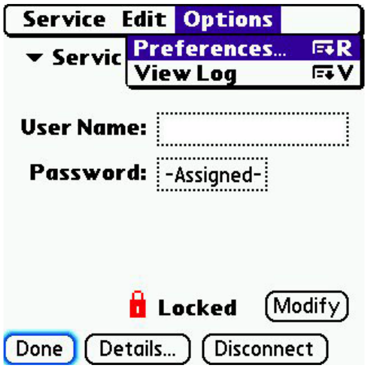
☑ **Ask before connecting to the Internet.**

OK | Cancel

The Sprint Treo 700p smartphone includes a new option that lets a user decide whether or not they want to interrupt an active Power Vision data connection with an incoming call, or if the call should be sent to voicemail. See the following screens for settings.

To set this option in the Network Preferences panel, users must select **Network > drop-down menu > Options > Preferences**. Whether a user sets this feature or not, an application does not need to account for it in any way.

NOTE: Of the three options on the Preferences form, only the option, "Send voice calls to voicemail during active Power Vision data connection" is new to the Sprint Treo 700p smartphone only. This option is not available for Verizon.



Service Edit Options

Preferences... R

View Log V

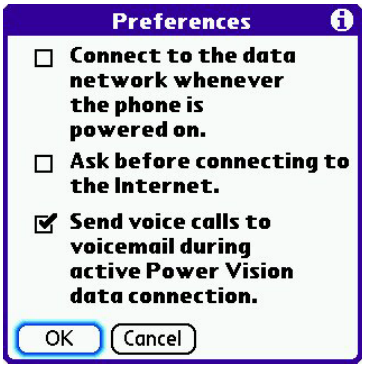
▾ **Servic**

User Name:

Password: -Assigned-

Locked Modify

Done | Details... | Disconnect



Preferences

□ **Connect to the data network whenever the phone is powered on.**

□ **Ask before connecting to the Internet.**

☑ **Send voice calls to voicemail during active Power Vision data connection.**

OK | Cancel

The Network Preference panel supports the legacy Network Preference panel’s limited launch code API, such as enumerating profile names, getting or setting the default profile, and so forth. Applications such as the HotSync application use this API to select the appropriate network preference profile. The new implementation provides full backward-compatibility with the legacy API.

- `sysAppLaunchCmdPanelCalledFromApp`

  Displays the network panel as if it were a dialog box popped up from the calling application, returning to the calling application when the dialog box is dismissed by tapping the Done button, for example.

- `svcCFACmdQuickEdit`

  Manifestation of `sysAppLaunchCmdPanelCalledFromApp` that brings up the “quick- edit” form of the panel, such as the phone number form for a dial-up service profile.

  - `sysSvcLaunchCmdSetServiceID` - Sets the default service.
  - `sysSvcLaunchCmdGetServiceID` - Gets the default service.
  - `sysSvcLaunchCmdGetServiceList` - Gets a list of service names and corresponding IDs.
  - `sysSvcLaunchCmdGetServiceInfo` - Gets the service name when the unique ID of the service is given.
  - `sysSvcLaunchCmdGetQuickEditLabel` - Gets the “quick-edit” value string to display to the user, such as the phone number value from a dial-up service profile.

NOTE: The network preference database has been restructured to support the new parameters needed by the persistent data connection. Any preexisting application that reads, creates, or modifies network services or profiles directly in the original Palm OS network preference database will probably not work with the products that support the latest architecture. If standard Palm OS 3.5 APIs were used, such applications might still work. Legacy profiles are supported because they are converted to the new structure of the database the first time they are accessed.
To create or read network profile information in new applications, use the NetPref Library. The library provides all the necessary routines to interface with the network preference database. There is no longer any need to read/write directly to the network preference database.

5.2 NetMaster library API

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

This section describes in detail the NetMaster library features and APIs.

Palm created the new NetMaster library to:

- Provide better support for handling and managing network logins, network service connections, network context, and session controls needed by network applications in the Treo smartphones by Palm.
- Allow multiple concurrent applications or tasks to detect, log in, preempt, and switch network profile connections.

Palm® designed the NetMaster library API to work around the limitations of the current Palm OS® network architecture. For example, the MMS application, running in the background, may receive a trigger and need to log in with the MMS APN (network profile), while the browser application has NetLib open with the Internet or browser-specific APN. NetLib does not provide a way to arbitrate between the needs of both applications. Thus, NetLib could not support multiple concurrent data sessions over the same network interface (network profile).

The NetMaster library API attempts to bridge the gap by keeping track of the current NetLib usage by various tasks and making intelligent decisions allowing when a particular network profile connection request may preempt and shut down another previously active profile. This API also attempts to simplify and make more robust the process of logging in with a network profile that is not the “default” network profile. Before this API, applications had to get the current default network profile ID, set a new default, call NetLibOpen, do their networking, and then restore the default ID. This works if there is only single data networking application at a time. However, with multiple concurrent clients possibly running different tasks, system data integrity (current or default profile ID) is susceptible due to ill-managed multiple writers, system reset, or system crash.

NOTE: The NetMaster library API is *not* intended for all networking applications. It is intended to be a temporary solution to a temporary limitation in Palm OS software’s Network library. Future versions of Palm OS software or NetLib may make it impossible or unnecessary for this API to be supported, and it would then be deprecated.

Most networking applications that connect using the “default” network profile (as selected in the Network Panel) should continue to use the standard NetLib API (NetLibOpen and NetLibClose) in order to remain compatible with future releases of Palm OS software.

5.2.1 Usage model

This section details important information and guidelines for using the NetMaster library API:

- Only the Motorola 68K version of the NetMaster Data Session Control API is provided. However, ARM code may call this API using the Palm OS software 5.x PACE API, including `PceSysLibFind68Klibrary` and `PceCall68KlibRoutine`.
- *Do not* intermix the NetMaster Data Session Control API with NetLib's *session control* API, which includes `NetLibOpen`, `NetLibOpenConfig`, `NetLibOpenIfCloseWait`, `NetLibClose`, `NetLibConnectionRefresh`, `NetLibIFUp`, `NetLibIFDown`, `NetLibIFAttach`, and `NetLibIFDetach`. You *must* use either the one set of session control API or the other, exclusively.
- The NetMaster Data Session Control API works closely with the NetPref Library. Applications first look up the desired network profile record using the NetPref Library API, and then provide this record's ID to `NetMasterSCNetAttach` via the `netPrefRecID` parameter. This API only works with network profiles that are managed by the NetPref Library. Other profiles are *not* supported.
- The design of the NetMaster Data Session Control API is based on the concepts of data sessions and data contexts. A given data session represents an established (logged-in) data session via a specific network profile ID. An *active* data session is one that is believed to be logged in; otherwise, it is *inactive*. A given data context represents a *client* (an executable such as an application or library) that successfully attached to a data session by calling `NetMasterSCNetAttach`.
- Multiple data contexts may be "attached" to a single data session. The Data Session Control API provides functions that operate on both data contexts and data sessions. Most clients utilizing this API use the functions `NetMasterSCNetAttach`, `NetMasterSCNetDetach`, `NetMasterSCSessionIDGetFromContext`, and `NetMasterSCSessionIsActive`. The remaining functions are mainly for troubleshooting purposes.
- A client begins networking over a particular network profile by calling `NetMasterSCNetAttach`( ) with the desired network profile ID and other specialized parameters. The client uses `NetMasterSCNetAttach` instead of NetLib's `NetLibOpen` or `NetLibOpenConfig`. If there is already an active data session where the requested network profile ID is either the primary or fallback profile, `NetMasterSCNetAttach` attaches the caller to that data session. See the NetPref API documentation for definitions of primary and fallback profiles.

  If, on the other hand, the active data session was established from a different network profile, `NetMasterSCNetAttach` employs an internal algorithm to see if it can preempt (shut down) the active data session, and to do so if it can. If it cannot make room for a new data session by tearing down an existing data session, the function fails.

  If there is no active data session or if one was successfully shut down to make room for the new data session, `NetMasterSCNetAttach` attempts to establish a new data session with the requested network profile, and attach the client to that data session. If it's successful, `NetMasterSCNetAttach` returns an error code of 0 and a nonzero Context ID of a newly created data context that is attached to the data session. The returned Context ID may be passed to other functions of this API family that require a data context ID. This data context ID is valid only until you destroy it by calling NetMasterSCNetDetach. Once the Context ID is destroyed, it *must not* be passed to any functions.

If NetMasterSCNetAttach fails, you may need to retry at a later time. The error code netErrAlreadyOpenWithOtherConfig indicates that NetMasterSCNetAttach could not preempt another active data session. Other nonzero error codes are typically either NetLib or NetMaster library error codes. When the client has finished using the network session that was acquired with NetMasterSCNetAttach, such as when exiting the networking application or terminating its task, the client *must* destroy the data context by calling NetMasterSCNetDetach. Users of the NetMaster Data Session Control API call NetMasterSCNetDetach instead of NetLibClose.

- Once attached to a data session, the client may periodically call NetMasterSCSessionIsActive to check if that session is still logged in. NetMasterSCSessionIsActive takes a data session ID as a parameter. Call NetMasterSCSessionIDGetFromContext to get the data session ID from a valid data context ID. If it reports that the data session is not active, this means that the data session was shut down for some reason, such as loss of network coverage for an extended time, wireless mode being turned off, preempted by another client requesting a different network profile, and so on. When this occurs, you should destroy the data context by calling NetMasterSCNetDetach, since this API has no concept of data session reactivation. If you need to resume your data session, you need to get a new data context via NetMasterSCNetAttach, as discussed previously.
- If the anchor timeout that the application initially requested when calling NetMasterSCNetAttach is now bigger than necessary, the application *must* reduce its anchor timeout to the minimum acceptable value by calling NetMasterSCContextAnchorTimeoutSet so that other services may be activated more quickly when necessary.

5.2.2 Loading the library

The NetPref Library is designed as a Palm OS shared library. The system software preloads the NetMaster library at system reset/startup before broadcasting the sysAppLaunchCmdSystemReset launch code. Clients of the NetMaster library should only call SysLibFind (netMasterLibName,...) to get a library refNum of NetMaster. If SysLibFind returns a nonzero error, clients *must* assume that NetMaster was not loaded for a good reason (such as when the user performs a safe reset), or that NetMaster is simply not present on the system, and fail gracefully.

NOTE: Clients must not load NetMaster themselves such as via SysLibLoad or SysLibInstall. Keep in mind that if the system didn't load it, there was a good reason.

The following code sample demonstrates how to use the NetMaster library.

```
UseNetMasterLibrary(UInt16* libRefP)
{
    Err error  = 0;
    Err ifErrs = 0;

    // Routine is pointless without this parameter
    if (!libRefP)
        return memErrInvalidParam;

    // Get the NetMaster Library
    error = SysLibFind("HsNetMasterLibrary.lib", libRefP);
    if (error)
    {
        //It’s not already here—don’t load it:
        //there is a good reason it’s not loaded
    }
    return error;
}
```

5.2.3 Library information

The following table contains the attributes of the library and related information.

NOTE: The library code is compiled for structures to be aligned on 2-byte boundaries. This is especially important for CodeWarrior users, as the default setting might not be compatible.

Description	Attribute	Comment/Description
Creator ID	HsNM	
Type ID	libr	
Library’s database name	NetMasterLibrary	
Library name	HsNetMasterLibrary.lib	
Header files	NetMasterLibrary.h NetMasterLibErrors.h NetMasterLibTarget.h NetMasterLibTraps.h	By including NetMasterLibrary.h you are effectively including the other files.

5.3 HTTP library

Available on:

- LifeDrive™ mobile manager
- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5, Tungsten™ E2, and Palm® T|X handhelds

The HTTP library is a shared library. This HTTP library was added to Palm OS software 5.X to give applications a high-level interface to implement HTTP access.

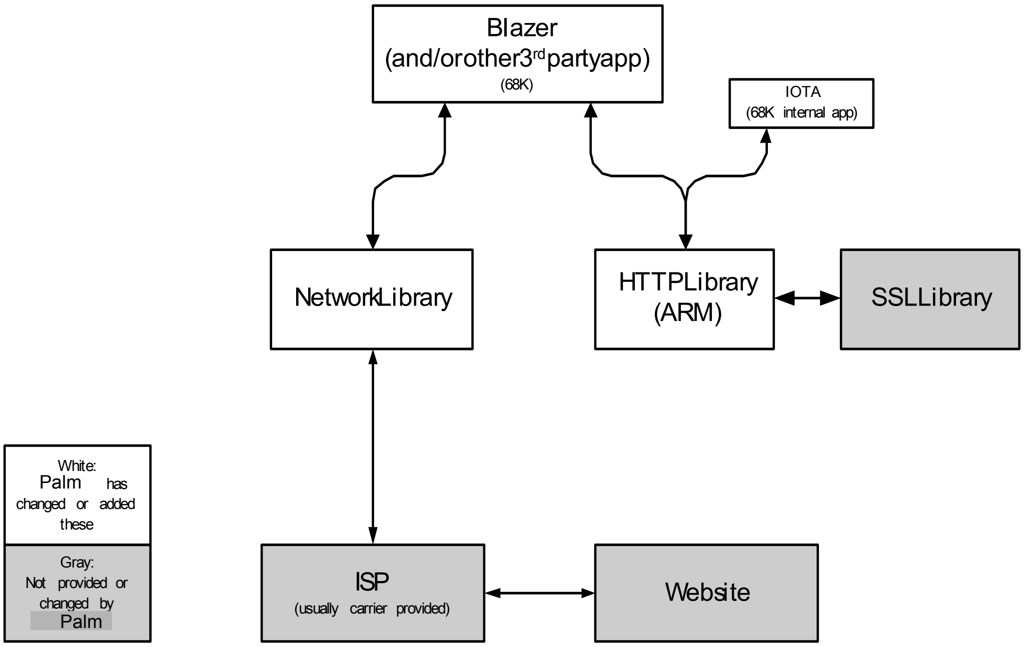
The HTTP library is used by the Palm Blazer® web browser and other applications. Third-party applications can share and use the HTTP library to implement their own HTTP access requirements, however, they should not access the HTTP library at the same time. To indicate this, a new error message has been added with the Treo 680 smartphone. For more information, see **Section 5.3.3 on page 96**.

The HTTP library supports HTTP protocol versions 1.0 and 1.1 and the WAP 2.0 HTTP client profile. The HTTP library also supports SSL using the Palm OS SSL library for secure (HTTPS) connections, proxy configuration, and cookies.

5.3.1 Architecture

The HTTP library is provided at the Palm OS library level. It is implemented at a peer level with the Palm OS NetLib library and SSL library. Applications must call the NetLib library to initialize and enable the TCP sockets for the HTTP library. It will call the SSL library directly to implement authentication and cryptography necessary for secure access. So, after the NetLib library is initialized in the standard way, the applications will directly call into the HTTP library to implement all HTTP access.

The following figure illustrates the architecture of the HTTP library.



5.3.2 Functional highlights

The HTTP library is designed to be shared by multiple applications, though it is not re-entrant and should not be actively called by more than one application at a time. If the HTTP library is already being used by an application, and another application calls the HTTP library with `HS_HTTPLibOpen()`, the applications may crash.

The HTTP library is implemented as a single instance running in the execution task of caller applications. The library does not launch any additional tasks and is safe to use as a background task, because it does not display a user interface. The library does provide the necessary callbacks to allow applications to handle a user interface in the application code, if necessary.

The HTTP library requires applications to handle the NetLib library interface by passing the HTTP library a reference to NetLib wrapper function callbacks. The HTTP library intelligently manages the pool of sockets. The library provides the calling application an API to specify the maximum number of sockets used by the HTTP library.

The HTTP library supports the following:

- HTTP versions 1.0 and 1.1 as defined in RFCs 1945 and 2616, and the WAP 2.0 HTTP client profile
- Basic, digest, and proxy authentication as specified in RFC 2617
- SSL (HTTPS) connections
- GZIP and Zlib (using deflate) compression formats
- Chunked encoding allowing applications to begin sending data before the application knows the total amount of data to be sent
- Individual application user agent profile - An application can control the user agent profile by adding a simple string or WAP 248 UA Prof to the request header.
- Keep-alive connections - Keep-alive connections are not shared among applications. Different sockets are used for multiple keep-alive connections. For example, two sockets are used to open two separate connections to **www.yahoo.com**.
- Non-blocking sockets

5.3.3 httpErrorLibraryAlreadyOpen error message for Treo™ 680 smartphones

To assist in preventing application crashes, `HS_HTTPLibConst.h` has been updated with a new error message. As of the release of the Treo 680 smartphone, if an application has already opened the HTTP library with the call `HS_HTTPLibOpen()`, any other application that makes the same call will be returned the error `httpErrorLibraryAlreadyOpen`. This new error message will also be included in future maintenance releases.

For example, if a user is using the Blazer web browser to access the Internet, and a background application, such as MMS tries to open the HTTP library, the background task will receive the error `httpErrorLibraryAlreadyOpen` and the HTTP library will not be opened. This example is illustrated in the following code sample:

```
Err err = HS_HTTPLibOpen();

if(err!= httpErrorOK)

{

ErrNonFatalDisplay(''error opening the httplibrary; it is already in use;
please try again later'');

}
```

5.3.4 HTTP library interface to SSL

Palm OS 5.x and later includes two security-related shared libraries: the SSL library and the Cryptography Provider Manager. These two libraries provide sufficient crypto functionality to negotiate secure SSL connections with most secure websites.

The SSL library in Palm OS 5.x and later includes:

- SSL protocol implementation, version 3 only—not SSL v2 or TLS v1
- RSA public/private key algorithm for key exchange
- RC4 symmetric cipher for bulk data encryption
- Authentication of the server-side of the connection using digital certificates and signature verification
- Message verification using the MD5 and SHA-1 hash algorithms
- SSL session resumption

The SSL library in Palm OS software supports four SSL cipher suites:

- sslCs_RSA_RC4_128_MD5
- sslCs_RSA_RC4_128_SHA1
- sslCs_RSA_RC4_56_SHA1
- sslCs_RSA_RC4_40_MD5

The first two cipher suites include a connection that uses the RC4 symmetric cipher with a 128-bit key for data encryption, the RSA algorithm for key exchange, and either the MD5 or the SHA1 hash algorithm for verifying message integrity. These two cipher suites are widely supported by popular web servers on the Internet.

The other security-related library included in Palm OS software is the Cryptography Provider Manager (CPM). The CPM exports an API that allows you to perform specific cryptographic operations. The CPM in Palm OS software provides access to the following:

- RC4 symmetric cipher, variable key length
- SHA-1 hash algorithm
- Message verification

5.3.5 HTTP library use of certificates/public key infrastructure

The HTTP library reads a set of root certificates from a database on start-up. These root certificates identify each of the major certificate authorities and are used by the HTTP library during SSL connection establishment to authenticate the remote web server. The database containing the root certificates is burned into the ROM with the HTTP library.

Certain large corporations and institutions act as certificate authorities and issue their own certificates. Such an organization then uses certificates signed using its self-issued root certificate to identify its secure web servers. In order for a user's web browser to negotiate a secure SSL connection with a web server identified by the certificate, the user must add the corporation's self-issued root certificate to his or her web browser's set of trusted root certificates. The HTTP library does not include a native mechanism that allows the user to add trusted root certificates to the certificate database on the user's device. However, you can design your calling application to check the remote server's certificates and display a UI to add them as trusted.

5.3.6 HTTP library implementation

The HTTP library APIs can be categorized into these four groups:

1. Palm OS library management - The Palm OS library management APIs include functions to open, close, sleep, wake, or count the HTTP library.
2. Library initialization and finalization - The initialization and finalization APIs include functions to load, open, initialize, close, and remove the HTTP library.
3. Stream operations - The stream operation APIs include functions to create, configure, send, and receive requests and responses. They also include functions to load, open, initialize, close, and remove the HTTP library.
4. SSL - The SSL category APIs include functions to authenticate, certify, encode, and decode secure connections.

See the *Palm OS Platform API Guide* for more details about the available HTTP APIs.

5.3.7 General HTTP program information

The following pseudo code demonstrates the usage model of a typical client application using the HTTP library:

```
Library Open
   find or load HTTP library
Library Initialize
   Initialize global environment variables:  application,
   netlib, peer
   Open NetLib library
   Initialize HTTP library.
   Set up connection time-outs
   (Confirm certification)
   (Set proxy)
Stream Create
Stream Initialize
Stream Send Request and Read Response
   Send request
   Loop on Read Response until Read terminates
Stream Close
Library Finalize
Library Close
```

5.3.7.1 Initialization

The following sample code demonstrates the HTTP library initialization. The sample code shows that the initialization includes opening both the HTTP library and the NetLib library, setting all the callback for calling NetLib's TCP socket functions, and setting the application execution environments through the three global variables structures—struct HS_HTTPLibNetInfo, struct HS_HTTPLibPeer, and struct HS_HTTPLibAppInfo.

The application's SSL certificate, proxy connection, and connection timeouts are also initialized.

```
void HTTPLibInitialize(void)
{
err = HS_HTTPLibOpen(gRefNum);

   /* gPeer */
   MemSet(&gPeer, sizeof(HS_HTTPLibPeer));0
   gPeer.HS_HTTPLibPeerTCPOpen = &PrvTCPOpen;
   gPeer.HS_HTTPLibPeerTCPClose = &PrvTCPClose;
   gPeer.HS_HTTPLibPeerTCPIsConnected = &PrvTCPIsConnected;
   gPeer.HS_HTTPLibPeerTCPConnect = &PrvTCPConnect;
   gPeer.HS_HTTPLibPeerTCPRead = &PrvTCPRead;
   gPeer.HS_HTTPLibPeerTCPWrite = &PrvTCPWrite;
   gPeer.HS_HTTPLibPeerTCPCanReadWrite = &PrvTCPCanReadWrite;

   gAppInfo.maxSockets = 3;
   gAppInfo.isForeground = true;
   gAppInfo.cookieMaxJarSize = (UInt16)300 * (UInt16)1024;

   PrvPeerTCPInitialize();
   gLibHandle = HS_HTTPLibInitialize(gRefNum, &gAppInfo,    &gNetLibInfo,
&gPeer);
```

```
   /* set callbacks */
   //HS_HTTPLibSetSSLServerCertConfirmProc(gRefNum,    gLibHandle,
&test_confirm_cb,    (HS_HTTPLibOpaque)gLibHandle);
   //HS_HTTPLibSetTunnelingCallback(gRefNum, gLibHandle,
   &PrvTunnelingCallback, NULL);

   /* set timeout time */
   HS_HTTPLibSetConnectTimeOut(gRefNum, gLibHandle, -1);
   HS_HTTPLibSetReqTimeOut(gRefNum, gLibHandle, -1);
   HS_HTTPLibSetRspTimeOut(gRefNum, gLibHandle, 10 * 1000);

   /* set proxy info if used*/
   //HS_HTTPLibSetProxy(gRefNum, gLibHandle, ProxyHost,
   StrLen(ProxyHost), ProxyPort, ProxyPort, NoProxyHost, 0);
   //HS_HTTPLibSetUseProxy(gRefNum, gLibHandle, true);
}
................
................

/* Wrappers for NetLib callbacks */
void PrvPeerTCPInitialize( ) {.... NetLibOpen( .... }

Int32 PrvTCPOpen( ) {..... NetLibSocketOpen( .... }

void PrvTCPClose( ) { .... NetLibSocketClose( .... }

Int32 PrvTCPIsConnected( ) {.... NetLibSelect( .... }

Int32 PrvTCPConnect( ) {.... NetLibSocketConnect( .... }

Int32 PrvTCPRead( ) {..... NetLibReceive( .... }

Int32 PrvTCPWrite( ) {.... NetLibSend( .....}

Int32 PrvTCPCanReadWrite( ) {....  NetLibSelect( .... }
```

5.3.7.2 Finalization

The following sample code demonstrates the HTTP library finalization. The finalization appears as a short sequence of freeing memory and closing the NetLib and HTTP libraries.

```
void HTTPLibInitialize(void)
{
HS_HTTPLibFinalize(gRefNum, gLibHandle);
PrvPeerFinalize();
HS_HTTPLibClose(gRefNum, &count);
}

void PrvPeerTCPFinalize( ) { .... NetLibIFDown( .... }
```

5.3.7.3 Processing Loop

The HTTP library does not contain an internal processing loop, so applications should implement a processing loop to send and receive incoming stream data. Applications can implement the processing loop as a state machine that models the sequence of communication between the client and the server through the HTTP protocol. The following example shows how an HTTP sequence is modeled into a state machine.

Common HTTP accesses follow this sequence pattern:

1. Generate an HTTP request and send the request.
2. Read the response header.
3. Read the content of the data stream.
4. Continue reading content until the end or until an error occurs.
5. Close the stream connection.

Applications can define the preceding state transitions into the state machine to process streaming data.

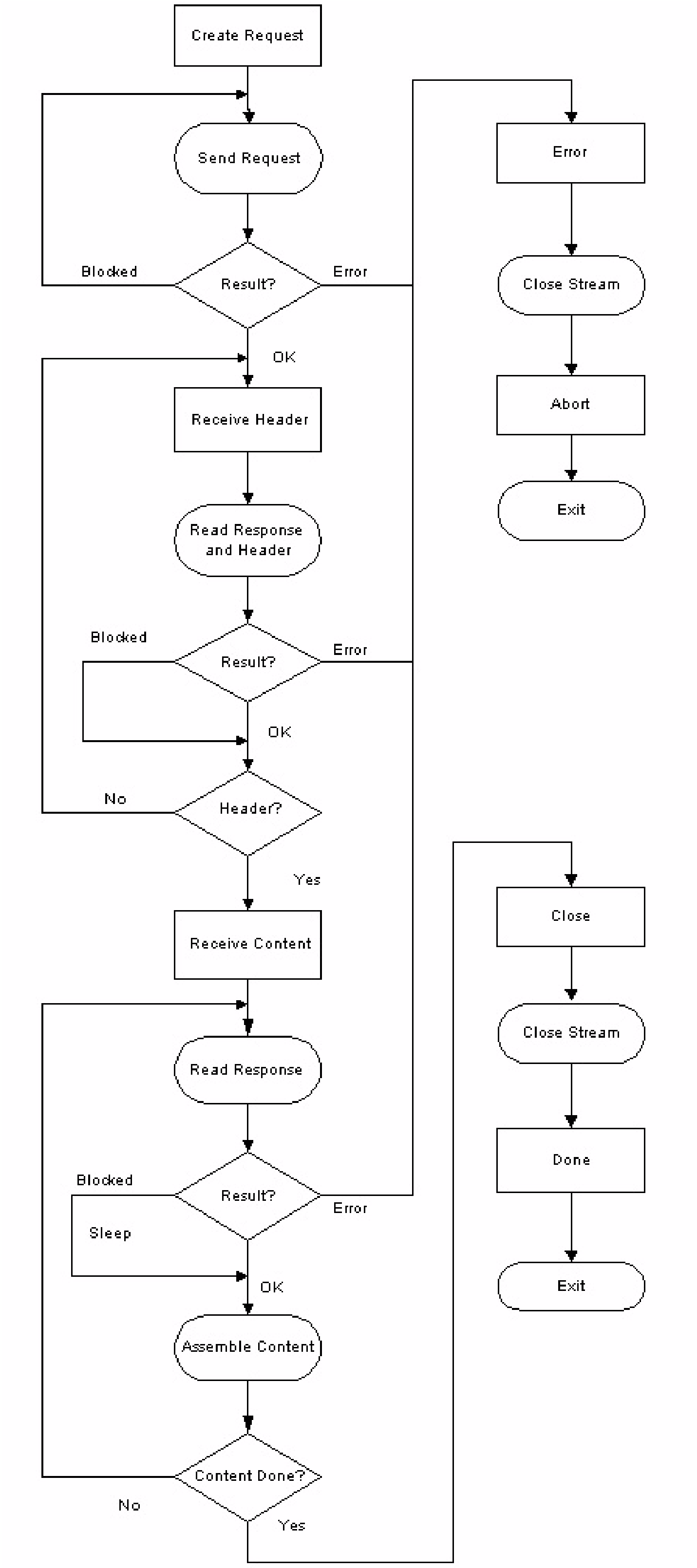
Applications can also implement the following state transition pattern for successful HTTP accesses in the state machine:

1. Initiate the state machine with a request creation with the state `kDownloadState_Request`.
2. Through the state machine, send a request out and switch the state to `kDownloadState_ReceiveHeader`.
3. Read the initial response and header and then transition to the state `kDownloadState_ReceiveContent`.
4. Continue to loop and read the response until the data is complete, and then transition to the state `kDownloadState_Close`.
5. Close the stream and switch to the state `kDownloadState_Done`.
6. Exit with the condition `httpErrorOK`.

An error can occur during the state `kDownloadState_Request_xyz` or `kDownloadState_Receive_xyz` when switching to the state `kDownloadState_Error`, `kDownloadState_Cancel`, or `kDownloadState_Abort`. These states trigger a loop exit, and the appropriate error conditions are recorded.

The sample code in the Palm sample application call `HTTPLibTest` includes code for an application's processing loop to send an HTTP request and receive the response through a state machine. This processing loop can be modified to adapt to other applications. Refer to the `HTTPLibTest` project.

The flowchart on the following page illustrates how an HTTP sequence is modeled into a state machine.


Create Request
Send Request
Blocked
Result?
Error
OK
Receive Header
Read Response and Header
Blocked
Result?
Error
OK
No
Header?
Yes
Receive Content
Read Response
Blocked
Result?
Error
Sleep
OK
Assemble Content
Content Done?
No
Yes
Error
Close Stream
Abort
Exit
Close
Close Stream
Done
Exit

5.4 Net Services API

Available on:

- LifeDrive™ mobile manager
- Tungsten™ C and Palm® T|X handhelds

This section provides reference information for the Net Services API. You can use the functions in this API to check a handheld's radio hardware, to add or change network user profiles, and to implement other 802.11 network service tasks.

The NetServices library is available only on handhelds equipped with Wi-Fi (wireless fidelity), either through built-in hardware resident on the device or through a Wi-Fi add-on accessory.

The Net Services API is declared in the header file `PalmNetServices.h`. The Net Services API also uses data structures declared in the header file `PalmWiFiCommon.h`.

5.4.1 Overview of the Net Services feature

Handhelds that include Wi-Fi functionality include a panel that allows users to add network profiles in order to connect to different 802.11 Internet access points. Users can choose different profile names, SSIDs (service set identifiers), encryption methods, and other profile characteristics based on the requirements of the access points and on their own personal preferences.

Using the Net Services API, you can create your own panel to allow users to create profiles, to specify encryption methods, and to connect to access points.

NOTE: The Net Services API does not provide a method to add profiles to the existing Wi-Fi panel. If you create a Net Services application, you must design your own panel to display and create profiles, connect to access points, and so forth. Furthermore, if you plan to add, delete, or modify your own separate set of profiles, you should design your own panel because the default Wi-Fi panel may overwrite the profiles you create and modify. If you simply want to replace the default Wi-Fi panel, set the creator ID and panel type to that of the default Wi-Fi panel.

CHAPTER 6

6. HTML Library

This chapter provides reference information on the HTML library, including its usage model, architecture, and features.

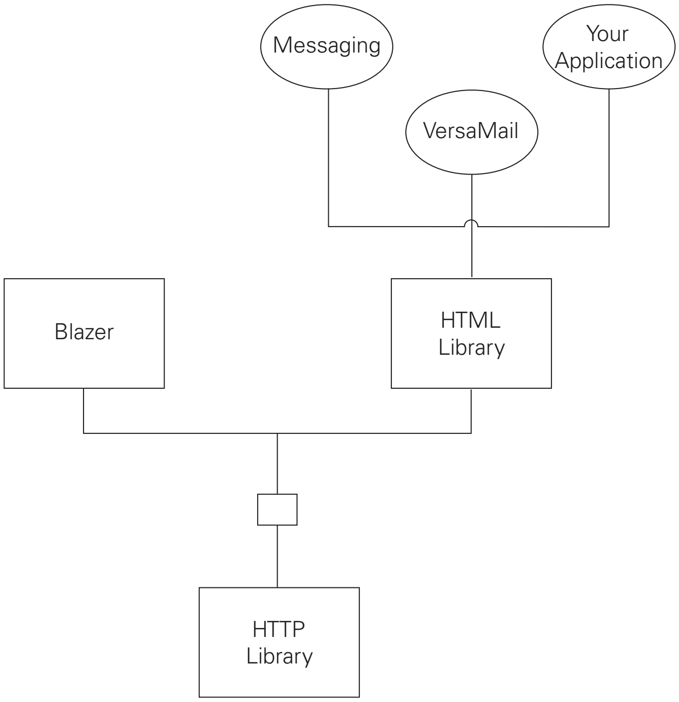
Available on:

- LifeDrive™ mobile manager
- Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Palm® T|X™ handheld

The HTML library is a shared library, added to enable applications to render data. It is only available on the devices listed at the beginning of this chapter. The HTML library API is declared in the header file `HtmlLib68K.h`. For more information, refer to the *Palm OS Platform API Guide* at **http://pluggedin.palm.com**.

6.1 Architecture

The HTML library is provided at the Palm OS® library level. It is used by VersaMail® and Messaging applications. The following figure shows the architecture of the HTML library.



6.2 Usage model

When using the HTML library, keep the following details in mind:

- Only one application should be using the HTML library at a time. When the browser is running, other applications cannot use the HTML library. Conversely, when another application is using the HTML library, the browser should not be running.
- The HTML library does not support frames, iframes, forms, and JavaScript.

6.2.1 Image rendering

For HMTL content that includes images, the application can provide the image content to the HTML library in one of the following methods:

1. Provide image content(s) with `InclusionCallback`. To do so, call `HtmlLibAddImageData` when `HtmlLibrary` calls `InclusionCallback`.
2. Provide image content(s) by calling `HtmlLibAddImageData` before `HtmlLibRenderData`. This method is particularly useful if the HTML content contains a lot of images you do not want the application to show "no image" icons. This way, the image content(s) are provided to the HTML library before the page starts rendering.

6.2.2 Usage model

The following steps demonstrate the usage model of a typical application using the HTML library. For more information, refer to the sample code `HtmlLibTest68K` in the Sample Code section of the SDK.

1. Find and load the HTML library:

```
Err SysLibLoad (UInt32 libType, UInt32 libCreator, UInt16 *refNumP)
```

2. Open the HTML library:

```
Err HTMLLibOpen (UInt16 refnum)
```

3. Initialize the HTML library:

```
MemHandle HtmlLibInitialize (UInt16 refnum, RectangleType bounds,
Err *errP)
```

4. Set up callback functions as needed:

- `typedef void HtmlLibLinkSelCallback (MemHandle htmlLibH, Char *url, void *cbData)`
- `typedef Boolean HtmlLibScanPhoneNumberCallback (MemHandle htmlLibH, Char *buffer, Int32 length, Int32 *patternStart, Int32 *patternEnd)`
- `typedef void HtmlLibInclusionCallback (MemHandle htmlLibH, Char *url, void *cbData)`
- `typedef void HtmlLibSubmitFormCallback (MemHandle htmlLibH, Char *url, HtmlSubmitFormMethod method, Char *query, void *cbData)`

5. Create content data objects as needed:

```
MemHandle HtmlLibCreateContentObject (UInt16 refnum, MemHandle htmlLibH)
```

6. Add image/text data:

- `Err HtmlLibAddTextData (UInt16 refnum, MemHandle contentH, Char *url, Char *mimeType, Char *charset, void *data, Int32 dataLen)`
- `Err HtmlLibAddImageData (UInt16 refnum, MemHandle contentH, Char *url, Char *mimeType, void *data, Int32 dataLen)`

7. Render as needed:

```
void HtmlLibRenderData (UInt16 refnum, MemHandle contentH)
```

8. Destroy content data objects:

```
void HtmlLibDestroyContentObject (UInt16 refnum, MemHandle contentH)
```

NOTE: Make sure to call `HtmlLibAbortRenderData` before destroying a content object.

9. Finalize the HTML library:

```
void HtmlLibFinalize (UInt16 refnum, MemHandle htmlLibH)
```

10. Close the HTML library:

```
Err HtmlLibClose (UInt16 refnum)
```

11. Unload the HTML library:

```
SysLibRemove()
```

6.3 Debugging

If you have trouble rendering data, use the following steps to troubleshoot:

1. Try sending the same HTML that you are trying to render to the Blazer® web browser programmatically (using the Exchange Manager or a filestream). If it also crashes the Blazer application, there is a bug in the HTML Renderer.
2. Modify the HTML library sample code to render the same HTML.
3. Recompile. If it crashes the sample code but not the Blazer application, there is probably a bug in the HTML library.
4. If it works in both the Blazer application and the sample code, but crashes your application, it is something that you are doing differently from the sample code, and you should investigate this difference.
5. Try rendering your HTML from the SD card using the Blazer web browser. First, make sure that the browser is in optimized mode. To render your HTML from the SD card, use the following path:

   ```
   file:///<OPTIONAL_SDCARDNAME>/<OPTIONAL_PATH>/filename
   ```

   If the content renders correctly, there may be a bug in your application.

NOTE: Link walking is only supported in the table unrolled version of the HTML library. If you use the header `<META NAME="HandheldFriendly" content="True">` then you are not in optimized mode, and link walking will not work.

CHAPTER 7

7. Telephony

This section provides reference material for the telephony APIs in the Palm OS® SDK.

7.1 Overview of the Telephony API libraries

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

The `HsPhone.h` header file provided in the Palm OS SDK contains all the public files referenced in this section, including all constants, structure definitions, and function prototypes. For more details, refer to the *Palm OS Platform API Guide* at **http://pluggedin.palm.com**.

The telephony libraries include the following categories:

Phone library category	Description
SMS	Functions that apply to sending, receiving, and managing SMS messages. Declared in `HsPhoneSMS.h`.
GSM	Functions that apply to GSM products with some functions that apply to both GSM and CDMA products. Declared in `HsPhoneGSM.h`.
CDMA	Functions that apply only to the CDMA product. Declared in `HsPhoneGSM.h`.

The telephony libraries depend on a set of mostly common structures, types, and enumerations. You can also look at the latest version of the header files in the Palm OS SDK for the most up-to-date definitions.

NOTE: The Palm Telephony library does not support third-party applications that control phone calls directly. The supported method is to use the helper application described in **Section 7.3 on page 112**.

Because the telephony libraries contain so many different enumerations, structures, and types, the telephony header files are divided into categories so that they are easier to understand. These categories are defined in the following table.

Category	Description
Library	General Palm OS library functions and enumerations related to the telephony libraries. Declared in `HsPhoneLibrary.h`.
Network	Cellular network types and functions. Declared in `HsPhoneNetwork.h`. Developers should have a basic knowledge of how a cellular network behaves. The following concepts should be familiar to you if you want to use the Telephony Network APIs: ■ Current operator versus home operator ■ How to select the current operator when more than one is available ■ Phone registration process with the wireless network ■ Interactions with a SIM card ■ Voicemail box interaction from the network
Audio	Specific audio definition: ringing profile and slider switch.
Events	Telephony events sent to an application that registers for them. Its main enum is `PhnEventCode`, which contains the notification received by a registered application. Refer to the sample code in the Palm OS SDK.
Security	Password Type enumerations.
IOTA	Internet Over The Air enumerations.
Misc	Other functions. Declared in `HsPhoneMisc.h`.

NOTE: The telephony libraries support the specific requirements of the Palm OS-based Treo smartphones. Treo smartphones do not support Palm OS telephony *functions*. If you want to use the telephony functions on the Treo smartphone, you must use the Palm Telephony library functions.

7.1.1 CDMA and GSM libraries

For Treo 680 smartphones with Phone Application 3.0, the GSMLibrary has been replaced by the PhoneInterfaceLibrary, which is used for both GSM and CDMA. The PhoneInterfaceLibrary supports the same APIs and functionality as the GSM library.

Library	Constant (#define)	Value	Description
Basic definition	phnLibDbType	'libr'	Database type ID
CDMA and GSM			
	phnLibCDMADbCreator	'PIL!'	CDMA library creator ID
	phnLibCDMADbName	''Phone Library''	CDMA library Database name
	phnLibCDMAName	''Phone Library''	CDMA library name

For Treo 600, Treo 650, and Treo 700p smartphones, the CDMA and GSM Telephony APIs are almost the same. However, because the actual radio architecture differs, Palm has two different libraries as defined in the following table. It is important to use the correct library for the correct radio architecture when using the Telephony APIs.

Library	Constant (#define)	Value	Description
Basic definition	phnLibDbType	'libr'	Database type ID
CDMA			
	phnLibCDMADbCreator	'HsCL'	CDMA library creator ID
	phnLibCDMADbName	''Phone Library''	CDMA library Database name
	phnLibCDMAName	''PhoneLib.prc''	CDMA library name
GSM			
	phnLibGSMDbCreator	'GSM!'	GSM library creator ID
	phnLibGSMDbName	''Phone Library''	GSM library Database name
	phnLibGSMName	''GSMLibrary.lib''	GSM library name

7.1.2 Using indicators

Indicators are available for all Palm OS-based Treo smartphones.

7.1.2.1 GSM Connected indicator

On a Treo smartphone, if you want your application to determine whether the smartphone is registered with a network, use the Telephony library function `PhnLibRegistered`.

You may want your application to update the GSM Connected indicator when the following phone events occur:

- `phnEvtRegistration`
- `phnEvtError`
- `phnEvtIndication`
  - `indicationNetworkAvailable`
  - `indicationStartingRadio`
  - `indicationResettingRadio`
  - `indicationPoweringOffRadio`

NOTE: To convey whether the phone is connected to a network, the simplest approach is to use the Palm system Signal gadget. (See **Section 13.2.4 on page 262** for more information.) It appears when the phone is connected to a network, and does not appear when the phone is not connected.

7.1.2.2 Operator’s name indicator

To retrieve the current operator’s name, use the Telephony library function `PhnLibCurrentOperator`.

You may want your application to update the Operator’s Name indicator when the following phone events occur:

- `phnEvtRegistration`
- `phnEvtError`
- `phnEvtIndication`
  - `indicationNetworkAvailable`
  - `indicationStartingRadio`
  - `indicationResettingRadio`
  - `indicationPoweringOffRadio`

7.1.2.3 Voicemail indicator

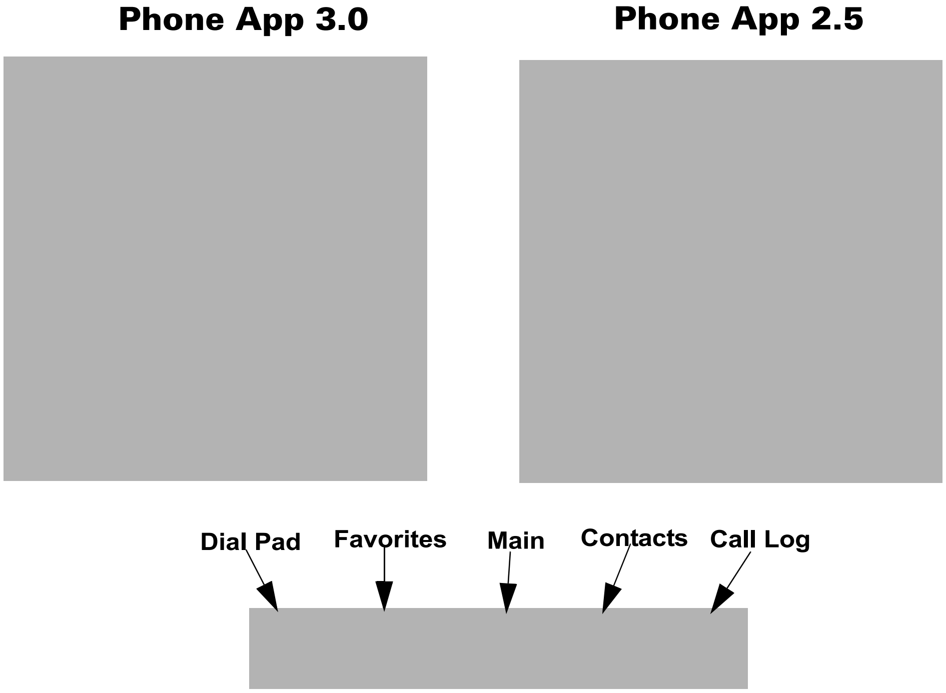
To retrieve the current status of Voicemail, use the Telephony library function `PhnLibBoxInformation`.

You should update the Voicemail indicator in your application when a `phnEvtVoiceMail` event occurs. `phnEvtVoiceMail` events occur when new voicemail messages are received and when users clear their voicemail.

7.2 Phone Application 3.0

The Phone Application has been updated to version 3.0 in Treo 680 smartphones. This update features a redesigned user interface that integrates the Main, Dial Pad, Favorites, Contacts, and Call Log views into a more intuitive user experience. Most changes to the application are transparent to developers, but a few items listed in this section are different.

The redesigned Phone Application 3.0 interface is shown here in comparison to Phone Application 2.5:



The Phone Application version 3.0 has been rewritten in ARM, where previously it was written in 68K. One difference for developers to note is that ARM uses little endian sequencing method, while 68K uses big endian sequencing.

NOTE: All features in this chapter will work with Phone Application 3.0 except where noted.

For more information on Phone Application views, see the User Manuals at the Palm Customer Service and Support website, **http://www.palm.com/us/support/**.

7.2.1 Overlapping gadgets

In Treo 680, support has been added to `PmSysGadgetLibrary` for overlapping gadgets. If a gadget is defined with the same boundaries as an existing gadget, it will be given a lower priority than the previously defined gadget, and will only be displayed if the other gadget is not visible.

7.2.2 Call in Progress gadget

In Treo 680, the overlapping gadget feature is used to display the new “Call in Progress” message above the operator status gadget. This message indicates that a call is in progress. This gadget is included in the five main Phone Application views: Main, Dial Pad, Favorites, Contacts, and Call Log.

7.3 Launching the Phone application in a specific view

This section details how to launch the Phone application on Palm OS-based Treo smartphones in a specific view. For more information, refer to the `Launch Commands` sample code in the Palm OS SDK.

7.3.1 Required headers

The headers required to launch the Phone application in a specific view are as follows:

- `Common/System/HsAppLaunchCmd.h`

  This header file includes Phone application launch commands and corresponding launch command parameter structures.

- `Common/System/HsCreators.h`

  This header file includes the Phone application creator type.

7.3.2 Launching the Phone application in Call Log view

To launch the Phone application in the Call Log view, use the `phoneAppLaunchCmdViewHistory` launch command as follows:

```
DmGetNextDatabaseByTypeCreator ( true,
                                 &searchState,
                                 sysFileTApplication,
                                 hsFileCPhone,
                                 true,
                                 &cardNo,
                                 &dbID);

err = SysUIAppSwitch( cardNo,
                      dbID,
                      phoneAppLaunchCmdViewHistory,
                      NULL /*paramsP*/);
```

7.3.3 Launching the Phone application in Dial Pad view

When launching the Phone application in Dial Pad view, you can do one of the following:

- Launch in Dial Pad view with no number filled in.
- Launch in Dial Pad view and prefill the number field in the Dial Pad view with a specified number without automatically dialing it.
- Launch in Dial Pad view and automatically dial a specified number.

7.3.3.1 Launching without a phone number

Use the following code as reference to launch the Phone application in Dial Pad view without pre-filling the number field:

```
DmGetNextDatabaseByTypeCreator ( true,
                                 &searchState,
                                 sysFileTApplication,
                                 hsFileCPhone,
                                 true,
                                 &cardNo,
                                 &dbID);

err = SysUIAppSwitch( cardNo,
                       dbID,
                       phoneAppLaunchCmdViewKeypad,
                       NULL /*paramsP*/);
```

7.3.3.2 Launching with the number field prefilled

NOTE: This feature will not work for Treo 680 smartphones with Phone Application 3.0.

Use the following code as reference to launch the Phone application in Dial Pad view and prefill the number field:

```
PhoneAppLaunchCmdDialPtrparamsP = NULL;
UInt16 size = sizeof(PhoneAppLaunchCmdDialType);
Char* numberP = < PHONE_NUMBER_TO_PREFILL_FIELD_WITH>;

// Setup a parameter block so the Phone application pre-fills
// a phone number in the Dial Pad number field

if (numberP)
  {
size += StrLen(numberP) + 1;
  }

paramsP = MemPtrNew (size);
MemSet (paramsP, size, 0);
```

```
paramsP->version = 1;
paramsP->failLaunchCreator = <YOUR_APP_CREATOR>;
if (numberP)
  {
    paramsP->number = MemPtrNew (StrLen(numberP) + 1);
    StrCopy(paramsP->number, numberP);
    MemPtrSetOwner (paramsP->number);
  }

MemPtrSetOwner (paramsP, 0);

DmGetNextDatabaseByTypeCreator ( true,
                                 &searchState,
                                 sysFileTApplication,
                                 hsFileCPhone,
                                 true,
                                 &cardNo,
                                 &dbID);

err = SysUIAppSwitch( cardNo,
                       dbID,
                       phoneAppLaunchCmdViewKeypad,
                       paramsP);
```

7.3.3.3 Launching and automatically dialing a phone number

Use the following code as reference to launch the Phone application in Dial Pad view and automatically dial a phone number:

```
PhoneAppLaunchCmdDialPtrparamsP = NULL;
UInt16 size = sizeof(PhoneAppLaunchCmdDialType);
Char* numberP = <THE_PHONE_NUMBER_YOU_WANT_AUTO_DIALED>;

// Set up a parameter block so the Phone application
// automatically dials a phone number

if (numberP)
  {
size += StrLen(numberP) + 1;
  }

paramsP = MemPtrNew (size);
MemSet (paramsP, size, 0);

paramsP->version = 1;
paramsP->failLaunchCreator = <YOUR_APP_CREATOR>;
if (numberP)
  {
paramsP->number = MemPtrNew (StrLen(numberP) + 1);
    StrCopy(paramsP->number, numberP);
    MemPtrSetOwner (paramsP->number);
  }

MemPtrSetOwner (paramsP, 0);
```

```
DmGetNextDatabaseByTypeCreator ( true,
                                 &searchState,
                                 sysFileTApplication,
                                 hsFileCPhone,
                                 true,
                                 &cardNo,
                                 &dbID);

err = SysUIAppSwitch( cardNo,
                      dbID,
                      phoneAppLaunchCmdDial,
                      paramsP);
```

7.3.4 Launching the Phone application in the Favorites view

To launch the Phone application in the Favorites view, use the `phoneAppLaunchCmdViewSpeed` launch command as follows:

```
DmGetNextDatabaseByTypeCreator ( true,
                                 &searchState,
                                 sysFileTApplication,
                                 hsFileCPhone,
                                 true,
                                 &cardNo,
                                 &dbID);

err = SysUIAppSwitch( cardNo,
                      dbID,
                      phoneAppLaunchCmdViewSpeed,
                      NULL /*paramsP*/);
```

7.4 Launching the Contacts application with the New Contact window open

On Palm OS-based smartphones, you can launch the Contacts application with the New Contact window open.

The headers required for launching the Contacts application with the New Contact window open are as follows:

- `Common/System/HsAppLaunchCmd.h`

  This header file includes Contact application launch commands and corresponding launch command parameter structures.

- `Common/System/palmOneCreators.h`

  This header file contains the Contacts application creator type.

To launch the Contacts application with the New Contact window open, use the `addrAppNotificationCreateNewRecord` launch command as follows:

```
notifyParamP = MemPtrNew(sizeof(SysNotifyParamType));

MemSet(notifyParamP, notifyParamSize, 0);

    notifyParamP->notifyType = addrAppNotificationCreateNewRecord;
    notifyParamP->broadcaster = <YOUR_APP_CREATOR>;
    notifyParamP->notifyDetailsP = NULL;
    notifyParamP->handled = false;

DmGetNextDatabaseByTypeCreator( true,
                                &searchState,
                                sysFileTApplication,
                                kpalmOneCreatorIDContacts,
                                true,
                                &cardNo,
                                &dbID);

err = SysUIAppSwitch(   cardNo,
                        dbID,
                        sysAppLaunchCmdNotify,
                        notifyParamP);
```

7.5 EvDO on Treo™ 700p smartphones

Unlike previous Treo smartphones, Treo 700p smartphones are capable of connecting to 1xEvDO networks. To develop applications for Treo 700p smartphones, keep the following points in mind.

During a data connection session on a 1xEvDO network, applications should give priority to an incoming voice call and allow it to interrupt the data session. Unlike Treo 650 CDMA smartphones, which only support 1xRTT network connections, on the Treo 700p smartphone it is possible for incoming calls to be received even when the data network is already connected and not dormant, as opposed to going directly to voicemail. Wireless applications should take this into account and perform the necessary work to clean up or record the states of the data transfer.

Upon voice call disconnect, applications that require an always-on data session could re-establish the data session and continue transferring data. In order to do this properly, applications should register for the following phone events:

- `phnEvtStartIncomingCall` - This phone event is broadcasted to registered applications when there is an incoming phone call
- `phnEvtDisconnectInd` - This phone event is broadcasted to registered applications when the voice call is disconnected
- `phnEvtDisconnectConf` - This phone event is broadcasted to registered applications when the voice or data call in conference mode (3-way calling) is disconnected

7.5.1 Detecting EvDO vs. 1xRTT

Because the Treo 700p smartphone is capable of both EvDO and 1xRTT connections, it may be useful for applications to determine when the device is using the EvDO connection and when it is using the 1xRTT connection.

When connecting to an EvDO network, the user is shown the icons displayed in the following table.

Carrier	Icon
Sprint	▲▼
Verizon	EV
Treo 700p Rest of World* carriers	EV

To be notified of which connection a Treo 700p is using, the application should register for `phnEvtDataSessionStatus`. Once it is registered for the `phnEvtDataSessionStatus` event, use its data field to obtain `dataSesstionStatus`'s session type. Then check against the `PhnDataServiceType` enumerations for EvDO.

NOTE: Please note the extra 't' in the spelling of `dataSesstionStatus`.

* For the current list of carriers included in the Treo 700p ROW release, visit the Palm Developer website at **http://pluggedin.palm.com** and navigate to the Treo 700p device page.

Here is an example of detecting the communication type:

```
switch(pEvt -> eventType)

{

   ...

   case phnEvtDataSessionStatus:

            if (pEvt -> data.dataSesstionStatus.sessionType == phnDataService1xEVDO)

                 // Data session has just switched to EVDO


            if (pEvt -> data.dataSesstionStatus.sessionType == phnDataService1xRTT)

                // Data session has just switched to 1xRTT

   ...

}
```

Please refer to the *Palm OS Platform API Guide* and to the `HsPhoneEvent.h` and `HsPhoneNetworkTypes.h` header files for more details of the structures referenced in the previous example.

7.5.2 Troubleshooting incoming voice calls

If you application is not handling incoming voice calls correctly, you may see the following symptoms:

- The voice call goes to voicemail, but the smartphone briefly displays an incoming call dialog, then displays a missed call dialog.

  This happens because the incoming phone event is already coming through, but because the wireless application does not give up the handle on time, it is already too late for the Phone application to accept and connect the call.

- The wireless application freezes while waiting for data.

  This could happen if the wireless application is using a blocking socket with an infinite timeout, or does not abort when data stops transferring. When an incoming voice calls interrupts the data session, no more data can be sent or received. Applications must handle this appropriately by cleaning up, maintaining the state, registering for phone call disconnect events, and re-initializing variables.

CHAPTER 8

8. SMS

This chapter describes the SMS library usage model. *SMS* stands for Short Message Service. This service allows short text messages to be sent and received by your mobile phone. *NBS* stands for Narrow Band Socket. NBS is a special kind of SMS message. If an SMS message contains `//SCK <code>` it is treated as an NBS message.

8.1 What is the difference between SMS and NBS?

NBS messages on Palm devices are treated in a silent manner. The message is invisible to the user. An alert is shown every time an SMS message is received. No alert is shown to the user when an NBS message is received.

NBS messages can be silently deleted.

8.2 SMS library

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

The SMS Messaging application is the main interface to the SMS Database and SMS features on a device. In addition to the SMS application, you can create your own applications to receive, send, and manage SMS messages.

SMS is a useful way to wake up a device remotely and trigger specific actions defined by your application. For example, an SMS could trigger an email application to retrieve new email from a corporate server.

Technically, the SMS library is part of the Telephony library, but it is logically a separate unit. The SMS library relies on functionality from the Telephony library and uses similar methods.

This chapter describes some of the key features of the SMS library including:

- Sending messages
- Receiving messages
- Encoding
- Segmenting and reassembling messages
- Storing messages in a database

8.3 What is SMS?

The point-to-point SMS provides a means of sending short messages to and from a phone. SMS is implemented using a service center that acts as a store and forwarding center for short messages. The SMS library architecture described here generally applies to CDMA.

Two point-to-point services are defined in the SMS specification:

1. **Mobile originated messages -** These messages are transported from a phone to a service center. These messages may be destined for other mobile users or an email gateway.
2. **Mobile terminated messages -** These messages are transported from the service center to a phone. They messages may have originated from another phone or from a variety of other sources such as an email application or a website.

A single message sent on the SMS network is limited to 160 characters. Longer messages must be segmented.

8.4 Why use the SMS library?

The SMS library enables the sending and receiving of short messages from a smartphone to another SMS-enabled recipient.

On the Treo smartphones, these messages can be sent much more quickly than with a PPP connection. This is because SMS does not require an initial connection to an ISP. Connecting to an ISP can take up to 10 to 15 seconds, including modem negotiation time and user authentication.

NOTE: When sending an SMS message, the current SMS library architecture has a three- to four-second delay before finishing the sending API call. This is due to radio architecture latency.

Cost is another consideration for using SMS. A typical U.S. service provider charges 15 cents a minute for data service, but only 10 cents for a short message.

Additionally, SMS messages can be sent directly to a device. They do not require a client application to dial in to the network to check for new email; instead, the message is sent directly to the client application. The client can even receive an SMS message while a voice or data call is in progress.

8.5 Understanding the SMS library

The SMS library takes care of the low-level details of communicating with a device. All incoming messages are indicated to a registered application using launch codes. A successful or unsuccessful transmission of a message is also indicated using launch codes.

The SMS library handles the following functions for SMS messages:

- Sending
- Receiving
- Encoding

This function refers only to character encoding. Currently, only the GSM alphabet is supported. The GSM alphabet is different from the Palm OS® alphabet. Additionally, encryption and compression of messages are not supported in the current version of the SMS library.

NOTE: The current version of the SMS library handles text messages for both the GSM and CDMA versions of devices. All messages handled by the library are assumed to be text and are handled appropriately.

The `PhoneInterfaceLibrary` (previously the GSM library) can also handle binary messages, but the CDMA library cannot. If a client application wants to send binary data on CDMA, it must encode and decode the data properly.

Also, the CDMA version supports only 7-bit ASCII characters, 160 characters maximum*, no segmentation*.

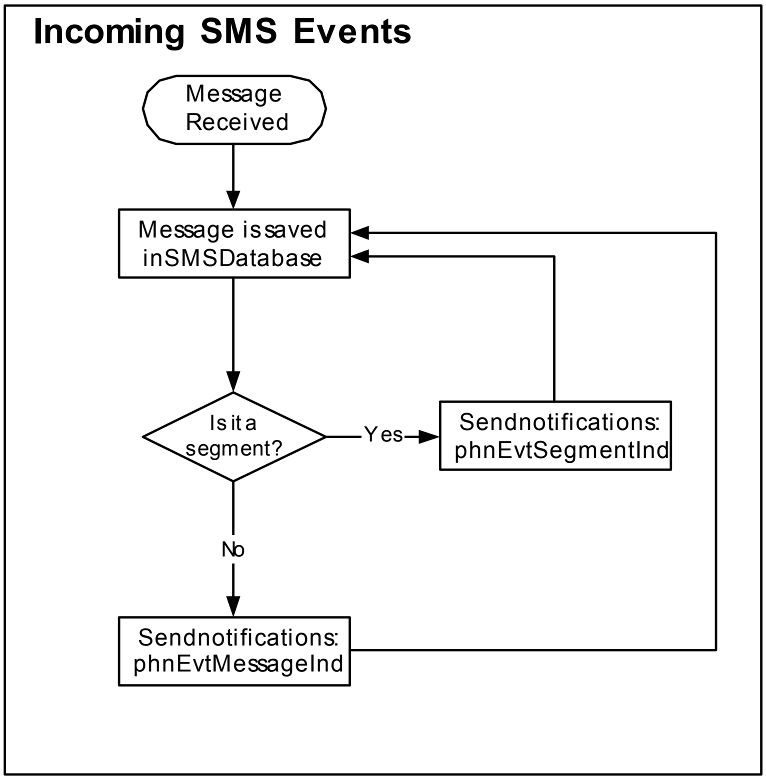
* On CDMA Treo 600, Treo 650, and Treo 700p smartphones

8.5.1 Incoming messages and message events

An application must register itself with the Telephony library in order to receive incoming message events. You register for the SMS service using `PhnLibRegister` where `services = phnServiceSMS`:

```
PhnLibRegister (libRef, appFileCreator, phnServiceSMS);
```

The following figure shows the workflow of incoming SMS messages.


Incoming SMS Events
Message Received
Message is saved in SMS Database
Is it a segment?
Yes
Send notifications: phnEvtSegmentInd
No
Send notifications: phnEvtMessageInd

Each incoming message is indicated to an application by sending a `phnEvtMessageInd` event unless it is a segment of a message. In that case, the library sends a `phnEvtSegmentInd` event. The library sends a `phnEvtMessageInd` only after all of a multisegmented messages's parts have been received.

If a new message is added to the database, the application is sent the `phnEvtSegmentInd` event to trigger an update of the message list. The new message is saved in the SMS database and stays there until it's deleted unless the message is a type NBS (Narrow Band Socket) message. In that case, the message is deleted after the `phnEvtMessageInd` notification is acknowledged by one of the registered applications.

8.5.2 Outgoing messages

A message is sent by creating a new outgoing message using `PhnLibNewMessage` and filling in the desired recipient and message text. More than one recipient may be specified if the message is being sent to a group.

The message text may be longer than 160 characters. The library segments and reassembles such messages automatically so that the segmentation is transparent to the user of the SMS library.

8.5.3 Handling the GSM alphabet and Palm OS® alphabet

A special alphabet is used to encode SMS messages. The text of all incoming and outgoing messages stored in the message database is encoded using standard Palm OS encoding.

When a message is received, its encoding is changed from the GSM alphabet to the Palm OS alphabet. Any missing characters are replaced by substitution strings. A message is encoded in the GSM alphabet when being sent. Optionally, substitution strings may be converted to their character equivalents. The following table shows the character with its corresponding substitution string.

GSM	Palm OS	GSM	Palm OS
Δ	\Delta	Π	\Pi
Φ	\Phi	Ψ	\Psi
Γ	\Gamma	Σ	\Sigma
Λ	\Lambda	Θ	\Theta
Ω	\Omega	Ξ	\Xi

NOTE: The client application should not assume that a message contains 160 characters or fewer. Even if the actual message contains fewer than 160 characters, the message's text may be longer than 160 characters because characters that are not available on Palm OS are replaced by substitution strings.

8.5.4 Message segmentation

Most mobile phones allow the user to compose messages of no more than 160 characters; however, in GSM, the Messaging application sets the maximum length of a message to 650 characters. Messages that contain more that 160 characters are segmented.

The SMS library supports three types of segmentation schemes. Two of these methods are text-based while the third is binary. The binary method is preferred, because it allows for the reassembly of messages even if they arrive out of order.

8.5.4.1 Binary segmentation

The binary segmentation scheme works by adding a UDH (user data header) to each segment of a segmented message. The UDH contains a reference number to identify the message, the segment's index, and the total number of segments. Because the UDH takes 6 bytes, the number of characters in a message is reduced to 154.

Using the UDH, it is possible to reassemble messages from their segments even if the segments arrive out of order. The reassembly of incoming segmented messages is transparent to the client application. The client application may retrieve a message's text even if all the segments have not been received. Use `PhnLibGetText` to retrieve the message.

When the first segment of a segmented message is received, the client receives a `phnEvtSegmentInd` event after the segment has been stored in the database. When all of the segments have been received, a `phnEvtMessageInd` event is sent.

Automatic reassembly of messages works if all parts of the message are received within six hours after the first segment is received. After six hours, segmentation information is deleted by the library.

NOTE: The automatic reassembly of messages is a GSM feature. The CDMA version of products does not support automatic reassembly of segmented messages.

8.5.4.2 Textual segmentation

The SMS library supports two textual segmentation schemes. One segmentation scheme is used only for sending segmented messages to an email gateway. The other is used for segmenting regular text messages.

The segmentation scheme used to send messages to an email gateway does not allow the reassembly of the message if the messages arrive out of order. This scheme is a recognized GSM standard. It works by inserting "+" signs into the message's text. The length of an "inner" segment is reduced to 158 characters, and the length of the first and last segments is 159 characters. A message with three parts is segmented as follows:

```
First segment+
+Inner segment+
+Last segment
```

NOTE: For messages sent to an email gateway, the recipient's address adds to the message's length.

This segmentation scheme is used exclusively to send messages to an email gateway. The SMS library does not use this scheme to send text messages to normal subscribers.

The scheme for segmenting regular messages adds header information to every segment. The header is of the form *i/k*, where *i* is the segment's index and *k* is the total number of segments. The length of the header is not constant and is dependent upon the values of *i* and *k*. A message with three parts is segmented as follows:

```
1/3 First segment
2/3 Second segment
3/3 Last segment
```

The library does not attempt to reassemble messages when they are sent using this segmentation scheme. The application must reassemble the messages as needed. The reassembly is not automatically done by the library because the header does not indicate clearly to which message a segment belongs.

8.5.5 Message database

All incoming and outgoing SMS messages are stored in a message database on the device except for NBS-type messages. NBS message content is stored in the `paramBlock` when the application receives the notification.

An outgoing message stored in the database may be sent using the SMS library. Incoming messages received are also stored in this database. The SMS library handles only messages stored in this database. If you want an application to store the messages in a separate database, you must have the application copy the messages from the SMS database.

This section describes the fields for a single SMS message. The standard Palm OS routines for databases are used to manage these records.

IMPORTANT: A message's internal structure is private and not simple. Client applications should modify data in an SMS message only by using the functions provided by the SMS library.

A record in the message database has four separate parts. The first part has a fixed size, and the size of the other three parts is variable. As a result, a complete record has a variable size.

The four separate parts of a message database record are as follows:

- Header information
- Segmentation information
- Address information
- Message text

8.5.5.1 Header information

The first part of each record is the message header information. It has a fixed size. The fields in the header information section of the record are used to store flags and determine the size of the *size[]* field. Some fields are not used in all messages. For example, *validity* is used only for outgoing messages, and *segments* is used only for incoming messages.

8.5.5.2 SMS header structure

```
typedef struct  {
  UInt32 owner;
  SMSMessageType type;
  SMSMessageStatus status;
  UInt32 date;
  UInt32 flags;
  UInt8 validity;
  UInt8 segments;
  UInt16 size[1];
}SmsHeader;
```

See the *Palm OS Platform API Guide* for details on each field.

8.5.5.3 Segmentation information

The second part of a message record contains segmentation information. This part is variable in size and is accessed through the `size` array. Each segment's size is represented with 2 bytes.

8.5.5.4 Address information

The third part of a message record contains address information. This part is variable in size. The size of this address information is defined in the `size` field. The address information contains the data in a `PhnAddressList` structure.

8.5.5.5 Message text

The fourth part of a message record is the actual text of the message. This part is variable in size. The size is calculated by taking the size of the complete message and subtracting the sizes of the first three parts. All characters in this part of the record are considered to be Palm OS encoded. For outgoing messages, the characters are converted to the GSM alphabet when the message is sent.

NOTE: The conversion of the text is done just before the message is sent. The result of the conversion is not stored with the message. If sending a message fails, the text is converted again when the message is sent again.

8.6 Launching SMS from the New SMS screen

On Treo smartphones, to launch the SMS application in the New SMS screen, use the Palm OS system Helper API:

```
HelperNotifyEventType   param;
HelperNotifyExecuteType execute;
SysNotifyParamType      notifyParam;
Err                    err = errNone;

MemSet(&param, sizeof(HelperNotifyEventType), 0);
param.version = kHelperNotifyCurrentVersion;
param.actionCode = kHelperNotifyActionCodeExecute;

execute.helperAppID = 0;  // Setting the helperAppID to 0 means
                           // "use default helper"
execute.serviceClassID = kHelperServiceClassIDSMS;

// If you want the New SMS screen to be prefilled with a phone number
// or email address, then set execute.dataP to the string (Char*)
// representing the phone number or email address.  If you do not
// want the New SMS screen to be prefilled with a number, set
// execute.dataP to NULL

execute.dataP = NULL;
execute.displayedName = NULL;
execute.detailsP = NULL;
param.data.executeP = &execute;

MemSet (&notifyParam, sizeof(SysNotifyParamType), 0);
notifyParam.broadcaster = <YOUR_APP_CREATOR>;
notifyParam.notifyType = sysNotifyHelperEvent;
notifyParam.notifyDetailsP = &param;
err = SysNotifyBroadcast(&notifyParam);
```

CHAPTER 9

9. System Extensions

This chapter provides details about the system extension features and APIs available in the Palm OS® SDK.

9.1 Transparency API

Available on:

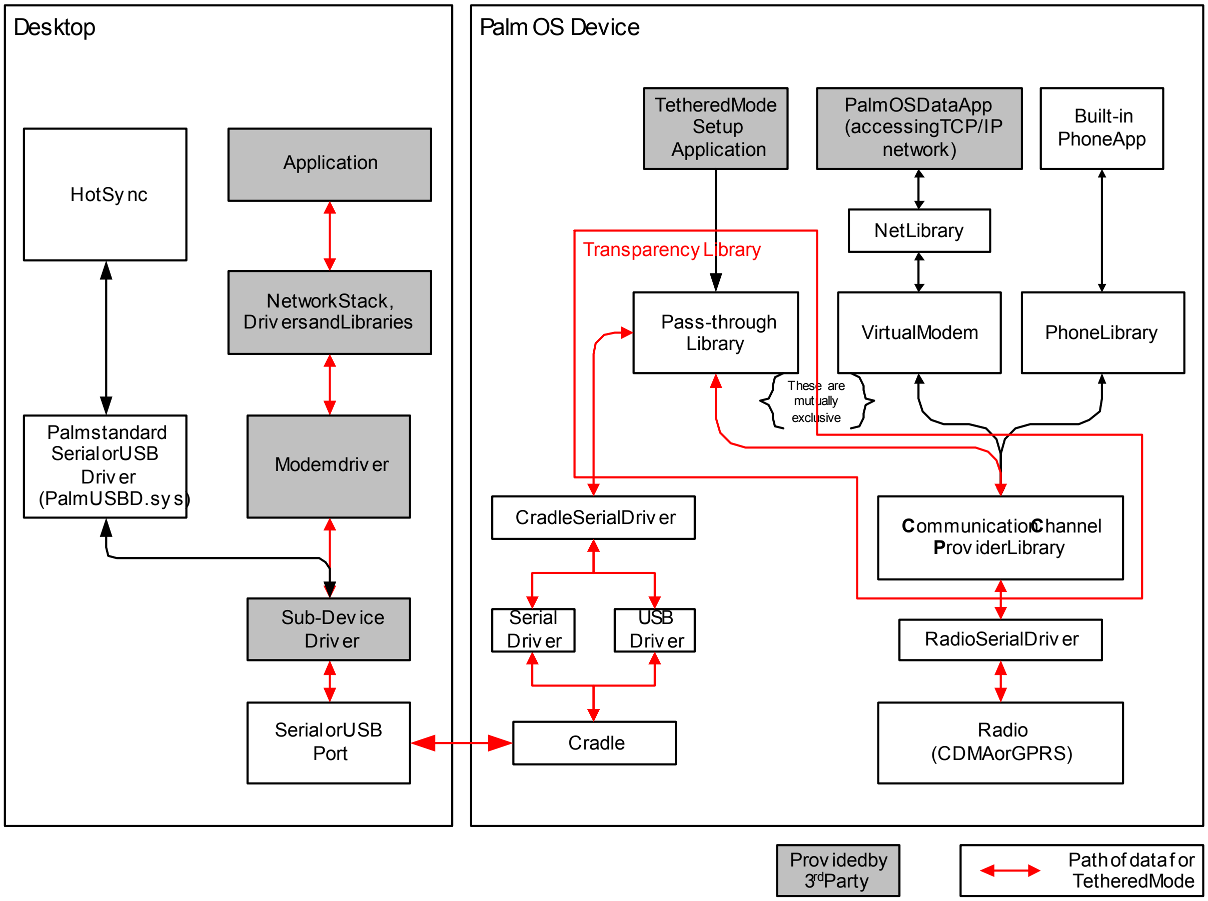
- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

The Transparency library is used to connect the radio modem directly to one of the data ports on a Treo smartphone.

The library is the preferred method to enable tethered mode in an application because it configures the radio in the right mode to transmit and receive data to the network. The Transparency API is preferable to directly trying to control the radio through its lower level serial driver and through the AT command.

It supports diagnostics or tethered mode. It does not support both simultaneously. See the *Palm OS Platform API Guide* for more details.

The following figure shows a possible architecture that one could use to connect the Treo smartphone modem to a desktop using tethered mode and the Transparency library.



9.2 File Browser API

Available on:

- LifeDrive™ mobile manager
- Tungsten™ T5 handhelds

The File Browser API uses the Exchange Manager registry with some new enums defined by PalmSource:

```
#define exgRegEditCreatorID        0xff7b  // creator ID registry
#define exgRegEditExtensionID      0xff7d  // filename
                                             extension registry
#define exgRegEditTypeID           0xff7e  // MIME type registry
```

These constants are defined in `FileBrowserLibCommon.h`. Applications should register using `ExgRegisterDatatype` with ID `exgRegEditExtensionID`. The description of a file type being registered should look like this:

“<Icon 1000,1100>Image”

The first number is the ID of a bitmap family resource for the large icon provided by the application. The second number is the ID of the small icon provided by the application. You can skip the second number if the small icon ID is one greater than that of the large icon:

“<Icon 1000>Image”

The text after the close-angle-quote is the description string that would normally be used. It isn’t currently exposed in the File Browser UI, but it could easily be exposed later on, so be sure to include a description.

The size of the large and small icons should match the dimensions of the large and small application icons in the Applications View: 22 x 22 pixels and 15 x 9 pixels. These dimensions are expressed in normal density; the double-density dimensions are 44 x 44 and 30 x 18. The absolute maximum dimensions supported by the File Browser and Favorites applications are 32 x 22 and 16 x 11—64 x 44 and 32 x 22 in double-density. As always, be sure to include a normal-density bitmap as the first element in each bitmap family.

When the File Browser wants to open a file, it does so through the Exchange Manager. Applications typically receive `sysAppLaunchCmdExgReceiveData` to open files. The application won’t receive a `sysAppLaunchCmdExgAskUser` sublaunch but will receive a `sysAppLaunchCmdExgReceiveData` sublaunch, just as it would for incoming beams.

Applications should check the name field in the socket to see if it is a “file:” URL. If so, the application should set the `goToCreator` field in the socket to its own creator ID. It can then proceed as if a beam was received, but it shouldn’t create a new record. Instead, it should store the parsed data somewhere temporarily and set the `goToParams` struct in the socket to refer to this temporary area.

Alternatively, once you know you’re handling a “file:” URL, you can have your application stop using the Exchange Manager. Have your application put the URL into a feature pointer and set the `goToCreator`. Then, when the application receives the `sysAppLaunchCmdGoTo` launch command, you can have the application look for this feature pointer. If the feature pointer is found, you can have the application parse the URL to get a `volRefNum` and path. Then you can have the application proceed as described earlier for `kSysAppLaunchCmdOpenFile`. This is the approach used in the sample application. The code to parse the “file:” URLs is included in the File Browser API library. The sample application available in the Palm OS SDK includes wrappers around this entry point to make the code easier to use.

The wrapper function is as follows:

```
static Char *ParseFileURL (const Char *url, UInt16 *volRefNumP)
   {
      Char *path = NULL;
      UInt16 refNum;
      Err err;

      err = SysLibFind(kFileBrowserLibName, &refNum);
      ErrFatalDisplayIf(err, "Can't find file browser lib");
      err = FileBrowserLibOpen(refNum);
      ErrFatalDisplayIf(err, "Can't open file browser lib");
      FileBrowserLibParseFileURL(refNum, url, volRefNumP, &path);
      FileBrowserLibClose(refNum);
      return path;
```

The entry point used in this wrapper function is:

```
Err FileBrowserLibParseFileURL( UInt16 refNum, const Char *urlP,
      UInt16 *volRefNumP, Char **filePathP );
```

It takes a “file:” URL as input and outputs a `volRefNum` and path. It also allocates the path. The caller is responsible for freeing it. If the URL can’t be parsed for any reason, it passes back `vfsInvalidVolRef` for the `volRefNum` and `NULL` for the path.

A `fileType` parameter is included in the Open and Save As dialog box APIs. Pass `NULL` for the `fileType` parameter to go to the root directory when switching volumes. The initial folder is the root directory unless you specify a root folder. To specify an initial file name, you must use a full path.

Pass an extension with the initial period or a MIME type to use the registered default directory for the specified file type. The default directory is used when switching volumes and when no initial directory is specified in the initial path.

For example, you could invoke the Save As dialog box with “.jpg” or “image/jpgeg” as the `fileType`, “MonaLisa.jpg” as the initial path, and the volRefNum for the SD card. The initial directory would then be /DCIM, and the file name would be pre-populated with `MonaLisa.jpg`. When the user presses the internal drive button, the/ Photos and Videos directory of the internal drive is displayed. When the user presses the internal drive button again, the root directory is displayed.

By registering with the Exchange Manager and handling `sysAppLaunchCmdExgReceiveData`, an application can ensure that its files appear with the correct icon in Files, and that selecting these files opens them in the application. This is the most important aspect of the File Browser API, but there is another side to it as well. Applications can use the File Browser library to display an Open or Save As dialog box. This is most appropriate for applications that attempt to mimic their desktop counterparts. These dialog boxes should not be used for other applications.

The File Browser library’s entry points are declared in `FileBrowserLib68K.h`.
To display the Open and Save As dialog boxes, only four of these entry points are required: `FileBrowserLibOpen`, `FileBrowserLibClose`, `FileBrowserLibShowOpenDialog`, and `FileBrowserLibShowSaveAsDialog`.
Some constants defined in `FileBrowserLibCommon.h` are also needed.

For example, to display an Open dialog box:

```
UInt16 refNum;
UInt16 volRefNum;
Char *path = MemPtrNew (kFileBrowserLibPathBufferSize);
const UInt16 numExtensions = 1;
const Char *extensions[numExtensions] = {"txt"};
Err err;

ErrFatalDisplayIf (path == NULL, "Can't alloc path");

// Find the library and call the Open function. There is no need
// to load the library.
err = SysLibFind (kFileBrowserLibName, &refNum);
ErrFatalDisplayIf (err, "Can't find file browser lib");
err = FileBrowserLibOpen (refNum);
ErrFatalDisplayIf (err, "Can't open file browser lib");

// If you want to start with a particular volume, set volRefNum
```

```
   // to that volume. Otherwise, use vfsInvalidVolRef.
   volRefNum = vfsInvalidVolRef;

   // If you want to start in a particular directory, set path to
   // that directory. Otherwise, use an empty string. You can include
   // a filename as well as a directory if you want a file to be
   // selected initially. You can specify a filename with no path, but
   // only if you specify a fileType.
   path[0] = chrNull;

   // Display the Open dialog box. Returns whether a file was selected.
   if (FileBrowserLibShowOpenDialog (refNum, &volRefNum, path,
      numExtensions , extensions,    // filter to show only these files
      "text/plain",                  // use default folder for this
                                          fileType
      "Select Item",                 // title for the dialog
      kFileBrowserLibFlagNoFolders)) // pick a file, not a folder
   {
      // Do something with volRefNum and path.
   }

   // Clean up. There is no need to remove the library.
   MemPtrFree (path);
   FileBrowserLibClose (refNum);
```

The File Browser library is pre-loaded when the device is reset, so you just need to find it and call the `FileBrowserLibOpen` and `FileBrowserLibClose` entry points. You don't need to call `SysLibLoad` or `SysLibRemove`.

The `volRefNum` and path are used both as input and as output. For input, you can do the following:

- Not specify a volume or a path (`vfsInvalidVolRef` and `""`)
- Specify a volume only
- Specify a volume and a directory but no file name
- Specify a volume, a directory, and a file name
- Specify a volume and a file name but no directory
- Specify a file name but no volume or directory

The last two options require that a `fileType` be specified as well. If the user selects a file or folder and selects OK, the volume and path of the selected file or folder is passed back in the `volRefNum` and `path` parameters and the function returns `true`. Otherwise, the parameters are left as they are and `false` is returned.

If a list of extensions is passed in, only files with one of the specified extensions are listed, along with all the folders. Use `0` for `numExtensions` and `NULL` for `extensions` to disable filtering.

You can specify a MIME type or an extension for the `fileType`. Be sure to include a period before the extension: `.txt`. If a `fileType` is specified, the Open dialog box automatically navigates to the default directory for the specified `fileType` when the user switches volumes. The default directory for a `fileType` can be set using `VFSRegisterDefaultDirectory`. It can be different for different media types—for example, SD/MMC as opposed to the internal drive. If the initial path doesn't include a directory and a `fileType` is specified, the default directory for the specified `fileType` is used. A `fileType` should be specified whenever possible; it makes it faster for the user to navigate to the appropriate directory. If you use `NULL` for the `fileType`, the user is taken to the root directory when switching volumes.

The title of the Open dialog box depends upon flag settings specified by the client application. If `NULL` is passed in for the title, the Open dialog box is given the default title specified by the flag settings in the client application.

You can use various combinations of the following flags defined in `FileBrowserLibCommon.h`:

- `kFileBrowserLibFlagOneVolume`—no volume picker
- `kFileBrowserLibFlagNoFiles`—no files, only folders
- `kFileBrowserLibFlagNoFolders`—no folders, only files

These flags should be logically combined. For example: `kFileBrowserLibFlagOneVolume | kFileBrowserLibFlagNoFiles`. Use zero to specify no flags. If you use `kFileBrowserLibFlagOneVolume`, be sure to specify a volume because the user won't be allowed to switch to any other volume. If you use `kFileBrowserLibFlagNoFiles`, the user is only allowed to pick a folder. Files won't be shown at all. If you use `kFileBrowserLibFlagNoFolders`, the user is only allowed to pick a file but can still navigate into folders to find a file. If you don't use either of these flags, the user is allowed to pick a file or a folder.

`FileBrowserLibShowSaveAsDialog` is very similar to `FileBrowserLibShowOpenDialog`. In addition to allowing the user to navigate to any directory, it includes a field where the user can enter a file name. If the specified path includes a file name, it appears in this field. An additional parameter for the default extension, if specified, is appended to the file name when the user does not enter an extension. Use `NULL` for the default extension to use the file name exactly as it is entered.

The flags used for the Save As dialog box are as follows:

- `kFileBrowserLibFlagOneVolume`—no volume picker
- `kFileBrowserLibFlagPromptOverwrite`—warn before replacing
- `kFileBrowserLibFlagRequireExtension`—only given extensions
- `kFileBrowserLibFlagNoNewFolder`—no New Folder button

The first flag is used in the same way as it is for the Open dialog box. Use `kFileBrowserLibFlagPromptOverwrite` if you want to warn the user when a file name of an existing file in the selected directory is selected. This is preferable to checking for duplicate file names afterward because it allows the user to edit the file name or choose a different directory. Use `kFileBrowserLibFlagRequireExtension` if you want to force the user to use a specific extension or one of several extensions. Pass in the list of legal extensions in the `numExtensions` and `extensions` arguments. Use the `kFileBrowserLibFlagNoNewFolder` flag if you want to prevent the user from creating new folders. This hides the New Folder button.

The `FileBrowserLibShowSaveAsDialog` function doesn't actually save anything. It just prompts the user for where to save the file and what to call it. It's up to you to do the following:

- Create the file, truncating the existing file, if any.
- Write to the file.
- Close the file.

Similarly, `FileBrowserLibShowOpenDialog` doesn't open the file or folder selected by the user. It's up to you to do the following:

- Open the file or folder.
- For folders, enumerate the contents.
- Close the file or folder.

9.3 Smart Text Engine API

Available on:

- LifeDrive™ mobile manager
- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

The Smart Text Engine (STE) shared library enables applications to implement rich text display and processing. The STE is designed to allow any application to automatically identify, render, and link web URLs, email addresses, and phone numbers to appropriate applications. For example, selecting a phone number in SMS dials the number, or selecting a URL in an email launches that URL in the web browser. The STE library offers a high level of convenience for end users as it seamlessly links information and communication applications.

The STE library performs three basic functions: parsing, rendering, and displaying. Applications supply the STE with a text stream object and specify the area on the screen to render. This area can include a scroll bar that is used to scroll the contents of a multi-page display. The STE passes the text through its three layers to create, display, and activate links.

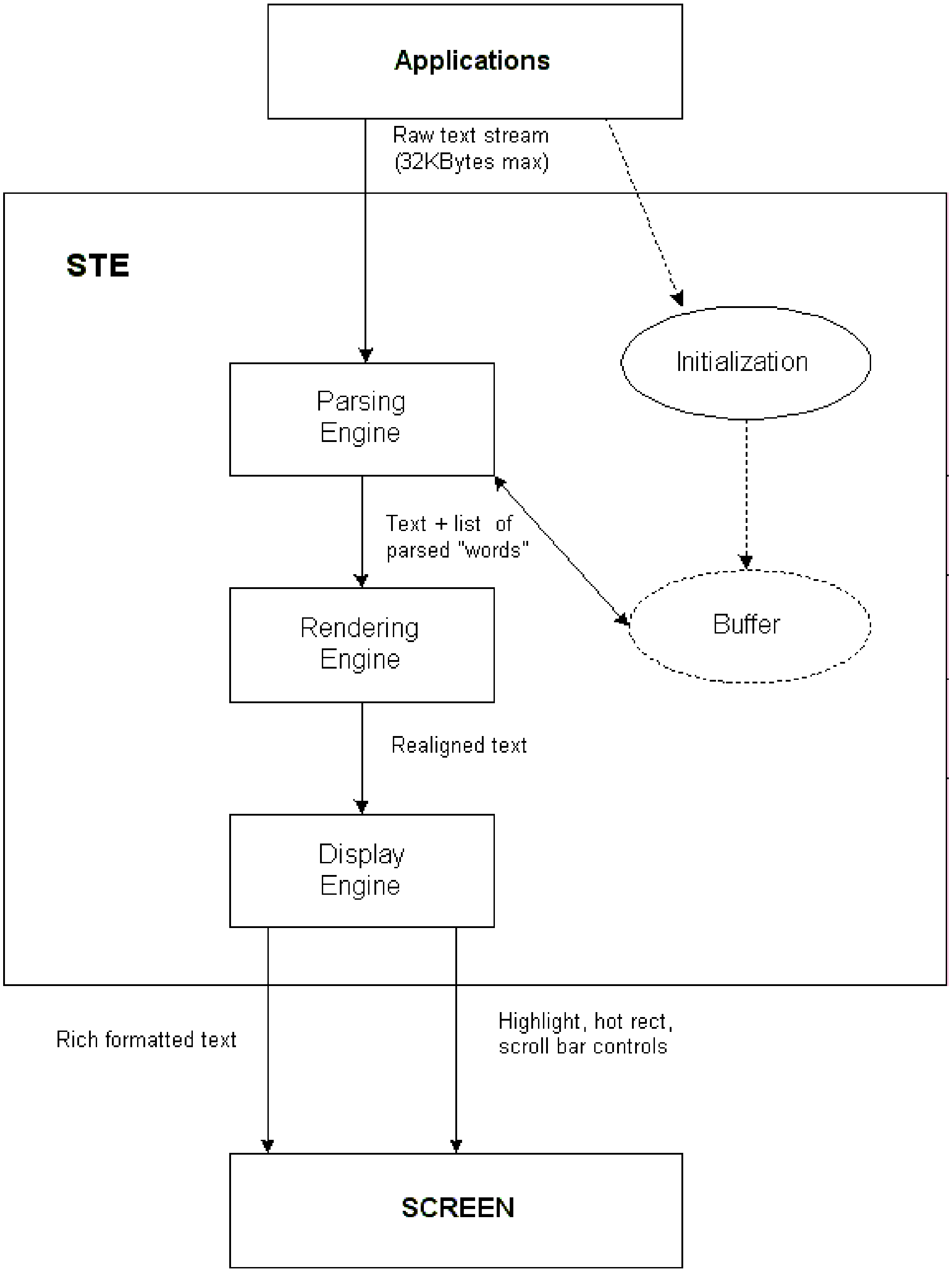
The STE library solves the traditional Palm OS software limitations of the text field: black- and-white display with one font style. Using the STE library, applications can mix bold and standard fonts, mix colors, add graphics, and even add emoticons.

In addition to the information provided here, you can also refer to the STETest.zip sample code file in the Palm OS SDK for information on how to use this library.

Refer to the *Palm OS Platform API Guide* for detailed information about each of the STE APIs.

9.3.1 STE architecture

The STE includes several components—the parsing engine, the rendering engine, the display engine, event handling, and text selection. This modular design allows new components to be added easily. For example, if an HTML parser is needed, it can be added to the STE library without major architectural modifications. The following figure shows the architecture of the STE.



9.3.1.1 STE parsing engine

The parsing engine is responsible for finding the URLs, email addresses, and phone numbers within text. It also detects emoticons and special Smart Text delimiters or tags that affect the text format display. This allows applications to quickly detect whether the text has STE delimiters.

Scanning for URLs, email addresses, and phone numbers requires complex processing in the STE library. A specific algorithm is used to check the validity of characters in URL and email addresses text strings. Checking phone numbers is more complex because it involves appending multiple numbers separated by spaces to compile the final phone number. A basic matching algorithm is used to find emoticons with one special condition: all smileys must have either a colon (:) or semicolon (;) for the eyes.

Smart Text delimiters are identified by the characters "//STE" followed by additional characters that define the exact properties of the delimiter.

The parsing engine works by separating the string into separate *words*—groups of characters separated by a space character. Each of the words is pre-scanned to check whether it is a potential URL, email address, phone number, or emoticon type. If the word qualifies as any of these types, it is then further scanned to see if it matches the requirements for that type. Phone number checks require scanning for consecutive groups of words to form the final complete phone number.

The result of the parsing engine is a list of parsed items. This list is then used by the rendering engine to format and display the rich text.

9.3.1.2 STE rendering engine

The rendering engine takes the text input, along with the parsed info list, and determines exactly where the text belongs in the list. If there is no formatting involved, this is very much like displaying text in a text field. When special objects and formatting are added to text, the rendering process becomes more complex.

The basic algorithm goes through the text string and determines whether the next word can fit on the current line in the display. All the STE text string display properties are considered when determining fit. The font can be bold, normal, or colored. There can be emoticons and other bitmaps displayed, as well. The different widths of the text and graphics in different display modes are also considered when calculating fit. The engine keeps track of the actual text that is displayed on each line to process text selection and manipulation.

After all the text has been parsed and rendered, it can be displayed.

9.3.1.3 STE display engine

The display engine takes the data structures created by the rendering engine and displays the correct data at the correct location in the list. The display engine also controls text highlighting and scroll bar positioning.

9.4 REM Sleep API

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Palm® T|X handheld

The REM Sleep API allows applications on a smartphone to run while the display is off and the keyboard and digitizer are disabled. The REM Sleep API is on the Treo 600, Treo 650, and Treo 700p smartphones, but not on Tungsten™ or Zire™ handhelds.

REM sleep mode is initiated at the point when the smartphone would otherwise go into deep sleep mode. You should already be familiar with the sleep-deferral and notification mechanisms in the Palm OS before using the REM Sleep API. For more information on notifications, refer to the "Notifications" section, in particular the "Sleep and Wake Notifications," in the *Palm OS Programmer's Companion, vol. I*.

The smartphone may be put to sleep for two reasons: The user presses the power button or another button that functions as a power button, or the smartphone remains idle for the duration set as the auto-off timeout value.

9.4.1 Normal sleep deferral

The process of a smartphone going to sleep begins with a virtual key event. In the case of a user pressing the power button, a `vchrHardPower` event occurs. In the case of the auto-off timeout value being reached, a `vchrAutoOff` event occurs.

When the initiating event is processed by SysHandleEvent, a sleep-request notification is broadcast to all registered recipient applications. If any recipient sets the `deferSleep` member of the notification parameter block, the system does not go to sleep and the smartphone continues to run.

When sleep is deferred, the application or library responsible should enqueue `vchrResumeSleep` after it has finished doing whatever caused it to defer the sleep. The event `vchrResumeSleep` works similarly to `vchrHardPower` and `vchrAutoOff` in that it causes the sleep-request notification to be broadcast. Another application may then set the `deferSleep` member, causing the defer process to continue.

If the sleep request is not deferred, the system enqueues a virtual key event with the `vchrPowerOff` character. When the `vchrPowerOff` event enters SysHandleEvent, a sleep notification is broadcast to inform its recipients that the system is going to sleep, and the system is immediately put to sleep thereafter.

9.4.2 REM sleep mode

REM sleep mode occurs in the time between when the sleep-request notification occurs and when the sleep notification occurs. If the sleep-request notification is not deferred, the display is turned off and then a REM-request notification is broadcast (`hsNotifyRemSleepRequestEvent`). The REM-sleep-request notification has the exact same parameter block as the sleep-request notification. A recipient of the notification that needs REM sleep simply sets the `deferSleep` member in the parameter block. If the `deferSleep` parameter is set in the REM-sleep-request notification, the system broadcasts a REM notification to inform recipients that REM sleep has been entered.

The expectation is that whatever is happening during REM sleep is a transient condition that will in most cases lead to deep sleep shortly thereafter. To accommodate this expectation, the REM-request notification is periodically resent until it is not deferred. The current implementation resets the auto-off timer to expire a few seconds after entering REM sleep so that the whole REM-request notification process repeats periodically. You should not rely on this particular implementation, but instead defer the REM request as often as it comes.

IMPORTANT: An application has to register for REM sleep notification (`hsNotifyRemSleepRequestEvent`) and normal sleep (`sysNotifySleeprequestEvent`) notification to support any kind of sleep deferral.

9.4.3 Detecting REM sleep mode

If you need to determine whether the smartphone is already in REM sleep while handling a REM-request notification, you'll have to register for the sleep-request notification and use `HsAttrGet()` to obtain the value of `hsAttrDisplayOn`. By the time the REM request is broadcast, the display is already turned off, and the sleep reason in the REM request simply reflects whatever the sleep reason was from the preceding sleep request.

9.4.4 LCD on/off notification

The Treo 680 and Treo 700p smartphones include a notification that lets an application know when the LCD screen has been turned on or off.

To register for this notification, please use:

```
SysNotifyRegister(myAppCardNo, myAppDbID, kPalmCreatorIDLcdState, 0,
sysNotifyNormalPriority, 0);
```

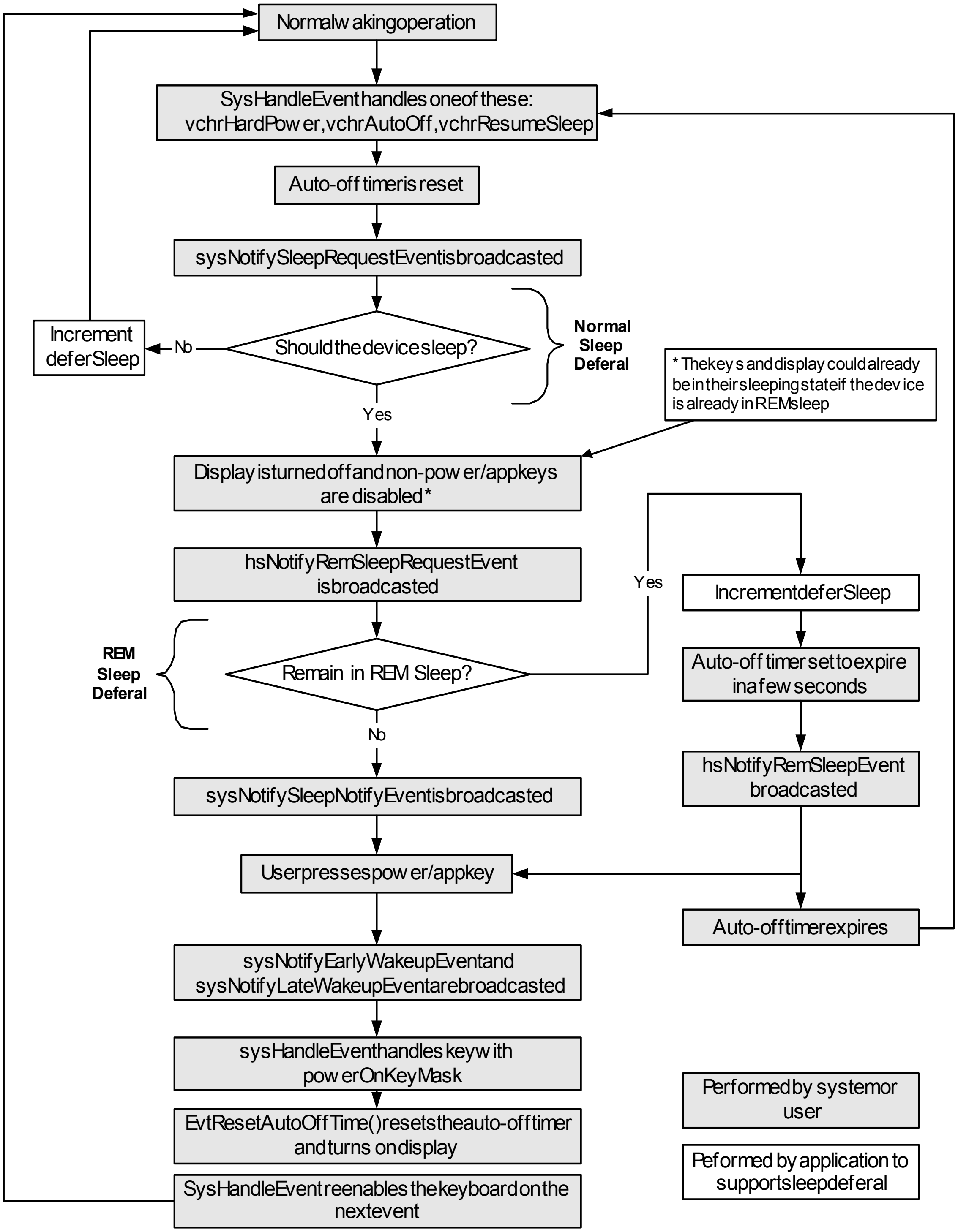
When receiving a notification, use the following code (in PilotMain) to check for the LCD on/off notification:

```
-
  case sysAppLaunchCmdNotify:

    pNotify = (SysNotifyParamType *) cmdPBP;

    switch (pNotify->notifyType)
    {
        case kPalmCreatorIDLcdState:
        if (pNotify->notifyDetailsP == 0)
        {
            // LCD is off
        }
        else
        {
            // LCD is on
        }
        break;
   }
```

The notification is located in the `palmOneCreators.h` header file, and can also be found in the *Palm OS Platform API Guide*.

Because the display information is sent as a notification, when an application receives this notification, the display state may have already changed. For this reason, if an application is interested in the current state of the display, it may be useful for the application to poll the display state. See **Section 9.4.3** for information on using `HsAttrGet()` to obtain the value of `hsAttrDisplayOn`.

The following figure shows the sleep mode flowchart of events.


Normal waking operation
SysHandleEvent handles one of these:
vchrHardPower, vchrAutoOff, vchrResumeSleep
Auto-off timer is reset
sysNotifySleepRequestEvent is broadcasted
Increment deferSleep
No
Should the device sleep?
Normal Sleep Deferal
Yes
* The keys and display could already be in their sleeping state if the device is already in REM sleep
Display is turned off and non-power/app keys are disabled*
hsNotifyRemSleepRequestEvent is broadcasted
Yes
Increment deferSleep
REM Sleep Deferal
Remain in REM Sleep?
Auto-off timer set to expire in a few seconds
No
hsNotifyRemSleepEvent broadcasted
sysNotifySleepNotifyEvent is broadcasted
User presses power/app key
Auto-off timer expires
sysNotifyEarlyWakeupEvent and sysNotifyLateWakeupEvent are broadcasted
sysHandleEvent handles key with powerOnKeyMask
Performed by system or user
EvtResetAutoOffTime() resets the auto-off timer and turns on display
Peformed by application to support sleep deferal
SysHandleEvent reenables the keyboard on the next event

9.4.5 Waking up from REM sleep mode

While the system is running in REM sleep mode, it may be necessary to “wake up” and turn the display on, which you can accomplish by calling `EvtResetAutoOffTimer`.

When displaying any UI that must be seen by the user immediately, you should call `EvtResetAutoOffTimer` to ensure that the display is on. However, it’s likely that a user won’t even pay attention to their smartphone that is in REM sleep mode. If the user must be notified, consider using the Attention Manager, instead.

In order to maintain the expected user experience, while in REM sleep mode the keyboard and touch screen are set to behave as if the smartphone is sleeping. That is, the touch screen is disabled and only those keys that would normally wake the smartphone are active. If one of the keys that would normally wake the smartphone is pressed, it generates a key event with the `poweredOnKeyMask` modifier bit set. When `EvtGetEvent` sees a key event with this bit set, it turns the display back on by calling `EvtResetAutoOffTimer`.

A version of REM sleep has been included in the Palm OS software since version 3.5. After waking up from deep sleep, the auto-off timeout has effectively already expired. If the event queue is emptied without the auto-timer ever being reset, a `vchrAutoOff` event is immediately returned from `EvtGetEvent`, causing `SysHandleEvent` to initiate putting the smartphone back to sleep right away. This behavior has not been changed, but has been accounted for in the REM Sleep API. There will not be a barrage of auto-off events if REM sleep is entered from deep sleep without the display ever being turned on. (This happens during mail sync in certain applications, for example.)

9.5 Keyguard API

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

The keyguard API prevents a smartphone from being turned on by accident. Sometimes when a smartphone is in a user’s pocket or purse, the power button or other key is pressed inadvertently. Applications can set or query the state of the Keyguard feature on the smartphone.

When Keyguard is active, the digitizer is locked and `EvtGetEvent` will not return any key events that came from the keyboard. Other key events not generated by the keyboard are returned.

To programmatically enable or disable Keyguard, use `HsAttrSet()` to set the value of `hsAttrKeyboardLocked` to `true`. Do *not* send an `hsChrKeyboardLock` key event to enable Keyguard.

To query whether Keyguard is active, use `HsAttrGet()` to get the value of `hsAttrKeyboardLocked`.

NOTE: `hsAttrKeyboardLocked` does not always indicate that the Keyguard dialog box is being displayed. There are states in Keyguard in which key and pen events are filtered and the Keyguard dialog box is not displayed.

To prevent Keyguard from being enabled, block the virtual character `hsChrKeyboardLock` from being handled by `SysHandleEvent`. In an active application, check for hsChrKeyboardLock between EvtGetEvent and SysHandleEvent. In an application running in the background, register for sysNotifyVirtualCharHandlingEvent notification and mark the notification handled when a virtual character comes through. Blocking hsChrKeyboardLock is all that is required. Even if Keyguard is already enabled, such as through auto-keyguard, Keyguard is disabled when hsChrKeyboardLock is blocked.

Setting the value of hsAttrKeyboardLocked to true does *not* immediately enable Keyguard. Instead, an internal state is set and hsChrKeyboardLock is enqueued. Only when hsChrKeyboardLock reaches SysHandleEvent is Keyguard enabled. At that time, the Keyguard dialog box is displayed, taking control from the active application.

When auto-keyguard is on, Keyguard is enabled after waking up from REM or deep sleep until either the dialog box is displayed or it is determined that Keyguard doesn't need to be enabled because the smartphone wasn't asleep long enough. This prevents extra keystrokes from being lost while a smartphone wakes up. If the value of hsAttrKeyboardLocked is set to false or hsChrKeyboardLock is blocked while the auto-keyguard process is occurring, Keyguard is disabled before the dialog box is displayed.

9.6 Option and Shift key APIs

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

The Option and Shift keys increase the range of input possibilities on Treo smartphones. For example, a map application, which uses a 5-way Up key press to scroll up, can use an Option+5-way Up key press to zoom in.

There are APIs available to detect whether Caps Lock or Option Lock is on. An application can also detect if the Option key or the Shift key has been pressed.

There are also APIs available to set Caps Lock or Option Lock and to programmatically simulate Option or Shift key presses.

Also, if an application includes a Graffiti Shift Indicator (GSI) UI object in the application's resource, then Option and Shift key presses can be visually detected.

9.7 MMS helper functions API

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

The MMS helper function APIs are only available on Treo smartphones. The MMS (Multimedia Messaging Service) application is the built-in application that provides an interface for other applications to send and receive MMS messages. You can interface with the MMS application through the Helper API.

The MMSHelperCommon.h header file provided with the Palm OS SDK contains all the public files.

You can also refer to the MMSReceiver.zip and MMSSender.zip sample code files in the Palm OS SDK to learn how to use this library.

9.7.1 MMS usage model

This section explains how to use the MMS Helper structures with the Palm OS Helper APIs to submit an MMS send request to the MMS application.

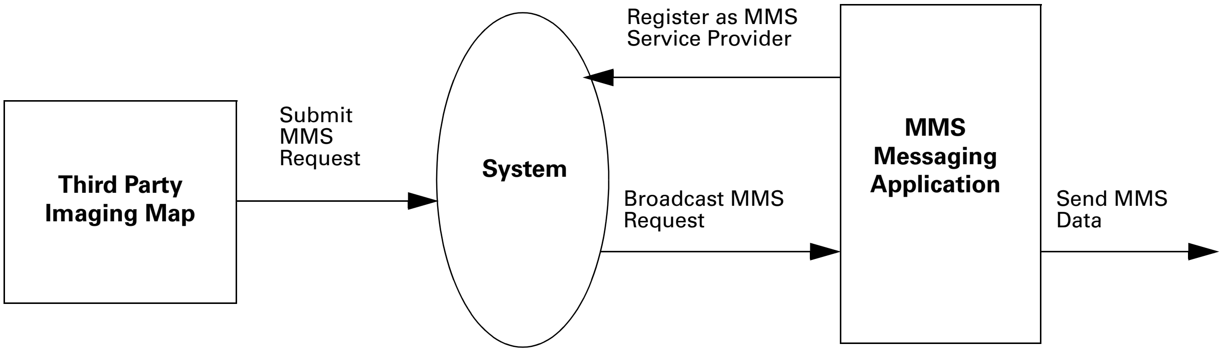
The built-in MMS application is registered in the system as a Helper service class for the MMS service type. Thus, when the system receives MMS Helper requests submitted by applications, the system broadcasts a notification to the MMS application to accept and receive the MMS helper data structure from the requesting application.

This gives audio and imaging applications an easy and convenient method for sending picture or audio files using a phone without having to implement the Phone API interface code. The application needs to know only the phone number or email address contact info of the recipient in order to send MMS data to the recipient.

NOTE: Currently, only the built-in MMS application is registered as an MMS Helper service provider. In the future, there may be multiple applications registered as MMS Helper service providers. Be as specific as possible when designing an application request for an MMS Helper service.

A Helper requesting application can specifically request which Helper service provider to invoke by specifying the exact creator ID of that Helper service provider in the `helperAppID` field of the `HelperNotifyExecuteType` structure. Setting `helperAppID` to `0` indicates all Helper service providers.

The following figure shows the MMS helper usage model.



9.7.2 MMS sample code

The following sample code shows how an application submits an MMS send request to an MMS service provider. The implementation first populates the `HelperServiceMMSDetailsType` and `HelperServiceMMSObjectType` structures with the data, address, and message information. It then attaches the detail structure into a `HelperNotifyExecuteType` so that it can be submitted to the system and be broadcast to all the service providers.

```
{
... ... ...
   case MMSSendButton:
    {
    BitmapPtr bitmapP = NULL;

    HelperServiceMMSDetailsType MMSDetails;
    HelperServiceMMSObjectTypeobject;

    MemSet(&MMSDetails, sizeof(HelperServiceMMSDetailsType),0);
    MemSet(&object,sizeof(HelperServiceMMSObjectType),0);

    bitmapP = MemHandleLock (gLockBitmapH);

    object.pageNum = 1;
    object.tempFileName = NULL;
    object.mimeType = "application/vnd.palm.bmp";
    object.bufferP = bitmapP;
    object.bufferLen = MemPtrSize(bitmapP);

    MMSDetails.object = &object;
    MMSDetails.version = 1;
    MMSDetails.justSend=false;


    MMSDetails.cc = "a cc address";
    MMSDetails.subject = "subject text";
    MMSDetails.message = "message text";

    err = PrvInvokeHelperService(kHelperServiceClassIDMMS,
          “recipient_address@palm.com”, "Helper Sender", &MMSDetails);

    MemHandleUnlock(gLockBitmapH);


... ... ...
```

9.8 NVFS API

Available on:

- LifeDrive™ mobile manager
- Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5, Tungsten™ E2, and Palm® T|X handhelds
- Palm® Z22 organizer

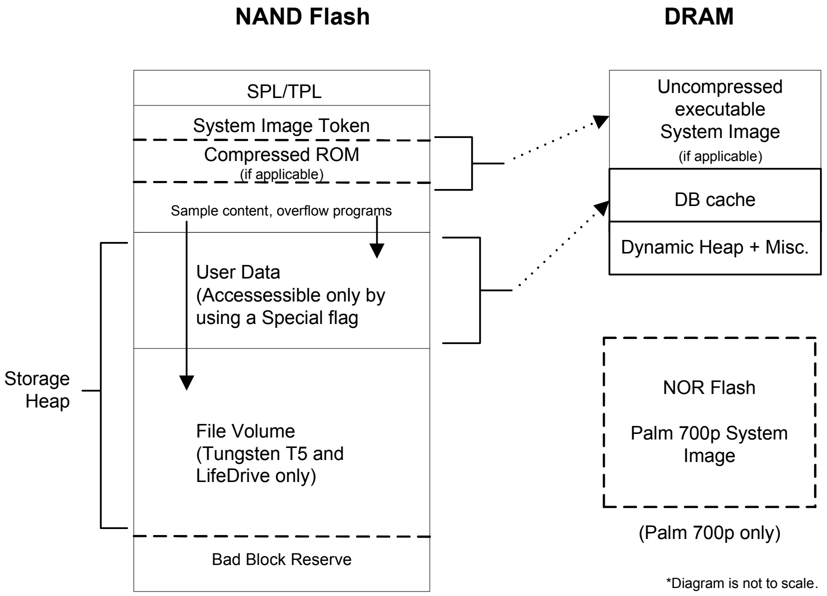
NVFS stands for Non-Volatile File System. Storage in Palm devices traditionally included nonvolatile NOR flash where the Palm OS and built-in applications were stored, and a volatile SDRAM (synchronous dynamic random access memory) where the Dynamic and Storage heaps were stored. If the power was removed, all data in the RAM was deleted.

Treo 650, Treo 680, and Treo 700p smartphones, LifeDrive, Palm T|X and Tungsten T5 and E2 handhelds have NAND flash memory, which is nonvolatile. NAND flash houses the storage heap and other data so that it is not erased even if the power is drained from the device. Unlike other devices, the Treo 700p includes both NOR and NAND flash memory.

The main difference between NOR and NAND flash memory is that NOR flash is completely XIP (execute in place), and all addresses in NOR flash are mapped using address pins so that each byte can be accessed. In NAND flash memory, data is accessed in blocks, and only a small section. The section that houses the boot code is XIP.

This means that code instructions cannot be executed out of NAND memory directly, and thus require the system image (rom), as well as any other application, to be executed from DRAM. For more information on NOR and NAND flash memory, see **Section 9.8.1**.

The following figure displays the NVFS memory map for the devices mentioned at the beginning of this section.



For devices where the system image resides in NAND flash memory, copying and uncompressing the system image to DRAM for execution occurs at early boot time. Other applications residing in the Storage Heap are copied upon launch from NAND to DRAM for execution. Both code and data is copied to/from the NAND Storage Heap into the portion of RAM used as a cache, called DBCache. DRAM must also contain another area for an application's local data; this area is called the Dynamic Heap.

Devices where the system image resides in NOR flash memory (Treo 700p smartphone only) do not go through the copying and uncompressing process.

Because DRAM is of a fixed size, and because it must contain the system image, DBCache, and Dynamic Heap, the size of the uncompressed system image directly affects the amount of DRAM memory available for the DBCache and Dynamic Heap. Since it is desirable to have the DBCache and Dynamic Heap be as large as possible, there is a mechanism that does just that, by reducing the size of the system image.

This is accomplished by having a separate area of NAND which contains compressed versions of applications, libraries, default content, and language overlays. This area is called *Overflow*. This Overflow area is flashed into the NAND during manufacturing, or a system image update, and not changed dynamically. Its size, and content, is set exclusively by Palm.

The Treo 700p smartphone does not contain a NAND Overflow. It contains 64MB NAND, most of which (61.8 MB) is available to the user for storage.

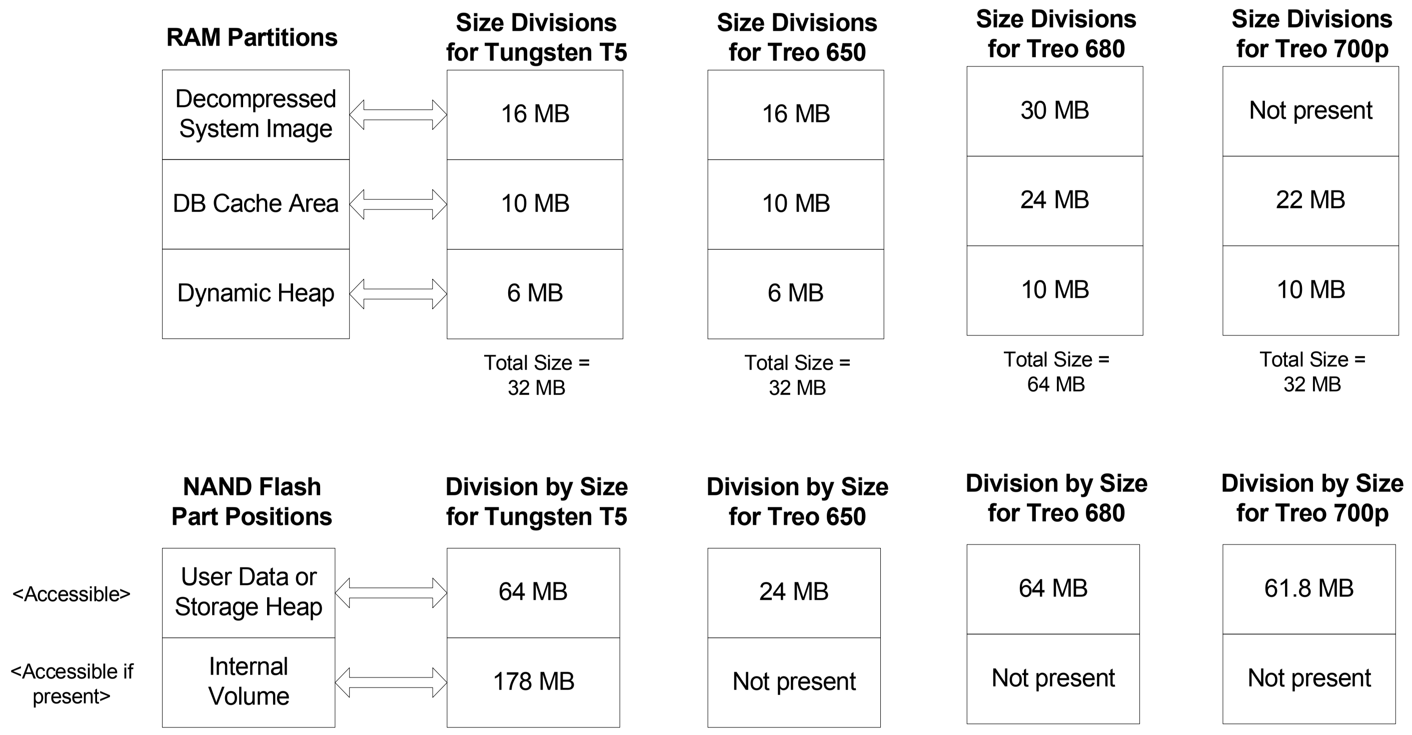
At a hard reset, the system finds this area and uncompresses the content from the Overflow area, and then saves it in the Storage Heap (which resides on NAND). This decreases the amount of Storage Heap space remaining available (by requiring that uncompressed versions of this data reside in the Storage Heap), but frees up an equivalent amount of memory in the system image, since these applications, libraries, and language overlays would otherwise be part of the system image. This mechanism thus allows more space for the Dynamic Heap and the DBCache on the fixed-size DRAM.

When an application is launched, records and resources are copied from flash, as required, into DBCache. In addition, when a database is opened by an application, it is copied from flash into DBCache and is accessed directly from DBCache. All application access to its databases goes directly to DBCache only; it does not know that there is flash storage behind it. Because the cache is write-back, writes to DBCache do not immediately propagate back to flash. Instead the OS writes back those changes at the following occurrences: the database is closed, the system goes to sleep (auto off or user powers the device off), a call is made to `DmSetDatabaseInfo`, or a call is made to the new NVFS API (`DmSyncDatabase`). At these times, the database is scanned for “dirty” records, and those records are written back to flash.

When the system goes to sleep, it makes sure that database changes are committed to flash memory. The system commits changes to NAND flash when it receives a sleep notification and does this at a normal priority. Applications that make database changes in response to sleep notifications should do so at a higher priority so the system can commit the changes. The system also commits changes back to flash memory when the database is closed and when `DmSetDatabaseInfo()` or `DmSyncDatabase()` is called.

The following diagrams illustrate how the RAM and NAND flash are partitioned. All memory sizes shown in the figures are approximate values.

RAM and NAND Flash Partitioning by Device



RAM Partitions	Size Divisions for Tungsten T5	Size Divisions for Treo 650	Size Divisions for Treo 680	Size Divisions for Treo 700p
Decompressed System Image	16 MB	16 MB	30 MB	Not present
DB Cache Area	10 MB	10 MB	24 MB	22 MB
Dynamic Heap	6 MB	6 MB	10 MB	10 MB
	Total Size = 32 MB	Total Size = 32 MB	Total Size = 64 MB	Total Size = 32 MB

	NAND Flash Part Positions	Division by Size for Tungsten T5	Division by Size for Treo 650	Division by Size for Treo 680	Division by Size for Treo 700p
<Accessible>	User Data or Storage Heap	64 MB	24 MB	64 MB	61.8 MB
<Accessible if present>	Internal Volume	178 MB	Not present	Not present	Not present

9.8.1 Differences between NOR and NAND flash memory

The NOR flash or masked ROM housed the system image (ROM) while RAM housed the dynamic and storage heaps. The RAM contains the dynamic heap and a DBCache area that acts as a temporary storage heap. The actual databases are stored in the NAND flash memory as files and are brought into the DBCache area when opened.

For devices where the system image is compressed and stored in NAND flash, during boot time the system image (ROM) is decompressed and brought into RAM storage. Then the Palm OS software starts executing OS code from the RAM. The portion of RAM that has the decompressed system image is read only so that users cannot corrupt OS code (see the preceding figure). The RAM also contains the dynamic heap as in the past. The compressed system image in NAND flash is not visible or accessible to users or developers.

Devices where the system image resides in NOR flash memory, such as Treo 700p, do not go through the copying and uncompressing process.

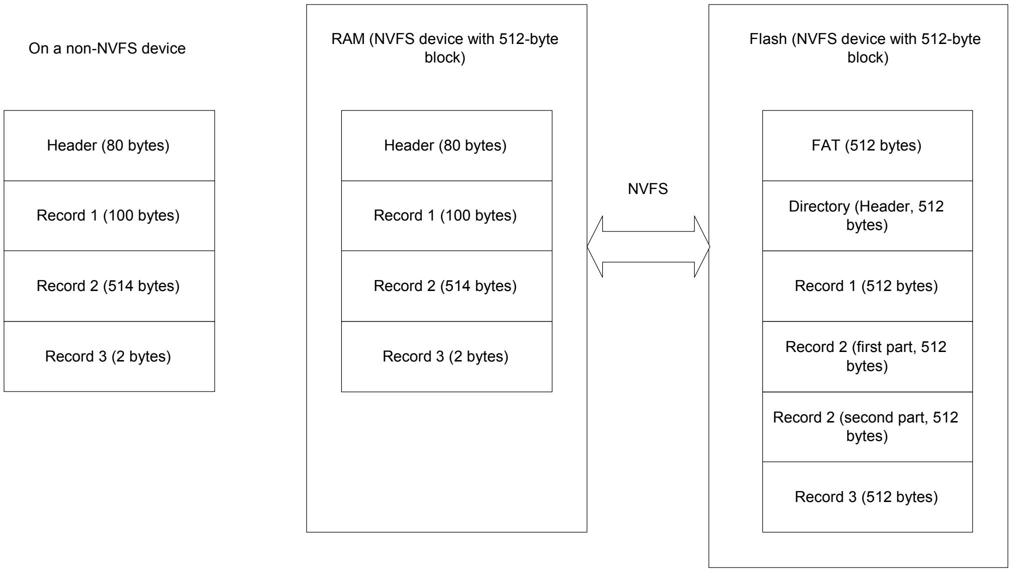
Performing a soft reset wipes the RAM clean and retrieves a fresh load of the system image from the NAND flash. A hard reset additionally erases the storage heap that is in the NAND flash.

The NAND flash is formatted into multiple partitions. Compressed system image is stored in one partition, User Store is stored in a second partition, and there can be an optional third partition as shown in the preceding diagram. The Palm OS software sees these partitions as nonremovable volumes accessible using `VFSMgr` calls. Data in the flash is stored as FAT files. The volume that houses the storage heap is hidden in all devices and can be accessed only by using a special private flag while enumerating the volumes. This volume is known as the *private volume*. Some devices include a partition that can be accessed similar to an SD slot. In Tungsten T5 handhelds, this partition is called INTERNAL. In the LifeDrive mobile manager, it is called LIFEDRIVE. Users can rename this partition like any other volume. To find this partition, look for the nonhidden, nonremovable volume.

The size of the resource database is limited to the size of the DBCache. For large record databases, the OS intelligently purges or flushes data from the cache to free space for new records: If the DBCache becomes full, the OS purges records that are not locked in memory. If the records are modified, they are committed back to flash memory. The purging of data takes place in the background and is seamless to the user. You should be aware that there are some performance issues associated with this method. There may be a noticeable time difference in performance compared to earlier devices when a large amount of data is flushed back from the cache into the NAND flash memory.

9.8.2 Database layout on NVFS devices

The figure below illustrates how the NVFS Database Management Solution works on NVFS devices (with 512-byte blocks) for a database with three records. Also see **Section 9.8.2.1**.



NVFS includes a mechanism for storing Palm OS databases in a FAT (file allocation table) file system. In the NVFS device, the file system is applied to flash (non-volatile) memory, also called the flash drive.

In this FAT file system, each file consists of multiples of 512-byte sectors. Each file is allocated in multiples of four sectors (for FAT16). This means that each file occupies multiples of 2K bytes in the file system. Each Palm OS database is stored in its own file in the file system on the flash drive. Additional overhead in the FAT system for tracking and managing the file system is independent of how the databases are laid out within it.

The header of the database and the record list occupy one or more sectors. RecordInfo entries that do not fit in the first sector become the extended record list and are allocated to other sectors, as needed. The additional sectors do not need to be contiguous.

For example, a database that contained 100 records would look something like this:

Sector 1
Database Header
RecordInfo 1
RecordInfo 2
RecordInfo 3
…
RecordInfo 39

Sector 2
RecordInfo 40
RecordInfo 41
...
RecordInfo 85

Sector 3
RecordInfo 86
RecordInfo 87
...
RecordInfo 100

The Database header includes the name, type, creatorID, and so on. The RecordInfo is a fixed size and includes the recordID, attributes, and other system information but does not include the actual record data, which is variable in length. Note that in this example the third sector is only partially used, leaving some wasted space.

The record data is kept separately, and its layout in the file sectors depends on the version of NVFS in use. Version 5.4.5 (included with the original Treo 650 smartphone and Tungsten T5 handheld) stores the data for each record in one or more sectors. For example, if the first record contained 60 bytes of data and the second record contained 700 bytes of data, the database would look something like this:

Sector 4
RecordData 1 (60 bytes)

Sector 5
RecordData 2 (first 512 bytes)

Sector 6
RecordData 2 (remaining 188 bytes)

In this example, the fourth and sixth sectors are partially used, leaving some space wasted.

9.8.2.1 Database layout

Palm OS 5.4.7 and later allows data from more than one record to share a sector. Logically the sector is divided into 16 sub-blocks of 32 bytes each. Then the record data is stored into a sector based on alignment of the data length with the available sub-blocks of the sector.

The number of sub-blocks is determined by the length of the record data. The length is rounded up to the nearest power of 2 to determine the number of sub-blocks. The placement of the data in the sector depends on this number and an associated alignment within the sector. For example, if the record data fits within a single sub-block, it can be positioned at any of the 16 sub-block alignments in the sector. If the record data requires two sub-blocks, then it can only be placed at the even-numbered sub-blocks, that is, on 64-byte alignments. If four sub-blocks are required, it can only be placed at 128-byte boundaries, and so on. As before, record data longer than 512 bytes will occupy as many complete sectors as required with the remaining bytes, following the rules above.

Using the same example, the database would look something like this:

Sector 4
RecordData 1 (60 bytes, occupying 64 bytes)
RecordData 2 (remaining 188 bytes, occupying 256 bytes)

Sector 5
RecordData 2 (first 512 bytes)

Note that in this example the fourth sector is partially used, leaving some space wasted, but there is no sixth sector used at all. In addition, if a third record is added that has less than 129 bytes of data, it can also be placed in Sector 4.

Generally, the layout with version 5.4.7 will have substantially less unused space for record data storage compared to version 5.4.5.

As records are added, changed, and deleted in the database, holes of unused space will develop in the file sectors. The NVFS system will monitor the total size of these holes, and if it gets too large, the file will be compacted. Compactions will reorganize the database records within the file sectors to fill in the holes and reduce the wasted space.

9.8.3 Programming on devices that have NVFS

The changes in how NAND flash works, as opposed to NOR flash, require some changes in how you program for the new devices and future devices. Although all applications should run without much modification, some cases may require special handling, such as those that deal with very large databases (over 5MB). Some of these cases are discussed in this section.

9.8.3.1 Checking for NVFS

To check if a device includes NVFS, use the following command:

```
FtrGet (sysFtrCreator, sysFtrNumDmAutoBackup, &returnVal);
```

If the `returnVal` is `1`, NVFS is present on the device. `sysFtrNumDmAutoBackup` is defined in the `PmPalmOSNVFS.h` header file.

9.8.3.2 Database issues

One of the issues with the DBCache area is that if a device loses power (for example, if the battery is removed from the Treo 650 smartphone) when a user is modifying a database, all modifications are lost, because database changes are committed back into the NAND flash only when the database is closed.

NOTE: There is no way to determine programmatically that the battery is about to be removed.

To overcome this problem, you might want your applications to call the `DmSyncDatabase()` API. This API ensures that database changes are committed to NAND flash. (Note that the `DmSyncDatabase()` API has nothing to do with the HotSync® feature.) `DmSyncDatabase()` takes a reference to the open database that needs to be synchronized. To use `DmSyncDatabase()`, you need the new `PmPalmOSNVFS.h` header file from the Palm OS SDK.

Use the following guidelines for developing applications for NVFS devices:

- If you call `DmSyncDatabase` or `DmCloseDatabase`, make sure to check for returned errors and clean up appropriately.
- Always check for errors from DataMgr calls that allocate memory, for example, calls such as `DmNewRecord` and `DmResizeRecord`.
- Be aware that the database cache guarantees that individual records are saved atomically. That is, if the device runs out of space in the middle of writing out the 200th modified 1k record in your database, you should expect the first 199 changed records to be saved, but changes to the 200th record will be completely lost rather than partially saved. If your application requires that the entire database be saved atomically (for example, if your application creates another application, or if modifications in one record depend on modifications in another record), your application must be aware of these failure scenarios and guard against them.

If there is space in DBCache while the storage heap is full, database creation and modification may work, but `DmCloseDatabase()` may fail because the database data cannot be committed to the storage heap.

To check the free bytes or size of DBCache, use MemHeapFreeBytes() and set the high bit of the heap ID as follows:

```
#define STORAGE_HEAP_ID 1
MemHeapFreeBytes(STORAGE_HEAP_ID | dbCacheFlag, &free, &max);
```

The call MemHeapFreeBytes(STORAGE_HEAP_ID, &free, &max); returns the free bytes in the storage in the NAND flash part of the memory (User Store).

To discover the total size of the DBCache area or User Store, you can use the Palm OS API MemHeapSize() with the same values for the STORAGE_HEAP_ID described previously.

Applications that work with resource databases larger than the size of the DBCache area cannot directly access files used to represent the databases on the internal volume, due to a special file format not readable by the application or application developer. As described in the next section, you can split the data in databases to span multiple databases, or access the file system to read and write to files instead of using databases.

9.8.3.3 Accessing the internal file or private volumes in NVFS

The volume housing the storage heap can be accessed using the VFSVolumeEnumerate() function as follows:

```
#define vfsIteratorStart              0L
#define vfsIteratorStop               0xffffffffL

UInt32 volIterator = vfsIteratorStart | vfsIncludePrivateVolumes; //
0x80000000L is the flag passed in to include the private volume...

while (volIterator != vfsIteratorStop)
{
   if ((err = VFSVolumeEnumerate(&otherVolRefNum, &volIterator)) ==
errNone) {
             err = VFSVolumeInfo(otherVolRefNum, &volInfo);
             if (err)
                  goto Done;
             if (volInfo.attributes & vfsVolumeAttrHidden)
             {
             // This is an internal file volume. Perform actions now...
             }
          }
}
```

After you retrieve the volume reference number, the volume can be accessed by VFSMgr as with any other volume. If the vfsIncludePrivateVolumes flag is omitted, the private volume is not enumerated. So, for example, in a Treo 650 smartphone or later, the preceding code enumerates a private volume and the SD slot’s volume. vfsIncludePrivateVolumes is defined in the PmPalmOSNVFS.h header file.

Applications that must access the private volume directly to store files in the FAT file system can do so if they are having problems working with large databases because of the DBCache size. You should use the private volume sparingly, however, because overuse cuts into the user storage space.

Similarly, you can use the Expansion Manager to see the private volume as a separate internal slot if it is used with the following flag:

```
#define expIteratorStart              0L
#define expIteratorStop               0xffffffffL

UInt32 slotIterator = expIteratorStart | expIncludePrivateSlots; //
0x80000000L is
flag passed in to include private slot;

while (slotIterator != expIteratorStop)
{
          if ((err = ExpSlotEnumerate(&slotRefNum, &slotIterator)) ==
          errNone)
{
              // Perform actions now...
          }
}
```

Other than the private volume, some devices may include a separate internal file volume that can be used for file storage. LifeDrive and Tungsten T5 handhelds, for example, have an internal file volume that is available as an internal drive. The following code enumerates two volumes: the internal file volume and the SD slot volume. You can use `vfsVolumeAttrNonRemovable` to check whether a volume is nonremovable, thus indicating that it is an internal volume. You need the new `PmPalmOSNVFS.h` header file from the Palm OS SDK to do so. The PalmSource® SDK may not have the flag defined. You can use the `vfsIncludePrivateVolumes` flag to access the third private volume in a Tungsten T5 handheld.

```
UInt32 volIterator = vfsIteratorStart;

while (volIterator != vfsIteratorStop)
{
   if ((err = VFSVolumeEnumerate(&otherVolRefNum, &volIterator)) ==
errNone) {
          err = VFSVolumeInfo(otherVolRefNum, &volInfo);
          if (err)
            goto Done;
          if (volInfo.attributes & vfsVolumeAttrNonRemovable)
          {
              // This is the internal file volume. Perform actions now...
          }
       }
}
```

Similarly, you can use the Expansion Manager to access the slots by using the capability flags `expCapabilityNonRemovable` and `expCapabilityHidden` from the `ExpCardInfoType` structure to check the slot details. You may need the new `PmPalmOSNVFS.h` header file from the Palm OS SDK for these flag definitions.

9.8.3.4 Feature pointer issues

Because feature pointers are allocated in the DBCache, it is possible to run out of space if you open a very large database. Even if the user store in the NAND flash has free space, a feature pointer call such as `FtrPtrResize` can fail if the DBCache is full. Query the free bytes in DBCache and take the appropriate actions as mentioned in the preceding sections if you allocate large feature pointers or if you are using feature pointers while working on large databases.

9.8.3.5 NVFS on Palm OS® 5.4.9

Available on:

- LifeDrive™ mobile manager
- Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5, Tungsten™ E2, and Palm® T|X handhelds
- Palm® Z22 organizer

NVFS on Palm OS v. 5.4.9 and later provides the following enhancements:

- Alerts for extreme low memory condition

  The system warns users more aggressively when the device storage heap is low on space. Please note that if the storage heap is already full and there is still data to be flushed, the data will be lost.

- Minimization of memory fragmentation

  The occurrence of `memErrNotEnoughSpace` should be significantly minimized as the result of better compaction of DBCache. This optimization in turn makes it easier for an application to exhaust the available memory. Applications should still check for available memory and chunk size whenever possible.

- Slower sorting

  Optimizations that are done in OS 5.4.9 have caused the sorting performance to be slower as a trade-off, but this should only be visible when a huge number of records are involved.

- DmQueryRecord is safe to use again

  The system should now be able to recover invalid handle and read the record data back from the non-volatile memory.

- More aggressive DBCache flushing

  Locked records are now unlocked automatically when a database is closed, including resource record. Closed databases and unlocked records are flushed more aggressively whenever more space is needed. Applications that are implementing callbacks or alarm procedures should be extremely careful and make sure that the code resource is locked at all times and protected with `DMDatabaseProtect()` when expected to run.

- Bug fix for `FtrGet(sysFtrCreator, sysFtrNumROMVersion, &romVersion)`, which now returns the correct OS version and build number.

NOTE: For information on how to lock code resource and protect a database, please consult the PalmSource Developer Knowledge Base.

Due to some changes in NVFS for the Treo 700p smartphone, when the device runs low on storage space, one of the following three things will happen (depending on what was happening when space ran out):

1. If the device runs out of space during `DmCloseDatabase`, the OS will back out the changes that were made since the last sync and return an error to the calling application. The user will then see an error alerting them that some data could not be saved because of low storage space.
2. If the device runs out of storage while it is flushing the cache to make room for a new allocation (for example, during `DmNewRecord` or `DmResizeRecord`), it is possible that the application that owns the database that is being flushed may not be the application doing the allocation. Since there's no way to notify the owner that the data was lost, there is no safe way to return the system to a stable state after backing out changes. In this scenario, the device will reset, and display the out-of-space alert after the reset.
3. If the device encountered an error during an explicit call to `DmSyncDatabase`, the OS will back out changes that were made since the last sync and return an error such as `vfsErrVolumeFull` to the caller. (No alert.)

9.9 5-Way Navigator and Keyboard API

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ and Palm® T|X handhelds
- Zire™ 31 and Zire™ 72 handhelds
- Palm® Z22 organizer

This section describes the software associated with the 5-way navigator button.

In addition to the information provided here, you can refer to the sample code in the Palm OS SDK for information on how to use this module.

9.9.1 5-way navigator terminology

The terms *object focus mode*, *application focus mode, tab order*, *action buttons*, and *interaction mode* appear throughout this section. A short description for each of these terms follows:

- *Object focus mode* refers to the state when a form's focus is enabled and the 5-way keys are used for navigation.
- *Application focus mode* refers to the state when a form's focus is not enabled and Up and Down are used as page-up and page-down keys.
- *Tab order* refers to the horizontal ordering of the objects or, in other words, the order in which objects receive the focus when Right is pressed repeatedly.
- *Action buttons* refers to the command buttons that are lined up along the bottom of a form.
- *Interaction mode* refers to the state when the 5-way keys interact with the object rather than move the focus. For example, a field object is in interaction mode when the 5-way keys move its insertion point, and a list object is in interaction mode when the 5-way keys move a highlight through the list items.

9.9.2 Overview of 5-way navigator

The navigation model is two-dimensional. Left and Right move the focus horizontally, while Up and Down move the focus vertically.

Depending on the object type of the object that has the focus, Center either simulates a tap on the focused object or toggles the interaction mode of the focused object.

To support this functionality, the system was expanded to generate and handle additional navigation events. These include 5-way key events and the focus change events. The events are handled when an application calls `FrmDispatchEvent()`. During such a call, the events are handled in the following manner. (Note that steps 2 and 3 are part of `FrmHandleEvent()`.)

1. The current form's custom event handler receives the event.

   This is when the application can override default navigation behavior. If the handler returns `true`, no more event processing occurs and steps 2 and 3 are never reached.

2. If the event is a key event, the focused object's type is obtained. If the event is a focus change event, the type of the object specified in the event is obtained.

   The handler specific to the object type obtained is then called on the event. (For example, `CtlHandleEvent()` is called if the object is a control.) The various object type handlers have been expanded to handle navigation events that are associated with type-specific navigation behavior. If the handler returns `true`, no more event processing occurs and step 3 is never reached.

3. A generic focus handler is called on the event. This handler is primarily responsible for moving the focus in the form.

9.9.3 Navigation events

The Treo smartphones and the Tungsten T5 handheld not only generate `keyDown` events for keys, but they also generate `keyHold` and `keyUp` events for keys. A `keyHold` event is generated when a key is held for one second and a `keyUp` event is generated when a key is released. `keyHold` and `keyUp` events have the same fields as `keyDown` events—character field, modifiers field, and key code field.

When object focus mode is on, the 5-way button generates `keyDown`, `keyHold`, and `keyUp` events with the following character values: `vchrRockerUp`, `vchrRockerDown`, `vchrRockerLeft`, `vchrRockerRight`, and `vchrRockerCenter`.

When object focus mode is off, the 5-way button generates `keyDown`, `keyHold`, and `keyUp` events with the following character values: `vchrPageUp`, `vchrPageDown`, `vchrRockerLeft`, `vchrRockerRight`, and `vchrRockerCenter`.

The page keys are enqueued when object focus mode is off so that forms that are not 5-way navigator–aware do not lose their paging functionality.

Focus change events are generated as the navigation focus moves in a form. A `frmObjectFocusTake` event is sent when an object should take the focus. The system's internal focus structures are updated when the event is *handled*, not when it is sent. A `frmObjectFocusLost` event is sent after an object has lost the focus. The system's internal focus structures have already been updated when this event is sent. Therefore, it simply initiates the redrawing of the object that lost the focus.

9.9.3.1 Option and Shift modifiers

Treo smartphones have Option and Shift keys. If the Option key is held down while the 5-way button is pressed, the `optionKeyMask` in the 5-way button's key events is set. Similarly, if the Shift key is held down while the 5-way button is pressed, the `shiftKeyMask` in the 5-way button's key events is set.

These masks allow applications to assign secondary features and functionality to the 5-way button on the Treo smartphones.

9.9.4 Including objects as skipped objects

Editable fields, tables with fields, pop-up triggers, and selector triggers automatically get navigation focus when the user taps them. If the object is not in the tab order, then the system simply moves the focus to the first object in the tab order when the user presses a directional button after tapping the object. Such a movement of the focus may not make sense to the user.

To ensure that focus movement is always logical to the user, such objects should be included in the tab order but marked as skipped by setting the `kFrmNavObjectFlagsSkip` flag. This flag can be set through `FrmSetNavEntry()`, through `FrmSetNavOrder()`, or in a navigation resource. The object is skipped when the user moves the focus with the 5-way buttons, but the system knows how to move the focus from the object after the user taps it.

9.9.5 Default navigation

If a form does not have a navigation resource, the system determines the navigation order for the form dynamically. It determines whether the form is initially in object focus mode or application focus mode, which UI objects can receive the focus, the tab order, the vertical order, where the focus begins, and whether the focus cycles.

IMPORTANT: To truly support 5-way navigator, an application should have `fnav` resources in its resource file rather than rely on the default navigation order.

9.9.5.1 Initial focus mode

Forms are separated into modal and nonmodal forms. The window of a modal form has the modal flag set. You can check this flag by calling `WinModal()` on the form's window. All other forms are considered nonmodal.

Initially, modal forms are placed in object focus mode, and nonmodal forms are placed in application focus mode. You can programmatically change the mode of a form with `FrmSetNavState()`.

9.9.5.2 UI objects included in the navigation order

All UI objects in a form are included in the navigation order. However, during form initialization, only the following objects are not marked as skipped:

- Usable, enabled controls (controls include command buttons, push buttons, check boxes, pop-up triggers, selector triggers, repeating buttons, sliders, and feedback sliders)
- Usable lists
- Usable, editable fields

NOTE: An application can clear the skipped flag for any object in the form by calling `FrmSetNavOrder()` or `FrmSetNavEntry()`.

If an object is not initially included in the default order, it is not included later if it becomes a valid focus object. For example, if a control that was initially disabled is enabled, it is not included in the default order when it is enabled.

However, objects that were initially included in the default order that later become invalid focus objects are skipped. For example, if a field was initially editable and was later made noneditable, it is skipped.

9.9.5.3 Tab order

The tab order is determined by taking the UI objects that can receive the focus and sorting them by their left coordinate and then their top coordinate. A stable sort is used (insertion sort) so that after sorting:

- Objects are sorted by their top position.
- Objects with the same top position are sorted by their left position.

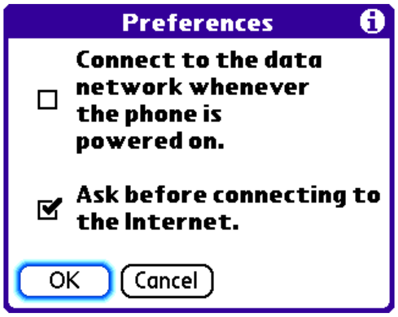
9.9.5.4 Vertical order

The objects in the vertical order are a subset of those in the tab order. The vertical order is determined by iterating from the first object in the tab order to the last and including only the following objects:

- The first object
- Any subsequent object that is completely below the previously included object

This algorithm results in only the leftmost objects of the form being included in the vertical order.

Because the vertical order may not include all the objects in the tab order, some objects that can receive the navigation focus cannot be navigated to by only using the Up and Down keys. In other words, navigating to objects that are in the tab order but not in the vertical order will require some use of the Left or Right key. For example, consider the following dialog box:



Preferences

□ Connect to the data network whenever the phone is powered on.

☑ Ask before connecting to the Internet.

The check box and the OK button are the leftmost objects in their row and therefore are the objects in the vertical order. To get to the Cancel button from the top check box, the user would have to press Down and then Right. There is no way to get to the Cancel button by using only the Up and Down keys.

If an object that was initially usable and was part of the vertical order is later made nonusable, and an application has not made any changes to the order through the navigation API functions, the vertical order is recalculated using the algorithm previously described. The vertical order is not recalculated when an application has made changes to the order, to ensure that the application's changes are not overridden.

9.9.5.5 Initial focus

If there are any action buttons, the focus is initially given to the leftmost one. If there are no action buttons, the focus is given to the first object in the tab order.

The first action button is identified using the following rules:

- The usable, enabled objects with the greatest top coordinate values are identified. In other words, the objects in the form's bottom row are identified.
- The first action button is the leftmost command button among those objects. If there are no command buttons among these objects, the focus is given to the first object in the tab order.

9.9.5.6 Cycling

On the Treo smartphones and the Tungsten T5 handheld, the focus never cycles horizontally. When the focus is on the first object in the tab order, pressing Left does not move the focus to the last object, and when the focus is on the last object, pressing Right does not move the focus to the first object.

Although the focus never cycles vertically on Treo 600 smartphones, the focus does cycle vertically in modal dialog boxes on Treo 650 smartphones and later, and Tungsten T5 handhelds. On Treo 600 smartphones and in nonmodal dialog boxes on Treo 650 smartphones and later, and Tungsten T5 handhelds, when the focus is on the top object in the vertical order, pressing Up does not move the focus to the bottom object, and when the focus is on the bottom object, pressing Down does not move the focus to the top object. In modal dialog boxes on Treo 650 smartphones and later, and Tungsten T5 handhelds, pressing Up while the focus is on the top object *does* move the focus to the bottom object, and pressing Down while the focus is on the bottom object *does* move the focus to the top object.

9.9.6 Custom navigation

Applications can customize navigation by providing a navigation resource for a form, by making navigation API calls, and by handling navigation events.

9.9.6.1 Hex navigation resource

A navigation resource specifies what UI objects in the form are included in the navigation order, what the tab order is, what the vertical order is, whether the focus is initially on or off, where the focus begins, where the focus can move, and what the bottom-left object is. (The bottom-left object information is needed to cycle the focus from the top of the form.)

IMPORTANT: As mentioned before, an application should include `fnav` resources in its resource file rather than rely on default navigation order.

For the system to detect a navigation resource, the navigation resource must be in the same database as its associated form. For the system to detect that a form has a navigation resource, the navigation resource must be in the same database as the form.

Technically, an application only needs a navigation resource if the behavior is not the correct behavior for a form. However, the creation of navigation resources for all forms that have navigation is recommended because the default navigation order may be different on various platforms and some platforms may not even provide a default navigation order.

The resource is a hex resource of type `formNavRscType` (`fnav`). It is defined as a 68K format (big endian) resource.

The term “hint” is appended to the name of those fields that are used only by some platforms. For example, the `bottomLeftObjectIDHint` is used only by those platforms that have their focus cycle from the top of the form to the bottom. If an application specifies a value for this field, it will run properly on platforms that do cycle and platforms that do not cycle.

The navigation resource has a header section and a list-of-objects section. The format of the header is described in the *Palm OS Platform API Guide*.

9.9.6.2 PilRC navigation resource

The PilRC resource compiler supports a navigation resource format that is easier to create than the HEX resource just described. Many of the fields required by the hex resource are optional in the navigation resource and a navigation map that allows UI objects to be specified in row-column fashion is supported. This format is supported starting with PilRC 3.0 and is documented in the manual packaged with PilRC. PilRC can be obtained at **pilrc.sourceforge.net**.

9.9.6.3 Objects that become nonusable

The system skips over nonusable objects when a user moves through the tab order. Objects that reside in the same position in the form and are alternately shown should therefore be placed next to each other in the tab order and have the same above and below objects.

If an object in the vertical order becomes nonusable, and the user navigates up to it, the object above receives the focus instead. The down case works the same way, except that the object below the nonusable object receives the focus. If you want an application to behave differently, use the API calls to explicitly set which object should replace the nonusable object in the vertical order.

9.9.6.4 Handling navigation events

System navigation behavior is executed when `FrmHandleEvent()` receives a navigation event. Because `FrmDispatchEvent()` calls a form's custom event handler before calling `FrmHandleEvent()`, a form can easily override default navigation behavior by handling navigation events in its custom event handler.

As explained earlier, the system's internal focus structures are updated when a `frmObjectFocusTake` event is handled, not when it is sent. Therefore, an application must explicitly call `FrmSetFocus()` on the event's associated object if it handles a `frmObjectFocusTake` event.

A `frmObjectFocusLost` event is sent after an object has lost the focus. The internal focus structures will have already been updated when this event is sent. Therefore, an application does not have to do anything besides implement its desired custom behavior if it handles a `frmObjectFocusLost` event.

With tables and gadgets, applications must intercept navigation events. These UI object types have minimal default behavior, if any.

For example, when an application has a table that is included in the focus order, the application might perform the following actions in its custom handler:

- `frmObjectFocusTake` event for table:

  Call `FrmSetFocus()` on the table, highlight the first row of the table, and return `true`.

- `frmObjectFocusLost` event for table:

  Unhighlight row in table and return `true`.

- An Up `keyDown` event when table has the focus:

  If the highlight is not on the table's top row, move the highlight up a row, and return `true`.

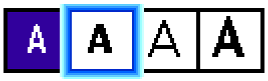
- A Down `keyDown` event when table has the focus:

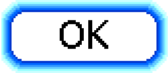
  If the highlight is not on the table's bottom row, move the highlight down a row, and return `true`.

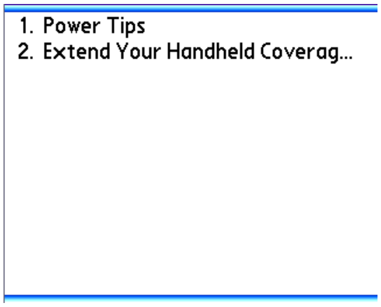
In general, it is assumed that most modal forms do not alter the default navigation behavior, while most nonmodal forms do. That is why navigation is automatically enabled only for modal forms. Nonmodal forms are usually the main views of an application and therefore require more custom behavior.

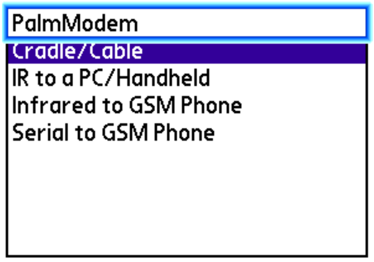
9.9.7 Focus treatment

The functions that draw UI objects are updated to know how to draw the new visual states introduced by navigation. The system uses a blue square ring, a blue rounded ring, or blue bars to indicate that an object has the focus:









`CtlDrawControl()` checks whether the control it is drawing has the navigation focus, and draws a focus ring around the control if it does.

`FldDrawField()` checks whether the field it is drawing has the navigation focus. The function then checks whether the field is in interaction mode. If it is not in interaction mode, the function draws focus bars above and below the field and does not draw the insertion point. If it is in interaction mode, the function draws the field normally and draws the insertion point.

If `LstDrawList()` is drawing an embedded list, it checks whether the list has the navigation focus. The function then checks whether the list is in interaction mode. If it is in interaction mode, the function draws a focus ring around the temporarily selected item. If it is not in interaction mode, the function draws a focus ring around the entire list.

API functions are provided if you want to draw focus rings around objects other than controls, fields, and lists in your application. On the Treo 600 smartphone, the functions are `HsNavDrawFocusRing()`, `HsNavRemoveFocusRing()`, and `HsNavGetFocusRingInfo()`. On the Treo 650 smartphone and later, and the Tungsten T5 handheld, the functions are `FrmNavDrawFocusRing()`, `FrmNavRemoveFocusRing()`, and `FrmNavGetFocusRingInfo()`.

The system ensures that no more than one ring is ever drawn on a form. If a ring is being drawn and there is already a ring on the form, the system removes the ring already displayed on the form before drawing the new ring. A ring drawn with `HsNavDrawFocusRing()` or `FrmNavDrawFocusRing()` should never be directly erased. If you want your application to remove the ring, it should call `HsNavRemoveFocusRing()` or `FrmNavRemoveFocusRing()`.

On Tungsten T5 handhelds, when the Active Input Area is collapsed or expanded, the system automatically removes any focus ring before the area is collapsed or expanded and, after the area has been collapsed or expanded, sends a `frmObjectFocusTake` event with the ID of the object that had the focus ring.

9.9.8 Navigational API, Button Mapping, and behavioral differences between Treo™ smartphones and Tungsten™ T5 handhelds

This section describes navigational differences between the Treo 600 smartphones and later, and the Tungsten T5 handheld.

9.9.8.1 Palm OS® features

Treo 600 smartphones and later, and Tungsten T5 handhelds, set the `hsFtrIDNavigationSupported` feature. The feature's creator is `hsFtrCreator`. The value of the feature is the version number of the Palm Navigation API. On Treo 600 smartphones the version is 1, and on Treo 650 and Treo 700p smartphones and later and Tungsten T5 handhelds the version is 2.

Treo 650 and Treo 700p smartphones and Tungsten T5 handhelds also set the `sysFtrNumFiveWayNavVersion` feature. The feature's creator is `sysFileCSystem`. The value of the feature is the version number of the PalmSource navigation API. On Treo 650 and Treo 700p smartphones and Tungsten T5 handhelds, the version is 1. Version 2 of the Palm Navigation API and version 1 of the PalmSource Navigation API are the same.

Treo 600 smartphones with software version 1.12, Treo 650 and Treo 700p smartphones, and Tungsten T5 handhelds set the s`ysFtrNumUIHardwareFlags` feature. The feature's creator is `sysFileCSystem`. The value of this feature is a bit field that describes what hardware is available on the device. The bit definitions used with the feature's value are as follows:

- `sysFtrNumUIHardwareHard5Way` - The device has a 5-way rocker
- `sysFtrNumUIHardwareHasThumbWheel` - The device has a thumb wheel
- `sysFtrNumUIHardwareHasThumbWheelBack` - The device has a thumb wheel with a Back button
- `sysFtrNumUIHardwareHasKbd` - The device has a dedicated keyboard

On Treo 600 smartphones with software version 1.12, Treo 650 and Treo 700p smartphones, and Tungsten T5 handhelds, the `sysFtrNumUIHardwareHas5Way` is set. On Treo 600 smartphones with software version 1.12 and on Treo 650 and Treo 700p smartphones, the `sysFtrNumUIHardwareHasKbd` is also set.

NOTE: The feature not being set on the original Treo 600 smartphone software was an oversight. This problem was fixed with software update 1.12 available from the Palm Customer Support download area.

The Tungsten T5 handheld no longer supports the `navFtrVersion` feature supported on Zire handhelds and earlier Tungsten handhelds.

9.9.8.2 Functions

Treo 600 smartphones and later support `HsNavDrawFocusRing()`, `HsNavRemoveFocusRing()`, `HsNavGetFocusRingInfo()`, and `HsNavObjectTakeFocus()` calls. Treo 650 smartphones and later, LifeDrive, Palm T|X, and Tungsten T5 handhelds support `FrmNavDrawFocusRing()`, `FrmNavRemoveFocusRing()`, `FrmNavGetFocusRingInfo()`, and `FrmNavObjectTakeFocus()` calls.

Except for the prefix differences in their names, these functions work exactly the same way. Applications should transition to using the `FrmNav` API calls, because the `HsNav` calls are deprecated and remain only on Treo 650 smartphones for Treo 600 smartphone backward compatibility.

IMPORTANT: Do not make `HsNav` calls on Tungsten T5 handhelds. `HsNav` calls made on Tungsten T5 handhelds will fail, most likely with a Sys0505 error, which means that the module that exports the function is not on the handheld.

Because Treo 600 smartphones support only the `HsNav` version of these calls and Tungsten T5 handhelds support only the `FrmNav` version of these calls, applications intended to run on both devices must check their context before making these calls. The suggested method is to check the version number of the `hsFtrIDNavigationSupported` feature and decide whether to make an `HsNav` call or a `FrmNav` call based on the version value. Specifically, `HsNav` calls should be made if the version is `1`, and `FrmNav` calls should be made if the version is `2`. The decision about what call to make must be made at runtime. For example:

```
if (FtrGet (hsFtrCreator, hsFtrIDNavigationSupported, &version) == 0)
  {
    if (version == 1)
      HsNavObjectTakeFocus (formP, objID);
    else // if version >= 2
      FrmNavObjectTakeFocus (formP, objID);
  }
```

9.9.8.3 Button Mapping

This section describes the button mapping schemes for Treo smartphones.

9.9.8.3.1 Virtual Keys on Treo Smartphones

Traditional Virtual Keys for Palm Devices
vchrHard1
vchrHard2
vchrHard3
vchrHard4
vchrHardPower
vchrPageUp
vchrPageDown
vchrLaunch (usually silk-screened on non-keyboard devices)
vchrMenu (usually silk-screened on non-keyboard devices)
vchrCalc (usually silk-screened on non-keyboard devices)
vchrFind (usually silk-screened on non-keyboard devices)

Treo Specific Virtual Keys
hsChrOptHard1
hsChrOptHard2
hsChrOptHard3
hsChrOptHard4
vchrHard11
hsChrOptHard11
hsChrOptHardPower

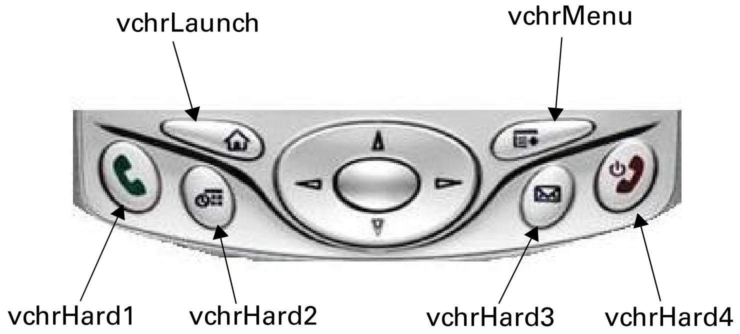
9.9.8.3.2 Button Mapping for Treo™ 600

The following table shows how the keyboard driver maps virtual characters to device keys for the Treo 600 smartphone.

NOTE: `EvtGetEvent` converts `vchrPageUp`/`Down` into `vchrRockerUp`/`Down` if navigation is enabled for the active form.

Treo 600		
Traditional Keys	**vchrHard1**	Phone key (1st key in app row)
	vchrHard2	Calendar key (2nd key in app row)
	vchrHard3	Mail/Msg key (3rd key in app row)
	vchrHard4	Screen key (4th key in app row)
	vchrHardPower	Power key (on top of device)
	vchrPageUp	Rocker-up key
	vchrPageDown	Rocker-down key
	vchrLaunch	Home key (bottom row of keyboard)
	vchrMenu	Menu key (bottom row of keyboard)
	vchrCalc	None
	vchrFind	Option + Left Shift key
Treo-specific Keys	**hsChrOptHard1**	Option + Phone key
	hsChrOptHard2	Option + Calendar key
	hsChrOptHard3	Option + Mail/Msg key
	hsChrOptHard4	Option + Screen key
	vchrHard11	None
	hsChrOptHard11	None
	hsChrOptHard Power	Option + Power key
	vchrMenu	Menu key (Right, flattened key in top row)
	vchrCalc	None
	vchrFind	Option + Left Shift key

9.9.8.3.3 Button Mapping for Treo™ 650

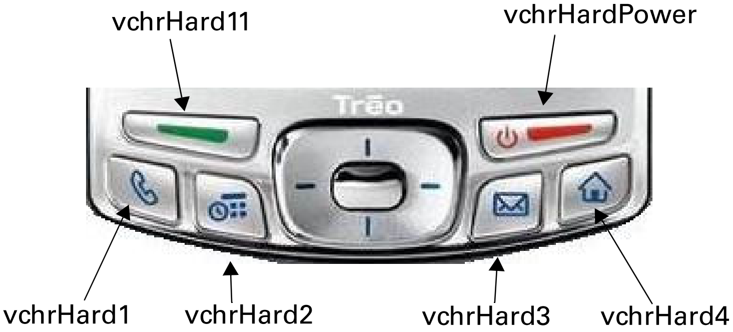


The following table shows how the keyboard driver maps virtual characters to device keys for the Treo 650 smartphone.

NOTE: `EvtGetEvent` converts `vchrPageUp`/`Down` into `vchrRockerUp`/`Down` if navigation is enabled for the active form.

Treo 650		
Traditional Keys	**vchrHard1**	Phone/Send key (1st key in app row)
	vchrHard2	Calendar key (2nd key in app row)
	vchrHard3	Mail/Msg key (3rd key in app row)
	vchrHard4	Power/End app key (4th key in app row)
	vchrHardPower	None
	vchrPageUp	Rocker-up key
	vchrPageDown	Rocker-down key
	vchrLaunch	Home key (Left, flattened key in top row)
	vchrMenu	Menu key (Right, flattened key in top row)
	vchrCalc	None
	vchrFind	Option + Left Shift key
Treo-specific Keys	**hsChrOptHard1**	Option + Phone/Send key
	hsChrOptHard2	Option + Calendar key
	hsChrOptHard3	Option + Mail/Msg key
	hsChrOptHard4	Option + Power/End app key
	vchrHard11	None
	hsChrOptHard11	None
	hsChrOptHard Power	None

9.9.8.3.4 Button Mapping for Treo™ 680 and Treo™ 700p



The following table shows how the keyboard driver maps virtual characters to device keys for the Treo 680 and Treo 700p smartphone.

NOTE: `EvtGetEvent` converts `vchrPageUp/Down` into `vchrRockerUp/Down` if navigation is enabled for the active form.

Treo 700p		
Traditional Keys	**vchrHard1***	Phone (1st key in app row)
	vchrHard2	Calendar key (2nd key in app row)
	vchrHard3	Mail/Msg key (3rd key in app row)
	vchrHard4*	Home key (4th key in app row)
	vchrHardPower*	Power/End key (Right, flattened key in top row)
	vchrPageUp	Rocker-up key
	vchrPageDown	Rocker-down key
	vchrLaunch*	Option + Home key
	vchrMenu**	Menu key (bottom row of keyboard)
	vchrCalc	None
	vchrFind	Option + Left Shift key
Treo-specific Keys	**hsChrOptHard1***	Option + Phone key
	hsChrOptHard2	Option + Calendar key
	hsChrOptHard3	Option + Mail/Msg key
	hsChrOptHard4*	None
	vchrHard11*	Send key (Left, flattened key in top row)
	hsChrOptHard11*	Option + Send key
	hsChrOptHardPower*	Option + Power/End key

* Indicates differences from Treo 650 smartphones.
** The vchrMenu key is in a different location on the device, but functionality is the same.

It is important to note that launching an application in response to pressing an application key occurs in `SysHandleEvent` after a `sysNotifyVirtualCharHandlingEvent` notification is sent. Therefore, any application that processes key events before `SysHandleEvent` and/or handles `sysNotifyVirtualCharHandlingEvent` notifications could prevent application launching from working properly.

9.9.8.3.5 New Button Mapping Scheme in Treo™ 680 and Treo™ 700p smartphones

The button mapping scheme of the Treo 680 and Treo 700p smartphones differ from the Treo 650 in the following significant ways.

1. Phone Application and Send Key

   On the Treo 650 smartphone, the Phone Application and Send functionality were on the same key. On the Treo 680 and Treo 700p, this has changed; Send functionality is no longer associated with the Phone Application key. To associate behavior with the Send key, you should now use `vchrHard11` instead of `vchrHard1`.

2. Home Key

   On the Treo 650 smartphone, the Home key was associated with the `keyLaunch keyCode` (or the `keyBitExt2Launcher` bit). The Home key on the Treo 680 and Treo 700p smartphones are now associated with the `keyHard4 keyCode` (and the `keyBitHard4` bit) instead. The Home key generates `vchrHard4` key events when it is not modified by Option. When it is modified by the Option key, the Home key generates `vchrLaunch` key events.

   It is important to note that instead of enqueueing `hsChrOptHard4` key events when the Launcher key is modified by an Option, `vchrLaunch` is enqueued. This is necessary because some games that perform pre-`SysHandleEvent` processing will only exit if they see a `vchrLaunch` key event.

NOTE: Because `vchrLaunch` is enqueued instead of `hsChrOptHard4`, any functionality associated with `hsChrOptHard4` will be lost on the Treo 680 and Treo 700p.

The Home key will switch to Launcher in two instances:

1. When it is unmodified by the Option key

   In this case, the Home key generates a `vchrHard4 keyDown` event, `SysHandleEvent` broadcasts a `sysNotifyVirtualCharHandlingEvent` notification, and then `SysHandleEvent` switches to Launcher if the notification is unhandled.

2. When it is modified by the Option key

   In this case, the Home key generates a `vchrLaunch keyDown` event, `SysHandleEvent` broadcasts a `sysNotifyVirtualCharHandlingEvent` notification, and then `SysHandleEvent` switches to Launcher if the notification is unhandled.

Additionally:

- Events generated by the Home key will have `keyHard4` in the keyCode field
- Passing the `keyLaunch` `keyCode` to `PmKeyKeysPressed`, `PmKeyStop`, or `PmKeyEnable` has no effect.
- Passing the `keyLaunch` `keyCode` to `PmKeyKeyCodeToChrCode` returns 0 for the character and modifiers.
- Passing the `keyHard4` `keyCode` to `PmKeyKeysPressed`, `PmKeyStop`, or `PmKeyEnable` affects the behavior of the Home key.
- Passing the `keyHard4` `keyCode` to `PmKeyKeyCodeToChrCode` returns `vchrHard4` if `optionKeyMask` is not set in the passed-in modifiers and `vchrLaunch` if `optionKeyMask` is set in the passed-in modifiers.
- Passing `vchrHard4` or `vchrLaunch` to `PmKeyChrCodeToKeyCode` returns `keyHard4`.
- Neither `vchrHard4` nor `vchrLaunch` can be remapped to a different application through the user interface or programmatically.

3. Power Key

   The dedicated power key, which was removed from the Treo 650, has been brought back on the Treo 680 and Treo 700p. The dedicated power key enqueues `vchrHardPower`.

4. PmKeyAttrGet

   Several new attributes have been added to `PmKeyAttrGet` that will allow an application to determine the functionality that is mapped to specific keys:

   - `pmKeyAttrGetLauncherKeyCode` returns the keyCode of the Home key
   - `pmKeyAttrGetMenuKeyCode` returns the keyCode of the Menu key
   - `pmKeyAttrGetSendKeyCode` returns the keyCode of the Send key
   - `pmKeyAttrGetEndKeyCode` returns the keyCode of the End key
   - `pmKeyAttrGetPhoneKeyCode` returns the keyCode of the Phone key

   Please note that these attributes are only available in devices that have PmKey Library API version 3 or later. Therefore, when you call `PmKeyAttrGet`, do one of the following things:

   1. Verify that the PmKey library is version 3 or later by using the following code:

   ```
   (sysGetLibAPIVersionMajor(pmKeyLibVersion) >= 3)
   ```

   2. Fail gracefully if `PmKeyAttrGet` returns `pmErrNotSupported`.

NOTE: Due to the new location of the Home key, if you cannot exit a game through the Home key, Option + Home key, or the game menus, try pressing and holding the Side key. This should launch the application associated with the Side key and allow you to exit the game.

9.9.8.4 Associating custom behavior with the Center button

Treo 600 smartphones, Treo 650 smartphones and later, and Tungsten T5 handhelds generate the following key events for Center button actions:

Action	Treo 600 smartphone	Treo 650 smartphones and later, and Tungsten T5 handheld
Press	keyDown event with chr=vchrRockerCenter, keycode=keyRockerCenter, and modifiers=commandKeyMask.	keyDown event with chr=vchrHardRockerCenter, keycode=keyRockerCenter, and modifiers=commandKeyMask.
Continuous Press	keyDown event with chr=vchrRockerCenter, keycode=keyRockerCenter, and modifiers=autoRepeatKeyMask | commandKeyMask.	keyDown event with chr=vchrHardRockerCenter, keycode=keyRockerCenter, and modifiers=autoRepeatKeyMask | commandKeyMask.
Held for one second or longer	keyHold event with chr=vchrRockerCenter, keycode=keyRockerCenter, and modifiers=commandKeyMask.	keyHold event with chr=vchrHardRockerCenter, keycode=keyRockerCenter, and modifiers=commandKeyMask.
Release	keyUp event with chr=vchrRockerCenter, keycode=keyRockerCenter, and modifiers=commandKeyMask.	keyUp event with chr=vchrHardRockerCenter, keycode=keyRockerCenter, and modifiers=commandKeyMask. (Consumed by SysHandleEvent if the system handled keyHold of vchrHardRockerCenter.) keyDown event with chr=vchrRockerCenter, keycode=0, and modifiers=commandKeyMask. (If the keyDown event vchr=vchrHardRockerCenter is not handled and the system does not handle the keyHold event of vchrHardRockerCenter.)

On Treo 600 smartphones and later, associating custom behavior with the Center button simply entails handling the vchrRockerCenter keyDown event. Applications can handle the other events as well, although most applications will not need to. If an application handles the other events, it is responsible for making sure that multiple actions are not triggered by the Center button. For example, an application that performs an action on keyUp should ensure that no action is performed on keyDown.

On Treo 600 smartphones, by default, a Center button press and hold does nothing different from a Center button press. On Treo 650 smartphones and later, and Tungsten T5 handhelds, however, if the Center button is pressed and held, the Attention dialog box is displayed.

As such, on Treo 650 smartphones and later, and Tungsten T5 handhelds, an application cannot associate an action with the press of the Center button because it is not yet known whether the Center button is going to be pressed or pressed and held. If an application associates an action on press and then the button is pressed and held, two actions will be triggered by the Center button. On Treo 650 smartphones and later, and Tungsten T5 handhelds, actions should occur on the *release* of the Center button and only if the Center button was not held.

To minimize the changes required to make Treo 600 smartphone applications work with Treo 650 smartphones and Tungsten T5 handhelds, on these devices a `vchrRockerCenter keyDown` event is generated on Center button release rather than on press, and it is only generated on release if the Center button was not held.

This means that an application can safely handle any `vchrRockerCenter keyDown` event it receives without the Center button triggering multiple actions. The application need not check to see if it is running on a Treo 600 smartphone, nor does it need to determine whether the Center button is held before handling the event. This also means that a continuous press `keyDown` event, a `keyHold` event, and a `keyUp` event for `vchrRockerCenter` are not generated on Treo 650 smartphones and Tungsten T5 handhelds. See the next section for what new events are generated on Treo 650 smartphones and Tungsten T5 handhelds.

9.9.8.5 New Center button events for Treo™ 650 smartphones and later, and Tungsten™ T5 handhelds

`vchrHardRockerCenter` key events are generated on Treo 650 smartphones and later, and Tungsten T5 handhelds in the same fashion that `vchrRockerCenter` key events are generated on Treo 600 smartphones. Only Treo 650 smartphone and later, and Tungsten T5 handheld applications that need more information on the state of the Center button than what the `vchrRockerCenter keyDown` event provides need to handle `vchrHardRockerCenter` key events.

The system will not handle a `vchrHardRockerCenter keyHold` event if a form's custom handler, the handler associated with a form by `FrmSetEventHandler`, handles a `vchrRockerHardCenter keyDown` event. This prevents an action from occurring on both the press and hold of the Center button.

If an application did not handle the `vchrHardRockCenter keyDown` event and the system did not handle the `vchrHardRockerCenter keyHold` event, a `keyDown` event with `chr=vchrRockerCenter`, `keycode=0`, and `modifiers=commandKeyMask` is generated on release.

Even though an application can handle Center presses, doing so is not recommended because it prevents the Attention dialog box from being displayed when the Center button is held.

9.9.8.6 Page scrolling

9.9.8.6.1 Page scrolling on Treo™ 600 and Treo™ 650

On Treo 650 smartphones and Tungsten T5 handhelds, paging through lists of records or through lines of text is easier than it is on Treo 600 smartphones. On Treo 600 smartphones, when the focus is on a multi-line field that is not in interaction mode, Up and Down move the focus off the field and to the object above or below. On Treo 650 smartphones and Tungsten T5 handhelds, Up and Down still move the focus to the object above or below if the top or bottom line of text is showing. However, if the top or bottom line of text is not showing, then Up and Down pages the field's text up or down. Only after the top or bottom is reached and Up or Down is released and pressed again does the focus move to the object above or below. Users can still easily move the focus off the field by pressing the Center button if the field is in interaction mode, and then pressing Left or Right. Focus bars above and below a field convey that Up and Down behave in this manner.

Navigation behavior for tables is to be completely implemented by third-party applications. For tables in Palm applications, the same paging behavior the system uses for multi-line fields is used for Up and Down. Additionally, if a table uses Center to open a record, Left takes the table out of interaction mode. Without this extra functionality added to the Left button, there would be no easy way to move the focus off a table.

For consistency's sake and to ensure a good user experience, third-party applications should follow these navigation conventions in their tables as well.

9.9.8.6.2 Page Scrolling on Treo™ 680 and Treo™ 700p smartphones

Treo 680 and Treo 700p smartphones include some new page scrolling behaviors. The main update is the change to the FIRST page scroll. The FIRST page scroll behavior (where the page is scrolled completely) is replaced with a behavior that moves the focus to the bottom item on the page.

New page scrolling behaviors in Treo 680 and Treo 700p smartphones are as follows:

1. When the user quickly presses and releases the Up or Down button, the focus scrolls a line.
2. When the user presses and holds the Up or Down button, the focus scrolls a page.
3. When the user presses and continues to hold the Up or Down button, the focus scrolls a page repeatedly.
4. When the user holds the 5-way rocker up or down for 0.5 seconds, the list will scroll 1 page and focus will be placed on the bottom item on the page (if the user is scrolling down).
5. When the user holds the 5-way rocker up or down for an additional 0.4 seconds, the list will start page scrolling every 0.4 seconds. Focus will remain on the bottom item on the page as paging occurs.

9.9.8.7 Navigation macros

The navigation macros supported on Tungsten and Zire handhelds also work on Treo 650 smartphones and Tungsten T5 handhelds. They continue to be supported to help minimize the code paths that an application needs to take to run on multiple devices. The details of these macros are thoroughly documented in the `palmOneNavigator.h` header file.

9.9.9 Tips and troubleshooting

9.9.9.1 Navigation order

- You must create a navigation resource any time they have a form whose initial navigation order is not the default navigation order. `FrmSetNavOrder()` and `FrmSetNavEntry()` are not intended to replace the use of navigation resources. A form that should initially have a custom navigation order should always have a navigation resource.

  Having the navigation information available at the time the system initializes the form is much cleaner than having the system initialize the form with the default navigation order and then having the order changed when the application performs its own form initialization. `FrmSetNavOrder()` and `FrmSetNavEntry()`

are mainly for dynamically created forms or forms with navigation orders that change sometime after form initialization.

- For forms that are “navigation-aware” (that is., forms that have a navigation resource and/or call navigation API functions), the vertical navigation order is not automatically updated as object attributes are changed, as objects are included in the order, or as objects are excluded from the order.

  You may expect that the vertical order will automatically be updated because the vertical navigation order of forms that are not “navigation-aware” *is* automatically updated. However, it is not prudent to automatically determine the navigation order for all forms. Automatic updating of navigation order is applied only when necessary—when a form does not know about navigation.

  If a form knows about navigation, it is the developer’s responsibility to specify the proper vertical order through a navigation resource and then update the vertical order as needed.

- Developers can enable basic navigation for existing applications by simply creating navigation resources for the application’s forms and including the resources into the application’s existing .prc.

- Pop-up lists do not technically receive the navigation focus. When they are not popped up, they are not usable and therefore cannot receive the focus. When they are popped up, the rocker keys have dedicated functionality—regardless of whether object focus mode is on or which object has focus. Therefore, there is no need to put pop-up lists in a custom navigation order (although no problems arise if they are placed in the order).

  If a form is using the default navigation order, the pop-up list will be included in the order but will most likely be marked as skipped (because the list will most likely not be usable when the form is initialized).

9.9.9.2 Focus

- Although `FrmSetFocus()` gives the focus to the specified object, it does not redraw the object. To give focus to a system-supported navigation object (controls, fields, or lists), an application should call `HsNavObjectTakeFocus()` on the object. `HsNavObjectTakeFocus()` sends a `frmObjectFocusTake` event for the object and `FrmHandleEvent()` processes the event by calling `FrmSetFocus()` on the object and redrawing the object.

- The effects of calling `FrmSetFocus()` to set the navigation focus will be lost if `FrmSetFocus()` is called in response to a `frmOpen` event. This is because a `frmObjectFocusTake` event that sets the form’s initial navigation focus is sent just after the `frmOpen` event.

  To properly give an object the initial focus, a navigation resource with the object specified as the initial focus object should be provided.

- If the object with the navigation focus is hidden, the form will be in a state where there is no navigation focus. The application is responsible for setting the new focus after it hides the focused object.

  If the application fails to do this and the user presses a directional rocker key when there is no focus on the form, the focus will be moved to the first object in the tab order.

9.9.9.3 Focus rings and redraw problems

- An application may run into redraw problems when it controls the drawing and/or removal of focus rings (when they directly call `HsNavDrawFocusRing()` and/or `HsNavRemoveFocusRing()`).

  Drawing focus rings around an object and properly restoring an object when it loses the focus ring is very tricky. The rings can be drawn over an object's frame, over another object, and over pixels directly drawn to the screen. When the system draws and removes the ring, it takes these possibilities into account and also contends with clipping rectangles and objects that change appearance between receiving and losing the focus ring. The system manages these complications fairly well when it is controlling the drawing and removal of rings.

  For an application to properly handle these complications, developers should have a basic understanding of the ring drawing and removal mechanism. Before a ring is drawn, the bits behind the ring are saved. When a ring is removed, the bits behind the ring are restored, the object is redrawn, and the portion of any object that was behind the ring is redrawn.

  Therefore, it is important that an application always draw an object in its normal state *before* drawing a focus ring around it. If the appearance of an object with the focus ring needs to change (that is, if an object's bounds needs to change) or if what's behind the focus ring needs to change (for example, if the background color of the form needs to change), an application should remove the ring, make the changes, draw the changes, and then draw the ring again.

9.9.9.4 Fields

- To give a field the insertion point, `FldGrabFocus()` should be called. `FldGrabFocus()` will take care of enabling the insertion point and putting the field into interaction mode. Similarly, to take the insertion point away from a field, `FldReleaseFocus()` should be called. `FldReleaseFocus()` will take care of disabling the insertion point and taking the field out of interaction mode.
- Since navigation causes fields to constantly receive and lose the insertion point, it is necessary to always set the proper shift state for a field when it receives the insertion point. The `hsNotifySetInitialFldStateEvent` notification accomplishes this task. An application that has a field that should always have a particular shift state should register for the notification.

  When registering, it should pass the field's form pointer as the user data for the notification. When it receives the notification, it should compare the active form pointer with the form pointer passed as the user data. If the pointers match, it should then call `FrmGetFocus()` to see which object has the focus. If it is the field that it wants to set the shift state for, the application should set the shift state and then mark the notification as handled.

9.10 Handspring® extensions

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

The Treo smartphone by Palm was originally designed by Handspring, and Handspring created new extensions to the Palm OS to support Treo smartphones. You can find the details of the new APIs in the *Palm OS Platform API Guide* available separately from Palm at **http://pluggedin.palm.com**.

9.11 Tips and Tutorials

Available on:

- LifeDrive™ mobile manager
- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5, Tungsten™ E2, and Palm® T|X handhelds
- Palm® Z22 organizer

A framework for applications to display formatted help content is included in the Palm OS SDK. This help content serves as an on-device training tool designed to provide customers with a quick introduction to a device, application, or accessory.

9.11.1 Terminology

9.11.1.1 Tips

Tips are a collection of one-screen HTML pages (`Lessons`) that provide succinct usage tips for an application. These Lessons are collected into one Topic.

Tips are accessed from a menu item in the application.

9.11.1.2 Tutorial

A Tutorial is a collection of several Topics.

Tutorials are accessed through an icon in the Applications View instead of directly from an application. A Tutorial consists of a menu, and a collection of ten or fewer Topics tied together in a logical manner. For example, the Tutorial that comes preinstalled on Treo smartphones contains Topics that provide customers with basic instruction on using their Treo smartphone.

On the Treo 600 smartphone, the Applications icon for the Tutorial is labeled “Tutorial.” On the Treo 650 smartphone and later, the Applications icon for the Tutorial is labeled “Quick Tour.”

9.11.1.3 Topic

A Topic is a collection of Lessons on a common theme.

A Tips file generally has one Topic, while a Tutorial file usually contains multiple topics. Tutorial files generally have a menu page that lets the user select which Topic they want to see. For example, the first Topic in the Tutorial that comes preinstalled on the Treo smartphone, “Getting Started,” covers basic familiarity with the Treo smartphone buttons and behavior. When you build an XML file, a Topic is defined by Sequence tags.

9.11.1.4 Lesson

A Lesson, sometimes referred to as a page, is a single screen within a Topic. It consists of text, images, or both. A single idea is usually conveyed by one Lesson, but more complex ideas may require multiple Lessons.

9.11.2 Content

9.11.2.1 Topic titles

Topic titles should fit on a single line—generally, 25 characters or less—and should clearly describe the logical connection between enclosed Lessons. Standard title capitalization rules should be used. When creating a Tips file, the Topic title should be the name of the application the Tips are about.

9.11.2.2 Lesson text

Most Lessons contain text. Standard manual writing guidelines should be used when writing text. Text should be limited to no more than 30 words per Lesson.

9.11.2.3 Lesson images

Whenever possible, images should be used to ground the text with specific examples of the device, application, or accessory in action. See the image creation guidelines for more information.

9.11.3 Tips and Tutorial structure

Before being converted into a Palm OS® PRC file, Tutorials and Tips are collections of HTML files and images organized in a directory. Components include:

- A folder to contain the complete contents of the Tips or Tutorial. This folder is referred to as the *root content folder*.
- A menu page that lists all the available topics. This menu page is contained in an HTML document that is usually named index.html. Tips files that contain only one topic do not need a menu page.
- An HTML page for each Lesson in each Topic:
    - If the HTML page references external content such as images or JavaScript, they must also be present within the root content folder, unless the external content is already in the device's ROM.
    - References to external content must be relative to the root content folder, not to any subfolders within the content. For this reason, it's frequently easiest to put all the content files into one folder and reference files by file name only.
    - HTML pages may also reference the shared content library in the device's ROM. See the shared content description document for more information.
    - A style sheet and JavaScript library that provide the standard Palm Tips and Tutorial styles and formatting are included in the shared content library in the device's ROM. We strongly recommend that all Tips and Tutorial content use these files. See the shared content description document for more information.
- An XML document, usually named tips.xml, that defines the elements and structure of the Tutorial or Tips.

9.11.3.1 Menu document

Tutorials have a menu document written in HTML (usually called index.html) that lets users select a topic to view. Tips files normally contain only one topic, so they do not have menu documents. The menu document contains the following elements.

9.11.3.1.1 Head

```
<html>
<head>
<meta name="HandheldFriendly" content="True">
<title>Tutorial Main Menu</title>
   <link rel="stylesheet" href="common/inc/style.css" type="text/css"
title="test_style">
   <script language="javascript" src="common/inc/tutorial.js"></script>
</head>
```

Where:

- `<meta name="HandheldFriendly" content="True">` prevents the rendering engine from transforming the content.
- `<title>Tutorial Main Menu</title>` is customizable.

  The content within the title tags should reflect the title of the Tutorial.
- `<link rel...>` and `<script language...>` tell the document which style sheet and JavaScript source file to use.

  These should refer to the shared style sheet and JavaScript files in the shared content library in the device’s ROM as shown earlier.

9.11.3.1.2 Body

```
<body onLoad="setPage('menu','');">
```

Where:

- `setPage` is a JavaScript routine that performs cookie actions appropriate to the type of page.
  - The first parameter defines what actions should be taken. The first parameter for a menu page should always be titled “menu.”
  - On a menu page, the second parameter should be empty.

9.11.3.1.3 Icon

```
<!-- icon -->
<div id="icon">
<img src="common/img/icon_menu.gif" height="42" width="35" border="0">
```

Where:

- `<div id="icon">` positions the icon.
- `<img src="common/img/icon_menu.gif">` points to the menu icon in the shared content library in the device’s ROM. All menus should use this icon.

9.11.3.1.4 Header and Content

```
<!-- header -->
<div id="menu_frame">
<img src="common/img/spacer.gif" height="42" width="35" border="0" class="r_float">
<p class="title">Tutorial Main Menu</p>

<!-- content -->
<img src="common/img/spacer.gif" height="10" width="125" border="0"><br>
<a class="menu" href="get_start_1.html"><img src="common/img/bullet_empty.gif"
name="hsgs" width="16" height="8" border="0">Getting Started</a><br>
<a class="menu" href="keyboard_1.html"><img src="common/img/bullet_empty.gif"
name="hskb" width="16" height="8" border="0">Keyboard Basics</a><br>
<a class="menu" href="top_ten_1.html"><img src="common/img/bullet_empty.gif"
name="hstt" width="16" height="8" border="0">Top 10 Fun Features</a><br>
<a class="menu" href="upgrade_1.html"><img src="common/img/bullet_empty.gif"
name="hsup" width="16" height="8" border="0">Upgrading From a Palm OS Device</a><br>
```

Where:

- `<div id="menu_frame">` defines the position and background image for the menu frame. This should not be changed.
- `<p class="title">Tutorial Main Menu</p>` defines the color and position of the title that will appear on the Tutorial menu page. Replace “Tutorial Main Menu” with the title of your Tutorial. When testing your Tutorial, make sure your title fits in the allotted space.
- Each Topic that is to appear in your menu should be coded as follows:
  `<a class="menu" href="get_start_1.html"><img src="common/img/bullet_empty.gif" id="ft01" width="16" height="8" border="0">Getting Started</a><br>`
  - Replace `get_start_1.html` with the name of the HTML document that defines the first Lesson in the Topic.
  - Replace `hsgs` with a code uniquely identifying the Topic. This code is used on the last Lesson of a Topic, so make a note of it for future reference. This is used to update the bullet to a checkmark once the Topic is completed by the user. See the built-in Quick Tour for an example of this behavior.
  - Replace `Getting Started` with the name of the Topic.

9.11.3.1.5 Footer

```
<!-- footer -->
<span id="menu_footer">Scroll Up or Down and press Center to select a topic</span>
</body>
```

This footer text should appear at the bottom of every menu. Do not change this section.

9.11.3.2 Lesson document

To make it easier to understand the structure, Lesson documents should be given a consistent naming structure. For example, the Lessons in the “Getting Started” Topic are named `get_start_1.html`, `get_start_2.html`, `get_start_3.html` and so on.

9.11.3.2.1 Head

```
<html>
<head>
<meta name="HandheldFriendly" content="True">
   <title>Getting Started</title>
   <link rel="stylesheet" href="common/inc/style.css" type="text/css"
   title="test_style">
   <script language="javascript" src="common/inc/tutorial.js"></script>'
```

Where:

- `<meta name="HandheldFriendly" content="True">` prevents the rendering engine from transforming the content.
- `<title>Getting Started</title>` is customizable.

  The content within the title tags should reflect the title of this Topic. All Lessons in the same Topic should use the same title. Tips files should use the name of the application that the Tips are about as the title of all Lesson documents.
- `<link rel...>` and `<script language...>` tell the document which style sheet and JavaScript source file to use.

  These should refer to the shared style sheet and JavaScript files in the shared content library in the device's ROM as shown in the example. The `<script language...>` tags are necessary only on the last Lesson of a Topic.

9.11.3.2.2 Body

```
<body onLoad="setPage('end','hsgs');">
```

Where:

- The last Lesson of a Tutorial Topic should have a body tag like the one shown in the example.
- `setPage` is a JavaScript routine that performs cookie actions appropriate to the type of page.
  - The first parameter defines what actions should be taken. If this is the last Lesson in the Topic, the first parameter should be set to `end`.
  - The second parameter should be the same as the code used to uniquely identify this Topic on the menu page.
  - This is used to update the bullet to a checkmark once the Topic is completed by the user. See the built-in Quick Tour for an example of this behavior.
- All other Lessons should have a regular `<body>` tag.

9.11.3.2.3 Icon

```
<!-- icon -->
<div id="icon">
<img src="common/img/icon_gs.gif" height="42" width="35" border="0">
<div id="icon"> positions the icon.
```

`<img src="common/img/icon_gs.gif"...>` points to the icon used for this Topic. Replace `common/img/icon_gs.gif` with the path to your icon image relative to the root folder. All Lessons in the same Topic should use the same image. See the attached image guidelines for more information.

9.11.3.2.4 Header and Content

```
<!-- header -->
<img src="common/img/spacer.gif" height="42" width="35" border="0" class="r_float">
<p class="title">Getting Started</p>

<!-- content -->
<img src="common/img/spacer.gif" height="5" width="125" border="0"><br>
<P>
<B>Congratulations on your purchase!</B>
</P>

<P>
The following tips will help you get started.
</P>

<img src="common/img/key_fiveway.gif" width="51" height="34" class="cap_none" border="0"
style="margin: 26 5 0 5">

<P>
Press the Center navigation button to go to the next page.
</P>

<!-- arrows and text -->
<img src="common/img/arrow_down_long.gif" width="8" height="30" border="0"
style="position:absolute; top:83; left:126;">
</div>

</body>
```

Where:

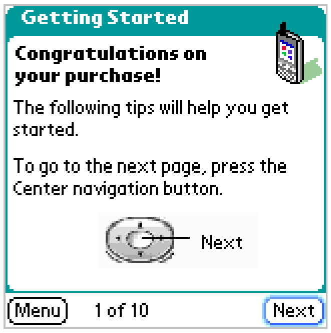
- `<div id="content_frame">` defines the position and area in which the content will appear. This should not be changed.
- `<p class="title">Getting Started</p>` defines the title for the Topic that will appear at the top of the screen. Replace "Getting Started" with your Topic title. The same title should be used for all Lessons in this Topic. Tips files should use the name of the application that the Tips are about as the title of all Lesson documents.
- All content should appear between `<!-- content --> <img src="common/img/spacer.gif" height="5" width="125" border="0"><br>` and `</div>`.

9.11.3.2.5 Lesson Content Formatting

There are several alternate ways of presenting content. In general, any Lesson may consist of the following:

- Text that flows vertically and horizontally in the main content frame
- Images that flow vertically within the main content frame and float right
- Images that flow vertically within the main content frame and float left
- Images that flow vertically within the main content frame and are centered
- Text or images that are removed from the flow of the main content frame and are absolutely positioned

- Text that appears in a graphic box on top of another image, otherwise known as a "callout."



Getting Started

Congratulations on your purchase!

The following tips will help you get started.

To go to the next page, press the Center navigation button.

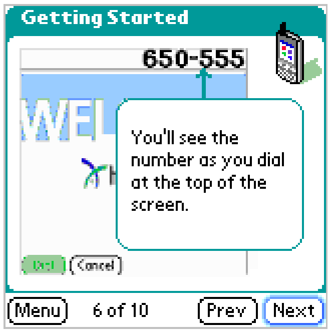
In this example, all text but the word "Next" flows vertically and horizontally in the main content frame. The image of the navigation button flows vertically within the main content frame and floats right. The word "Next" and the arrow pointing to the center button are removed from the flow of the main content frame and are absolutely positioned. The HTML that defines this content is as follows:

```
<!-- content -->
<img src="img/spacer.gif" height="5" width="125" border="0"><br>
<p>
<b>Congratulations on your purchase!</b> The following tips will help you get started.
</p>

img src="img/fiveway.gif" width="51" height="34" class="capp_top" borders="0">

<p>
To go to the next page, press the center navigation button.
</p>

<!-- arrows and text -->
<img src="img/arrow_down_long.gif" width="8" height="30" border="0"
style="position:absolute; top:63; left:125;">
<span style="position:absolute; top:52; left:126;">Next</span>
```

Where:

- The text that will appear within the main flow of the content frame must be set off with paragraph tags (`<p>` and `</p>`).
- Because HTML aligns paragraphs and images at the top of their respective blocks, `<img src="img/fiveway.gif"...>` appears after the first paragraph to align with the top of the second paragraph. The path to the image file, as always, is defined from the root folder.
- `<img...class="cap_top">` defines the margins, which are extended—in this case on top—to make room for a caption. The following are predefined classes and their margins. If you need larger margins, you will need to define them within the `img` tag using the style attribute.
  - `cap_none: top:5; right:5; bottom:0; left:5; float: right`
  - `cap_top: top:30; right:5; bottom:0; left:5; float: right`
  - `cap_left: top:5; right:5; bottom:0; left:30; float: right`

- `<img src="img/arrow_down_long.gif"...>` defines the path from the root folder to the arrow image. You'll find predefined arrows in the attached template documentation; use those as a template if you create your own. Within the `img` tag is the style attribute: `<img...style="position:absolute; top:52; left:126;">`. Use this syntax to place elements exactly, always defining distance from the top-left corner at 0,0 pixels.
- `<span style="position:absolute; top: 52; left: 126;">` is used to absolutely position text. Always define distance from the top-left corner at 0,0 pixels.



You'll see the number as you dial at the top of the screen.

This is an example of a callout. The following code generates the callout:

```
<span style="position: absolute; top: 40; left: 60;">
<table border="0" width="80" cellspacing="0" cellpadding="0" align="left" >
   <tr>
      <td><img src="common/img/pull_tl.gif" width="6" height="7" border="0"></td>
      <td><img src="common/img/pull_t.gif" width="68" height="7" border="0" ></td>
      <td><img src="common/img/pull_tr.gif" width="6" height="7" border="0" ></td>
   </tr>
   <tr bgcolor="#CCFFCC">
      <td><img src="common/img/pull_l.gif" width="6" height="55" border="0" ></td>
      <td>When on a call, press Center to Hang Up, or Right to choose another option.</
td>
      <td><img src="common/img/pull_r.gif" width="6" height="55" border="0" ></td>
   </tr>
   <tr>
      <td><img src="common/img/pull_bl.gif" width="6" height="7" border="0" ></td>
      <td><img src="common/img/pull_b.gif" width="68" height="7" border="0" ></td>
      <td><img src="common/img/pull_br.gif" width="6" height="7" border="0" ></td>
   </tr>
</table>
```

Where:

- `<span style="position: absolute; top: 40; left: 60;">` and `</span>` absolutely positions the entire callout on the screen.

  Always measure to the top and left of the block being positioned from the top- left corner of the screen at 0,0 pixels.

- `<table border="0" width="80" cellspacing="0" cellpadding="0" align="left">` starts the table that will draw the callout.

  The width can be adjusted to accommodate content, but should be no wider than 90 pixels.

- In the first row, `<td><img src="common/img/pull_tl.gif" width="6" height="7" border="0"></td>` defines the image of the top-left corner of the callout, `<td><img src="common/img/pull_t.gif" width="68" height="7" border="0"></td>` defines the image for the top bar of the callout, and `<td><img src=" common/img/pull_tr.gif" width="6" height="7" border="0">` defines the image for the top-right corner of the callout in the shared content library in the device's ROM.

  Always use these graphics when creating a callout. Adjust the width of `pull_t.gif` so that the width of all three images equals the width of the table.
- In the second row, `<tr bgcolor="#CCFFCC">` defines the background color of the callout.

  Always use #CCFFCC for the callout background color. `<td><img src=" common/img/pull_l.gif" width="6" height="45" border="0" ></td>` defines the left-side vertical bar of the callout, and `<td><img src=" common/img/pull_r.gif" width="6" height="45" border="0" ></td>` defines the right-side vertical bar of the callout in the shared content library in the device's ROM. The height of these two elements should be the same, and should be adjusted to encompass all of the text in the second cell: `<td>You'll see the number as you dial at the top of the screen.</td>`.
- In the third row, `<td><img src=" common/img/pull_bl.gif" width="6" height="7" border="0"></td>` defines the image of the bottom-left corner of the callout, `<td><img src=" common/img/pull_b.gif" width="68" height="7" border="0"></td>` defines the image for the bottom bar of the callout, and `<td><img src=" common/img/pull_br.gif" width="6" height="7" border="0">` defines the image for the bottom-right corner of the callout in the shared content library in the device's ROM.

  Always use these graphics when creating a callout. Adjust the width of `pull_b.gif` so that the width of all three equals the width of the table.

Some content may be in the form of bulleted lists. Because HTML doesn't support indented lists, use the following code to align numbered lists:

```
<p class="hanging_indent">
1. Press <img src="img/home_key.gif" width="21" height="23" border="0"><br></p>

<img src="img/keypad.gif" width="66" height="56" border="0" class="cap_none">

<p class="handing_indent">
2.Dial numbers directly from the keyboard dialpad.
</p>

<p class="hanging_indent">
3. Press Center to place the call.
```

Where:

- Each list item should be enclosed in a `<p class="hanging_indent">` and `</p>` tag.
- Each step is numbered individually.

9.11.3.3 XML document

An XML document, usually named tips.xml, catalogs the elements and structure of the Tutorial. It tells the PRC file creation utilities which content should be added into the Tips or Tutorial PRC file. It also defines the ordering of the lessons and the structure of the topics. It is an XML-formatted file that is processed by createTipsRsc.exe to create a standard Palm OS XRD resource file. For information about this process or clarifications about tips.xml syntax, please examine the source code for createTipsRsc.exe.

All XML tags and tag attributes are case sensitive. Filenames in the tips.xml file as well as within the HTML content are case sensitive. To make things simpler and easier, all file names within the tips.xml file and within all tags in the content should be in lowercase letters.

The header of the XML document is formatted as follows:

```
<?xml version="1.0" encoding="UTF-8"?>
<Tutorial Name="Device_Tutorial " Base="Tutorial_Tips" Description="Device
Tutorial">
```

Where:

- `<?xml version="1.0" encoding="UTF-8"?>` defines the document type. This should not be changed.
- `<Tutorial Name="Device_Tutorial" Base="Tutorial_Tips" Description="Device Tutorial">` needs to be edited.

  Replace `Device_Tutorial` in both the Name and Base attributes with the name of the PRC database that will be created by the Tips and Tutorial creation utilities. Replace `Device Tutorial` with the human-readable name of the Tutorial file you want to create when the XML document is compiled.

```
<Page Base="1" Default="1" File="index.html"/>
```

- Tutorials may contain pages that are not part of a Topic, such as the main menu page. The syntax shown demonstrates how this is accomplished:
  - `Base="1"` tells the creation utilities that this is a page that is shown directly and may load other content, as opposed to included pages such as images or style sheets.
  - `Default="1"` tells the creation utilities that this is the page that should be displayed when this Tutorial is first opened. Only one page in a tips.xml file should have the Default attribute set.

- Because the content in a Tips file is usually all in one Topic, Tips files usually do not have this form of the Page tag in their tips.xml files.
  - In a Tips file, the first page of the Topic should be flagged `Default="1"`

```
<Sequence Menu="index.html">
   <Page File="get_start_1.html"/>
   <Page File="get_start_2.html"/>
   <Page File="get_start_3.html"/>
   <Page File="get_start_5.html"/>
   <Page File="get_start_6.html"/>
   <Page File="get_start_7.html"/>
   <Page File="get_start_8.html"/>
   <Page File="get_start_9.html"/>
   <Page File="get_start_10.html"/>
   <Page File="get_start_11.html"/>
   <Page File="get_start_12.html"/>
   <Page File="get_start_13.html"/>
</Sequence>
```

- The sequence tag defines one topic. Because a Tips file usually contains one Topic, it will usually contain one pair of Sequence tags. Tutorials usually contain multiple Topics, so they will usually contain multiple pairs of Sequence tags.
- For a Tutorial, the sequence tag looks like this: `<Sequence Menu="index.html">`. The Menu attribute tells the system where to navigate when the Menu button is tapped. If you've named the menu page something other than index.html, you will need to change it here.
- For a Tips file, the sequence tag looks like this: `<Sequence Done="1">`. The Done attribute tells the system to show a Done button instead of a Menu button. The Done button, when clicked, exits Tips and returns the user to the calling application.
- `<Page File="get_start_1.html"/>` tells the creation utilities what HTML pages contain the Lessons for this Topic. Order is important in this section; the Lessons will be shown in the same order in which the Page tags appear within the Sequence tag.

```
   <Page File="inc\style.css"/>
   <Page File="inc\tutorial.js"/>
   <Page File="inc\active_call.gif"/>
```

- All other files used by the Tutorial or Tips file—other than shared content already in the device's ROM—need to be defined here using the relative path from the root folder. For instance, all images used by the Lesson pages must be included here. Order is not important in this section.

9.11.4 Converting Tips and Tutorial content in a PRC file

9.11.4.1 What you need

Use the provided utilities and guidelines to create Tips and Tutorials. The utilities are provided in the Palm OS® SDK under TipsTutorialsUtil.zip.

The contents of the TipsTutorialsUtil.zip file are as follows:

- Content developed using the guidelines in this chapter.
- The tips.xml file that defines the content in the shared content library in the device's ROM. This file should be copied into the root content folder.
- The createTipsRsc.exe program. The Perl source code for this program is also included for your reference.
- The Palm-BinTool.exe program.
- The PalmRC.exe program.
- A creator ID for the resulting PRC file. We highly recommend that the Tips and Tutorial PRC file have a different creator ID from that of the main application. This is the same type of creator ID as a standard Palm OS application and can be obtained from the PalmSource website: **http://www.palmsource.com/developers/**.

9.11.4.2 Converting content into an XRD resource file

To convert the content into a Palm XRD file, open a command prompt and change directory (cd) to the directory with the tips.xml file. (The tips.xml file is described in the guidelines.) Then run `createTipsRsc`.

The syntax for the `createTipsRsc` command is as follows:

```
createTipsRsc -i tips.xml -o tips.xrd -c CREATORID -s
shared_content.xml -p c:\bin\palm-bintool.exe -f
```

Where:

- `-i` specifies the input XML file.
- `-o` specifies the output XRD file.
- `-c` specifies the creator ID for the final PRC file. `CREATORID` is a filler. You should obtain an authentic one from PalmSource.
- `-s` specifies the XML file that describes the shared content library in the devices ROM.
- `-p` specifies the full path to the palm-bintool.exe file.
- `-f` is an optional flag that sets the backup flag on the final PRC file. This tells the HotSync operation to back up this file and to restore it automatically after a hard reset.
- `-l` is an optional flag that sets the current locale. For instance, `esES`.

9.11.4.3 Converting a Palm XRD resource file into a PRC

To convert the XRD file into a PRC, run PalmRC with the following syntax:

```
PalmRC.exe tips.xrd -p ARM -overlayFilter BASE -target 4.0 -o tips.prc
```

Where:

- `tips.xrd` is the name of the input XRD file.
- `tips.prc` is the name of the output PRC file.

Do not modify any of the other command-line parameters.

The resulting PRC file can then be placed onto the device through a normal HotSync operation.

9.11.5 Displaying Tips and Tutorial content

Use the methods described in this section to display Tips and Tutorial content.

9.11.5.1 Displaying application tips

To display tips within an application, launch the Blazer® web browser in Tutorial mode. The command block should be a pointer to a null-terminated string that is the name of the PRC database containing the application tips to be displayed. After the browser exits, the calling application is relaunched automatically.

```
#define myappTipsDbName                "MyApp_Tips"
#define myappTipsDbNameLength          10

void DisplayTips() {
   Char* startPage;
   startPage = MemPtrNew( myappTipsDbNameLength + 1 );
   MemPtrSetOwner(startPage, 0);
   StrCopy( startPage, myappTipsDbName );
   AppLaunchWithCommand( hsFileCBlazer3,
sysAppLaunchWebBrowserTutorialMode, startPage );
}
```

9.11.5.2 Displaying a Tutorial

There is little programmatic difference between displaying Tips and displaying a Tutorial. Tips are displayed by launching the Blazer® web browser in Tutorial mode from within an application, whereas a Tutorial is displayed by launching the Blazer web browser in Tutorial mode from a stub application that appears in the Applications View. This stub application has two functions:

- Provide a user-visible entry point into the Tutorial by displaying an icon in the Applications View.
- Launch the Blazer web browser in Tutorial mode with the command block pointing to a null-terminated string that is the name of the PRC database that contains the Tutorial to be displayed.

The following is an example of a stub application:

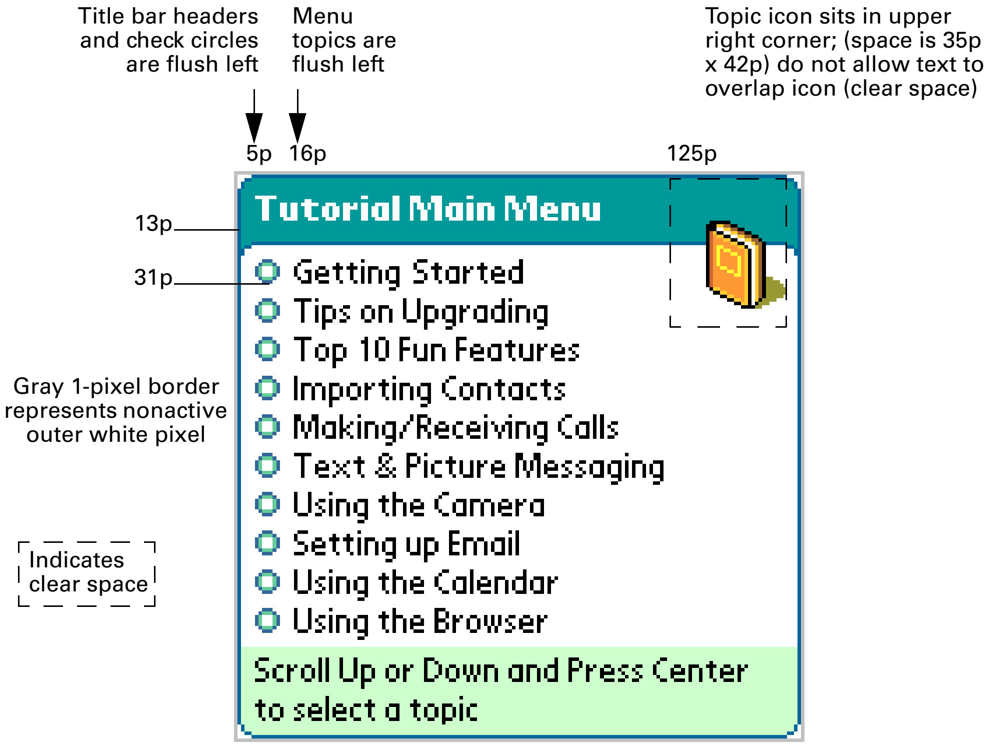
```
#define Tutorial_Start_Page "Tutorial_Tips"
#define Tutorial_Start_Page_Length 13

UInt32  PilotMain(UInt16 cmd, MemPtr cmdPBP, UInt16 launchFlags)
{
  if (cmd == sysAppLaunchCmdNormalLaunch) {
    Char* startPage;
    startPage = MemPtrNew(Tutorial_Start_Page_Length + 1);
    StrCopy(startPage, Tutorial_Start_Page);
    MemPtrSetOwner(startPage, 0);

    AppLaunchWithCommand(hsFileCBlazer3,
sysAppLaunchWebBrowserTutorialMode, startPage);
   }

  return 0;
}
```

9.11.6 Graphic element design guidelines

This section details the graphic element design guidelines.

9.11.6.1 Tutorial main menu

The Tutorial main menu is as follows:



Title bar headers and check circles are flush left

Menu topics are flush left

Topic icon sits in upper right corner; (space is 35p x 42p) do not allow text to overlap icon (clear space)

Gray 1-pixel border represents nonactive outer white pixel

Indicates clear space

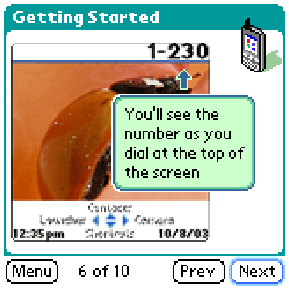
Tutorial Main Menu

- ○ Getting Started
- ○ Tips on Upgrading
- ○ Top 10 Fun Features
- ○ Importing Contacts
- ○ Making/Receiving Calls
- ○ Text & Picture Messaging
- ○ Using the Camera
- ○ Setting up Email
- ○ Using the Calendar
- ○ Using the Browser

Scroll Up or Down and Press Center to select a topic

Icons for upper right corners: Each icon used per chapter should be drawn in Photoshop at 30/60 degree increments using 2x1 stepping. Each icon should face left and have a cast shadow to the right.

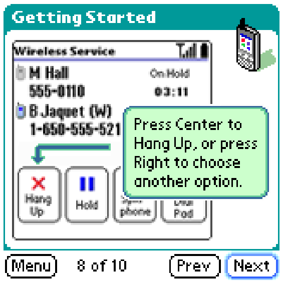
9.11.6.2 Tutorial content pages



Getting Started

1-230

You'll see the number as you dial at the top of the screen



Getting Started

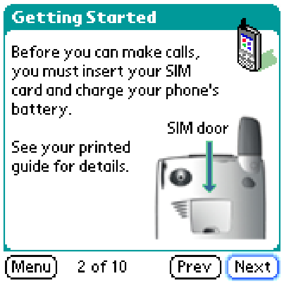
Wireless Service

M Hall On Hold
555-0110 03:11
B.Jaquet (W)
1-650-555-521

Press Center to Hang Up, or press Right to choose another option.

Content Page: large graphic & pull quotes
Full screens should be approximately 70% and placed on the left side of the screen. Pull quotes should be placed to the right as shown, with arrow pointing to area that text is referencing. Please use arrows (and circles) that exist in the template or request a set from Palm.

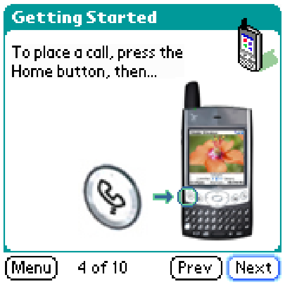
Same clear space
(32p x 42p) applies
on content pages



Getting Started

Before you can make calls, you must insert your SIM card and charge your phone's battery.

See your printed guide for details.

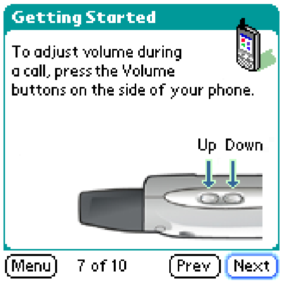


Getting Started

To place a call, press the Home button, then...

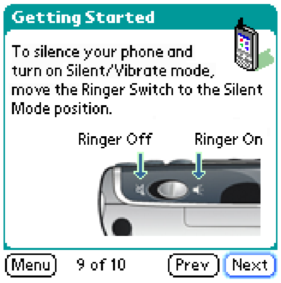
Content Page: graphic (tall) & text
All graphics, except when they completely fill the screen, should be placed in the lower right corner. Use arrows with or without text to point out information and circles to call out specific details. Small graphics should be enlarged so that they are clear.

Same clear space
(35p x 42p) applies
on content pages



Getting Started

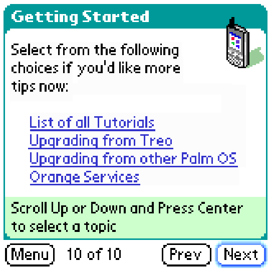
To adjust volume during a call, press the Volume buttons on the side of your phone.



Getting Started

To silence your phone and turn on Silent/Vibrate mode, move the Ringer Switch to the Silent Mode position.

Content Page: graphic (wide) & text
All graphics, except when they completely fill the screen, should be placed in the lower right corner. Crop the images so that they are recognizable.

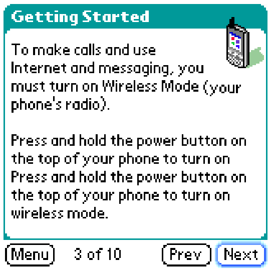


Getting Started

Select from the following choices if you'd like more tips now:

- List of all Tutorials
- Upgrading from Treo
- Upgrading from other Palm OS
- Orange Services

Scroll Up or Down and Press Center to select a topic

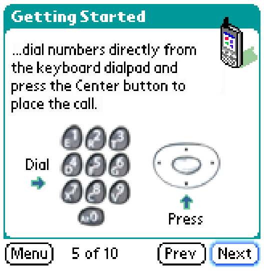


Getting Started

To make calls and use Internet and messaging, you must turn on Wireless Mode (your phone's radio).

Press and hold the power button on the top of your phone to turn on Press and hold the power button on the top of your phone to turn on wireless mode.

Content Page: Text only
Clear space for the icon still applies. For “scroll up or down” please use the same format from the Main Menu.

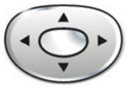


Getting Started

...dial numbers directly from the keyboard dialpad and press the Center button to place the call.

All button or key graphics should appear as shown in this screen.

Do not crop buttons like this:



Content Page: graphic (centered) & text
Certain graphics will look better when centered. This is the exception, not the rule. Note that elements such as buttons or keys from the device should be cropped as shown above.

Graphics: All icons used in the upper right corner should be drawn in Photoshop. All other placed images, such as screen shots or device images, must be taken from the original source files and reduced to fit into the space allowed per page. All images should be saved out of Photoshop using “save for web” at actual size in either jpeg or gif format, whichever is smaller. For JPEG, quality setting should be 20 or 30, depending on the image, with 0 blur. For GIF, preferences should be set to GIF 32 No Dither.

All device images are the property of Palm, and may be used with permission.

9.11.6.3 Images that are in the shared content library in the device’s ROM

The images available directly from the device’s ROM for your own Tips and Tutorials can be found in the utility section of the Palm OS SDK available at **pluggedin.palm.com**.

9.12 Full-Screen Writing API

Available on:

- LifeDrive™ mobile manager
- Tungsten™ T5, Tungsten™ E2, and Palm® T|X handhelds
- Zire™ 31, Zire™ 72, and Palm® Z22 organizers

This section contains reference information for the full-screen writing feature that is provided programmatically through the GoLCD (Graffiti® 2 writing on LCD) Manager API. You can use the functions in this API to enable or disable full-screen writing, enable and disable the Graffiti 2 shift indicator (GSI) as a control for full-screen writing, enable and disable Graffiti 2 inking, and even change the colors of Graffiti 2 inking and the GSI.

The GoLCD API is declared in the header file `PalmGoLCD.h`.

Full-screen writing allows users to enter Graffiti 2 characters in the application area of a handheld's display as well as in the Graffiti 2 writing area.

By setting Graffiti 2 Preferences, users can enable full-screen writing and choose whether to show, or *ink*, the Graffiti 2 strokes in the application area.

In each application the availability of full-screen writing is indicated by a shaded, rectangular Graffiti 2 shift indicator (GSI) in the lower-right corner of the display. The user can tap the GSI to turn full-screen writing off and on. The GSI appears as an outline when full-screen writing is off, and as a solid rectangle when it is on. In addition, the shift indicator, punctuation-mode indicator, and shift-lock indicator appear superimposed on the shaded rectangle when the user draws the appropriate Graffiti 2 strokes to activate those modes.

Graffiti 2 strokes in the application area are distinguished from taps on application controls, depending on the duration and direction of tap-and-hold events. GoLCD interprets pen events in the writing bounds of the application area, which you can set using `GoLCDSetBounds`. If the pen is held down for a certain length of time and travels significantly across the screen in the writing bounds area, GoLCD enters `goLcdGraffitiMode` and interprets all pen events as Graffiti 2 strokes. GoLCD exits `goLcdGraffitiMode` and stops interpreting pen events as Graffiti 2 strokes when the pen is lifted from the screen for a certain amount of time. For more information, see the *Palm OS Platform API Guide*.

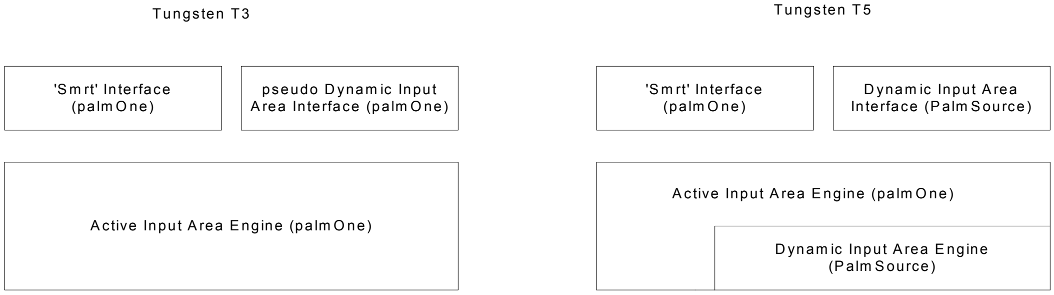
9.13 Dynamic Input Area (DIA)

Available on:

- Tungsten™ T3 and Tungsten™ T5

Dynamic Input Area (DIA) aware applications that worked on Tungsten T3 handhelds behave differently or do not work on Tungsten T5 handhelds. This section explains the DIA-related differences between Tungsten T5 and Tungsten T3 handhelds.

The PalmSource® DIA and the Palm Active Input Area (AIA) were initiated independently at around the same time to achieve similar goals, providing a status bar and a dynamic replacement for the silk-screened Graffiti input area. The AIA ran atop Palm OS 5.2, while the DIA originally targeted Palm OS 6. Early in the course of their development, many of the public APIs were unified with the goal of easing the transition to Palm OS 6.


Tungsten T3
'Smrt' Interface (palmOne)
pseudo Dynamic Input Area Interface (palmOne)
Active Input Area Engine (palmOne)
Tungsten T5
'Smrt' Interface (palmOne)
Dynamic Input Area Interface (PalmSource)
Active Input Area Engine (palmOne)
Dynamic Input Area Engine (PalmSource)

Overview of the Input Area System on Tungsten T3 and T5

As shown in the figure, when the initial delivery of the PalmSource DIA was accelerated to appear with Palm OS 5.3, Palm created a compatibility layer to mimic the behavior of the DIA APIs from Palm OS software 5.3, while running atop the Palm AIA on Palm OS software 5.2. The goal was, and continues to be, to provide support for the PalmSource APIs, regardless of the implementation underneath.

The most significant difference between the AIA and DIA models is in the scope of "tall screen awareness"—the AIA model is application-centric, using a "Smrt" resource to flag an entire application as "tall-screen–aware," and the DIA model is form-centric, using an API call during the setup of a form to flag that form as "tall-screen–aware." Newer applications from Palm are written to use the DIA model, but legacy code still exists, using the AIA model.

Tungsten T5 handhelds using Palm OS 5.4 software include DIA support in the OS, so the problem shifted from providing forward compatibility—handhelds adding a pseudo-DIA interface to Palm OS 5.2 software—to providing backward compatibility for our legacy code. As you might imagine, this is not a simple feat; it's somewhat like having a car with two steering wheels. There's only one input area, but two concurrent models for controlling it.

CHAPTER 10

10. Applications

This chapter details the features and APIs available in some of the Palm® applications.

10.1 Web Browser API

This section describes the various technical features of the Palm web browser system that allow website designers and programmers to deliver a better web experience.

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5, Tungsten™ E2, and Palm® T|X handhelds
- LifeDrive™ mobile manager

The Palm Blazer® web browser is an application designed for devices that use Palm OS®. It can access multiple Internet content formats, including HTML, xHTML, cHTML, and WML. With the web browser, a user can download web pages from the Internet and view them on the compact device screen. The key features of the web browser are as follows:

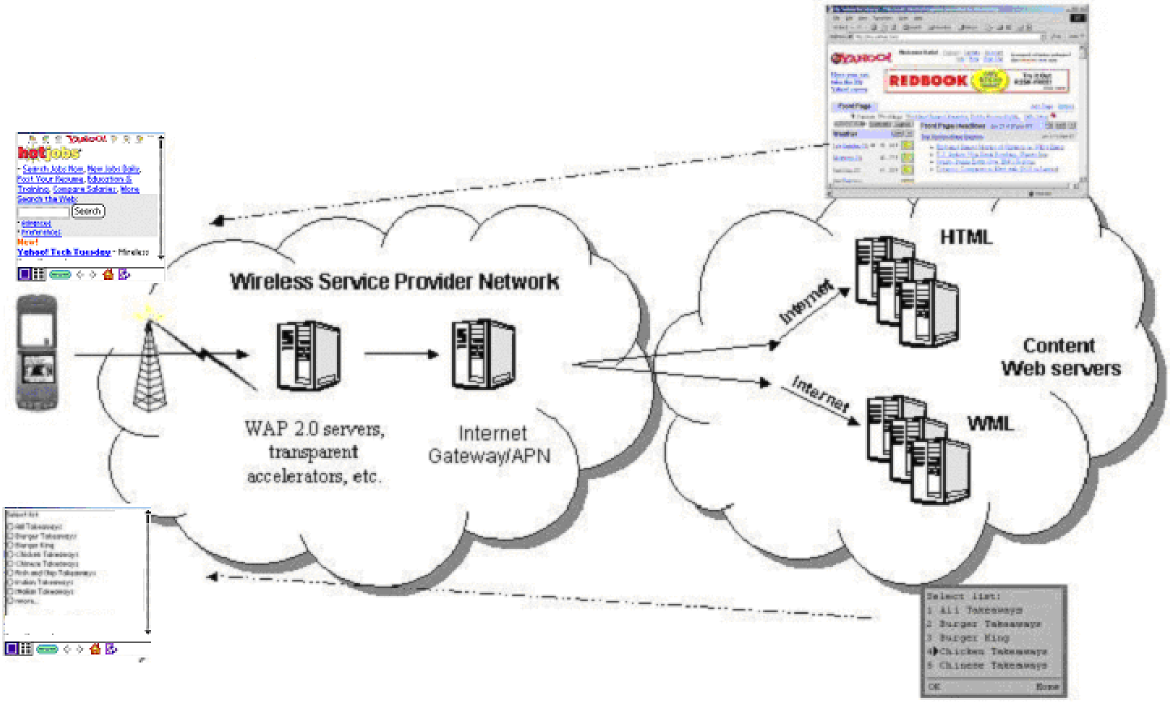
- An intuitive graphical interface
- Support for multiple markup languages
- Support for secure websites
- Choice of display modes:
  - Optimized mode for optimization of content for Palm OS devices
  - Wide Page mode for the display of content similar to that of a desktop browser
  - Normal or fast mode for page rendering
- 5-way navigator support
- A variety of UI features including History, Saved Pages, and Beaming Bookmarks
- Ability to download applications, ring tones, images, and more
- Support for streaming content in Blazer 4.5

10.1.1 How the web browser works

Versions of the web browser before Blazer version 3.0 were built as a proxy solution. The proxy server adapted pages from the remote web servers and streamed content to the client. The client application received the content from the proxy server and displayed the web page on the device’s screen. Since Blazer 3.0 however, the Palm web browser is a proxyless, client-only browser. (It is capable of using a standard HTTP proxy in the same way a desktop browser would use a proxy.)

There are several reasons why this new architecture was chosen. For one, having a client-only solution allows devices to access more wireless service provider services, such as downloads and mobile content. Also, device processing power has reached the point where the content optimizations can be accomplished efficiently enough on the client.

The figure below shows how the current proxy-less web browser accesses web pages.



The Blazer web browser uses the Palm OS Network Library for Bluetooth® wireless technology, WiFi, and the Palm NetMaster Library for GSM/CDMA to make the connection to the wireless service provider infrastructure.

10.1.2 Web browser feature overview

This section covers the features of the web browser. This information is useful for understanding the software requirements, technical features, and user interface elements.

10.1.2.1 Protocol stack support

The web browser uses the internet standard HTTP stack for communications. While the browser does support WML, there is no support for the WAP 1.x protocol stack.

10.1.2.2 Overview of key web browser features

The web browser incorporates a number of key technical features described in this section.

10.1.2.2.1 Intuitive graphical interface

The web browser's user interface takes advantage of the device's screen size. The web browser provides one-touch access to bookmarks, navigation, the home page, and new web pages. It also gives users a familiar look and feel comparable to that of a desktop browser.

10.1.2.2.2 Support for multiple markup languages

The web browser supports several markup languages, as well as cascading style sheets and JavaScript. This allows users to access a wide variety of web and wireless content from a single browser and gives content providers flexibility in determining what type of markup language to use. The Palm web browser supports the following markup languages:

Markup Language
HTML 4.01
XHTML 1.1
XHTML Mobile Profile
cHTML (iHTML)
WML 1.3
DHTML
DOM

For special tags that the browser supports, see **Section 13.1.9 on page 259**.

10.1.2.2.3 *Support for secure websites*

The web browser supports the following security features:

- End-to-end security using SSL 3.0
- 128-bit encryption using the RC-4 algorithm
- RSA-based key exchange
- RSA-based digital signature verification for verifying the authenticity of signed certificates, signed code, and so forth.
- MD5 and SHA-1 secure hash algorithms
- SSL 3.0 with server-side authentication only
- Support for X.509 certificates
- Indication of a secure connection by a lock icon in the toolbar or URL bar.

10.1.2.2.4 *Optimization of content for device screens*

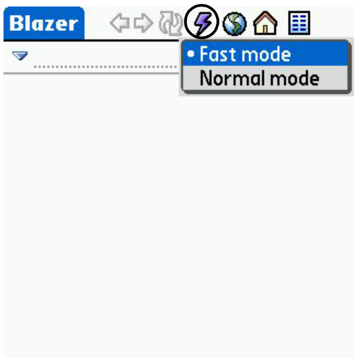
The web browser optimizes the content to take advantage of device characteristics such as screen size and navigation.

10.1.2.2.5 *Normal or fast mode for rendering pages*

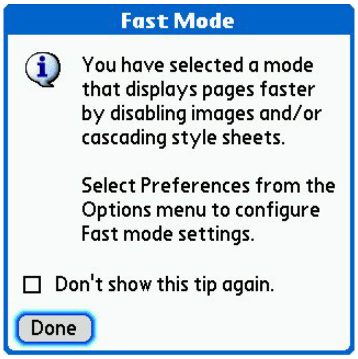
Blazer v. 4.3 and later allows a user to choose how they want their pages to be rendered: normal or fast. Normal mode renders a page the same way that previous versions rendered pages. Fast mode is by default rendering with no cascading style sheets and no images. While in fast mode, users can still download individual images by tapping an image and holding it for longer than one second.

Users can set preferences for what fast rendering does on their device. In addition, there is a normal/fast mode quick switch (the icon looks like a lightning bolt) available on the Blazer main form page, where the optimized/wide page quick switch used to be. The optimized/wide page mode setting is now only in the Blazer “options” menu.

Select mode



Set preferences



Fast Mode

You have selected a mode that displays pages faster by disabling images and/or cascading style sheets.

Select Preferences from the Options menu to configure Fast mode settings.

□ Don't show this tip again.

10.1.3 Download manager

The web browser incorporates download management technology that allows users to download files over a wireless network. There are a variety of applications for this technology:

- Posting applications, ring tones, images, and so forth for your users to download
- Incorporating mechanisms in your application to either auto-check for updates and download them, or allow the user to manually download updates

10.1.3.1 Content support in Blazer® 3.0 and Blazer® 4.0

When a user attempts to download a file, the download manager first checks with the Exchange Manager to see if a content handler has registered for that type of file. If a content handler is registered, then the download proceeds. If no content handler registered is, different versions of Blazer behave differently.

- Blazer 3.0 notifies the user that they must first install a content handler for that file type before they will be able to download the file.
- Blazer 4.0 allows all non-DRM-protected content to be saved to an expansion card, if one is present, even if there is no Exchange Manager handler for that content type.
- For Blazer 4.5, see **Section 10.1.3.2 on page 198**.

For example, if the user tries to download a MIDI ring tone, because there is an application in the device's ROM that handles MIDI, the download proceeds. However, if the user attempts to download an Adobe® Acrobat® file, unless they have an application installed on their device that handles Acrobat files and that has registered with the Exchange Manager as a handler for Acrobat files, the user is not allowed to proceed with the download unless the user is running Blazer 4.0 and has an expansion card inserted in their device. If the user is running Blazer 4.0 and has an expansion card inserted in their device, the user could download the Acrobat file directly to the expansion card. For devices with an internal drive (for example, Tungsten T5 handhelds and LifeDrive mobile managers), in the absence of an expansion card, the file is downloaded directly to the internal volume.

In order to avoid memory problems, Blazer 4.0 limits the size of downloaded files to 2MB. If a user tries to download a bigger file, an error message is displayed. This restriction has been removed for devices with Blazer 4.1. and later (currently only LifeDrive mobile managers). Without this restriction, if the file is less than 2MB and the device has sufficient memory in the DBCache, the file is downloaded through the Exchange Manager. If the file is larger than 2MB or there isn't enough space in the DBCache, users will see a dialog informing them that the file will be downloaded to the internal drive via VFS Manager.

For your convenience, Blazer 4.0 lists every type currently registered in the Exchange Manager in the HTTP Accept header.

10.1.3.2 Content Support in Blazer® 4.5

10.1.3.2.1 Caching rules

Blazer 4.5 includes some new rules for caching. Specifically:

1. Any web page that exists in Blazer history will be read from cache at first, and Blazer will not access the network unless it does not have a cache entry for that page. Only if there is no cache entry for a page will Blazer access the network.
2. The no-cache message is ignored. No-store and SSL caching rules are respected.

10.1.3.2.2 Streaming content

Blazer 4.5 has added support for streaming content. The web browser can stream content in two ways:

1. It can search the web page for an embedded object. If it finds an `<EMBED>` or `<OBJECT>` tag on the page with a MIME-type that an application is registered for, then Blazer will display a Play button. Links are then passed to the streaming application via the exchange manager when a user clicks those links.
2. Streaming content may also be presented as a direct link. If an application registered for streaming that type of content, the user will be presented with a dialog box that allows the user to choose whether to play the content, save it to the device, or save it to the card.

10.1.3.2.3 Link protocol types

You can use the RTSP or HTTP URL scheme in an application to link to streaming content:

- **RTSP -** Using RTSP links, an application will redirect the user immediately to the registered streaming content. The user will not be presented with a dialog or a play button.
- **HTTP -** Using HTTP links, if an application is registered for streaming the type of content to be downloaded, an application will present a dialog box that allows the user to play the content, save it to the device, or save it to the card. If no streaming application is registered to handle the MIME-type or file extension, an application will present only the save option.

For more information on audio and video streaming in Blazer® 4.5, see **Section 13.1.4.4 on page 246**

10.1.3.2.4 Supported formats for streaming content

The following table lists formats supported by Blazer 4.5 for streaming, but please note that all codecs will not be available for all devices. For a list of codecs available by device, see **Section 4.1.4 on page 68**.

Scheme	Formats
URL scheme	http://
	mms://
	rtsp://
Media File Formats	.3GP
	.3G2
	.MP4, .M4A
	.MP3
	.ASF, .WMA, .WMV
Video codecs	MPEG4
	H263
	WMV
	AVC H.264
Audio codecs	AMR
	QCELP
	MP3
	WMA
“Wrapper” file formats	SDP
	ASX
	WAX, WVX
	M3U

NOTE: For Windows Media video codecs to work properly on the Treo 700p smartphone, the compression profile should be set to “Baseline” or “Simple”. This must be changed from the default “Main” profile using a compression tool.

10.1.3.3 Download restrictions

The web browser includes download restrictions listed in the following sections.

10.1.3.3.1 JPEG images

Normal behavior for a browser is to render JPEG images within the browser, as opposed to downloading them and saving them on the device. Therefore, an image must be specially flagged if it is to be downloaded rather than rendered in the browser. There are two ways to flag an image for download:

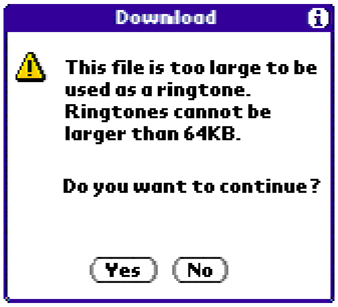
- Use a descriptor file to precede the image. The download manager treats any images called by descriptor files as a download, and does not render them in the browser.
- Flag the image with a special MIME type. If the web browser sees an image with the following MIME type, it will know the image is for download, not rendering: **x-handspring-image/jpeg**.

The only images officially supported for download are JPEG images. All other images are rendered in the browser.

In Blazer 4.0 and later, the user can also tap-and-hold most images to bring up a Save As dialog box that allows the user to save the image to the Exchange Manager or to an expansion card (if present).

10.1.3.3.2 Ring tones

The Palm Ring Tone manager can only play ring tones that are under 64KB. If the user attempts to download a ring tone that is larger than 64KB, they are presented with the following message:



Download

This file is too large to be used as a ringtone. Ringtones cannot be larger than 64KB.

Do you want to continue?

10.1.3.3.3 Multiple file downloads

There are several schemes for supporting multiple file downloads. The most common is to combine the files in a ZIP file and then extract that file onto the device. In order for this to work, the user must first have an application on the device that can extract ZIP files and that registers for ZIP files with the Exchange Manager.

Alternatively, the Nutshell installer from Ecamm Network (**www.ecamm.com**) works well. You can use the installer to package multiple PRC and PDB files into a single PRC file. When the user runs the resulting installer PRC, the installer unpacks the PRCs and PDBs and installs them on the device.

10.1.3.3.4 Digital rights management

The download manager provides some digital rights management functionality. Specifically, wireless service providers can specify domains from which downloads will be forward locked, which means that the file cannot be beamed, sent, and so forth. Forward lock applies to several multimedia types. It does not apply to PRC applications. PRC applications have built-in digital rights management, and those rights management schemes (for example, tying usage to HotSync® ID) should be employed at the content developer’s discretion.

10.1.3.4 Streaming code example

The following example code will allow you to determine if a streaming application is available, and if so, to stream to that application. To use this code, you must know how to determine the MIME-type or file extension of the content to be streamed.

```
/**
*Check to see if a file can be streamed.
*
*Inputs:
*   Char* mimeType: mimetype of content or NULL
*   Char* extension: extension of content or NULL
*   UInt32* creatorId: empty
*
*Outputs:
*   Boolean: true if streaming app. found, else false.
*   UInt32 *creatorId: creator id of the streaming application if found
*/
Boolean HasStreaming(Char *mimeType, Char *extension, UInt32 *creatorID, Boolean
*nullMime)
{
   Boolean isStreamingApp = false;
   if(nullMime)
      *nullMime = false;

   if (mimeType) //valid mimetype
   {
      if ((errNone == ExgGetDefaultApplication(creatorID, exgRegStreamingTypeID,
           mimeType)) ||
          (errNone == ExgGetDefaultApplication(creatorID, exgRegStreamingType1ID,
           mimeType)) ||
          (errNone == ExgGetDefaultApplication(creatorID, exgRegStreamingTypeSkipUIID,
           mimeType)))
      {
         isStreamingApp = true;
      }
      else if (extension)
      {
         if ((errNone == ExgGetDefaultApplication(creatorID,
              exgRegStreamingExtensionID, extension)) ||
             (errNone == ExgGetDefaultApplication(creatorID,
              exgRegStreamingExtension1ID, extension)) ||
             (errNone == ExgGetDefaultApplication(creatorID,
              exgRegStreamingExtensionSkipUIID, extension)))
         {
            isStreamingApp = true;

            if(nullMime)
               *nullMime = true;
         }
      }
   }
   else if (extension) //valid extension
   {
      if ((errNone == ExgGetDefaultApplication(creatorID, exgRegStreamingExtensionID,
           extension)) ||
          (errNone == ExgGetDefaultApplication(creatorID, exgRegStreamingExtension1ID,
           extension)) ||
         (errNone == ExgGetDefaultApplication(creatorID,
          exgRegStreamingExtensionSkipUIID, extension)))
      {
         isStreamingApp = true;
      }
   }

   return isStreamingApp;
}

/**
*Pass url to streaming application.
*
*Inputs:
*   Char* url: url to be passed to streaming application
*   Uint32 creatorId: creator id received from query to exchange manager in case
*                   streaming content supported
*
*Outputs:
*   Err: any error received from exchange manager transactions
*/
Err StreamToExgMgr(Char *url, UInt32 creatorId, Char *documentExtensionP, Char
*mimeType)
{

   UInt32 bytes;
   UInt32 bytesSent;
   ExgSocketType exgSocket;
   Err error;
   Char* tempUrlPtr;
   EventType event;

   Int extLen = 0;
   if (!url)
      return memErrInvalidParam;

   if(documentExtensionP)
   {
      extLen = StrLen(documentExtensionP);
   }

   tempUrlPtr = url;
   bytes = StrLen(url) + sizeOf7BitChar('\0');


   //create exchange manager socket
   MemSet(&exgSocket, sizeof(exgSocket), 0);
   exgSocket.length = bytes;
   exgSocket.target = creatorId;//application to receive message
   exgSocket.goToCreator = creatorId;//application to launch after mesg received
   exgSocket.localMode = true;//limit to local application
   exgSocket.noStatus = true;//don't display progress dialog
   if (mimeType != "text/plain")
      exgSocket.type = StrDup(mimeType);//set the type of the file who's url is being
      passed

   exgSocket.name = MemPtrNew(StrLen("filename.") + extLen + sizeOf7BitChar('\0'));
```

```
    StrCopy(exgSocket.name, "filename.");

    if(extLen > 0)
    {
        StrCat(exgSocket.name, documentExtensionP);
    }


    if (NULL == exgSocket.name)
    {
        if (NULL == exgSocket.type)//this should not happen
        {
            ErrNonFatalDisplay("Trying to pass a file with invalid mimetype and
            extension");
        }

        exgSocket.name = StrDup("InvalidExtension");

        if (NULL == exgSocket.name)//out of memory?
            return 1;
    }

    //send data to target application
    error = ExgPut(&exgSocket);

    if(error == exgErrDeviceFull || error == exgMemError)
    {
        //MJP: attempt flushing the dbcache and try again
        PrvForceDBCacheFlush();
        error = ExgPut(&exgSocket);
    }
    if (errNone != error)//check for error
    {
        if (exgSocket.type)
            MemPtrFree(exgSocket.type);
        if (exgSocket.name)
            MemPtrFree(exgSocket.name);
        return error;
    }

    //loop send until entire url is sent
    while ((errNone == error) && (bytes > 0))
    {
        bytesSent = ExgSend(&exgSocket, tempUrlPtr, bytes, &error);
        bytes -= bytesSent;
        tempUrlPtr = tempUrlPtr + bytesSent;
    }

    error = ExgDisconnect(&exgSocket, error);

    if (exgSocket.type)
        MemPtrFree(exgSocket.type);
    if (exgSocket.name)
        MemPtrFree(exgSocket.name);

    return error;
}
```

10.1.4 Launching the web browser on Treo™ smartphones

If you want your application to take the user directly to a web page, the web browser has the ability to launch a specific URL. The following code sample shows how to launch the web browser and go to a specific web page.

```
static void
LaunchBlazerWithURL(Char* urlP)
{
   Err err = 0;
   UInt16 cardNo;
   LocalID dbID;
   DmSearchStateType searchState;
   Char* url;

   // first check if web browser is installed
   err = DmGetNextDatabaseByTypeCreator(true, &searchState, sysFileTApplication,
      hsFileCBlazer3, true, &cardNo, &dbID);
   if (err)
      {
         // Display appropriate error dialog...
         return;
      }
   // ok, now let's call the web browser with the URL. Must first copy the URL,
   // because it will be disposed of by the system after the browser exits
   url = MemPtrNew(StrLen(urlP)+1);
   if (!url)
      {
         return;
      }
   StrCopy(url, urlP);
   // set the memory owner to zero, so it is not deleted
   // by the system when we switch apps
   MemPtrSetOwner(url, 0);
SysUIAppSwitch(cardNo, dbID, sysAppLaunchCmdGoToURL, url);
```

10.1.5 Launching the web browser in minimal mode

The web browser includes a minimal UI mode. This mode lets you display a web page with the simplest possible UI. The following code sample shows how to launch the web browser in minimal mode, and go to a specific web page.

```
static Boolean doWebBrowserMinimalMode( Char * url )
{
    webBrowserMinimalModeLaunchInfo* minimalModeInfo;
    UInt16 currentFormId;
    Char* tempStr;

    minimalModeInfo = MemPtrNew ( sizeof(webBrowserMinimalModeLaunchInfo) );

    // Since we're calling into ARM, byte-swap the pointers
    minimalModeInfo->launchUrl = (Char*)ByteSwap32(url);

    tempStr = MemPtrNew( 5 );
    StrNCopy(tempStr, "Done", 5);

    // Since we're calling into ARM, byte-swap the pointers
    minimalModeInfo->doneButtonLabel = (Char*)ByteSwap32(tempStr);

    MemPtrSetOwner (tempStr , 0);
    MemPtrSetOwner (minimalModeInfo, 0);
    MemPtrSetOwner (url, 0);

    AppLaunchWithCommand( hsFileCBlazer3, sysAppLaunchWebBrowserMinimalMode,
minimalModeInfo );

    return true;
}
```

10.2 VersaMail® application API

Available on:

- Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5, Tungsten™ E2, and Palm® T|X handhelds
- LifeDrive™ mobile manager

This section provides reference information for the VersaMail application Device APIs. You can use these APIs to create attachment plug-ins for VersaMail attachments, add email to VersaMail folders programmatically, create background network connections, and so forth.

10.2.1 Before using the VersaMail® Device APIs

The VersaMail APIs assume a working knowledge of the following:

- VersaMail application itself
- Palm OS programming
- Palm OS 68K runtime environment

10.2.2 Overview of the VersaMail® Device APIs

The VersaMail Device APIs consist of five main components that are documented in the remaining portions of this section:

- VersaMail Account Configuration

  This component allows you to distribute a PDB file to multiple users to set their initial VersaMail configuration automatically.
- Adding Outgoing Emails to VersaMail Folders

  This component allows you to add email messages to VersaMail folders programmatically. It can be used to distribute Welcome email, corporate information email, application information email, and so forth.
- VersaMail Font library

  This component allows you to set the fonts displayed in the VersaMail Font Picker dialog box, as well as get and set information about fonts programmatically.
- VersaMail Attachment Plug-ins API

  This component allows you to create a plug-in for a type of attachment (for example, BMP attachments) that allows users to send and view VersaMail email attachments.

10.2.2.1 VersaMail® Account Configuration

In an enterprise environment, it is often useful to set up all users with one or more baseline VersaMail account configurations. You can do so by distributing a database called __MMDevice.pdb. This feature will work in the VersaMail application, version 2.0 or later. For VersaMail 3.1 and later, the __MMDevice database version must be `0x1003`.

10.2.2.2 Overview of the MMDevice database

The MMDevice database consists of various records that set default values in VersaMail accounts. Each record follows the same basic syntax. When the VersaMail application is started on a handheld, it looks for the __MMDevice.pdb, sets account information based on the values therein, and then deletes __MMDevice.pdb. You should not confuse the file __MMDevice.pdb with _MMDevice.pdb (single underscore), which is usually created when an account configuration has changed.

__MMDevice.pdb is a case-sensitive name. It should have type and creator codes of `asc3` and a version number of 4.2 in hex (`0x0420`).

You can use the VMAccConfig application in the samples folder of the Palm OS SDK to create an __MMDevice.pdb database automatically.

10.2.2.2.1 MMDevice database record syntax

The syntax for each record in the MMDevice database is as follows:

```
set <key> <account slot> <value>
```

with one or more spaces or tab characters between each field.

- `set`

  This string literal is required at the beginning of each record.

- `key`

  A string referencing the particular account parameter you want to set. For more information, see **Section 10.2.2.3 on page 209**.

- `account slot`

  You should set this value to `0`. The account will be added to the end of the list of existing accounts. The VersaMail application accepts only a total of 8 accounts.

- `value`

  The value you want to set for the particular account parameter.

  The value is not parsed other than for keys that must be numeric. Trailing and leading whitespace are trimmed, however.

  To specify the default value for a record key, simply omit the entire record key line. If you include the record key line with a blank value, the key's value is explicitly set to an empty string that may or may not be valid for a particular record key.

For example, the following record would set the incoming mail server for the next account in the list to `mail.mac.com`:

```
set incomingServer 0 mail.mac.com
```

NOTE: The `title` key is mandatory. See **Section 10.2.2.3.12 on page 209** for more information.

10.2.2.3 MMDevice database record keys

The following MMDevice record keys are valid. The keys are not case sensitive and, unless otherwise noted, default to an empty value.

10.2.2.3.1 apn

The string that specifies the default access point name (APN) to be used for the account. This refers to a service setting set in the Network preferences panel. If not specified, the default service is used.

10.2.2.3.2 connectionType **(deprecated in VersaMail 3.1)**

How the connection is made with the email server. You can set it to `SyncOnly`, `PalmWireless`, or `ModemDialup`. For `ModemDialup`, the dial-up settings must be configured through the system's Network preferences panel.

10.2.2.3.3 emailAddress

The fully qualified address for the email account.

10.2.2.3.4 incomingPort

The TCP/IP access port for the incoming email server. The default value is blank, but the default TCP/IP access port for POP servers is `110`, and the default access port for IMAP servers is `143`. This value must be specified if the `serverType` value is specified. For more information, see **serverType (deprecated in VersaMail 3.1)**.

10.2.2.3.5 incomingServer

The server for incoming email. The incoming server is usually a POP or IMAP server.

10.2.2.3.6 outgoingPort

TCP/IP access port for the outgoing email server. Typically, this is the SMTP port `25`.

10.2.2.3.7 outgoingServer

The server for outgoing email. The outgoing server is usually an SMTP server.

10.2.2.3.8 password

The password for the account.

10.2.2.3.9 replyTo

The fully qualified email address for the Reply-To header of outgoing mail.

10.2.2.3.10 rootMailbox

For an IMAP email account, this specifies the root prefix of the account. This is typically not needed with most IMAP servers.

10.2.2.3.11 serverType **(deprecated in VersaMail 3.1)**

The protocol of the incoming email server—`POP`, `PalmDotCom`, `Enterprise`, or `IMAP`. The default for this key is `POP`. If you specify this key, you must specify the `incomingPort`, as well. For more information, see **incomingPort**.

10.2.2.3.12 title

The title of the account as shown in the VersaMail application. For example, "Personal Mail." You must enter a value for this record key.

10.2.2.3.13 useEncryptedPassword

Whether the account uses an encrypted password. Specify `YES` or `NO`.
The default is `NO`.

10.2.2.3.14 useEsmtp

Whether the account requires authenticated SMTP. Specify `YES` or `NO`.
The default is `NO`.

10.2.2.3.15 userName

The username for the account.

10.2.2.3.16 samcreatorid (only in VersaMail 3.1)

The creator ID of the service access module that provides the service. Valid choices are `'pop3'`, `'Imap'` or `'ExAs'`.

NOTE: Values are case sensitive and require the surrounding single quotes (`''`) as part of the value string.

10.2.2.3.17 samtypeid (only in VersaMail 3.1)

The type ID of the service access module. For VersaMail 3.1, this must be `'appl'` (with the apostrophes).

10.2.3 Adding outgoing email to VersaMail® folders

This section describes the various methods used to add outgoing email to VersaMail folders. You can use the launch codes provided by the VersaMail application directly or use the Exchange Manager or Helper Notification methods documented in the *Palm OS Programmer's Companion, Volumes I and II* and the *Palm OS Programmer's API Reference*.

The direct and Exchange Manager methods work in the VersaMail application, version 2.0 or later. The Helper Notification method works in the VersaMail application, version 2.5 or later.

10.2.3.1 Overview of adding email to the Outbox

There are three basic methods for adding email to the VersaMail Outbox:

- Using the Exchange Manager

  An application can use the Exchange Manager Send command or the _send URL send scheme to sublaunch a Compose email message form. The Compose form allows the user to add text to the message and save the message in the VersaMail Outbox or Drafts folder for later sending. Using the Send command displays a list box that gives the user a choice of Bluetooth® wireless technology, SMS, or the VersaMail application to send the email. If the VersaMail application is not on the device, the list box does not contain the VersaMail option. Similarly, on devices that don't have the Bluetooth® wireless technology or SMS option, the VersaMail application is automatically launched.

The following sample code shows how an application can use the Exchange Manager to sublaunch a Compose email message form:

```
/* Use the Exchange Manager to create a New mail message */
/* Lets you add an attachment */

ExgSocketType exgSocket;
Err err = errNone;

Char      *textBuf = "test";
UInt32    size = StrLen(textBuf) + 1;

// it's important to initialize the structure to null values

MemSet(&exgSocket,sizeof(exgSocket),0);
exgSocket.description = "Testing";

/* A box pops up with an option to pick SMS, VersaMail application, etc.
 * You may not see the VersaMail option in the list if the VersaMail
 * application is not installed on the device.
 */

   exgSocket.name = "?_send:Sample.txt";

   /* send is important here */

   exgSocket.type = ".txt";
   err = ExgPut(&exgSocket);

 if (err == 0) {
       ExgSend(&exgSocket,textBuf,size,&err);
       ExgDisconnect(&exgSocket,err);
  }
```

For more information on using the Exchange Manager method, see the *Palm OS Programmer's Companion, Volume II* and the *Palm OS Programmer's API Reference*.

- Using Helper notifications

  This method supports a `SysUISwitch` from the launching application to a full VersaMail email Compose form and back again. The full compose form is opened when the appropriate control is tapped in the launching application, and once the user has saved or sent the message, they are returned to the launching application.

  For more information on the Helper notifications method, see the *Palm OS Programmer's Companion, Volume I,* the *Palm OS Programmer's API Reference,* and the sample code `AddEmail` in the Samples folder of the Palm OS SDK.

- Programmatically using the strategies documented in this chapter

  You must use the strategies documented in this chapter to allow a third-party application to add outgoing email messages to a VersaMail folder.

  All of the strategies documented in this chapter use VersaMail launch commands.

10.2.3.1.1 VersaMail launch commands

There are three basic launch commands that you can use:

- `sysAppLaunchCmdAddRecord`

  This launch command creates a basic message without an attachment. You can use `MailAddRecordParamsType` to simply add the message to the VersaMail Outbox or `MailAddRecordsParamsTypePlus` to add the message to a different VersaMail category, such as Drafts.

  The attachment functionality of `MailAddRecordsParamsTypePlus` is ignored by the VersaMail application when it is used with `sysAppLaunchCmdAddRecord`. To use the attachment functionality of `MailAddRecordsParamsTypePlus`, you must use the next launch code, `MMPRO_ADD_MESSAGE_WITH_ATTACHMENT`, instead.

  `sysAppLaunchCmdAddRecord` is available in the `systemMgr.h` header file, `MailAddRecordsParamsType` is available in the `AppCmdLaunch.h` header file, and `MailAddRecordsParamsTypePlus` is available in the `PalmVMLaunch.h` header file.

- `MMPRO_ADD_MESSAGE_WITH_ATTACHMENT`

  This launch command works much like `sysAppLaunchCmdAddRecord`, except you can use `MailAddRecordsParamsTypePlus` to specify both a category and an attachment.

  `MMPRO_ADD_MESSAGE_WITH_ATTACHMENT` is available in the `PalmVMLaunch.h` header file.

- `MMPRO_LAUNCH_CODE`

  This launch command actually launches the VersaMail application itself and presents the user with a full email compose form. The `MMPRO_LAUNCH_CODE` command uses the `MMProLaunchStruct` data structure to add attachments smaller than 64KB and `MMProLaunchStruct2` to add attachments larger than 64KB.

  `MMPRO_LAUNCH_CODE`, `MMProLaunchStruct`, and `MMProLaunchStruct2` are available in the `PalmVMLaunch.h` header file.

10.2.4 VersaMail® Font library

This section provides information on how to use the VersaMail Font library. You can use the Font library to set the VersaMail Font Picker user interface and to work directly with font information on a device. More information on the Font library can be found in the *Palm OS Platform API Guide*.

10.2.4.1 Checking whether the Font library is present

To check whether the Font library is present and loaded on a handheld, use `SysLibFind` to check for the library name `PalmSGFontLib` and a `0` error return value.

The VersaMail Font library is not included in the current versions of the VersaMail application. The library has to be retrieved, and you must perform a HotSync® operation to install it on a device. The library is available in the Palm OS SDK.

Also, the Font library requires the font databases—PalmSGHiResFonts.pdb for high-resolution devices and PalmSGLowResFonts.pdb for low-resolution devices. The font databases are available in the VersaMail application, version 2.5 or later, and in the Palm OS SDK.

10.2.4.2 Using the Font library

The Font library is loaded during many handheld events, such as HotSync operations, but in order to use the functions in the Font library, you need to obtain and store the library reference number. You can use standard methods to maintain easy access to the reference number, such as globals with associated accessor routines or Palm OS `FtrSet` and `FtrGet` calls. For more information, see `VMFontOpen`.

Also, before you use any of the Font Picker user interface functions, you must initialize the Font Picker user interface data structure using `InitFontUI`. You currently can apply only one style to a font. For example, you can apply bold or italic to a font, not bold and italic.

10.2.5 VersaMail® Attachment Plug-ins API

This section provides information on how to create a plug-in so that users can view and send email attachments using your plug-in in the VersaMail application. The VersaMail Attachment Plug-ins API is declared in the header file `PalmVMPlugin.h`.

This feature works with the VersaMail application, version 2.6 or later. The Palm OS SDK includes a sample plug-in for TXT attachments.

10.2.5.1 Overview of how the VersaMail® application handles plug-ins

The handling of email attachments in the VersaMail application is controlled by the VersaMail Plug-in Manager.

When a user attempts to view a particular attachment in the VersaMail application, the VersaMail Plug-in Manager first tries to find the appropriate plug-in given the attachment's MIME type. If multiple compatible plug-ins are found, the VersaMail application displays a list so the user can choose the plug-in they want to use.

If no plug-in is found, the Plug-in Manager attempts to find an application registered with the Exchange Manager as the default application to handle the particular MIME type. If no Exchange Manager application is found, the message "No viewer for this attachment type" is displayed and the attachment can be viewed with the plain text viewer.

When a user attempts to send a particular attachment in the VersaMail application, all installed plug-ins are queried to find out what type of attachment each of them supports. When an appropriate plug-in is found, the VersaMail application queries the plug-in to display a list of possible attachments that can be sent. When a user selects an attachment from this list, the VersaMail application calls the appropriate plug-in to provide the data required to send the attachment.

10.2.5.2 Overview of plug-in design

A plug-in should be designed as a Palm OS PRC file with the application type "mmpl" that supports the specific VersaMail launch commands detailed in this section. Because plug-ins are seamless to the user and should not appear to be separate programs, plug-ins should be created without an associated program icon. Furthermore, when a plug-in has finished viewing or sending an attachment, it should return control to the VersaMail application, not to the Applications View or to any other application.

The VersaMail application builds a dynamic list of all available plug-ins so that the user can install or remove them as desired. A separate plug-in should be provided for each type of file attachment. If there are multiple plug-ins that support the same type of file attachment, the user is provided with a list of possible plug-ins.

The VersaMail launch command that plug-ins must support are as follows:

- `MMPRO_PLUGIN_GET_INFO_LAUNCHCODE`

  This launch command is sent by the VersaMail application when it is trying to get information about what plug-ins are available to send a particular attachment.

- `MMPRO_PLUGIN_QUERY_LAUNCHCODE`

  This launch command is sent by the VersaMail application to get a list of possible attachments a user can send.

- `MMPRO_PLUGIN_EXTENDED_QUERY_LAUNCHCODE`

  This launch command is sent by the VersaMail application to get a more complete description of possible attachments a user can send. This launch command is provided for applications in which a simple, short description of a possible attachment is not enough information for a user to understand what the attachment is. For example, in Date Book, a simple date without the information associated with that date might not be enough information for a user to determine if they want to send the date as an attachment.

- `MMPRO_PLUGIN_SEND_LAUNCHCODE`

  This launch command is sent by the VersaMail application when a user has selected an attachment to send. The plug-in prepares the attachment so that it can be sent in response.

- `MMPRO_PLUGIN_RECEIVE_LAUNCHCODE`

  This launch command is sent by the VersaMail application when an attachment of the appropriate type is received. It allows the plug-in to do whatever you would like the plug-in to do with a received attachment. For example, you might want to display the attachment in a window that includes a Done button that users can tap when they have finished viewing the attachment.

CHAPTER 11

11. Developing SDIO Applications for Palm® Handhelds

This chapter provides information on writing Palm OS® applications that interact with SDIO hardware. Because there is a wide range of possible SDIO devices, it focuses solely on those aspects of program design specific to the Palm OS application, Palm handhelds, and the SDIO slot driver.

This chapter provides:

- Pointers to the software, hardware, and documentation you'll need to create your application
- Aspects of the Palm OS that you'll use when writing your application
- Programming guidelines specific to SDIO applications
- Pointers relative to creating the SDIO card itself

Much of an SDIO application is dictated by the hardware with which it interacts. However, because SDIO is a standard, and because these SDIO applications run on the Palm OS, all such applications have a number of traits in common. This commonality is the subject of this chapter.

11.1 The SDIO SDK

The latest Palm SDIO SDK is available for download from **http://pluggedin.palm.com**. It contains the SDIO headers, *API Guide*, and sample code.

In addition to the information in this chapter on creating SDIO applications, you'll want to have a copy of the SDIO Specification and an up-to-date copy of the *Palm OS Programmer's API Reference* and *Companion* (**http://www.palmos.com/dev/support/docs/palmos/**).

If you are developing SDIO hardware, you will also want to know about Palm's HDK (Hardware Development Kit) and EDK (Expansion Development Kit). The HDK contains mechanical specifications, drawings, and documentation that assist with the design of peripherals. The EDK is a set of parts or items available for purchase at the Palm Expansion Parts Store (**http://pluggedin.palm.com/regac/pluggedin/auth/PalmPartsStore**). Information on all of these items can be found at the PluggedIn Program website (**http://pluggedin.palm.com**).

11.1.1 SD, SDIO, and MultiMediaCard Specifications

The SD Card Association (SDA) publishes the *SDIO Card Specification*, which is based on and refers to the SDA document titled *SD Memory Card Specifications, Part 1, PHYSICAL LAYER SPECIFICATION*. Both of these documents provide essential foundation material for the contents of this document. You should be familiar with the *SDIO Card Specification* and with those parts of the *SD Memory Card Specifications* that document card modes, card initialization, interrupts, registers, and card reading and writing. Depending on the SDIO hardware with which you are working, additional sections of the *SD Memory Card Specifications* document may be of interest.

The SD Card Association's website can be found at **http://www.sdcard.org/**. You'll need to be a member in order to obtain the specifications from the SD Card Association.

NOTE: Creating Palm OS applications that can use and exchange data from other products via SD Memory cards is outside the scope of this document. However, to make sure that data can be interchanged with present and future SD products, please refer to the appropriate SD Association specification depending on the type of application.

For developers working with MultiMediaCards, the MultiMediaCard Association's website can be found at **http://www.mmca.org/**. The MultiMediaCard specifications are available from the MultiMediaCard Association to its members.

The SDIO slot driver has been written to accommodate the following specifications:

- MultiMediaCard memory cards, V1.4 to V3.0
- SD memory cards, Part 1, V1.0 (and the supplement to part 1)
- SDIO V1.0

11.1.2 Palm OS® SDK

General Palm OS programming concepts are documented in the *Palm OS Programmer's Companion*. Reference documentation for the APIs made public by the Palm OS software can be found in the *Palm OS Programmer's API Reference*. Both of these documents are installed as part of the Palm OS Software Developer's Kit (SDK), which can be found at **http://www.palmos.com/dev/tools/core.html**. SDIO applications are not supported on versions of the Palm OS prior to 4.0.

Although you'll want to be familiar with a number of different aspects of Palm OS programming, pay particular attention to the portions of the *Companion* and *Reference* that cover the Expansion and VFS Managers; these chapters show you how to read and write expansion media, including SD memory cards.

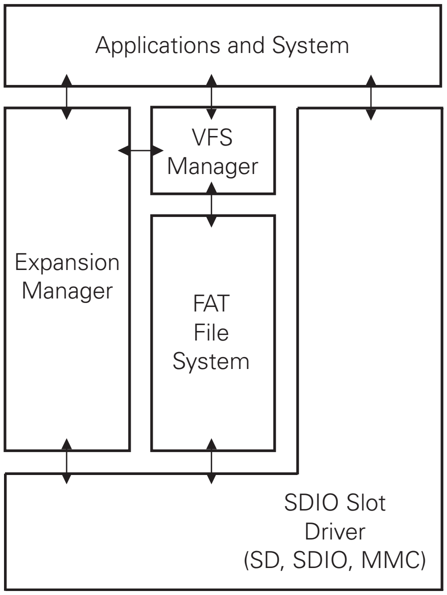
In addition to the Palm OS SDK, you should also have the header files for the SDIO slot driver and copies of the SDIO sample applications provided by Palm. These are included with the Palm SDIO SDK. The header files included with the SDIO SDK are compatible with the Palm OS SDK and must be copied into a folder in your project's "include" path.

11.2 Software Architecture of an SDIO Application

Palm OS applications that interact with SDIO cards make use of the functions provided by the Expansion Manager, the VFS Manager, and the SDIO slot driver. Before you can write such a Palm OS application, you should have an understanding of how your application will interact with these and other features of the Palm OS software.

The following figure presents a simplified view of how the SDIO slot driver relates to your applications, the Expansion Manager, and the VFS Manager. Unlike other Expansion Manager slot drivers, the SDIO slot driver exposes its APIs to applications. Because it also lies beneath the Expansion and VFS managers, you access SDIO hardware through a combination of Expansion Manager, VFS Manager, and SDIO slot driver calls. Note that you use the VFS Manager with a given SDIO card only if there is an SD or SDIO file system present on that card.

The VFS Manager APIs are used for all file system access on an expansion card. When inserted, SD memory and SDIO CSA memory is mounted as file system memory. Therefore, access to these memory areas is done using the VFS Manager APIs. Details of accessing data on file systems can be found in the standard Palm OS documentation on Expansion Manager and VFS APIs.



11.2.1 Expansion Manager

The Expansion Manager is a software layer that manages slot drivers on Palm OS handhelds. The Expansion Manager is not solely responsible for support of expansion cards; rather, it provides an architecture and higher-level set of APIs that, with the help of low-level slot drivers and file system libraries, support various types of media.

The Expansion Manager:

- broadcasts notification of card insertion and removal
- plays sounds to signify card insertion and removal
- mounts and unmounts card-resident volumes

NOTE: Some of the functions provided by the Expansion Manager are designed to be used by slot drivers and file systems and are not generally used by third-party applications.

For a detailed explanation of the functions that make up the Expansion Manager, see the “Expansion Manager” chapter in the *Palm OS Programmer’s API Reference* (**http://www.palmos.com/dev/support/docs/palmos/PalmOSReference/ReferenceTOC.html**).

11.2.2 VFS Manager

The VFS (Virtual File System) Manager provides a unified API that gives applications access to many different file systems on many different media types, including SD media. The VFS Manager is used for all file system access on an expansion card. In the case of an SDIO card, the VFS Manager is typically used to access any function CSA memory. The data stored in CSA memory is structured as a FAT12/16 file system (FAT 12/16/32 for the LifeDrive™ mobile manager) and is therefore ideally suited for access by the VFS Manager.

Combo cards may contain SD memory that is also accessed through the VFS Manager APIs.

For a detailed explanation of the functions that make up the VFS Manager, see the “Virtual File System Manager” chapter in the *Palm OS Programmer’s API Reference* (**http://www.palmos.com/dev/support/docs/palmos/PalmOSReference/ReferenceTOC.html**).

11.2.3 SDIO Slot Driver

To simplify the interaction with the SDIO hardware, Palm has created an SDIO slot driver. It replaces the Palm OS SD/MultiMediaCard slot driver, which isn’t SDIO-aware, and consists of data structures and functions that allow you to easily manage power, interrupts, and data on the SDIO card.

The SDIO slot driver controls all media supported by an SD expansion slot, including SD media, MultiMediaCard media, and SDIO media.

An examination of the functions provided by the SDIO slot driver shows that it implements most of the software functionality outlined in the SDIO Card Specification. It does not, however, support the following:

- SDIO Suspend/Resume Operation
- SDIO Read Wait Operation
- SDIO RW Extended Block Operation in “forever” mode

11.2.4 Notification Manager

The Palm OS Notification Manager allows applications to receive notification when certain system-level or application-level events occur. Although the Notification Manager has many uses, developers of SDIO applications should particularly take note of the fact that you use it to detect card removal by registering for a `sysNotifyCardRemovedEvent` (see **Section 11.3.3 on page 223**).

11.3 Guidelines for SDIO Applications

All SDIO applications need to be aware of the power needs of the SDIO card. As well, they need to be able to handle interrupts generated by the card, and must be aware of when an SDIO card is inserted or removed from the handheld's SD slot. The following sections discuss these and other SDIO-application-specific topics.

11.3.1 Power Management

When the handheld awakes from sleep mode, it doesn't turn the card on. Only when there is a request to access the card does it turn the card on.

11.3.1.1 Turning on Card Functions

You can turn on a given SDIO card function explicitly with `SDIOSetPower`. Be aware that you, as an application developer, are responsible for managing card power.

You must ensure that the total of all function hardware that is active does not draw in excess of the SDIO-specified maximum of 200ma.

Perform the following steps to explicitly turn on an SDIO card function:

1. Disable SDIO interrupts with `SDIODisableHandheldInterrupt`—even if your application doesn't use interrupts.
2. Verify that there is sufficient current available to power the card function. To aid in the power management process, the SDIO slot driver provides three functions: `SDIOGetCurrentLimit`, `SDIOSetCurrentLimit`, and `SDIORemainingCurrentLimit`.

   NOTE: These three functions do not detect or limit current draw, check the battery level, or reflect how much energy the battery has left.

   The current limit for each function can be obtained by calling `SDIOGetCurrentLimit` or changed by calling `SDIOSetCurrentLimit`. Prior to enabling power to a given function, call `SDIOGetCurrentLimit` to determine how much power it will draw, and compare it to the value returned from `SDIORemainingCurrentLimit`, which indicates how much current can be spared.
3. Turn the function on using `SDIOSetPower`.
4. Reenable interrupts by calling `SDIOEnableHandheldInterrupt`.

   After turning off an SDIO card function (with `SDIOSetPower`), be sure to call `SDIOSetCurrentLimit` and set its current limit to zero.

   When a card is removed, all of the in-memory current limits are automatically set to zero.

11.3.1.2 Auto Power Off

The `SDIOSetAutoPowerOff` function allows you to specify an amount of time after which the power and data signals to a given function on an SDIO card should be turned off. You specify this time interval in system ticks; there are `SysTicksPerSecond` ticks per second. To disable the auto-power-off feature, simply call this function and supply a tick count of zero.

To obtain the current auto-power-off settings for a given SDIO card function, use `SDIOGetAutoPowerOff`.

11.3.1.3 Callbacks

The SDIO slot driver allows your application to register callback functions that will be invoked whenever the corresponding event occurs on the SDIO card. Several of these callbacks relate to power management.

Whenever the Palm handheld is about to be put to sleep, the callback function corresponding to `sdioCallbackSelectSleep` is called. Just after the handheld wakes, the function corresponding to `sdioCallbackSelectAwake` is called. These callback functions can be called from either an interrupt routine or a non-interrupt routine; as a result interrupts may be disabled or enabled. In either case, they should always be as fast as possible.

Whenever SDIO card power is turned on or is about to be turned off, the callback function corresponding to `sdioCallbackSelectPowerOn` or `sdioCallbackSelectPowerOff`, respectively, is called. While processing these functions, never call `SDIOSetPower` in order to turn an SDIO card's power on or off. These functions can be called from within an interrupt handler, so they should be as fast as possible.

11.3.2 Interrupt Handling

An SDIO card is capable of interrupting the host device into which it is inserted—in this case, the Palm handheld. The SDIO slot driver allows you to register a callback function that is called whenever the card interrupts the handheld.

Register for the interrupt callback by calling `SDIOSetCallback` and specifying that you are registering for `sdioCallbackSelectInterruptSdCard`. In your callback function, be sure to reset the interrupt source to prevent the interrupt callback from being called again inadvertently.

Whether or not you have registered an interrupt callback function, you can enable or disable the SDIO interrupt on the handheld by calling `SDIOEnableHandheldInterrupt` or `SDIODisableHandheldInterrupt`. Note that these functions only affect interrupts on the handheld; they do not turn on or off interrupts on the SDIO card itself.

These functions are implemented as an incrementing counter, making them re-entrant. For instance, for every call to `SDIODisableHandheldInterrupt` there must be an equal number (or more) of calls to `SDIOEnableHandheldInterrupt` in order to re-enable interrupts.

By default, when the card is inserted interrupts on the handheld are enabled, but are disabled internally until an interrupt callback is set with `SDIOSetCallback`. Note that in order to receive the SDIO interrupt, power to the card must be on, even if the handheld is asleep.

11.3.3 Detecting Card Insertion and Removal

Applications that depend on the presence of the SDIO card in the slot should register for a `sysNotifyCardRemovedEvent`, which is broadcast when the user removes the card from the SD slot.

Be sure to unregister for the `sysNotifyCardRemovedEvent` notification and any SDIO callbacks when your application terminates.

For more information on registering and unregistering for notifications, see the Notification Manager chapter in the *Palm OS API Reference Guide* (**http://www.palmos.com/dev/support/docs/palmos/PalmOSReference/ReferenceTOC.html**). The “Expansion” chapter of the *Palm OS Programmer’s Companion*, vol. I (**http://www.palmos.com/dev/support/docs/palmos/PalmOSCompanion/CompanionTOC.html**) discusses, among other things, the various notifications that are issued when a card is inserted or removed, or when a volume is mounted or unmounted.

11.3.4 Auto Run

When a card is inserted into the SD slot, after it has been initialized any file system memory present on the card is mounted by the Expansion Manager. This includes all SD memory, in the case of a standard SD card or SDIO combo card, and all SDIO Function CSA memory for functions 0-7.

After mounting of the file systems, the SDIO slot driver broadcasts a series of Auto Run (`sysNotifyDriverSearch`) notifications. These notifications are sent in an attempt to locate function- or card-specific drivers, and allow those drivers that are already on the handheld to launch themselves.

The typical sequence of events after a card is inserted is as follows:

1. Power is applied to the card.
2. The card is initialized according to the SDIO, SD, or MultiMediaCard specification, as appropriate.
3. Information about the card (tuples, clock speed, CSD, CID, etc.) is read.
4. Any recognized file systems are mounted.
5. `sysAppLaunchCmdCardLaunch` is sent to `start.prc` on each mounted file system.
6. The Auto Run notifications (`sysNotifyDriverSearch`) are sent.
7. `sysAppLaunchCmdNormalLaunch` is sent to `start.prc` on each mounted file system.

For SDIO cards, one Auto Run notification is broadcast for the SD memory portion of a combo card, and an additional notification is broadcast for each card function (up to 7). For SD memory and MultiMediaCard memory cards, only one such notification is sent. The notifications are sent starting with SD memory, followed by function 7 (if there is one) and proceeding to function 1 as appropriate.

The `notifyDetailsP` field of the `SysNotifyParamType` structure that accompanies the Auto Run notification points to an `AutoRunInfoType` structure. Each driver that has registered for `sysNotifyDriverSearch` should examine the contents of the `AutoRunInfoType` structure to determine if it is the driver that should control the inserted card. If so, the driver should then check the `SysNotifyParamType` structure's `handled` field. If `handled` is set to `true`, another driver has received the broadcast and will control the card. If `handled` is set to `false`, the driver should set it to `true` to indicate that it will control the device.

11.4 Developing the SDIO Peripheral

An SDIO application is only as good as the hardware with which it interacts. The following sections provide some tips for the creation of an SDIO peripheral to be used with a Palm handheld.

11.4.1 EDK

Palm® has made available the SDIO Developer Card #1, a sample SDIO design demonstrating an SDIO interface to a microcontroller. It is an Expansion Developer Kit (EDK) that allows hardware developers to experiment with SDIO hardware and software for prototyping and evaluation purposes. The card includes a flash programmable PIC microcontroller and a CPLD for maximum flexibility in prototyping.

Palm's EDK is available for purchase at the Palm Expansion Parts Store (**http://pluggedin.palm.com/regac/pluggedin/auth/PalmPartsStore**).

11.4.2 Specifications

When developing an SDIO peripheral, it is extremely important that you following the specifications identified in **Section 11.1.1 on page 218** Be sure to pay close attention to the power restrictions, as the Palm handheld isn't able to deliver more power to an SDIO peripheral than the specification maximum.

11.4.3 SDIO Slot Driver

A Palm handheld running Palm OS 4.0 or 5.0 supports SD/MultiMediaCard expansion cards. If the SDIO slot driver is installed, it will also support SDIO expansion cards. In both cases, only one file system can be mounted for a given expansion card. Future versions of the Palm OS will likely lift this restriction, allowing up to seven file systems to be mounted for an SDIO expansion card.

In order to support SDIO peripherals, handhelds running Palm OS 4.0 must either be flash-upgraded to a version of the OS that supports SDIO, or must have the SDIO slot driver separately installed in RAM. The SDIO slot driver can be downloaded from the Palm website and installed as a PRC file in RAM on Palm OS 4.0 devices. After a soft reset, the slot driver in RAM is recognized and takes precedence over the SD/MultiMediaCard slot driver in ROM.

NOTE: Devices based on Palm OS 5.0 have the SDIO slot driver built into the ROM.

You can verify whether a given slot driver is "SDIO-aware" by calling `SDIOAPIVersion`. This function returns `expErrUnimplemented` if the specified driver doesn't support SDIO, or errNone if it does. If the driver does support SDIO this function also returns the slot driver version number through the `versionP` parameter.

To remove the SDIO slot driver from RAM, you must perform a hard reset of the handheld. You cannot delete the SDIO slot driver using the Application Launcher's "Delete" function. Note that to avoid having the SDIO slot driver reinstalled on the handheld during the next HotSync operation, you must remove the slot driver PRC from the Backup directory of your desktop computer.

11.4.4 SDIO Card Initialization and Identification on Palm OS®

The process of identifying and initializing an SDIO card is specified in the *SDIO Card Specification*. One of the first steps in developing an SDIO card is to have the card identify itself as an SDIO card to the host.

11.4.4.1 Identification

Identification of a card is done only once, at the time the card is inserted in the handheld's SD slot. Information obtained from the card during the identification phase is retained in the handheld's memory until the card is removed. Among other things, this information includes:

- the type of card in the slot
- what the card contains
- the card's limits
- data read from tuples

By default SDIO cards power-off automatically after a certain amount of inactivity. This behavior can be modified with the `SDIOSetAutoPowerOff` function.

11.4.4.2 Initialization

A card is initialized every time it is turned on. The SDIO slot driver follows the appropriate initialization flowchart—SD mode or SPI mode—from the "SDIO Card Initialization" section of the *SDIO Card Specification* to initialize the card.

During the initialization phase, the handheld operates within the range of SD or SPI clock frequencies specified in the SD Memory Card Specifications (from zero to 400kHz). The actual clock frequency used depends upon the model of the Palm handheld.

The TPLFID_FUNCTION tuple, located immediately after the CISTPL_FUNCID tuple in the CIS for function 0, contains the TPLFE_MAX_TRAN_SPEED byte. This byte indicates "the maximum transfer rate per one data line during data transfer"; essentially, the maximum clock frequency that the card can support. As soon as this tuple is read, the SDIO slot driver increases the clock speed to the highest possible frequency that doesn't exceed the maximum specified in TPLFE_MAX_TRAN_SPEED.

11.4.5 Code Storage Area (CSA)

In order for an SDIO card's Code Storage Area (CSA) to be readable by the Palm OS software, the CSA should be in FAT12/16 format (FAT 12/16/32 for the LifeDrive™ mobile manager), and any drivers, data, or applications that the peripheral would like to be automatically detected by the Palm handheld should reside in the `/Palm` and `/Palm/Launcher` directories. Once the CSA area is mounted, applications may access any data within the CSA, irrespective of the directory in which that data resides.

PART II

Debugging

This part of the guide provides details on how to debug problems with the code you create.

CHAPTER 12

12. Debugging

This chapter details how to debug problems with Palm APIs using various utilities available for Treo™ smartphones.

12.1 Overview

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

The following sections explain the tools and methods available for developing and debugging applications. These tools and methods include:

- Simulator
- Debug Simulator
- DebugPrefs
- Metrowerks CodeWarrior
  - Metrowerks CodeWarrior with Simulator
  - On-device debugging
- PalmDebugger

12.2 Simulator

This section describes the Treo smartphone version of the Palm OS® simulator.

12.2.1 Overview

Simulators are available for most Palm products, and can be a useful development tool. The Palm OS handheld and Treo smartphone simulators do not run true ARM code. Instead, ARM code is complied to x86 code. For this reason, you may see slight differences in behavior and error messages. But even with these differences, the simulator is still a useful debugging tool, especially because of the extra benefits and features that are described in the following sections, and because of the fact that the simulator allows you to load and run a newly generated PRC quickly.

12.2.2 Simulator features

The simulator includes several features that make it useful for debugging.

The Events view allows you to view all events that are generated. To access the Events view, use the following steps:

1. Launch the simulator.
2. Right-click the simulator.
3. Select **View**.
4. Choose **Events**.

The Heaps and Databases views are also useful for debugging. To access the Heaps or Databases views, use the following steps:

1. Launch the simulator.
2. Right-click the simulator.
3. Select **View**.
4. Choose **Heaps** or **Databases**.

12.2.3 Keystroke equivalents

Palm devices do not usually use their individual skins. For this reason, it is useful to know how to simulate the possible keystrokes of a device.

The following table decodes the keystrokes that can be simulated in the Treo smartphone version of the Palm OS simulator:

Right-Shift	Option	
Left-Shift	Shift	
Right-Ctrl	Menu	
Left-Ctrl	Various virtual characters:	
	Left-Ctrl-A	vchrMenu
	Left-Ctrl-B	vchrLowBattery
	Left-Ctrl-C	vchrCommand
	Left-Ctrl-D	vchrConfirm
	Left-Ctrl-E	vchrLaunch
	Left-Ctrl-F	vchrKeyboard
	Left-Ctrl-I	vchrFind
	Left-Ctrl-K	vchrCalc
	Left-Ctrl-N	vchrNextField
	Left-Ctrl-P	vchrPrevField
	Left-Ctrl-L	chrCarriageReturn
Esc	vchrHardPower (radio power)	

F1	vchrHard1 (Phone)
F2	vchrHard2 (Calendar)
F3	vchrHard3 (Messaging)
F4	vchrHard4 (Screen power)
End	hsChrSymbol (Alt)
Home	vchrRockerCenter
Clear	vchrRockerCenter
Left-Arrow	vchrRockerLeft
Right-Arrow	vchrRockerRight
Up-Arrow	vchrRockerUp/vchrPageUp (depending on focus mode)
Down-Arrow	vchrRockerDown/vchrPageDown (depending on focus mode)
Page-Up	hsChrVolumeUp
Page-Down	hsChrVolumeDown
F5	Toggle coordinate display in title bar
F7	Sticky-shift (toggles press/release of shift key)
F8	Sticky-Option (toggles press/release of option key)
F9	Plug-in/Unplug a simulated charger
F11	Increase simulated battery charge by 1%
F12	Decrease simulated battery charge by 1%
Left-Ctrl-R	Soft Reset
Shift-Left-Ctrl-R	Hard Reset
Left-Ctrl-S	Power off (simulates down/up of Esc key)

12.3 Debug simulator

Fatal errors are handled differently on Treo smartphones than on Palm's earlier products. In the released device, fatal errors are not displayed to end users. If a fatal error occurs, the system performs a soft reset and the error is logged. This process results in a better user experience.

However, as a developer, it is important to have access to information about these errors and where they happen.

The Debug simulator is a tool for developers that displays all the otherwise hidden fatal and non-fatal alerts and errors that a production device (and the Release simulator) would skip. Using the Debug simulator, you will be able to investigate and fix issues to improve the quality of your applications.

The Debug Simulator is available for almost all Palm products, and can be found in the same location as the Release simulator at the Palm Developer website at **http://pluggedin.palm.com**.

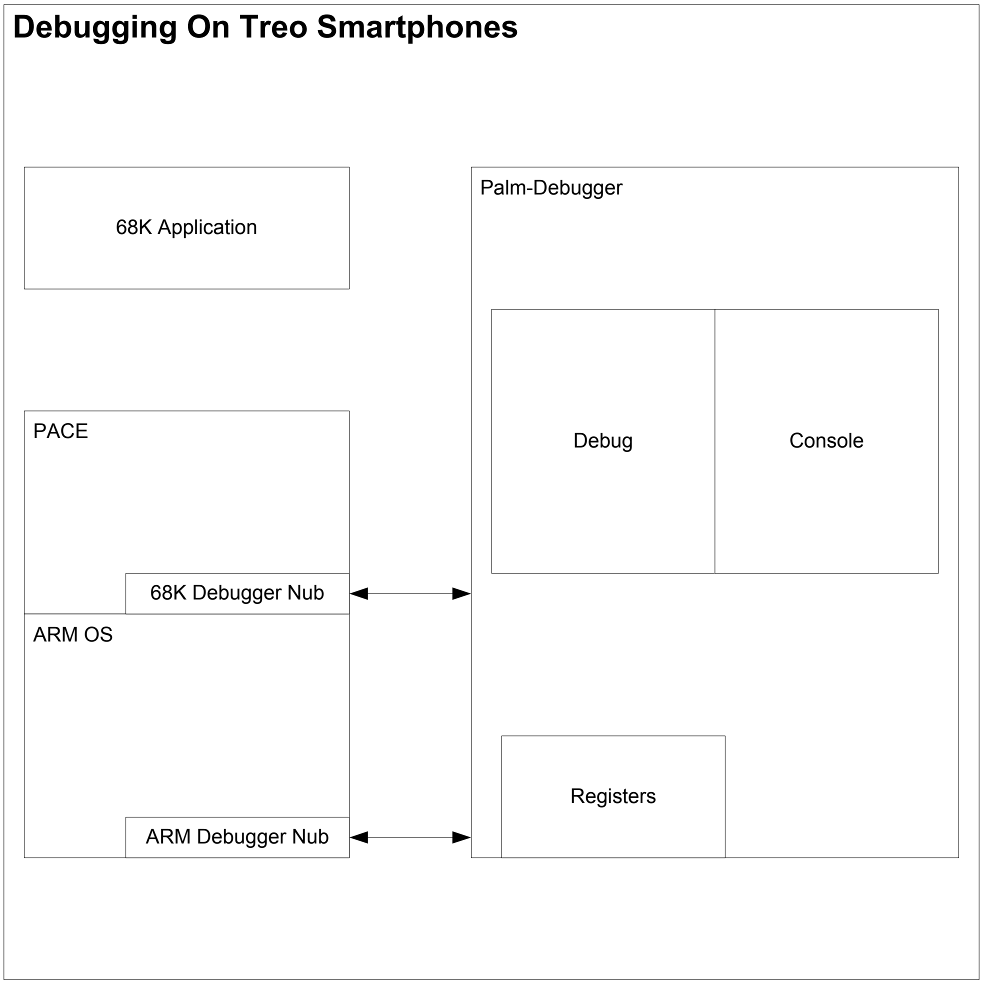
12.4 DebugPrefs

12.4.1 Background: Debugger nubs

The following section assumes that you understand some background information on the Palm OS 5.0 architecture and environment, including details of the relationship between the 68k, PACE, and ARM layers.

For background information, refer to the PalmSource website at **http://www.palmsource.com/home.html**.

The following figure shows the various debugger nubs and where they are located within the Palm OS on a Treo smartphone.



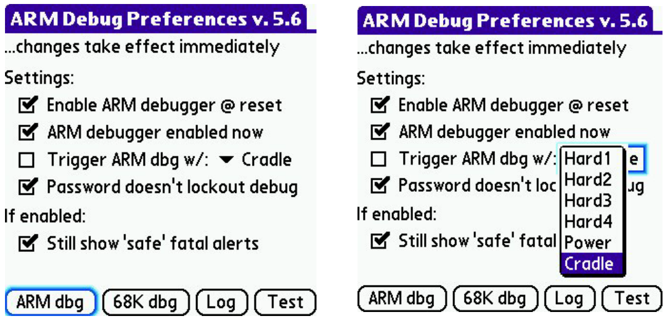
- **68K PACE debugger nub -** The 68K PACE debugger nub is active if you see a blinking block in the lower-left corner of the screen.
- **68K PACE console mode -** The 68K PACE console mode is active if you see a blinking block in the lower-right corner of the screen.
- **ARM debugger nub -** The ARM debugger nub is active if you see a blinking line at the top of the screen and flashing keyboard.

NOTE: The PACE debugger nub stops the PACE environment, not the ARM. The ARM debugger nub stops everything and shows the current 68K state as accurately as possible. It might not always be valid, because there is a state for each thread or task.

12.4.2 DebugPrefs overview

As discussed in **Section 12.3 on page 232**, on production devices, errors are hidden from the user for a better user experience. However, for developers, the DebugPrefs application will expose those errors for a better development experience.

DebugPrefs is an application that allows you to configure how you want a Treo smartphone to behave when an error occurs, as shown:



ARM Debug Preferences v. 5.6

...changes take effect immediately

Settings:

- ☑ Enable ARM debugger @ reset
- ☑ ARM debugger enabled now
- □ Trigger ARM dbg w/: ▼ Cradle
- ☑ Password doesn't lockout debug

If enabled:

- ☑ Still show 'safe' fatal alerts

DebugPrefs is available from the Palm Developer website at **http://pluggedin.palm.com**.

12.4.3 DebugPrefs settings

The DebugPrefs application includes checkbox settings and button options, which are explained in the following sections.

12.4.3.1 Checkbox settings

The DebugPrefs application includes the following checkbox settings:

- **Enable ARM debugger @ Reset**

  Puts the smartphone in debugger mode every time the system resets.

  One of the following actions will take place when a fatal error occurs:

  - The ARM Debugger nub will start using the serial port
  - The 68K PACE Debugger Nub will start using the serial or USB port

- **ARM debugger enabled now**

  This is used to enable the ARM debugger. (For more information on ARM development, see the PalmSource website.)

- **Trigger ARM dbg w/:**

  This allows the user to choose a “trigger” that will drop the user in the debugger. The user no longer needs to switch to DebugPrefs or press and hold the HotSync® button. This trigger requires the event loop to be running. The options for the trigger are: Cradle (HotSync®), Power, Hard1, Hard2, Hard3, and Hard4.

- **Password does not lockout debug**

  Check this option to enable the usual debug triggers even if you have set a password for a smartphone.

  NOTE: This option doesn't make a smartphone any less secure, because it is always possible to programmatically launch the debugger if you have infrared (beaming) access to a smartphone.

- **Still show "safe" fatal errors**

  If the system determines that an error is not a major error, then it displays the error. If it determines it is a major error, the system either automatically resets the smartphone or launches the smartphone in debugger mode, depending on how the Enable ARM debugger @ Reset setting is set.

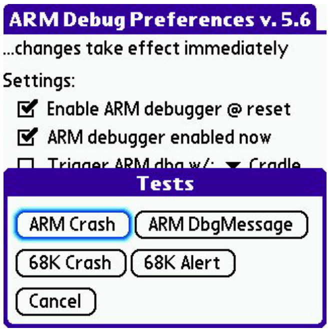
12.4.3.2 Button options

The following options are available by tapping the buttons at the bottom of the screen:

- **68K dbg -** Immediately launches the ARM debugger nub.
- **ARM dbg -** Immediately launches the 68K PACE debugger nub.
- **Log -** Shows the last fatal error dialog box.

  NOTE: This feature is particularly useful because, as mentioned earlier, a Treo smartphone does not display fatal errors when they occur; it simply performs a soft reset. This log will display the last logged time the error happened.

- **Test -** Simulates one of the following errors:



ARM Debug Preferences v. 5.6

...changes take effect immediately

Settings:

☑ Enable ARM debugger @ reset

☑ ARM debugger enabled now

□ Trigger ARM dbg w/: ▼ Cradle

12.5 Metrowerks CodeWarrior

CodeWarrior for Palm OS v9 allows you to do source debugging on a Palm OS simulator or Treo smartphone.

To debug using CodeWarrior:

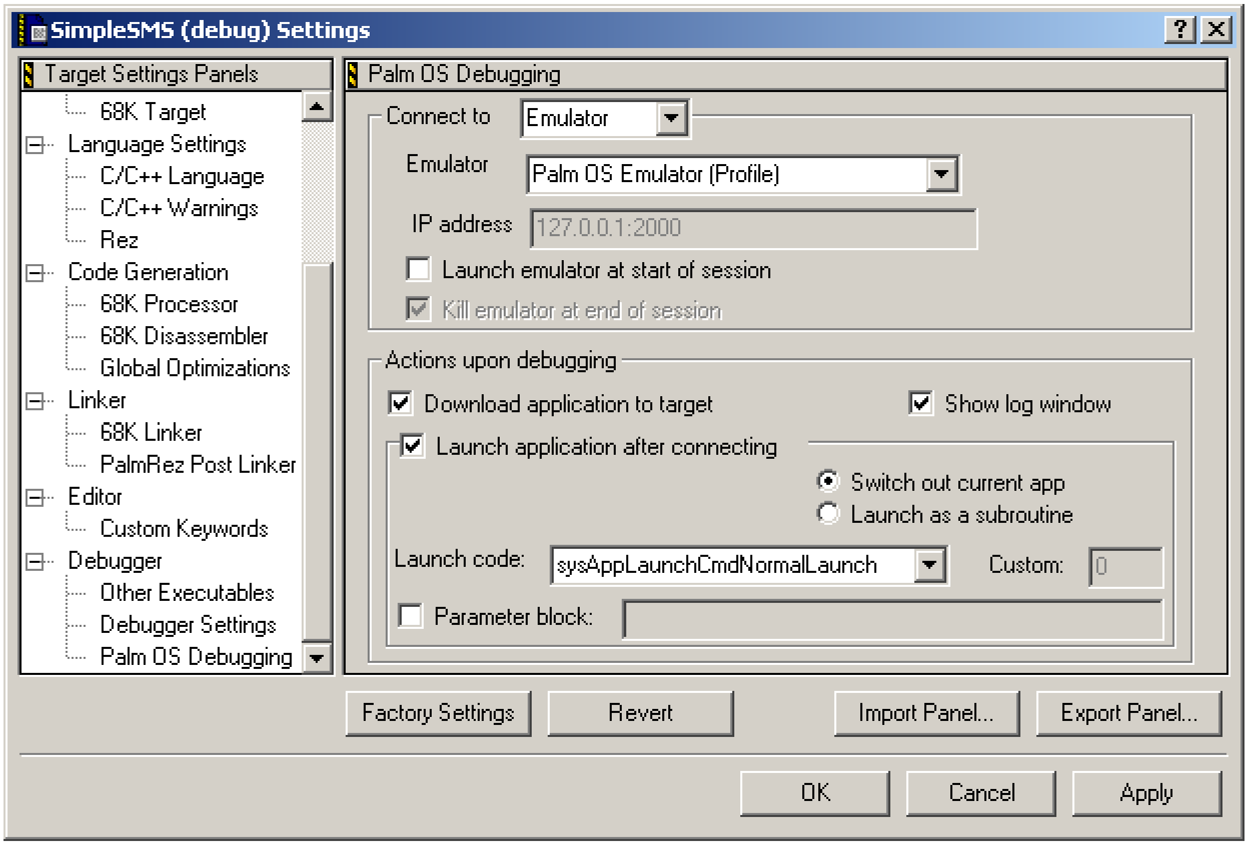
1. Select the project settings to build your project object code with symbolic information:

   Settings > 68K Linker > Debugger Info > Generate SYM File

2. Do one of the following:

   – To debug using the Palm OS simulator, configure the project settings as follows and launch the Palm OS simulator.

     Settings > Palm OS Debugging > Connect to > Emulator



SimpleSMS (debug) Settings

Palm OS Debugging

Connect to: Emulator

Emulator: Palm OS Emulator (Profile)

IP address: 127.0.0.1:2000

□ Launch emulator at start of session

☑ Kill emulator at end of session

Actions upon debugging

☑ Download application to target

☑ Show log window

☑ Launch application after connecting

● Switch out current app

○ Launch as a subroutine

Launch code: sysAppLaunchCmdNormalLaunch

Custom: 0

□ Parameter block:

   – To debug on a Treo smartphone, configure the following project settings and place the Treo smartphone into Debug or Console mode using the following method:

     - Press **Option+Shift+Find** to open the Find dialog box.
     - Press **S**, and then press **Alt**.
     - The shortcut character appears as an option, usually at the bottom of the screen.
     - Select the shortcut character, enter a period (**.**), and then press **Option-1** or **Option-2** to switch to Debug or Console mode, respectively.

NOTE: Alternatively, press **Shift+HotSync** to activate 68K console mode.

To activate the ARM debugging mode:

- Hold the HotSync button and toggle the 'ring/mute' switch twice. (Treo smartphones only.)
- Hold the HotSync button for 5 seconds or more.
- Select 'debug' when the blue Fatal Alert occurs.

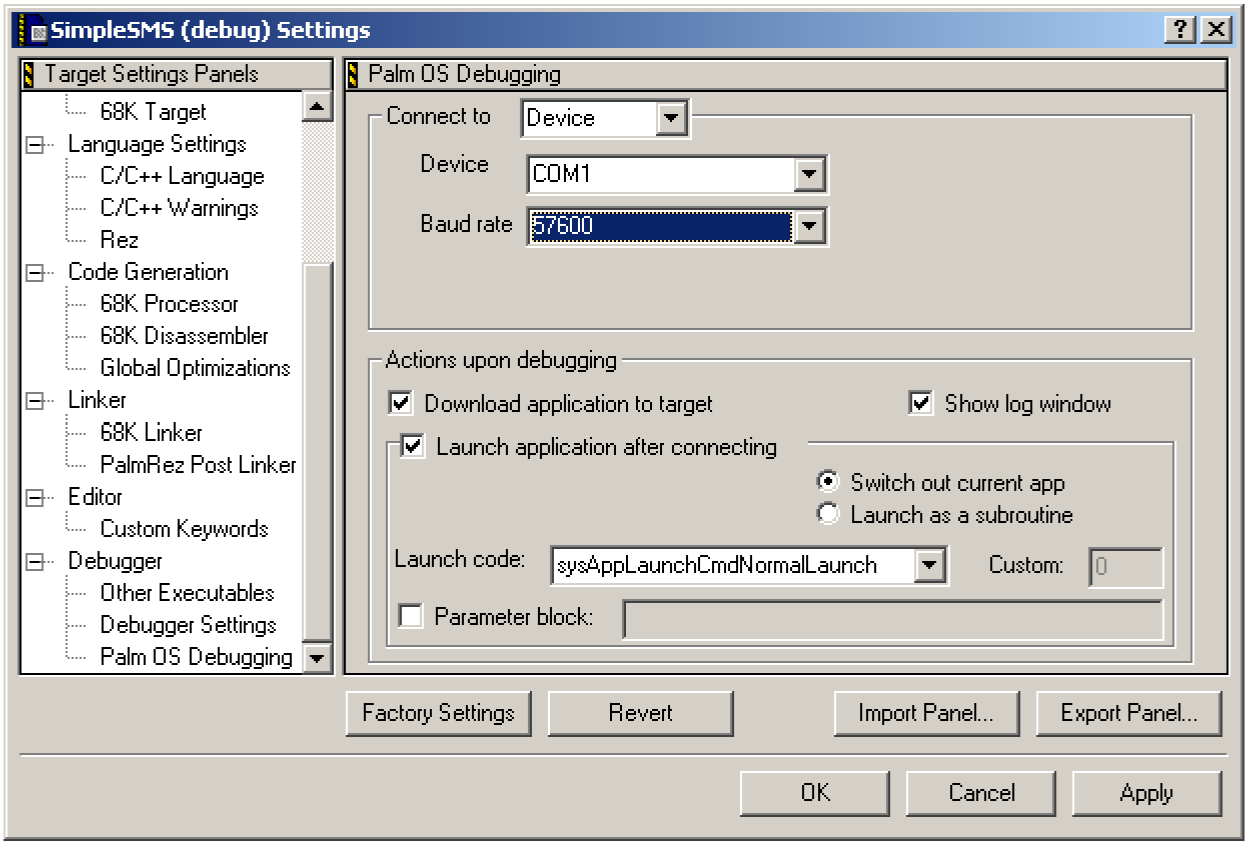
NOTE: The ARM debugging mode is especially useful when a device is in an infinite loop or non-responsive and you want to capture a 68K trace using PalmDebugger.

– Next, select:

Settings > Palm OS Debugging > Connect to > Device

Device > COM1 or USB (for serial or USB connection, respectively)

NOTE: The Treo 600 smartphone only supports serial debugging.



SimpleSMS (debug) Settings

Palm OS Debugging

Connect to: Device

Device: COM1

Baud rate: 57600

Actions upon debugging

☑ Download application to target

☑ Show log window

☑ Launch application after connecting

● Switch out current app

○ Launch as a subroutine

Launch code: sysAppLaunchCmdNormalLaunch

Custom: 0

□ Parameter block:

TIP Make sure the following are true:
The right COM port and baud rate (57600) are selected.
The COM or USB port is not currently being used by other applications.
The serial cable is connected to the right COM port.

3. Load your application and its symbols and run it by selecting Source > menu > Run (or press F5).

   CodeWarrior displays a dialog box notifying you that the application is being loaded to the target.

4. Set any breakpoints you need, and begin your debugging session.

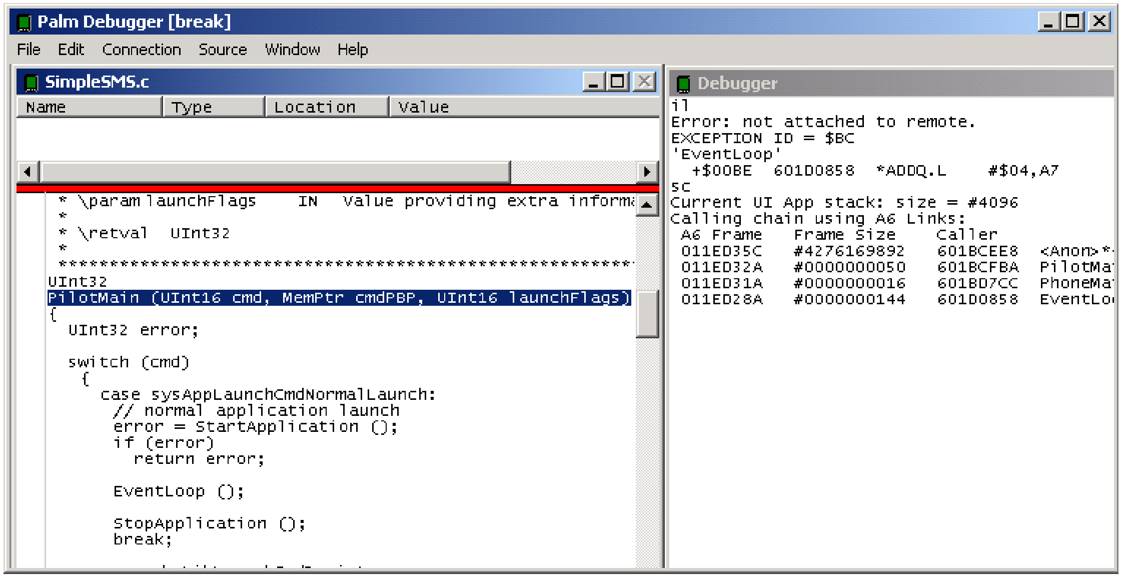
12.6 PalmDebugger

To support debugging on Treo™ smartphones, the PalmDebugger has been updated to communicate with the Palm OS® PACE and the ARM-based debugger nubs.

NOTE: There is no USB support for debugging on Treo 600 smartphones, so you will need to use a serial cable for debugging.

The Treo 650 and Treo 700p smartphones support USB debugging for 68K applications. They also support serial debugging for ARM / PNOlet applications.

For serial debugging on the Treo 650 and Treo 700p smartphones, you will need the Treo 650 smartphone serial cable adapter and a Treo 600 smartphone serial cable.



```
 * \param launchFlags    IN   Value providing extra informa
 *
 * \retval  UInt32
 *
 *************************************************************
UInt32
PilotMain (UInt16 cmd, MemPtr cmdPBP, UInt16 launchFlags)
{
  UInt32 error;

  switch (cmd)
   {
     case sysAppLaunchCmdNormalLaunch:
      // normal application launch
      error = StartApplication ();
      if (error)
        return error;

      EventLoop ();

      StopApplication ();
      break;
```

```
il
Error: not attached to remote.
EXCEPTION ID = $BC
'EventLoop'
  +$00BE  601D0858  *ADDQ.L    #$04,A7
sc
Current UI App stack: size = #4096
Calling chain using A6 Links:
 A6 Frame   Frame Size    Caller
 011ED35C   #4276169892   601BCEE8  <Anon>*
 011ED32A   #0000000050   601BCFBA  PilotMa
 011ED31A   #0000000016   601BD7CC  PhoneMa
 011ED28A   #0000000144   601D0858  EventLo
```

PalmDebugger is a modified version of the **PalmDebugger.exe** application. It allows debugging for 68K code in Palm OS 5 and includes some post-crash debugging ability. You can download the latest version from the Palm Developer website.

To debug using PalmDebugger:

1. Build your project object code to generate symbolic information (filename.sym).

   You can use the sample code available on the Palm developer website at **http://pluggedin.palm.com**. You must compile your code with something resembling the following:

   ```
   m68k-palmos-gcc -O2 -g -Wall SimpleSMS.o -o Obj/SimpleSMS.sym
   ```

2. Do one of the following:

   – To connect to the Palm OS simulator, launch PalmDebugger, select Connection as Emulator, and then launch the Palm OS simulator.

   – To connect to a Treo smartphone, launch PalmDebugger and select Connection as Serial, and then put the Treo smartphone into Debug or Console mode using the method described in **Section 12.5 on page 236**.

NOTE: USB is not supported for post-crash debugging. Also, USB debugging is not supported for Treo 600 smartphones.

3. Install the database or databases that represent your application, and load its symbols from the Source menu or by using the F8 hot key.
4. Open or load the appropriate .prc, .sym, and .c files. Skip the gdbstub.c file by selecting Cancel.
5. Set any breakpoints you need, and begin your debugging session.

To use PalmDebugger for post-crash debugging and display 68K traces:

1. Configure PalmDebugger to use the serial port.
2. Make sure your serial port isn't being used by something else. Check HotSync and Palm OS Debugger.
3. Using the Treo 600 serial cable, connect the Treo 650 serial adapter to the COM port.
4. In the "Debugger" window, enter the command `"att"`.

NOTE: You may need to retry a few times by shutting and restarting PalmDebugger. PalmDebugger will return the `<pc>` message when it is successfully attached.

The following list defines commonly used PalmDebugger commands:

- **il pc-20 40 \bytes -** Disassembles around the current PC.
- **sc a6 20 -** Attempts a 68K stack crawl.
- **opened -** Shows opened databases.
- **wh \a pc -** Identifies the database containing the PC. (This command is slow).
- **hd 0 -** Dumps the dynamic heap. (This command is slow).
- **dm <addr> <numBytes> -** Reads arbitrary memory addresses.

DBCache with “hd 1”:

- Displays feature pointers and loaded resources or records. It works very slowly via serial (takes approximately 45 minutes)
- Displays labeled chunks that belong to particular applications:
  - D (dirty) vs. d (not dirty)
  - M (moveable) vs. m (not moveable)
- Displays sizes in hexadecimal values.

PART III

Style Guide

This part of the guide provides guidelines for the “look and feel” of applications that use software components in the Palm OS® SDK.

CHAPTER 13

13. Style Guide

This chapter outlines the style guidelines that you should follow when designing certain Palm® product line Palm OS® SDK features.

13.1 Designing pages for the Blazer® web browser

Available on:

- LifeDrive™ mobile manager
- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5 and Tungsten™ E2 handhelds

Although the Blazer web browser's table unrolling technology does a good job of adapting websites for mobile devices, advance planning can reduce the translation and download time and ensure that results are as expected. This section covers the various factors that website designers and programmers should take into account when designing web pages.

13.1.1 General rules for web page design

Here are some general rules that apply when designing websites for mobile devices:

- Make content accessible within one or two links.

  Because the user is typically using a slow, costly connection, it is important that the information the user is trying to access be easily available within one or two navigational moves.

- Keep relevant content and links within the viewable area.
- Personalize and prefill forms whenever possible.
- Use as much screen space as possible without cluttering the screen.
- Keep graphics use to a minimum. When you have to use graphics, keep them simple and small.
- Keep the page size small, preferably under 4KB to 6KB.
- Keep the page simple. Limit the use of JavaScript, and don't use frames or plug-ins. While JavaScript is supported, most JavaScript runs slower on the Blazer web browser than on other handheld browsers due to memory and CPU limitations. For simple JavaScript this is not noticeable, but the use of more elaborate JavaScript may create noticeable delays.

Due to the various restrictions on designing web pages for mobile devices, a website should contain a parallel “mobile” version. The full website can take advantage of all the web technologies, while the mobile site is a slimmed- down version designed to support mobile devices. For example, the Palm website contains a page that is designed for mobile devices: **mobile.palm.com**.

Web developers can have their web server automatically load the appropriate page based on the user agent of the browser. For information about the user agent for the Blazer web browser, see **Section 13.1.5.2 on page 255**.

13.1.2 Screen resolution

Mobile devices have a screen size that is much smaller than a desktop screen’s resolution. On low resolution Treo smartphones, the full-screen resolution is 160 x 160 pixels, and the available space in the browser, due to the toolbar and scroll bar dimensions, is 155 x 145 pixels. On high-resolution Treo smartphones, the full screen resolution is 320x320, and on high-resolution Tungsten™ handhelds the resolution is 320x320, or 320x480, depending on the current state of the Graffiti area. Blazer 4.0 web browser also has a URL bar that users can choose to display or hide. When it is displayed, it takes space away from the current web page display area. Designers should take these dimensions into account when creating images, tables, lists, and other components of web pages. Developers who want to alter their page based on the current screen resolution should note that the current screen resolution is included in the User Agent. See **Section 13.1.5.2 on page 255** for more information.

13.1.3 Connection speed

Users can connect to the Internet at several speeds. The speeds available depend on the type of network the user is accessing and the device they are using to connect (CSD, 1xRTT, GPRS, EDGE, EvDO). Field-tested speeds can range from 10kbps (CSD dial-up) to over 150kbps (EDGE). EvDO connection speed ranges from 400kbps to 600kbps (based on 1MB FTP file downloads). Website designers should keep in mind that different users can connect using a wide range of speeds and should optimize their web pages to load appropriately.

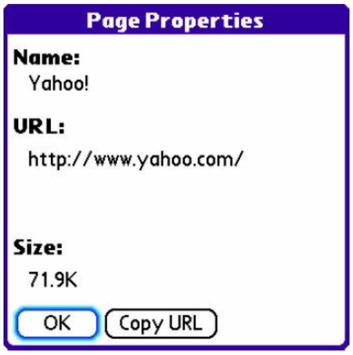
For information on detecting EvDO vs. 1xRTT connections, see **Section 7.5.1 on page 117**.

13.1.4 Content

In Optimized mode, the Blazer web browser typically reformats web pages into a small, screen-friendly format. Sites that have a simple layout with minimal tables and graphics have a good chance of being displayed properly after the reformatting. The sections details the factors to keep in mind when designing your web pages.

13.1.4.1 Page titles

The Blazer web browser does not display web page titles in web page view. To view the title of a web page, users must open the Page Properties dialog box, as shown in the following figure. The page title is used to prepopulate the bookmark description or title field when adding a bookmark.



Page Properties

Name:
Yahoo!

URL:
http://www.yahoo.com/

Size:
71.9K

13.1.4.2 Content optimized for the Blazer® web browser

You can also insert the following tag into the HEAD section of a web page to minimize the amount of reformatting that the Blazer web browser does:

```
<META name="HandheldFriendly" content="True">
```

This tag tells the Blazer web browser to render tables without any special reformatting. If this tag is not present, tables may be unrolled or reformatted. Also, if this tag is present, Blazer 4.0 displays the content in one pass instead of the usual two-pass rendering method.

13.1.4.3 Embedded audio playback

The Blazer 3.0 and 4.0 web browser supports embedded audio playback using the `<OBJECT>` tag. The `<BGSOUND>` and `<EMBED>` tags are not supported. For instance:

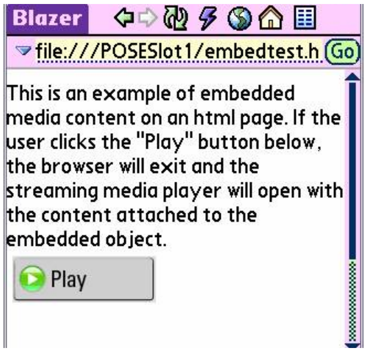
```
"<object data="oscar.mid" type="audio/midi" width="0"  height="0" ></object>"
```

loads and plays the MIDI file oscar.mid while the current page is displayed.

All devices with Blazer 3.0 or Blazer 4.0 loaded in ROM support embedded MIDI. Some devices may also support embedded AMR and/or embedded QCELP.

13.1.4.4 Streaming embedded content in Blazer® 4.5

The Blazer 4.5 web browser supports embedded content playback using the `<EMBED>` and `<OBJECT>` tags. To do so, Blazer 4.5 searches web pages for embedded objects. If it finds an `<EMBED>` or `<OBJECT>` tag on the page with a MIME-type that an application is registered for, then the browser will display a Play button, as shown:

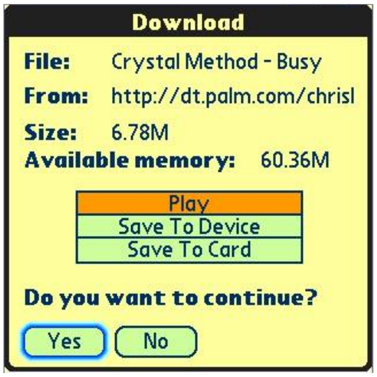


file:///POSESlot1/embedtest.h

This is an example of embedded media content on an html page. If the user clicks the "Play" button below, the browser will exit and the streaming media player will open with the content attached to the embedded object.

Links are then passed to the streaming application via the Exchange Manager when a user clicks a link.

Streaming content may also be presented as a direct link. If an application registered for streaming the type of content, the user will be presented with a dialog box that allows the user to choose whether to play the content, save it to the device, or save it to the card, as shown:



Download

File: Crystal Method - Busy

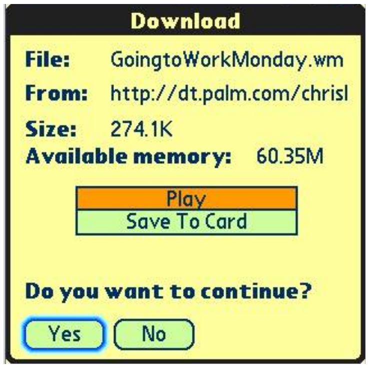
From: http://dt.palm.com/chrisl

Size: 6.78M

Available memory: 60.36M

Do you want to continue?

Once content is downloaded to the device, if there is no application registered to display the content, the user will see the following:



Download

File: GoingtoWorkMonday.wm

From: http://dt.palm.com/chrisl

Size: 274.1K

Available memory: 60.35M

Do you want to continue?

The following code is an example of an `<EMBED>` tag that the Blazer 4.5 browser will support:

```
<object id="MediaPlayer"

classid="CLSID:22d6f312-b0f6-11d0-94ab-0080c74c7e95"

codebase="http://activex.microsoft.com/activex/controls/mplayer/en/
nsmp2inf.cab#Version=6,4,5,715"

align="baseline" border="0"

type="application/x-oleobject">

<param name="FileName" value="http://mediaframe.yahoo.com/
buildlist.asp?p=movies&f=1808624572&=Sony%20Pictures%20Classics&type=t&id=1349284-
145632&m=wmv&r=700&l=SAV&b=e18qn9911a2ga428e61cf">



                  <!-- Embedded Microsoft Media Player Object for Netscape Navigator. -->

<embed src="http://mediaframe.yahoo.com/
buildlist.asp?p=movies&f=1808624572&=Sony%20Pictures%20Classics&type=t&id=1349284-
145632&m=wmv&r=700&l=SAV&b=e18qn9911a2ga428e61cf"

                        align="baseline" border="0"

                        width="320" height="298"

                        type="application/x-mplayer2"

            pluginspage="http://www.microsoft.com/isapi/
redir.dll?prd=windows&amp;sbp=mediaplayer&amp;ar=media&amp;sba=plugin&amp;"

                        name="MediaPlayer">

                         </embed>

</object>
```

13.1.4.5 Link protocol types

You can use RTSP or HTTP protocol links in an application to link to streaming content:

- **RTSP -** Using RTSP links, an application will redirect the user immediately to the registered streaming content. The user will not be presented with a dialog or a play button.
- **HTTP -** Using HTTP links, if an application is registered for streaming the type of content to be downloaded, an application will present a dialog box that allows the user to play the content, save it to the device, or save it to the card. If no streaming application is registered to handle the MIME-type or file extension, an application will present only the save option.

Important notes on Blazer® 4.5

- The Blazer 4.5 browser does not support a file location being sent via JavaScript post rendering.
- The Blazer 4.5 browser will not display any customized playback buttons. It will use its own Play button, shown previously.

13.1.4.6 File upload

Blazer 4.0 and later has limited file upload support. Blazer only supports uploading files from an expansion card; it does not currently support any uploading from Palm OS main memory. When Blazer is rendering a page with a form containing the file upload tag, Blazer displays a single-line text field. To upload a file, the user must type in the fully-qualified path to the file on the expansion card to be uploaded. (In the future, a Browse button may be added that allows the user to browse for the file to be uploaded.)

On the LifeDrive™ mobile manager, a user can upload files from Palm OS main memory. On devices with the file browser program and Blazer 4.1 and later, the single text line is replaced with a browser button that allows a user to utilize the file browser program to select a file to upload from anywhere the file browser program can explore. File uploads have succeeded up to about 1MB; in general, a 500K upload will succeed.

13.1.4.7 mailto command

The Blazer web browser does support the `mailto` command to send email.

Typically on desktop systems, the web browser launches an email application to send mail when a `mailto` command is encountered. On devices, it is not guaranteed that a mail application is installed. If an email application is installed, a `mailto` command launches the default email application as defined in the Defaults panel in Prefs.

For dialing telephone numbers, see the `tel:` and `phoneto:` tag discussions in the **Section 13.1.5.1 on page 255** section.

13.1.4.8 Multipass rendering

Unless the `HandheldFriendly` tag is present, Blazer 4.0 and later renders each page in two passes. In the first pass, all the text on the page is displayed. In the second pass, images are downloaded and JavaScript is downloaded and executed. By making the text immediately available to the user, the site appears more responsive and the user can read content and select links before the entire page has downloaded. There are several things a content developer can do to ensure that a page is more usable during the first pass:

- Minimize the use of images, especially images with text.

  Because images are not displayed until the second pass, if a site's content is image-based the user has to wait longer before interacting with the page.

- When images are used, include descriptive ALT tags.

  During the first pass the text of the ALT tag is displayed in place of the image.

- Do not use JavaScript in links.

  Usually, when a user selects a link during the first pass, the link is immediately activated. If the link includes JavaScript (and JavaScript is enabled), the browser cannot follow the link until the second pass because the JavaScript engine is not available until the second pass is complete. Thus, if the user clicks on a link with JavaScript during the first pass, an error message is displayed and the link is not activated.

13.1.4.9 Forms

The Blazer web browser supports standard HTML and WML forms, including text boxes, radio buttons, check boxes, text inputs, select lists, multiple selects, and drop-down menus. However, there are some guidelines to follow when you design forms for mobile devices:

- Make sure that the form’s open and close tags (`<form>` and `</form>`) are not contained inside a table. Form input may safely be placed inside table cells.
- Text input is supported, but the maximum length of the text is the length of the text input dialog box.

13.1.4.10 Tables

In Optimized mode, the Blazer web browser supports tables by reformatting or unrolling the table so that it fits on the small screen of a mobile device. The table-rendering engine is optimized for displaying simple text-based tables. Web page designers should avoid using one-pixel spacer images for precise content control, because the images and subsequent reformatting may not look ideal on a mobile device.

Table width attributes are not supported. However, table cell width attributes are supported. To widen tables, change the width attribute of the table cells. To preserve the width on the client display, use the `HandheldFriendly` tag. For more information, see **Section 13.1.4.2 on page 245**.

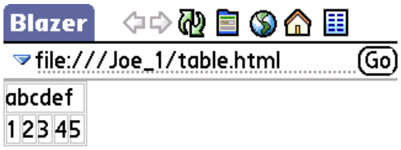
For example, the following HTML code displays a table with a table width of 140:

```
<table border="1">
<tr>
   <td width="140" colspan=5>abcdef</td>
</tr>
<tr>
   <td>1</td>
   <td>2</td>
   <td>3</td>
   <td>4</td>
   <td>5</td>
</tr>
</table>
```

The table appears on a desktop web browser as follows:

abcdef				
1	2	3	4	5

This same HTML code is displayed in the Blazer web browser without the extra spacing if the `HandheldFriendly` tag is not included:



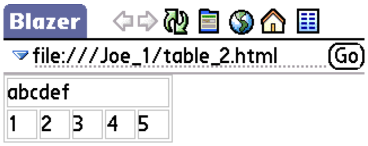
file:///Joe_1/table.html

abcdef				
1	2	3	4	5

To have the Blazer web browser display the table as intended, include the `HandheldFriendly` tag within the HEAD section of the web page, as follows:

```
<META name="HandheldFriendly" content="True">
```

This causes the device to display the table with the width tag enabled, as shown in the following figure:



file:///Joe_1/table_2.html

abcdef				
1	2	3	4	5

13.1.4.11 Images

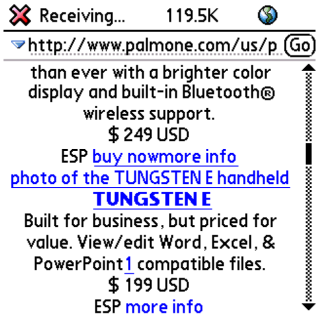
Using images on a website can enhance the presentation of content and the user experience. At the same time, the use of images slows down the web browsing experience. Therefore, it's important to carefully consider which images to display on mobile devices.

All images pass through an imaging processor in the Blazer web browser client that scales down any image that exceeds the current screen size. The bit-depth of the image is also adjusted to match the device's image display settings.

When designing images for mobile devices, keep the following in mind:

- Image size should be very small (under 4KB).
- Use only a few graphics per page to reduce the load time.
- Use images that are high contrast for easy readability.
- Use ALT tags to display text content while images download.

  Here is what is displayed while the image is loading:

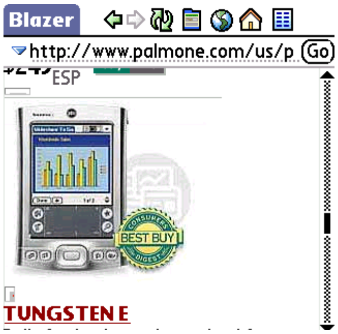


Receiving... 119.5K

http://www.palmone.com/us/p Go

than ever with a brighter color
display and built-in Bluetooth®
wireless support.
$ 249 USD
ESP buy nowmore info
photo of the TUNGSTEN E handheld
TUNGSTEN E
Built for business, but priced for
value. View/edit Word, Excel, &
PowerPoint1 compatible files.
$ 199 USD
ESP more info

  And here is what appears after the image has finished loading:

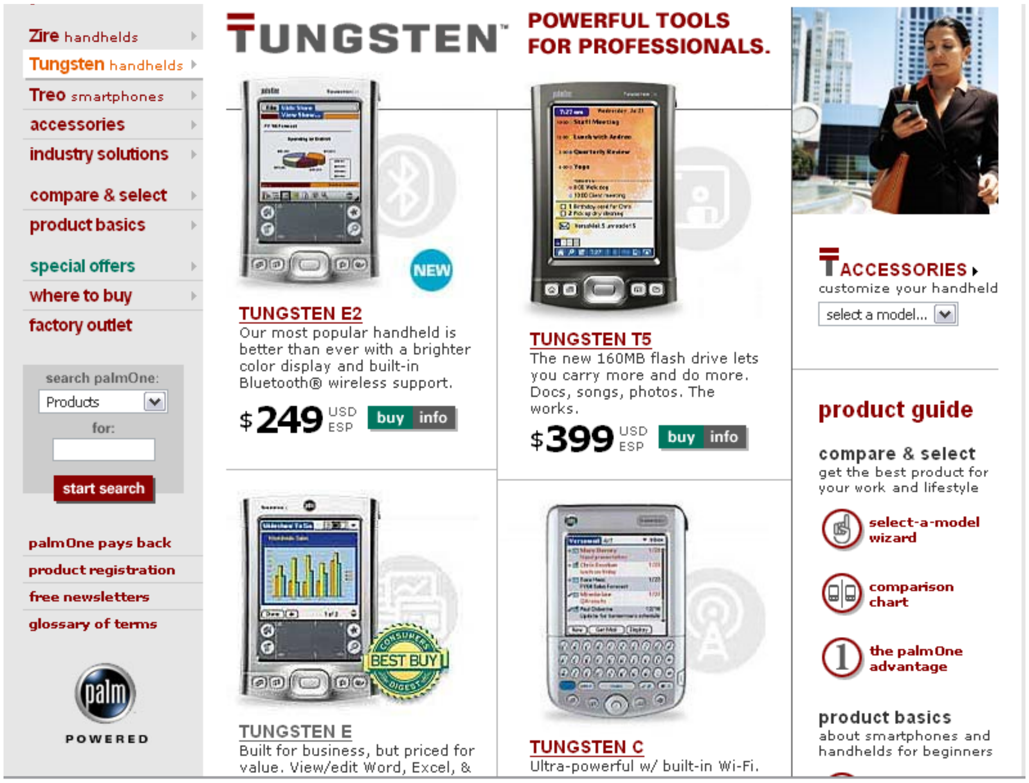


Blazer

http://www.palmone.com/us/p Go

13.1.4.11.1 Images with text

Avoid using images in place of text. Unnecessary images add to the total download time for each page. If the Blazer web browser needs to scale the image, the text may become unreadable. The following images show how a text image can look fine on a desktop browser but can become unreadable when scaled and displayed in the Blazer web browser.



Zire handhelds

Tungsten handhelds

Treo smartphones

accessories

industry solutions

compare & select

product basics

special offers

where to buy

factory outlet

search palmOne:

Products

for:

start search

palmOne pays back

product registration

free newsletters

glossary of terms

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TUNGSTEN E2

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The new 160MB flash drive lets you carry more and do more. Docs, songs, photos. The works.

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ACCESSORIES ▸

customize your handheld

select a model...

product guide

compare & select

get the best product for your work and lifestyle

select-a-model wizard

comparison chart

the palmOne advantage

product basics

about smartphones and handhelds for beginners

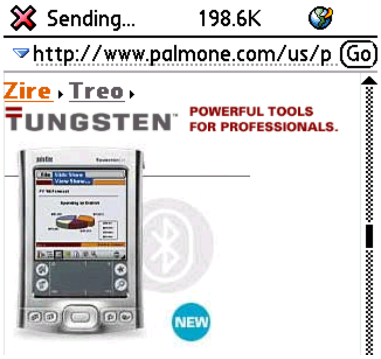
CONSUMERS DIGEST BEST BUY

TUNGSTEN E

Built for business, but priced for value. View/edit Word, Excel, &

TUNGSTEN C

Ultra-powerful w/ built-in Wi-Fi.



Sending... 198.6K

http://www.palmone.com/us/p Go

Zire ▸ Treo ▸

TUNGSTEN™ POWERFUL TOOLS FOR PROFESSIONALS.

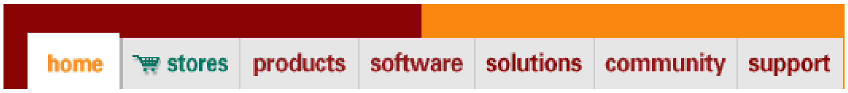
NEW

13.1.4.11.2 Horizontal header images

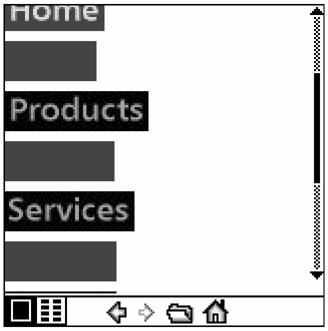
Many websites use a horizontal header image for navigation purposes. Typically, this image consists of many smaller images that are formatted in a table with zero- length borders.

On a desktop browser, such an image is displayed appropriately. The Blazer web browser, however, typically reformats such a page so that the images are stacked vertically. The following images demonstrate this behavior.

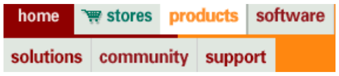
Header images on a desktop browser:

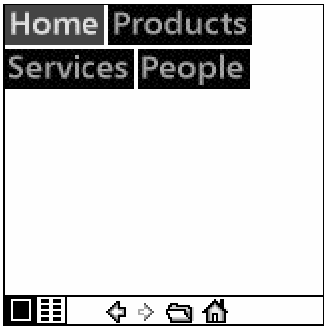


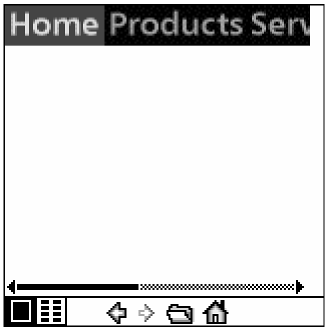
The same images on the Blazer web browser:



You can clean up the web page by removing spacer images and inserting the `HandheldFriendly` tag at the beginning of the page. The next figure shows the updated page without spacer images in the table. The second figure shows the page in the Blazer web browser without the `HandheldFriendly` tag. Because the spacer images are not present, the browser displays the image in a more readable format. The third figure shows the same page with the `HandheldFriendly` tag present. This tag instructs the Blazer web browser not to reformat the tables. As a result, the table is displayed as intended. The Blazer web browser provides horizontal scroll bars to allow the user to view the entire image.







13.1.4.11.3 Supported image formats

The Blazer 3.0 web browser supports the following image formats:

- GIF
- JPEG
- PNG
- Animated GIF
- WBMP
- BMP (Blazer 4.0 web browser)
- PJPEG

13.1.4.12 Unsupported content

While the Blazer web browser supports most of the HTML 3.2 specification, there are certain unsupported elements. Some of the additional web technologies that are not supported in the Blazer web browser include:

- Java applets
- WMLScript
- Animations (Macromedia Flash)
- Audio, although the Blazer web browser can download an audio file to be played by an application that can handle the audio format
- Browser Plug-Ins

When the Blazer web browser encounters an unsupported element, it ignores the associated code when displaying the web page. In most cases, the user experiences the web page with reduced functionality. If the website requires the unsupported technologies to view the information, the Blazer web browser users will not be able to use the website.

13.1.5 Working with the Blazer® web browser

This section discusses topics that are specific to the Blazer web browser and Palm OS® software. You should make note of these issues when implementing web pages that you have optimized for use with the Blazer web browser.

13.1.5.1 Palm OS™ software integration tags

In general, all HTML files must begin with the `<html>` tag or the Blazer web browser may not recognize them as HTML.

Blazer Web Browser 3.0 and 4.0 do not support date picker and time picker. Support may be added in a later release of the Blazer web browser.

13.1.5.2 Browser identification with user agent string

As part of communication to a web server, web browsers send out a string indicating what type of browser is accessing the server. This is referred to as the user agent string.

The Blazer 3.0 web browser user agent string is:

```
User-Agent: Mozilla/4.0 (compatible; MSIE 6.0; Windows 95; PalmSource;
Blazer 3.0) 16;160x160
```

The Blazer 4.0 web browser user agent string is:

```
User-Agent: Mozilla/4.0 (compatible; MSIE 6.0; Windows 98; PalmSource/
hspr-H102; Blazer/4.0) 16;320x320
```

The Blazer 4.5 web browser user agent string is:

```
User-Agent: Mozilla/4.0 (compatible; MSIE 6.0; Windows 98; PalmSource/
Palm-D052; Blazer/4.5) 16;320x320
```

In the user agent strings above, `hspr-H102` for Blazer 4.0 and `Palm-D052` for Blazer 4.5 respectively indicates which Palm device the browser is running on; different devices return different strings.

Also, the current screen size is included, so if the user changes the state of the Graffiti area, the user agent string is updated to match the screen size. For these reasons, you should not search for an exact match when checking for the presence of the Blazer 4.0 web browser. Instead, simply check to see if the user agent string contains the substring `Blazer`.

Web developers can use this header to send the version of a web page optimized for display by the Blazer web browser.

13.1.5.3 Cookies

The Blazer web browser contains support for cookies. Typically, website developers use cookies to store a small amount of information about a user's ID or profile, website personalization, and so forth. As with any web browser, users can have the Blazer web browser not accept cookies or clear out the cookie store. Cookies are stored on the local Palm OS device.

The Blazer web browser contains full support for the `SET-COOKIE` header. The only restriction is that the value attribute must not exceed 2000 bytes. Cookies with a value attribute larger than 2000 bytes may be rejected. Other types of cookie headers are not supported.

If a cookie has an expiration date, then it is a persistent cookie. If there is no expiration date, it is a session cookie. Session cookies are kept post-session so that a user can get back into their previous session as long as it is within the time limit described below.

13.1.5.4 Session handling

On a desktop browser, a session cookie persists until the user quits the web browser. On a Palm OS device, only one application can be active at any given time. To take into account that a user may temporarily switch to another application while using the Blazer web browser, the system ends a session 20 minutes after the Blazer web browser exits. (This time may vary based on the wireless service provider.)

13.1.5.5 Security

The Blazer web browser uses the standard Palm OS security libraries—the same libraries that are shipped with every version of Palm OS 5.2.1 and later. The Blazer web browser incorporates 128-bit SSL 3.0 encryption technology to ensure that visiting any site with a device is as secure as browsing from a desktop. The 128-bit encryption uses the RC4 algorithm and RSA-based key exchange. It also incorporates RSA-based digital signature verification, MD5 and SHA-1 secure hash algorithms, support for X.509 certificates, and an intuitive indication of a secure connection by a lock icon in the toolbar or URL bar.

13.1.5.6 Caching

The Blazer web browser includes a web page cache to improve performance. If a page requires a regular refresh, or should not be cached, the web server must send the appropriate standard HTTP cache control headers in the HTTP response.

13.1.5.7 Downloads

The Blazer 4.0 web browser limits downloads to 2MB. On the LifeDrive™ mobile manager with the Blazer web browser 4.1 and later, much larger downloads are possible. If an item is 2MB or less and there is sufficient DBCache, a standard download occurs. If an item is larger than 2MB or there is insufficient DBCache, the user sees a dialog stating that Blazer is writing to the internal drive. The Blazer web browser writes a VFS file directly to disk rather than using the Exchange Manager.

13.1.6 Testing your website

Designing your web pages will most likely be an iterative process. Test your websites early and frequently to ensure that you are able to achieve the intended design and layout. The following sections contain a few pointers to help you successfully test your website's content.

13.1.6.1 Multiple devices

If you intend your content to be accessible through a variety of devices, be sure to test your website with as many of those devices as possible during the development process. Areas you should look at in particular are device memory and screen size.

13.1.6.2 Refreshing content

Because the Blazer web browser uses cached pages on a device to provide quick access to frequently viewed content, constant updates to a web page during development may not be visible on the device. Set the cache size to zero during testing. During development, you should use the Clear button in Preferences to clear out the cache and use the Page -> Refresh menu command to make sure the current page is loaded. Images are typically refreshed when the page is refreshed. If images are not being updated in the Blazer web browser, the cache should be cleared out or the image file name should be changed.

13.1.7 International support

The Blazer web browser client supports the Palm OS character set. This character set is similar to the ISO-8859-1 character set. The Palm OS character set allows support for most Western European characters. The Blazer web browser application has also been localized into the following European languages:

- English
- French
- Italian
- German
- Spanish
- Brazilian Portuguese

13.1.7.1 HTML encoding

The Blazer web browser supports web pages that are encoded using the ISO-8859-1 and UTF-8 character formats. This allows Western European languages to be displayed properly on the Blazer web browser client. All HTML files must begin with the `<html>` tag or they may not be recognized as HTML.

Web pages that are encoded in UTF-8 must indicate so by including one of the following tags:

Content-type HTTP Header:

```
Content-Type: text/html; charset=utf-8
```

HTTP-equiv META Tag:

```
<META http-equiv="content-type" content="text/html; charset=utf-8"\
```

13.1.7.2 WML encoding

WML content is typically encoded in UTF-8 format. WML pages that are encoded in the ISO-8859-1 format must indicate so by including one of the following tags:

Content-type HTTP Header:

```
Content-Type: text/vnd.wap.wml; charset=iso-8859-1
```

HTTP-equiv META Tag:

```
<META http-equiv="content-type" content="text/vnd.wap.wml; charset=iso-
8859-1"\
```

XML Tag:

```
<?xml version="1.0" encoding="iso-8859-1"\
```

13.1.7.3 Accept headers

The Blazer web browser client supports Accept HTTP headers. The client sends this header to the web server based on the languages the client supports. You can use this header to determine what type of content to deliver to the device.

The Blazer Web Browser 3.0 Accept headers for an English ROM appear as follows:

```
Accept: text/html, application/vnd.wap.xhtml+xml, application/xhtml+xml;
profile="http://www.wapforum.org/xhtml", image/gif, image/jpeg, image/
pjpeg, */*
Accept-Language: en, *;q=0.8
```

For Blazer 4.0 and later, the Accept header is similar to the Blazer 3.0 header, except that it also includes every type currently registered with the Palm OS Exchange Manager.

(The Accept-Language header varies based on the current language selected upon setup of the device.)

```
Accept-Encoding: deflate, gzip
```

13.1.8 List of acronyms

The following table lists web browser and Internet acronyms.

Acronym	Definition
cHTML	Compact HTML. A subset of HTML for mobile devices. Primarily used in i-Mode devices.
ECMA	European Computer Manufacturers Association.
GIF	Graphics Interchange Format.
HDML	Handheld Device Markup Language. An old format used for web-enabled phones. This is no longer used.
HTML	Hypertext Markup Language.
HTTP	Hypertext Transfer Protocol.
ISO	International Organization for Standards. The name is derived from the Greek word *iso*, meaning “equal.”

Acronym	Definition
JPEG	Joint Photographic Experts Group.
PNG	Portable Network Graphics.
TCP/IP	Transmission Control Protocol/Internet Protocol.
UCS	Universal Character Set.
UTF	UCS Transformation Format.
WAP	Wireless Application Protocol.
WBMP	Wireless Bitmap. A graphic format optimized for wireless devices.
WML	Wireless Markup Language.
XHTML	Extensible HTML. A cross between HTML and XML.
XML	Extensible Markup Language.

13.1.9 Palm OS® integration tags

In general, all HTML files must begin with the `<html>` tag or the Blazer web browser may not recognize them as HTML.

The Blazer web browser supports several tag attributes that extend HTML support for Palm OS devices, as shown in the following table.

Keyword	Description
HandheldFriendly	This attribute for the META tag tells the proxy server that the web page has been specifically designed for small screens. The proxy server tries to render the tables as close to specification as possible. Example: `<META name="HandheldFriendly" content="True">`
Palm	This keyword is used in the HREF attribute to launch a specific application on the device. Blazer web browser exits and the specified application becomes the active application. Example: `<A HREF="palm:memo.appl">Memo Pad</A>`
Palmcall	This keyword is similar to the Palm keyword except that Blazer web browser sublaunches the specified application. Once the application exits, the user returns to Blazer web browser. For example: `<A HREF="palmcall:flip.appl">Flipper</A>` Parameters can also be passed into the application using the `sysAppLaunchCmdURLParams` launch code. For more information on this and the `palm` and `palmcall` tags, refer to the following tutorial on the Palm OS developer website: **www.palmos.com/dev/tech/webclipping/tutorials/tutorial_palm.html**

Keyword	Description
phoneto: and tel:	These keywords are equivalent and are used in the HREF attribute to dial a specific phone number. Blazer web browser exits and the phone application becomes the active application when these keywords are used. Examples: `<A HREF="tel:555-1212">Jenny</A> and <A HREF="phoneto:588-2300">Empire</A>`

file:	This keyword is used in the `HREF` attribute, in the URL bar, and in the Open URL dialog box to access browser content stored locally on an expansion card. A network connection is not required when accessing content using `file:///`.
	Note that the syntax always includes three slashes after `file:`
	Blazer 3.0 web browser supports the following syntax:
	`file://dir1/dir2/file.txt`
	In this example, Blazer 3.0 web browser would attempt to open the file file.txt located on the expansion card in directory /dir1/dir2.
	In addition to the Blazer 3.0 syntax, Blazer 4.0 web browser includes support for an additional syntax that handles devices with multiple expansion cards better, such as the Tungsten T5 handheld.
	An example of the additional syntax is:
	`file:///volname/dir1/dir2/file.txt`
	In this example, Blazer 4.0 would locate the expansion card named volname, and then open file file.txt in directory /dir1/dir2 on that expansion card.

13.2 Gadgets

In the Phone application on Treo smartphones, there is a fixed position for the system gadgets. For third-party applications to be consistent with the Phone application, they should position the system gadgets in the same location. We have included instructions for placement of the gadgets based on the Phone application.

13.2.1 Required headers and libraries

The following headers and libraries are required to use the gadgets:

- PmSysGadgetLibrary
  - `68K/Libraries/PmSysGadgetLib/PmSysGadgetLib.h`
  - `Common/Libraries/PmSysGadgetLib/PmSysGadgetLibCommon.h`

  This is the library that contains the system Battery, Signal, and Bluetooth® wireless technology gadget implementation.

13.2.2 Overlapping gadgets in Treo™ 680

In Treo 680, support has been added to `PmSysGadgetLibrary` for overlapping gadgets. If a gadget is defined with the same boundaries as an existing gadget, it will be given a lower priority than the previously defined gadget, and will only be displayed if the other gadget is not visible.

13.2.3 How to include the Battery gadget

To include the Treo smartphone Battery gadget in an application form:

1. Add a gadget to the application form at position (304, 0) for 320 x 320 resolution for a Treo 650, Treo 680, or Treo 700p smartphone. Use half these dimensions for a Treo 600 smartphone.

   Because the system determines the height and width of the gadget, the width and height specified in the rcp/rsrc file will not matter.

2. In the application form event handler for `frmOpenEvent`, add the following code:

```
PmSysGadgetStatusGadgetTypeSet ( gPmSysGadgetLibRefNum
                                  frmP,
                                  <YOUR_BATTERY_GADGET_ID>,
                                  pmSysGadgetStatusGadgetBattery);
```

Updates and events associated with the Battery gadget are handled automatically.

13.2.4 How to include the Signal gadget

To include the Signal gadget in an application form:

1. Add a gadget to the application form at position (278, 0) for 320 x 320 resolution for a Treo 650, Treo 680, or Treo 700p smartphone. Use half these dimensions for a Treo 600 smartphone. Because the system determines the height and width of the gadget, the width and height specified in the rcp/rsrc file will not matter.
2. In the application form event handler for `frmOpenEvent`, add the following code:

```
PmSysGadgetStatusGadgetTypeSet ( gPmSysGadgetLibRefNum
                                  frmP,
                                  <YOUR_SIGNAL_GADGET_ID>,
                                  pmSysGadgetStatusGadgetSignal);
```

Updates and events associated with the Signal gadget are handled automatically.

13.2.5 How to include the Bluetooth® wireless technology gadget

NOTE: The Treo 600 smartphone does not include Bluetooth wireless technology.

To include the Bluetooth wireless technology gadget in an application form:

1. Add a gadget to the application form at position (260, 0) for 320 x 320 resolution for a Treo 650, Treo 680, or Treo 700p smartphone. Use half these dimensions for a Treo 600 smartphone. Because the system determines the height and width of the gadget, the width and height specified in the rcp/rsrc file will not matter.
2. In the application form event handler for `frmOpenEvent`, add the following code:

```
PmSysGadgetStatusGadgetTypeSet ( gPmSysGadgetLibRefNum
                                 frmP,
                                 <YOUR_BLUETOOTH_GADGET_ID>,
                                 pmSysGadgetStatusGadgetBt);
```

Updates and events associated with the Bluetooth gadget are handled automatically.

PART IV

Hardware Developers Kit

This part of the guide provides details on how to develop for hardware on Treo™ 650 and Treo™ 700p smartphones, and Tungsten™ T5 and Tungsten™ E2 handhelds. For older devices, see the archive section of the developer site at **http://pluggedin.palm.com**.

CHAPTER 14

14. Multi-connector Specifications

This chapter defines the interfaces and interactions of the Palm® expansion Multi-connector and its surrounding circuits and controlling software.

14.1 Overview

Available on:

- Treo™ 650, Treo™ 680, and Treo™ 700p smartphones
- Tungsten™ T5 and Tungsten™ E2 handhelds and LifeDrive™ mobile managers

This chapter specifies the electrical and software interface characteristics of Palm's Multi-connector. These characteristics include sets of various charging, cradle, and cable configurations, but from a handheld or smartphone perspective the electrical specification and systems software requirements are consistent across multiple devices. Specific devices may not, however, implement all of the features of the Multi-connector.

The Multi-connector supports the following features:

- Charging power from an external adapter with adapter detection ability
- Universal Serial Bus (USB)
- Serial communications (no flow control, logic levels)
- Dedicated HotSync® technology interrupt
- Power out
- Stereo headphone-level output
- Peripheral detection

The Multi-connector interface supports interaction with the following devices:

- USB HotSync® cables and cradles
- Other serial devices

  Due to serial peripheral detachment detection requirements, a device cannot be created that employs automatic serial peripheral detachment detection *and* utilizes the USB VBUS line for USB charging, signaling, or connections. Any device requiring both serial peripheral detection and USB functionality cannot automatically detect detachment of the peripheral through the normal serial peripheral detachment mechanism. Detachment for this situation must be handled through a nonstandard mechanism, such as serial error handling. For more information on the peripheral detection mechanism, see **Section 14.4 on page 273**.

- Pass-through peripherals

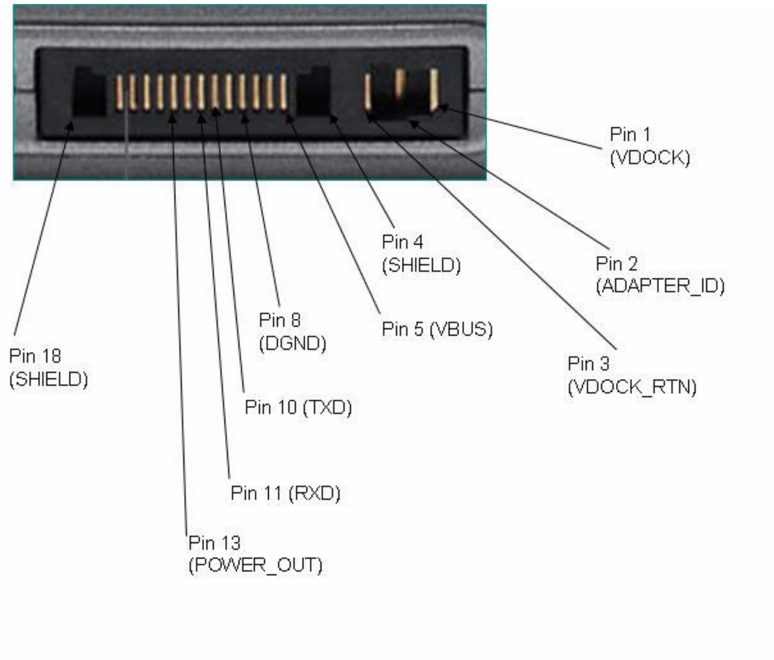
  These include peripherals that connect to a handheld or smartphone and have another connector to allow the peripheral to be connected to a USB HotSync cable or cradle.

14.2 Pinout of the Multi-connector

The pinout, with or without mounts, is described in the following table. All pin references that follow in this chapter refer to the device connector pin-numbering scheme shown in this table.

Pin # on device/ Multi-connector	Pin # on charger/ adapter connector	Pin# on data/ cable connector	Name	Direction with respect to the device	Default state with no attachment	Function
1	1		VDOCK	Power	CHRG_IN	DC charging voltage, 5V
2	2		ADAPTER_ID	Input	VCC, weak pull-up	Adapter identification
3	3		VDOCK_RTN	Power	GND	DC charging return
4	-	1	SHIELD	Shield	GND	Cable shield
5	-	2	VBUS	Power	VBUS_IN	USB charging voltage, 5V typical, 500 mA max
6	-	3	USB_DP	Input/output	Floating	USB Data +
7	-	4	USB_DN	Input/output	Floating	USB Data -
8	-	5	DGND	Power	GND	Digital ground, and VBUS return
9	-	6	Reserved	NA	NA	Do not connect
10	-	7	TXD	Input/output	VCC, weak pull-up	Transmit data, 3.3V logic level
11	-	8	RXD	Input	VCC, weak pull-up	Receive data, 3.3V logic level
12	-	9	HOTSYNC	Input	VCC, weak pull-up	HotSync input, active low, pulled up on device
13	-	10	POWER_OUT	Output	High impedance	Power output to external devices

Pin # on device/ Multi-connector	Pin # on charger/ adapter connector	Pin# on data/ cable connector	Name	Direction with respect to the device	Default state with no attachment	Function
14	-	11	SPKR_L	Analog output	AC coupled	Speaker output left
15	-	12	SPKR_R	Analog output	AC coupled	Speaker output right
16	-	13	AGND	Power	GND	Analog ground
17	-	14	MIC_IN	Analog input	DC coupled	Microphone input
18	-	15	SHIELD	Shield	GND	Cable shield



14.2.0.1 Shielding

On all peripheral devices, the shield pins 4 and 18 should be grounded with any available shielding system ground. For example, on a USB cable these pins should be connected to the USB cable outer shield, which in turn connects to the shield on the USB connector at the other end of the cable.

Where no external shielded ground is available peripherals should connect pins 4 and 18 to the peripheral's system ground.

14.2.1 USB

Pins 5, 6, 7, and 8 constitute the USB VBUS, D+, D-, and GND pins respectively.

The handheld is designed to accept the following parameters on pins 5, 6, 7, and 8:

Name	Description	Minimum	Average	Maximum	Units
(V)USB_VBUS_CHG	Input charging voltage	4.375	5.0	5.25	V
(V)USB_VBUS_CHG	Input serial peripheral detection voltage	2.97	3.3	3.63	V
(I)USB_VBUS_L	Input charging current, no negotiation, sunk from VBUS	-	-	100	mA
(I)IUSB_VBUS_H	Input charging current, with negotiation, sunk from VBUS	-	-	500	mA

14.2.2 Serial interface hardware

Pins 10 and 11 provide 3.3V logic-level serial connections with no dedicated hardware flow control pins. The direction of these pins with respect to the device is as follows:

- Pin 10 transmits from the handheld
- Pin 11 receives into the handheld.

The serial port connected to pins 10 and 11 supports the following bit rates and configuration options:

- 1,200 baud
- 2,400 baud
- 4,800 baud
- 9,600 baud
- 14,400 baud
- 19,200 baud
- 28,800 baud
- 38,400 baud
- 57,600 baud
- 115,200 baud
- 7 data bits
- 8 data bits
- No stop bits
- 1 stop bit
- Parity bit
- No parity bit

Both pins 10 and 11 are pulled high within the device by weak pull-ups. For more information on how these weakly pulled, high input characteristics are used in the peripheral detection mechanism, see **Section 14.4 on page 273**.

Pins 10 and 11 operate at 3.3V nominal voltage levels.

Treo 650 smartphones, Tungsten T5 handhelds and E2 handhelds, and LifeDrive mobile managers are designed to accept the following parameters on pins 10 and 11:

Name	Description	Minimum	Average	Maximum	Units
(V)RXTX_INL	Input logic low voltage*	0	-	0.594	V
(V)RXTX_INH	Input logic high voltage*	2.904	-	3.63	V
(V)TX_OUTL	Output logic low voltage*	0	-	0.3	V
(V)TX_OUTH	Output logic high voltage*	2.67	-	3.63	V
(V)TX_OC	Open circuit TX line voltage*	-	3.3	-	V
(V)RX_OC	Open circuit RX line voltage*	-	3.3	-	V

*With respect to digital ground, pin 8

14.2.3 Serial interface software

The Multi-connector serial pins interface with the Palm OS® software as a virtual serial port.

14.2.4 HotSync® interrupt hardware

Pin 12 provides a HotSync Interrupt pin. The HotSync interrupt is weakly pulled high inside the device.

A HotSync interrupt is initiated when pin 12 is pulled to GND.

The HotSync interrupt is not used in the peripheral detection mechanism; it only initiates a HotSync operation.

The presence of the pullup on the HotSync pin can be used by a peripheral as a method to detect when a device is attached to the peripheral.

Treo 650 smartphones, Tungsten T5 handhelds and E2 handhelds, and LifeDrive mobile managers are designed to accept the following parameters on pin 12:

Name	Description	Minimum	Average	Maximum	Units
(V)HS_INL	Input logic low-voltage* triggering interrupt	0	-	0.594	V
(V)HS_OC	Open circuit line voltage*	-	3.3	-	V

*With respect to digital ground, pin 8

14.2.5 HotSync® interrupt software

The HotSync interrupt is always set as an input. The default interrupt detection occurs on a falling edge.

14.2.6 Power output

Pin 13 provides a power output to power an external peripheral. This power output is limited to low-current capability only. The power output is normally driven LOW or floated as a high impedance signal to minimize the chances of a short to GND damaging the device.

Treo 650 smartphones, Tungsten T5 handhelds and E2 handhelds, and LifeDrive mobile managers are designed to accept the following parameters on pin 13:

Name	Description	Minimum	Average	Maximum	Units
(V)POUT_L	Output inactive voltage*	0	-	0.363	V
(V)POUT_H	Output active voltage*	2.97	3.3	-	V
(I)POUT	Output current supplied	30	-	-	mA
(R)POUT	Minimum load series resistance to GND*	89	-	-	Ohms
(C)POUT	Maximum load capacitance	-	-	4.7	µF

*With respect to digital ground, pin 8

14.2.7 Audio detection

Tungsten T5 handhelds and E2 handhelds, and LifeDrive mobile managers automatically detect and switch audio if they detect an attached audio peripheral and the audio peripheral indicates that a headset is inserted into the handheld.

Tungsten T5 handhelds and E2 handhelds, and LifeDrive mobile managers should not, however, have a headset inserted into the headset jack and be attached to an audio peripheral at the same time. The audio signal would be shared between the two, resulting in a loss of volume on the headset and the Multi-connector audio output channels.

14.2.8 Audio output

Pins 14 and 15 provide headphone-level stereo audio output. This output is intended to drive an external audio output device (such as a “boom box”), or to interface with a car kit.

Devices typically connect pins 14 and 15 directly to their headset stereo output signals.

14.3 Peripheral requirements

For information on the peripheral detection mechanism that drives many of the requirements listed in this section, see **Section 14.4 on page 273**.

Peripherals are required to conform to the following specifications to ensure successful operation with Treo 650 smartphones, Tungsten T5 handhelds and E2 handhelds, and LifeDrive mobile managers:

Name	Description	Minimum	Average	Maximum	Units
(C)PHL_LOAD	Capacitive load on POWER OUT pin	-	-	4.7	μF
(R)PHL_LOAD	Minimum load series resistance on POWER OUT pin	121	-	-	Ohms
(V)PHL_RXTX_INL	Serial line input logic low voltage*	0	-	0.594	V
(V)PHL_RXTX_INH	Serial line input logic high voltage*	2.904	-	3.63	V
(V)PHL_RX_OUTL	Serial handheld receive line output logic low voltage*	0	-	0.3	V
(V)PHL_RX_OUTH	Serial handheld receive line output logic high voltage*	2.67	-	3.63	V
(R)PHL_TX_DOWN	Pull-down to GND on TX*	1K	-	10K	Ohms
(R)PHL_RX_DOWN	Pull-down to GND on RX*	1K	-	10K	Ohms

*Pull-downs required for peripheral detection mechanism. May not be required on either or both of the RX and TX lines.

14.3.1 Audio peripherals

Audio peripherals should conform to the following requirements:

Name	Description	Minimum	Average	Maximum	Units
(R)PHL_A_DET	Maximum series resistance to ground on TX line for Audio Peripheral detection	-	-	10K	Ohms
(R)PHL_A_DET_HS	Maximum series resistance to ground on RX line for Audio Peripheral Headset Jack Insertion detection	-	-	10K	Ohms
(R)PHL_A_DET_NHS	Minimum series resistance to ground on RX line for Audio Peripheral Headset Jack Insertion Absence detection	10M	-	No maximum	Ohms
(R)AOUT_MIN	Minimum series resistance to ground on pins 14 and 15	8	-	-	Ohms

14.3.2 General serial peripherals

Serial peripherals should conform to the following requirements.

Name	Description	Minimum	Average	Maximum	Units
(T)PHL_SER_DLY == (T)DET_RXTX_DLY	Delay from POWER OUT applied to peripheral driving into Rx line	450	-	-	mS
RPHL_SER_DET	Series resistance to ground on TX and RX line before POWER_OUT applied for Serial Peripheral detection	6.8K	-	-	Ohms
VPHL_SER_DET	Minimum voltage on TX and RX line after POWER_OUT applied for Serial Peripheral detection	2.904	-	POWER_OUT	V
RPHL_SER_NDET	Maximum series resistance between VBUS and POWER_OUT for Serial Peripheral Detachment detection	-	-	10	Ohms

14.4 Peripheral detection

The Multi-connector interface provides class-level peripheral detection. The class-level detection mechanism is performed using hardware detection with no software requirements on the peripheral.

Peripheral detection is initiated by triggering either the serial TX or serial RX lines in their GPIO states as falling edge interrupts. After detection of an interrupt, software in the device debounces the interrupted line for at least (T)DET_DBC milliseconds. If the condition causing the interrupt on the TX or RX lines still exists after (T)DET_DBC milliseconds, class-level detection initiates.

14.4.1 Class-level detection

Class-level detection involves sampling the serial TX and RX lines as GPIO inputs both before and after the application of POWER_OUT. This provides four bits to define the attached peripheral, resulting in 12 possible attached configurations. (The situation in which both RX and TX stay high after attachment of the peripheral is invalid as no attachment interrupt is detected, thus invalidating four possible combinations.)

14.4.1.1 Peripheral attachment

Before attachment of any peripheral, the TX and RX lines are configured as GPIO inputs and have weak pull-ups attached to each line.

When a peripheral is attached, at least one of the TX or RX lines must by definition be low. After debouncing the signal, the device samples the RX and TX lines and applies power to the peripheral through the POWER_OUT signal. The device then waits (T)DET_PWR_DLY milliseconds to allow the peripheral to power up, and then samples the TX and RX lines again.

If you want a peripheral to identify itself, it must have strong pull-downs on the appropriate serial communications lines. Some serial peripherals may not require such strong pull-downs because the impedance to ground of the unpowered serial input pins may provide small enough resistance to GND to allow detection to operate effectively. Also, the peripheral must not power the RX line until (T)DET_RXTX_DLY milliseconds after power is applied.

When a Tungsten T5 or Tungsten E2 handheld or LifeDrive mobile manager detects that an audio peripheral is attached, the device automatically switches audio from the internal device speaker to the audio of the peripheral. As noted earlier, Tungsten T5 or Tungsten E2 handhelds and LifeDrive mobile managers should not have a headset inserted into the headset jack and be attached to an audio cradle at the same time. The audio signal would be shared between the two, resulting in a loss of volume on the headset and the Multi-connector audio output channels.

The truth table for class-level detection is as follows:

Before attachment		Peripheral attached, no POWER_OUT		Peripheral attached, POWER_OUT applied		Class
TX	**RX**	**TX**	**RX**	**TX**	**RX**	
1	1	0	0	0	0	Audio peripheral detected, headset not inserted
1	1	0	0	0	1	Reserved for future use
1	1	0	0	1	0	Reserved for future use
1	1	0	0	1	1	Serial peripheral detected
1	1	0	1	0	0	Reserved for future use
1	1	0	1	0	1	Audio peripheral detected, headset inserted
1	1	0	1	1	0	Reserved for future use
1	1	0	1	1	1	Reserved for future use
1	1	1	0	0	0	Reserved for future use
1	1	1	0	0	1	Reserved for future use
1	1	1	0	1	0	Reserved for future use
1	1	1	0	1	1	Reserved for future use

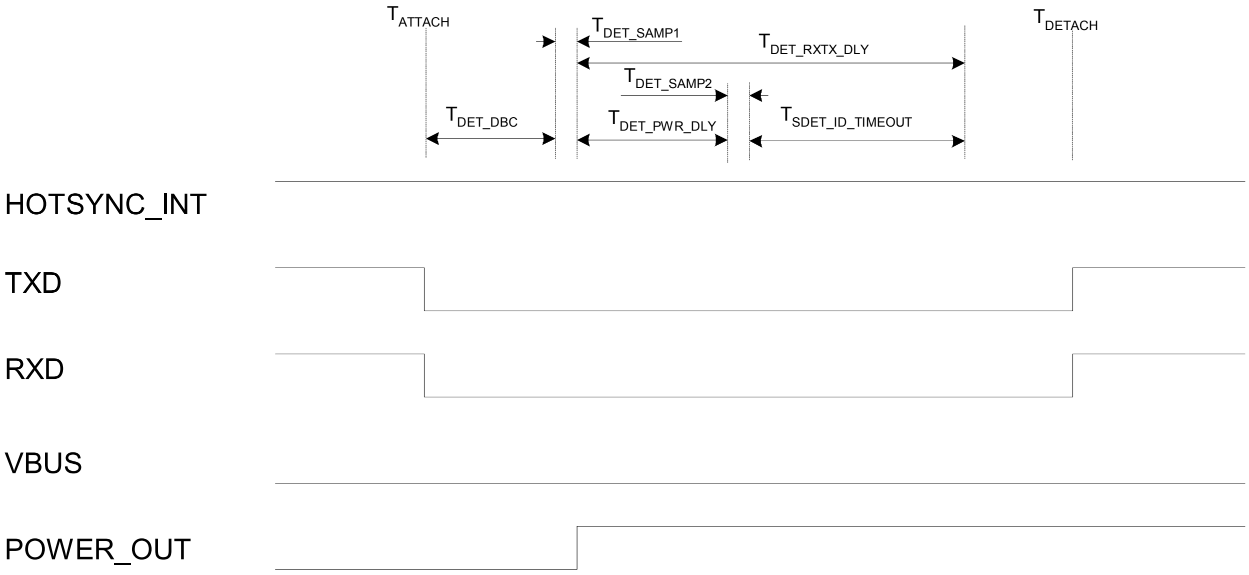
14.4.1.2 Peripheral removal

For audio class peripherals, detachment is detected by the TX and RX lines going high. The device detects these changing GPIO signals by detecting the rising edge, and initiates peripheral removal activities.

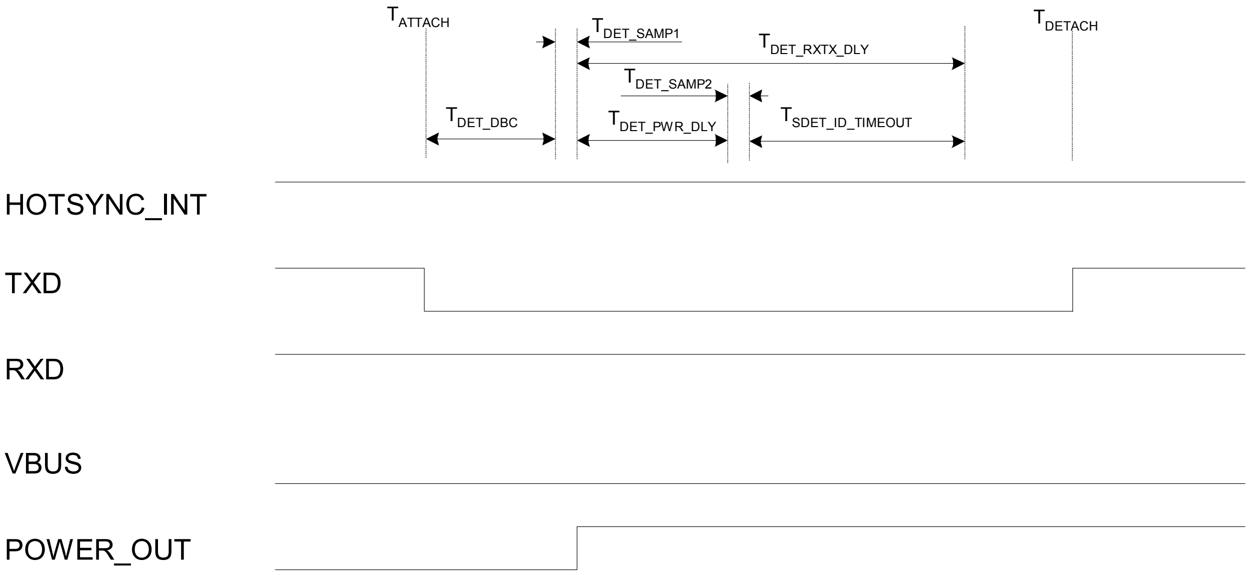
For serial class peripherals, detachment is detected by the absence of 3.3V on the USB VBUS line. The device detects this changing GPIO signal by detecting the falling edge and initiates peripheral removal activities.

14.4.2 Audio peripheral detection timing diagrams

The following figure shows the timing diagram upon attachment of an audio peripheral with a headset not inserted.

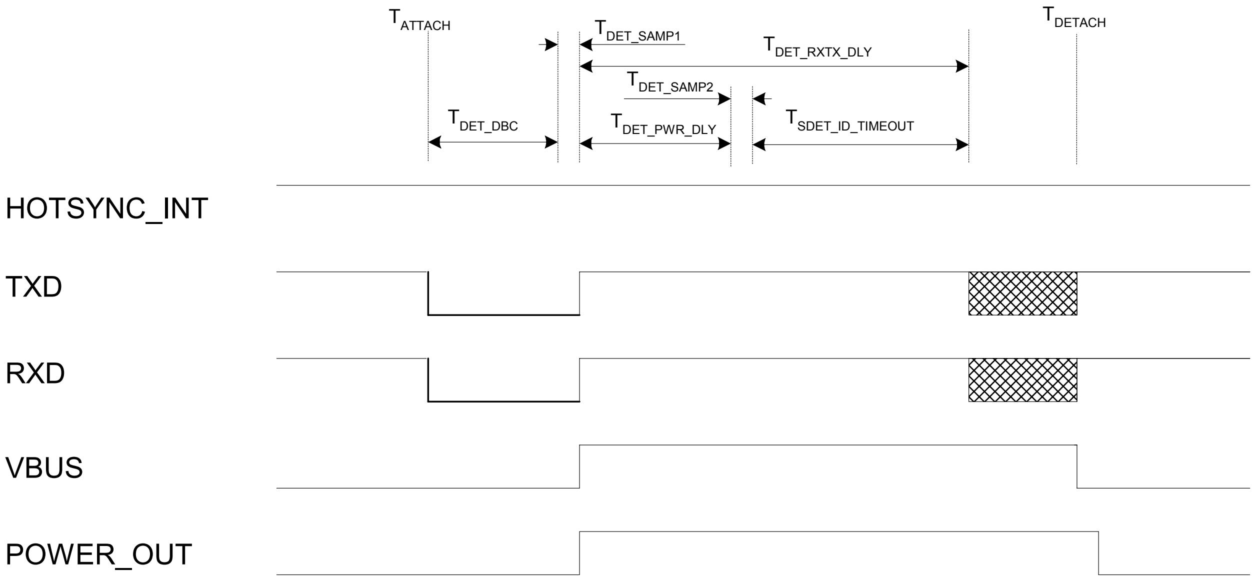


The following figure shows the timing diagram upon attachment of an audio peripheral with a headset inserted.



14.4.3 Serial peripheral detection timing diagram

The following figure shows the timing diagram upon attachment of a serial peripheral.



14.4.4 Peripheral detection timing specifications

The following are the timing requirements for the peripheral detection mechanism:

Name	Description	Minimum	Average	Maximum	Units
(T)DET_DBC	Attachment interrupt debounce duration	150	-	-	mS
(T)DET_SAMP1	Time to read the state of the RX and TX GPIO before POWER OUT applied	-	-	50	mS
(T)DET_PWR_DLY	Delay from POWER OUT applied to reading the state of the RX and TX GPIO	200	-	200	mS
(T)DET_SAMP2	Window of time from maximum (T)DET_PWR_DLY to read the state of the Rx and Tx GPIO after POWER OUT applied	-	-	50	mS

Name	Description	Minimum	Average	Maximum	Units
(T)SDET_ID_TIMEOUT	Timeout from (T)DET_SAMP2 window finished until determination that peripheral is Serial Protocol Level detection peripheral	200	-	200	mS
(T)DET_RXTX_DLY	Delay from POWER OUT application to peripheral driving into RX line	450	-	-	mS

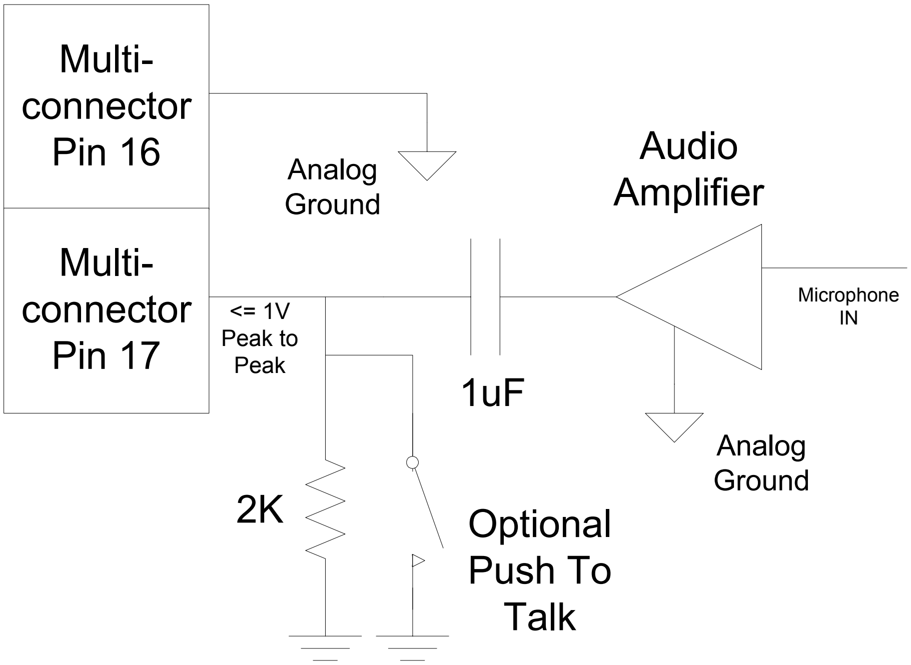
14.5 Interfacing with an audio peripheral

The recommended method for interfacing with an audio peripheral is for the peripheral to be wired as described in the following table:

Name	Pin #	Recommended configuration
VDOCK	1	Charging source if charging device; otherwise no connect.
ADAPTER_ID	2	Connect to pin 3 if charging device with >=1Amp source; otherwise no connect.
VDOCK_RTN	3	Charging source ground if charging device; otherwise system ground.
SHIELD	4	Shield ground or system ground.
VBUS	5	No connect.
USB_DP	6	No connect.
USB_DN	7	No connect.
DGND	8	System digital ground.
USB_ID	9	No connect.
TXD	10	10K Ohm pull-down to DGND.
RXD	11	Insertion detection switch on headset jack, if any. Signal should connect to GND when no headset is inserted. Signal should be high impedance when headset is inserted.
HOTSYNC	12	No connect.
POWER_OUT	13	Connect to system power if required by peripheral.
SPKR_L	14	Audio left signal.

Name	Pin #	Recommended configuration
SPKR_R	15	Audio right signal.
AGND	16	System audio ground.
MIC_IN	17	Microphone input.
SHIELD	18	Shield ground or system ground.

Circuit Needed for Proper Coupling and Bias of Microphone Input



14.6 Interfacing with a serial peripheral

The recommended method for interfacing with a serial peripheral is for the peripheral to be wired as described in the following table:

Name	Pin #	Recommended configuration
VDOCK	1	Charging source if charging device; otherwise no connect.
ADAPTER_ID	2	Connect to pin 3 if charging device with >=1Amp source; otherwise no connect.
VDOCK_RTN	3	Charging source ground if charging device; otherwise system ground.
SHIELD	4	Shield ground or system ground.
VBUS	5	Connect to POWER_OUT.
USB_DP	6	No connect.
USB_DN	7	No connect.
DGND	8	System digital ground.
USB_ID	9	No connect.
TXD	10	680 Ohm pull-up to POWER_OUT. 6.8K Ohm pull-down to DGND.
RXD	11	680 Ohm pull-up to POWER_OUT. 6.8K Ohm pull-down to DGND.
HOTSYNC	12	The presence of pull-up on this pin can be used by a peripheral as a method to detect when a device is attached to the peripheral.
POWER_OUT	13	Connect to system power if required by peripheral.
SPKR_L	14	No connect.
SPKR_R	15	No connect.
AGND	16	No connect.
MIC_IN	17	No connect.
SHIELD	18	Shield ground or system ground.

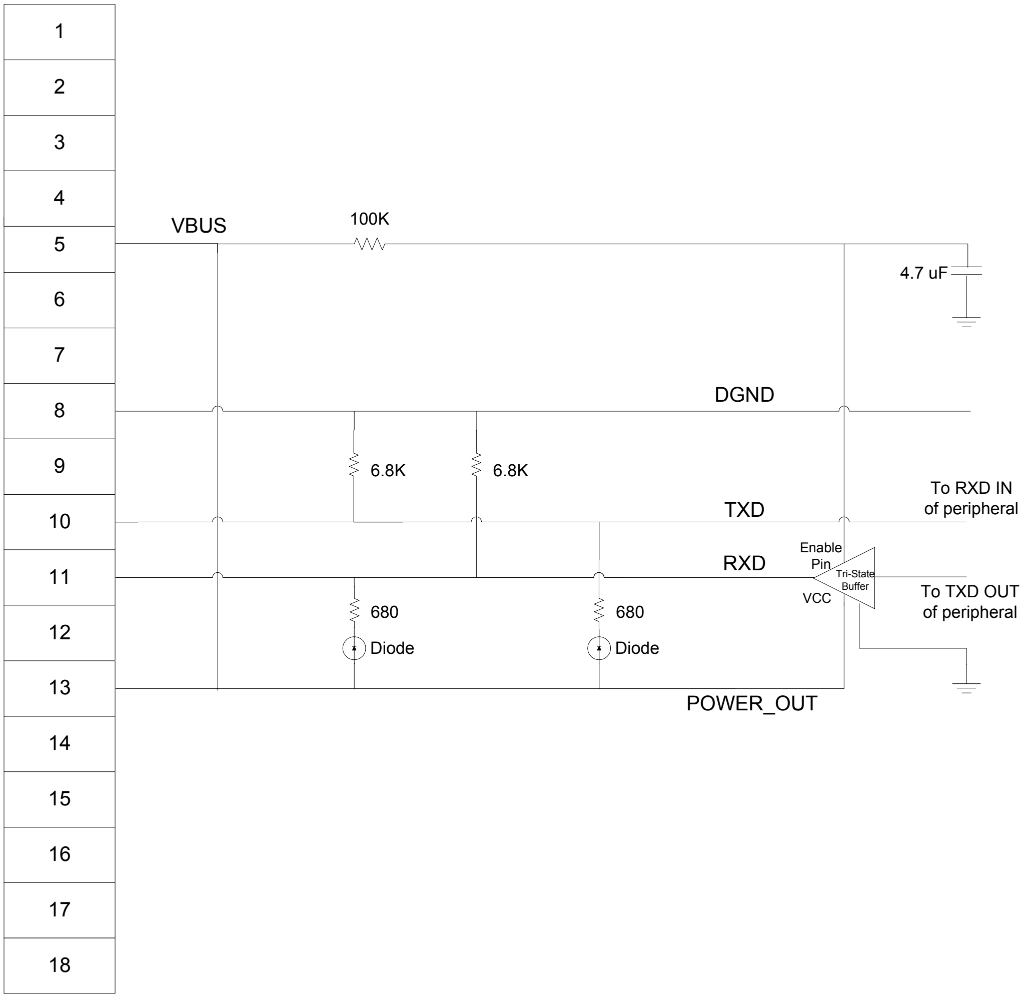
14.6.1 Electrical diagram of a serial peripheral

A peripheral that conforms to the following electrical diagram will be detected as a serial peripheral on Multi-connector devices.

To ensure that the peripheral works reliably with Treo 650 smartphones and other Palm devices, the serial peripheral's 1K resistors were changed to 680 ohm, and the 10K resistors were changed to 6.8K.

If the peripheral uses the POWER_OUT pin to detect that a device detached, it should include the diode shown in the circuit. This will ensure that there is no loop back from the Tx line (peripheral side) to the POWER_OUT pin. If a diode is included, then make sure to adjust for the voltage drop across the diode.

The Tx line of the peripheral always drives high according to the specification, and if the diode is not present, the POWER_OUT pin will drive high at all times. In this scenario, even if the device is removed, the POWER_OUT pin will stay high and prevent the peripheral from using the POWER_OUT pin to reliably detect that the device is detached.



14.6.2 Serial peripheral design guidelines

- (Optional) PWR_OUT tied to VBUS through a user selectable switch.
- 6.8K pull-down resistors on the TXD and RXD pins to ground.
- 680 Ohm pull-up resistors from TXD and RXD to PWR_OUT pins.
- Tie Multi-connector pins 4, 18 to pin 8 (digital ground).
- If the serial peripheral is going to be connected to a PC, a transceiver is needed to convert the logic level to RS-232. Make sure all flow control lines are handled at the DB9 side connected to PC. Connect pin 7 to pin 8 (RTS to CTS) and pin 1 and 6 to pin 4 (DSR to DTR and CD).
- Transceiver tied to TXD and RXD pins must be high impedance while PWR_OUT is low, and must remain high impedance 500mS after PWR_OUT goes high. This could be done with a charge up capacitor on the ENA or PWR pin of the transceiver or with a PIC microcontroller device. In other words, TXD and RXD must not be active while the peripheral detection is in progress. There should be no data on TXD and RXD while the detection is in progress.
- PWR_OUT will only source 30mA total.
- Do not drive any pins higher than 3.3 volts.
- Do not drive VBUS over 3.3V.
- HotSync going low is an indication of detachment detection.

14.7 Serial Peripheral Usage

14.7.1 Serial support on the Multi-connector interface

The Multi-connector interface supports serial connections with no hardware flow control. It provides 3.3V logic-level serial connections. It DOES NOT support RS-232 level serial connections.

The Multi-connector's Rx, Tx, and Gnd pins cannot be connected directly to a PC's Tx, Rx, and Gnd pins, respectively. To connect the Multi-connector to a PC, you will need a transceiver to convert the logic level to RS-232.

14.7.2 How to use the serial port

For devices that have the Multi-connector, applications must use the Serial Manager to control the serial port. To control the serial port, use the following functions:

- To open the serial port use the `SrmOpen` function.
- To close the serial port use the `SrmClose` function.
- Use the `serPortCradleRS232Port` function to define the port.

The following example shows how to open and close the serial port programmatically:

```
// To Open the Serial Port
err = SrmOpen( serPortCradleRS232Port, baudRate, &portId );

// To Close the Serial Port
err = SrmClose( portId );
```

Devices that use the Multi-connector DO NOT support port auto-detection. Also, the serPortCradlePort function DOES NOT work for serial connection.

14.7.3 Multi-connector peripheral attach and detach notifications

- `sysExternalConnectorAttachEvent` is sent when a peripheral is attached
- `sysExternalConnectorDetachEvent` is sent when a peripheral is removed
- `notifyDetailsP` determines the type of the peripheral
  - `DockStatusAttached` is sent when some type of peripheral is attached. The value is `0x0002`.
  - `DockStatusExternalPower` is sent when a peripheral is attached and using some type of external power source. The value is `0x0004`.
  - `DockStatusCharging` is sent when the internal power cells are recharging. The value is `0x0008`.
  - `DockStatusUSBCradle` is sent when a USB cable or cradle that is plugged into a PC (VBUS is present) is attached. The value is `0x0010`.

NOTE: This bit is not set for Treo 650 smartphones.

  - `DockStatusSerialPeripheral` is sent when a Multi-connector serial peripheral is attached. The value is `0x0040`.

NOTE: This bit is not set for Treo 650 smartphones.

14.7.3.1 Multi-connector serial peripheral notification

The Multi-connector uses the following serial peripheral notifications:

- `sysExternalConnectorAttachEvent` is sent when a serial peripheral is attached with `notifyDetailsP` equal to `0x0040` (`DockStatusSerialPeripheral`).
- `sysExternalConnectorDetachEvent` is sent when a serial peripheral is removed with notifyDetailsP equal to `0x0040` (`DockStatusSerialPeripheral`).

14.7.3.2 Notification support on Treo™ 650

Previously, a bug prevented notifications from being sent on Treo 650 smartphones.

Currently, this bug is fixed in all maintenance releases for Treo 650 smartphones, and notifications are now properly sent to applications.

NOTE: On Treo 650 smartphones, `DockStatusUSBCradle` and `DockStatusSerialPeripheral` bits are never set. Perform class detection using the `PmConnectorLib` library.

14.7.3.3 Notification support on Tungsten™ T5

Definitions for notifications sent on Tungsten T5 devices include:

- `DockStatusCharging` is sent when the Power Adapter is attached.
- `DockStatusUSBCradle` is sent when the USB cable or cradle is attached.

NOTE: A bug in Tungsten T5 also causes the DockStatusUSBCradle notification to be sent when a serial peripheral is attached.

14.7.4 Known Issues

A bug in Tungsten T5 causes the `DockStatusSerialPheripheral` notification to be sent when an audio peripheral is attached.

The same bug causes the `DockStatusUSBCradle` notification to be sent when a serial peripheral is attached.

14.7.5 Coding example

The following example illustrates how to use peripheral attachment and detachment notifications:

```
UInt32 PilotMain( const UInt16    cmd,
                  const MemPtr    cmdPBP,
                  const UInt16    launchFlags )
{
       Err                         error                = errNone;
       UInt16                      cardNo               = 0;
       LocalID                     dbId                 = 0;
       SysNotifyParamType         *notifyP              = (SysNotifyParamType *)NULL;
       UInt16                      connectorType        = 0;


       switch (cmd)
       {
           case sysAppLaunchCmdNormalLaunch:
                  error = SysCurAppDatabase( &cardNo, &dbId );
                 SysNotifyRegister( cardNo,
                        dbId,
                        sysExternalConnectorAttachEvent,
                        0,
                        sysNotifyNormalPriority,
                        0 );

              SysNotifyRegister( cardNo,
                        dbId,
                        sysExternalConnectorDetachEvent,
                        0,
                        sysNotifyNormalPriority,
                        0 );
                      ...
                      break;

              case sysAppLaunchCmdNotify:
                     notifyP       = (SysNotifyParamType *)( cmdPBP );
                     switch ( notifyP->notifyType )
                     {
                           case sysExternalConnectorDetachEvent:
                                  connectorType = ((UInt16)(notifyP->notifyDetailsP));
                                 // Connector Type is 0x0040 for the serial peripheral.
                                  break;
                 case sysExternalConnectorAttachEvent:
                    connectorType = ((UInt16)(notifyP->notifyDetailsP));
                                 // Connector Type is 0x0040 for the serial peripheral.
                                  break;
                     }
                     break;

              default:
                     break;
       }
}
```

14.7.6 Serial peripheral detection

To enable detection of a peripheral as a serial peripheral on a Multi-connector device, make sure that serial peripheral attachments and detachments are detected, and that appropriate notifications are sent, use the following steps:

1. Connect the 6.8K pull-downs on both Tx and Rx pins to the GND pin.
2. Connect the 680 ohm pull-ups on both Tx and Rx pins to the POWER_OUT pin.
3. Connect the VBUS signal to the POWER_OUT signal.

Once the serial peripheral is detected, the POWER_OUT pin will stay up as long as the peripheral is attached.

You may hear a beep when attaching or detaching the serial peripheral. This sound is related to detecting a serial peripheral attachment or detachment. But there is no guarantee that the beep will sound.

14.7.6.1 Serial peripheral detection on Treo™ 650

Previously, a bug prevented serial peripheral detection notifications from being sent on Treo 650 smartphones.

Currently, this bug is fixed in all maintenance releases for Treo 650 smartphones, and serial detection notifications are now sent properly to applications.

NOTE: Because the details bit from the notification is not set on Treo 650 devices, you may use the PmConnectorLib API to determine whether the peripheral uses a USB or serial connection.

14.7.6.2 Serial peripheral detection on Tungsten™ T5

A bug in the serial peripheral detection on Tungsten T5 devices causes the peripheral with the configuration detailed in Section 5 to be detected as a USB.

To detect a serial peripheral on Tungsten T5 correctly, use the following steps:

1. Attach the serial peripheral. A `sysExternalConnectorAttachEvent` notification with `notifyDetailsP` equal to `DockStatusUSBCradle` will be sent.
2. When the `sysExternalConnectorAttachEvent` (`DockStatusUSBCradle`) notification is received, turn off the Power_Out pin using the APIs provided in **Section 14.7.7.3 on page 287**.
3. The device will send a `sysExternalConnectorDetachEvent` notification with `notifyDetailsP` equal to `DockStatusUSBCradle`.
4. Next, the device will send a `sysExternalConnectorAttachEvent` notification with `notifyDetailsP` equal to `DockStatusSerialPeripheral`. This tells you that a serial peripheral is attached to the Tungsten T5.
5. Next, the device will send a `sysExternalConnectorDetachEvent` notification with `notifyDetailsP` equal to `DockStatusSerialPeripheral`.
6. Next, the device will send a `sysExternalConnectorAttachEvent` notification with `notifyDetailsP` equal to `DockStatusUSBCradle`. This tells you that attachment detection is complete.
7. When you remove the serial peripheral, the device will send a `sysExternalConnectorDetachEvent` notification with `notifyDetailsP` equal to `DockStatusUSBCradle`.

14.7.7 Connector library (PmConnectorLib)

Use the PmConnectorLib library to turn on and off the Power_Out pin programmatically.

14.7.7.1 PmConnectorLib on Treo™ 650

Previously, the PmConnectorLib library was not available on Treo 650 smartphones.

Currently, all recent maintenance releases of the Treo 650 smartphone and later include this library, and applications can utilize the APIs provided by the library.

14.7.7.2 PmConnectorLib on Tungsten™ T5

On Tungsten T5 devices, the `PmConnectorLib` library must use slightly different definitions than those available as part of the Palm OS SDK. Use the following definitions when using the `PmConnectorLib` on Tungsten T5:

```
#if (CPU_TYPE != CPU_68K) || (defined BUILDING_PMCONNECTOR_LIB)
   #define PMCONNECTOR_LIB_TRAP(trapNum)
#else
   #include <LibTraps.h>
   #define PMCONNECTOR_LIB_TRAP(trapNum) SYS_TRAP(trapNum)
#endif

#define kPmConnectorLibType  sysFileTLibrary
#define kPmConnectorLibCreator       'PmAt'
#define kPmConnectorLibName  "PmConnector"


#define kPmConnectorLibTrapOpensysLibTrapOpen
#define kPmConnectorLibTrapClosesysLibTrapClose

#define kPmConnectorLibCtrlPowerOn0x01
#define kPmConnectorLibCtrlPowerOff0x02

Err
PmConnectorLibOpen (UInt16 refNum)
      PMCONNECTOR_LIB_TRAP (kPmConnectorLibTrapOpen);

Err
PmConnectorLibClose (UInt16 refNum)
      PMCONNECTOR_LIB_TRAP (kPmConnectorLibTrapClose);

Err
PmConnectorLibControl (UInt16 refNum, UInt16 cmdId, void *parmP)
      PMCONNECTOR_LIB_TRAP (sysLibTrapCustom + 1);
```

14.7.7.3 Power_Out API

Once the serial peripheral is detected, the POWER_OUT pin will stay up as long as the peripheral is attached. However, if you would like to programmatically turn on or off the POWER_OUT pin, use the APIs in the following examples, which are available as part of `PmConnectorLib`:

NOTE: This API should be used only with `PmConnectorLib` version 1.3 and later.

To turn on the Power_Out pin:

```
// Send Power to the Power_out pin
{
    // Try to find the library
    err = SysLibFind(kPmConnectorLibName, &refNum);
    if (err != errNone)
         err = SysLibLoad(kPmConnectorLibType,
                    kPmConnectorLibCreator, &refNum);

    if(err) {
        FrmCustomAlert(InformationAlert,
                   "Unable to load connector library", NULL,
                   NULL);
    }
    else
    {
        PmConnectorLibOpen( refNum );
        PmConnectorLibControl(refNum,
                    kPmConnectorLibCtrlPowerOn,             (void *)NULL);
        PmConnectorLibClose( refNum );
    }
}
```

To turn off the Power_Out pin:

```
// Remove Power from the Power_out pin
{
    // Try to find the library
    err = SysLibFind(kPmConnectorLibName, &refNum);
    if (err != errNone)
         err = SysLibLoad(kPmConnectorLibType,
                    kPmConnectorLibCreator, &refNum);

    if(err) {
        FrmCustomAlert(InformationAlert,
                   "Unable to load connector library", NULL,
                   NULL);
    }
    else
    {
        PmConnectorLibOpen( refNum );
        PmConnectorLibControl( refNum,
                      kPmConnectorLibCtrlPowerOff,
                      (void *)NULL);
        PmConnectorLibClose( refNum );
    }
}
```

14.7.8 Serial HotSync®

Palm, Inc. does not officially support Serial HotSync on devices with the Multi-connector.

14.7.8.1 On Treo™ 650

Previously, Serial HotSync worked on Treo 650 by disconnecting VBUS from the POWER_OUT pin.

Currently, because the class detection mechanism was implemented in maintenance releases for Treo 650 ROMs, you should no longer disconnect VBUS from POWER_OUT to force serial detection. To ensure proper detection, connect VBUS to POWER_OUT.

14.7.8.2 On Tungsten™ T5

Serial HotSync works on Tungsten T5. To use Serial HotSync, make sure that the VBUS is not connected to the POWER_OUT pin. Also, be aware that Serial HotSync only works at lower baud rates on Tungsten T5 devices.

14.7.9 Known Issues

14.7.9.1 Data transfer via the Network Preferences Panel

Using the cradle or cable in Network Preferences to connect to the network over the serial connection may not work on Tungsten devices. There are two reasons for this problem:

1. The serial peripheral as described in this guide (with pull up resistors connecting POWER_OUT to Rx and Tx, pull down resistors connecting Ground to Rx and Tx, and the POWER_OUT pin connected to VBUS) is detected by the device as a USB.

   Network Preferences uses this detection to determine which port, Serial or USB, to open for the network connection.

   To work around this issue, make sure VBUS is NOT connected to the POWER_OUT pin. This will ensure that the serial port is open for the network connection. (Tungsten T5 only.)

2. Network Preferences enables flow control.

   The serial driver on Tungsten devices, which do not have serial flow control pins, does not handle disable flow control. The serial driver enables flow control and waits for the CTS to go high before transmitting data. With flow control enabled, the CTS will never go high. Therefore, Network Preferences cannot transmit data over the serial.

   To work around this issue, disable flow control on the serial port. For instructions, see the Tungsten T5 Flow Control Sample Code included in the Palm OS SDK.

14.7.9.2 Wake/Sleep loop on Palm® T|X

When a Palm T|X handheld is attached to a serial peripheral and goes to sleep, the device will automatically wake back up. If the device is set to auto-off, this bug will cause a wake/sleep loop.

By default, the device turns the POWER_OUT pin low when it goes to sleep. This causes the VBUS pin to go low. This change of state triggers an interrupt that wakes up the device.

14.8 Interfacing with Smart serial peripherals

Smart serial peripheral detection is a new detection scheme available only on Palm T|X handhelds and Treo 700p smartphones.

A smart serial peripheral is detected in two steps:

1. Smart serials use the class 110111. Do not allow smart serial peripheral detection to interfere with the class detection. In other words, smart serial peripheral detection MUST NOT drive the Tx or Rx pins during the class detection cycle. To prevent driving the Tx or Rx pins at this time, use tri-state buffers or set the GPIO pins on the Smart serial accessory to an “Input” state during class detection.

   The class detection cycle that detects a smart serial accessory is defined as the period when the POWER_OUT pin is low, then transitions to high. The period ends when the device begins to broadcast `'#''NAK'` (`0x23, 0x15`). (See Step 2 for details.)

   For details on the state of pins before and after the POWER_OUT cycle, refer to the Smart serial timing diagram that follows.

2. After class detection is completed, the Palm device will attempt handshakes with the Smart Serial accessory to identify the ID of the Smart Serial peripheral attached.

14.8.1 Smart serial peripheral handshaking process

The Smart serial peripheral interface uses the following handshaking procedure to communicate to the Palm device. Currently, only the Palm T|X and the Treo 700p smartphone uses the Smart serial peripheral interface.

14.8.1.1 Initialization

1. The device detects that a Smart Serial accessory is attached (Class code `0x07`).
2. The device configures its Tx pin as Serial Output and Rx pin as Serial Input.
3. The device opens the serial port at 9600 Baud (`8, N, 1`).

14.8.1.2 First Handshake

1. The device sends a `'#''NAK'` (`0x23, 0x15`) to the Smart Serial accessory.
2. The device waits to receive the Peripheral ID packet (8 bytes of data) from the Smart serial accessory:
   - If a Peripheral ID packet (8 bytes of data) is not received in 500mS, then the process enters the `SECOND_HANDSHAKE`.
   - If a Peripheral ID packet (8 bytes of data) is received within 500mS, then the packet is checked for validity:
     - The device checks that the first byte of data is `'P'` (`0x50`) and the second byte of data is `'1'` (`0x31`).
     - The device calculates the checksum by adding the first 7 bytes of data, and keeps the least significant byte of that data.
     - The device compares the calculated checksum with the last byte of data.
     - If the checksum does not match the last byte of data, then the process enters the `SECOND_HANDSHAKE`.
3. The device sends a `'#''ACK'` (`0x23, 0x06`) to the Smart serial accessory.
4. The device waits to receive `'#''ACK''O''K'` (`0x23, 0x06, 0x4F, 0x4B`).
   - If a `'#''ACK''O''K'` (`0x23, 0x06, 0x4F, 0x4B`) is not received in 500mS, then the process enters the `SECOND_HANDSHAKE`.
   - If a `'#''ACK''O''K'` (`0x23, 0x06, 0x4F, 0x4B`) is received in 500mS, then the process enters `FINALIZATION`.

14.8.1.3 Second Handshake

1. The device sends a `'#''NAK'` (`0x23, 0x15`) to the Smart serial accessory.
2. The device waits to receive the Peripheral ID packet (8 bytes of data) from the Smart serial accessory.
   - If a Peripheral ID packet (8 bytes of data) is not received in 500mS, then the process enters the `THIRD_HANDSHAKE`.
   - If a Peripheral ID packet (8 bytes of data) is received within 500mS, then the packet is checked for validity:
     - The device checks that the first byte of data is `'P'` (`0x50`) and the second byte of data is `'1'` (`0x31`)
     - The device calculates the checksum by adding the first 7 bytes of data, and keeps the least significant byte of that data.
     - The device compares the calculated checksum with the last byte of data.
     - If the checksum does not match the last byte of data, then the process enters the `THIRD_HANDSHAKE`.
3. The device sends a `'#''ACK'` (`0x23, 0x06`) to the Smart serial accessory.
4. The device waits to receive `'#''ACK''O''K'` (`0x23, 0x06, 0x4F, 0x4B`).
   - If a `'#''ACK''O''K'` (`0x23, 0x06, 0x4F, 0x4B`) is not received in 500mS, then the process enters the `THIRD_HANDSHAKE`.
   - If a `'#''ACK''O''K'` (`0x23, 0x06, 0x4F, 0x4B`) is received in 500mS, then the process enters `FINALIZATION`.

14.8.1.4 Third Handshake

1. The device sends a `'#''NAK'` (`0x23, 0x15`) to the Smart serial accessory.
2. The device waits to receive the Peripheral ID packet (8 bytes of data) from the Smart Serial accessory.
   - If a Peripheral ID packet (8 bytes of data) is not received in 500mS, then the process enters `FINALIZATION`.
   - If a Peripheral ID packet (8 bytes of data) is received within 500mS, then the packet is checked for validity.
     - The device checks that the first byte of data is `'P'` (`0x50`) and the second byte of data is `'1'` (`0x31`).
     - The device calculates the checksum by adding the first 7 bytes of data, and keeps the least significant byte of that data.
     - The device compares the calculated checksum with the last byte of data.
     - If the checksum does not match the last byte of data, then the process enters `FINALIZATION`.
3. The device sends a `'#''ACK'` (`0x23, 0x06`) to the Smart serial accessory.
4. The device waits to receive `'#''ACK''O''K'` (`0x23, 0x06, 0x4F, 0x4B`).
   - If a `'#''ACK''O''K'` (`0x23, 0x06, 0x4F, 0x4B`) is not received in 500mS, then the process enters `FINALIZATION`.
   - If a `'#''ACK''O''K'` (`0x23, 0x06, 0x4F, 0x4B`) is received in 500mS, then the process enters `FINALIZATION`.

14.8.1.5 Finalization

1. If a `'#''ACK''O'"K'` (`0x23, 0x06, 0x4F, 0x4B`) is received, then the Class Code and Peripheral ID received in the Peripheral ID packet is broadcast.
2. If a `'#''ACK''O'"K'` (`0x23, 0x06, 0x4F, 0x4B`) is not received, then the device will "soft" detach and re-attempt to detect the class type. (POWER_OUT goes low without mechanical detachment, then high after a time period).

See the following table for an example of the correct handshake sequence:

Step	Palm device	Smart Serial accessory
1	Class Detection	NO ACTION

2	`'#''NAK'`
	`(hex 23, hex15)`
		Send Peripheral ID CODE

3	Validate Peripheral ID code, Checksum	NO ACTION

4	`'#''ACK'`
	`(hex 23, hex 06)`
		`'#''ACK'O''K' (hex 23, hex 6, hex 4F, hex 4B)`

14.8.1.6 Handshake rule exception

If the Smart Serial accessory does not receive `'#''NAK'` from the device for 0.6 seconds, it will broadcast the Peripheral ID code unconditionally, and wait for `'#''ACK'` or `'#''NAK'` from the device for a maximum of 1.5 seconds. If the device and Smart serial accessory do not achieve a complete handshake sequence, then both will reset to an undocked condition and go through the process again.

14.8.1.7 Sample use case

When a valid class detection is complete, Treo 650 will begin to broadcast `"#''NAK'` (`hex23, hex 15`) repeatedly until either the peripheral returns a valid response, or the Treo 650 device times out (after 1 second without a valid reply from the peripheral).

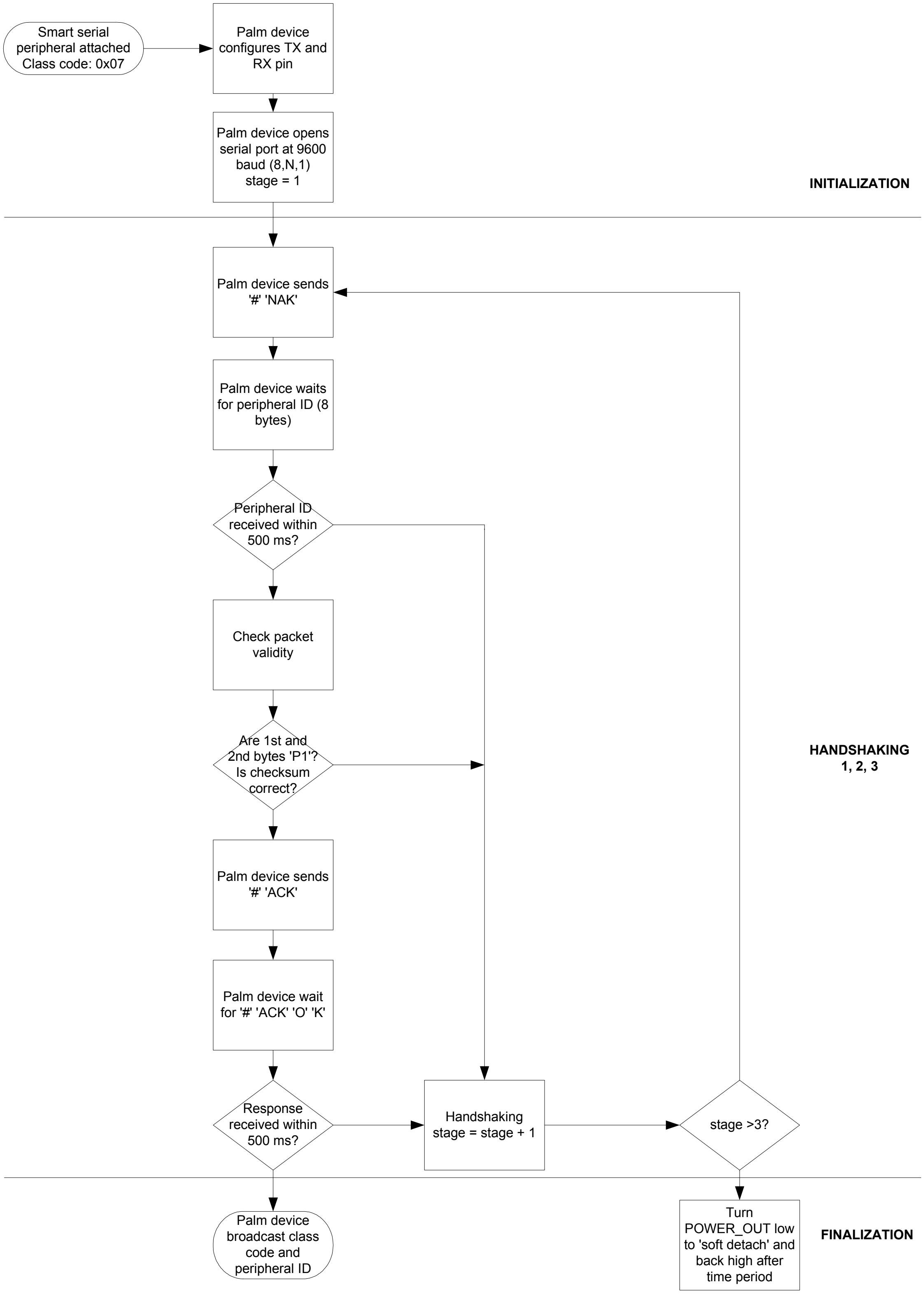
If the peripheral broadcasts the correct Creator ID code, then the device will broadcast `'#''ACK'` (`hex 23, hex 6`). The device will continue to broadcast `'#''ACK'` until the peripheral returns a valid reply.

Upon seeing the valid `'#''ACK'` from the device, the peripheral will reply `'#''ACK''O''K'` (`Hex 23, Hex 6, Hex 4F, Hex4B`).

If the peripheral never sees a `'#''NAK'` from the device after .5 seconds, it will broadcast the creator ID code unconditionally, then wait for `'#''ACK'` from Treo 650 for up to 1 second.

If neither the device nor the peripheral manages to synchronize after 2 seconds, both will reset to an undocked condition and go through the process again.

The tables on the following pages are examples of the correct handshake sequence.


Smart serial peripheral attached Class code: 0x07
Palm device configures TX and RX pin
Palm device opens serial port at 9600 baud (8,N,1) stage = 1
INITIALIZATION
Palm device sends '#' 'NAK'
Palm device waits for peripheral ID (8 bytes)
Peripheral ID received within 500 ms?
Check packet validity
Are 1st and 2nd bytes 'P1'? Is checksum correct?
HANDSHAKING 1, 2, 3
Palm device sends '#' 'ACK'
Palm device wait for '#' 'ACK' 'O' 'K'
Response received within 500 ms?
Handshaking stage = stage + 1
stage >3?
Palm device broadcast class code and peripheral ID
Turn POWER_OUT low to 'soft detach' and back high after time period
FINALIZATION

	Byte Order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Palm Device		#	NAK	#	NAK									#	ACK				
	Data	0x23	0x15	0x23	0x15									0x23	0x06				
Smart Serial Accessory						P	1	0	P	A	l	m	CK SUM			#	ACK	O	K
	Data					0x50	0x31	0x00	0x50	0x61	0x6C	0x6D	0x0B			0x23	0x06	0x4F	0x4B

CHAPTER 15

15. Headset Jack Specifications

This chapter defines the interface and interactions of the headset jack and its surrounding circuits and controlling software.

15.1 Overview

Available on:

- Treo™ 600, Treo™ 650, Treo™ 680, and Treo™ 700p smartphones

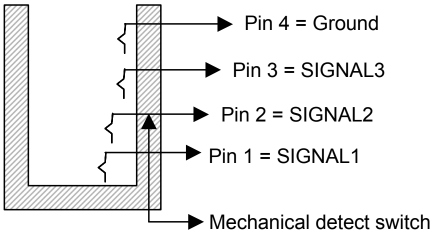
Audio accessories are used for the following general categories of functions:

- Cell phone audio—Mono-aural sound and mic input
- Stereo audio—MP3 playback, game, multimedia content
- Voice input—Voice dialing, voice recording

Typically, mono-aural sound accessories for cell phones have 2.5mm plugs with three or four contacts, while audio accessories that provide stereo audio (music) often have 3.5mm plugs.

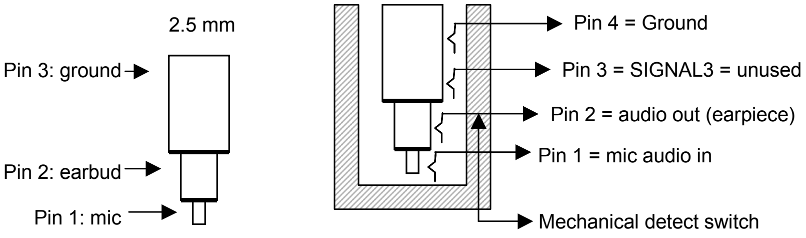
Treo smartphones use a 2.5mm plug. A 3.5mm headphone accessory may be used in a 2.5mm headset jack through a 3.5mm-to-2.5mm adapter/converter (available at most electronics retailers). This converter adapts the physical connector size while retaining the electrical signal connectivity. This chapter assumes that the 3.5mm accessories use a 3.5mm-to-2.5mm adapter in order to work with Treo smartphones.

Most stereo accessories (3.5mm with adapter) have three contacts on the plug. 2.5mm cell phone headsets may have three or four contacts on the plug (three-pole or four-pole plugs). The functional description of this headset jack is illustrated in the following diagram:

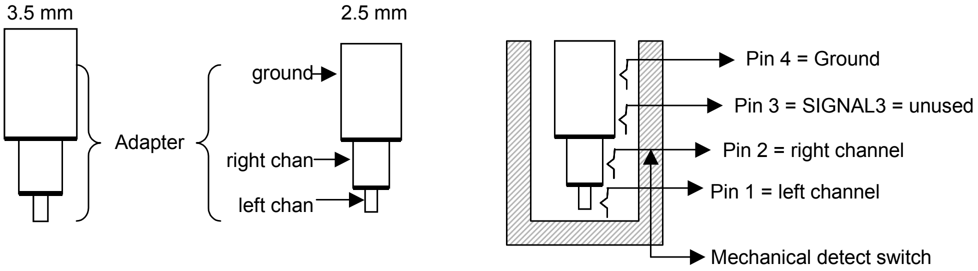


A mechanical detect switch is used to detect the presence of an external accessory. Electrically, SIGNAL1, SIGNAL2, and SIGNAL3 can each be biased separately on the motherboard to detect the impedance of the inserted audio accessory. These signals are measured by the applications processor to distinguish among possible accessories. The possible connection configurations are shown in the following figures.

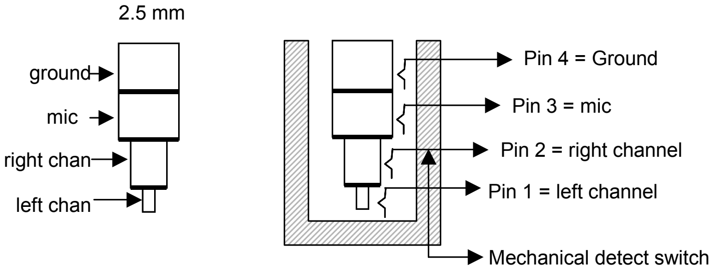
15.1.1 Standard 2.5mm cell phone headset (3-pin)



15.1.2 Stereo headphones (3-pin, 2.5mm or 3.5mm via adapter)



15.1.3 (Custom) Combination headphone/headset (4-pin, 2.5mm)



Each accessory is distinguished by the amount of impedance (electrical resistance) it presents to each signal pin (SIGNAL1, SIGNAL2, and SIGNAL3). Each signal may be biased via a resistor network. When the accessory is plugged into the jack, the voltage present at each pin is measured by the application processor and a decision algorithm is followed.

15.2 Stereo audio accessories

Stereo accessories that use passive speakers may have impedances of 8Ω, 16Ω, 32Ω, or 150Ω. Powered or amplified speakers may have similar low impedance, or they may have 2kΩ, 10kΩ, or higher impedances.

Stereo audio accessories are identified by the *relative* impedance of the left and right channels. The distinguishing characteristic of stereo accessories is that the right and left channels present the same level of impedance to the audio circuitry. Consequently, the application processor needs to measure the impedance on SIGNAL1 and SIGNAL2.

- If SIGNAL1 and SIGNAL2 are both high impedance, the software assumes that an active stereo circuit accessory has been inserted, and it routes the right and left audio channels appropriately.
- If SIGNAL1 is high impedance and SIGNAL2 is low impedance, the software assumes that a mono-aural cell phone headset has been inserted, and it routes the mic signal to SIGNAL1.
- If SIGNAL1 and SIGNAL2 are both low impedance, the software assumes that an active stereo circuit accessory has been inserted, and it routes the right and left audio channels appropriately.

The following table illustrates the results:

Processor measures SIGNAL1 and SIGNAL2	**Processor routes audio signals**	**Result**

SIGNAL1 = high impedance
SIGNAL2 = high impedance
	SIGNAL1 = left channel
	SIGNAL2 = right channel
		Stereo

SIGNAL1 = high impedance
SIGNAL2 = low impedance
	SIGNAL1 = microphone
	SIGNAL2 = passive speaker
		Mono

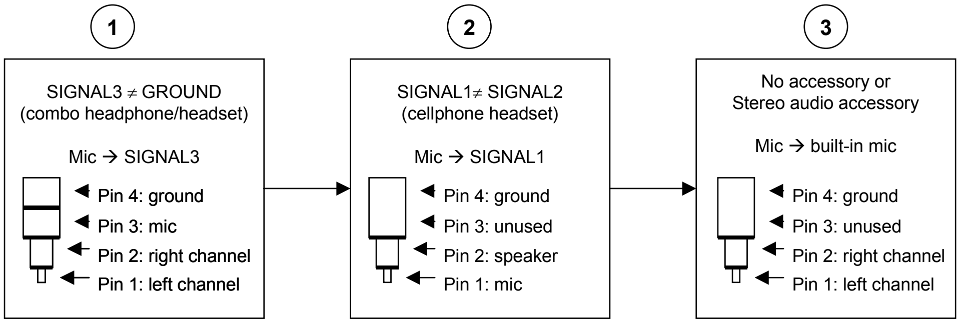
SIGNAL1 = low impedance
SIGNAL2 = low impedance
	SIGNAL1 = left channel
	SIGNAL2 = right channel
		Stereo

15.3 Microphones

There are three different microphone sources available in the Treo 650 smartphone: the built-in internal mic, the custom combination headphone/headset accessory, and the standard cell phone headset accessory.

The three potential microphone sources can be detected sequentially in the following priority:

1. Measure SIGNAL3. If SIGNAL3 is high impedance (not equal to GROUND), then the software assumes that a combination (hybrid) stereo headset/headphone has been detected. The mic path is routed to SIGNAL3.
2. Measure SIGNAL1 and SIGNAL2. If SIGNAL1 is high impedance and SIGNAL2 is low impedance, then a mic has been detected on SIGNAL1 (mono headset accessory). The mic path is routed to SIGNAL1.
3. If no accessory is inserted, then the software routes the signal to the built-in mic.



15.4 Speaker Architecture

The Treo smartphone has a two-speaker audio architecture. One speaker, called the receiver, is mostly dedicated to telephony sound and is tuned to voice frequency. The other, the external speaker, is mostly dedicated to system sounds and is tuned to polyphonic sounds. It is also used for the speakerphone mode. The Treo smartphone also enables the user to play stereo sound through the headset jack.

Treo smartphones have improved sound support, and their audio subsystem consists of three major categories:

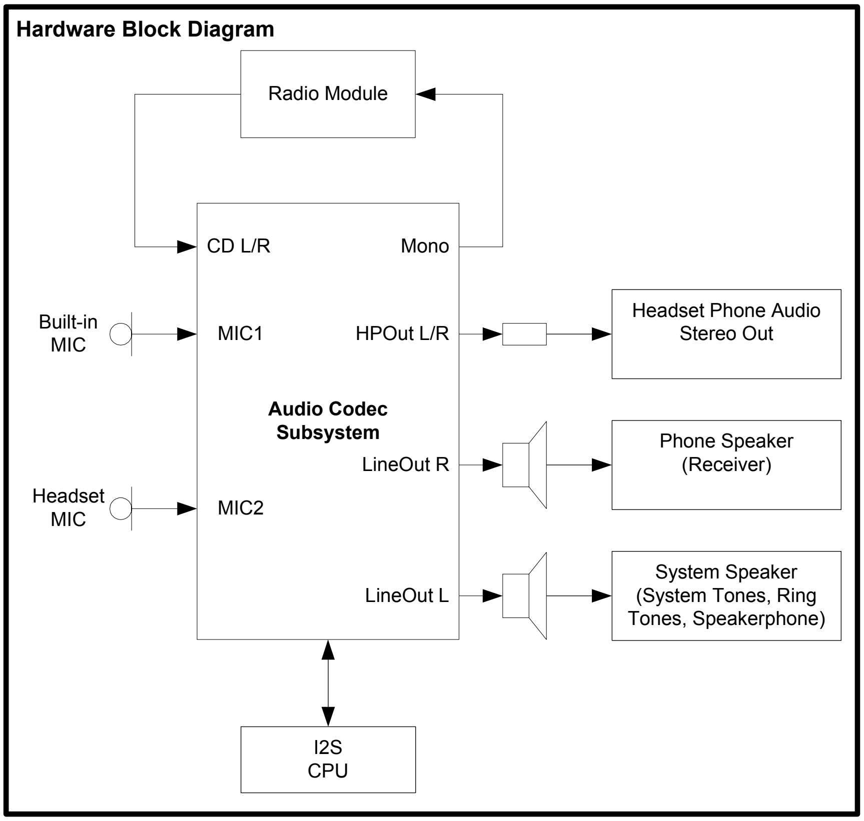
1. **Radio audio control -** Enables audio for the cellular radio, playback for received streams, and encoding and sending for recorded voice.
2. **System audio control -** Controls the speaker output for polyphonic sound playback and the microphone input for voice recording.

   NOTE: The Treo 600 smartphone does not capture the microphone input through an A/D converter.

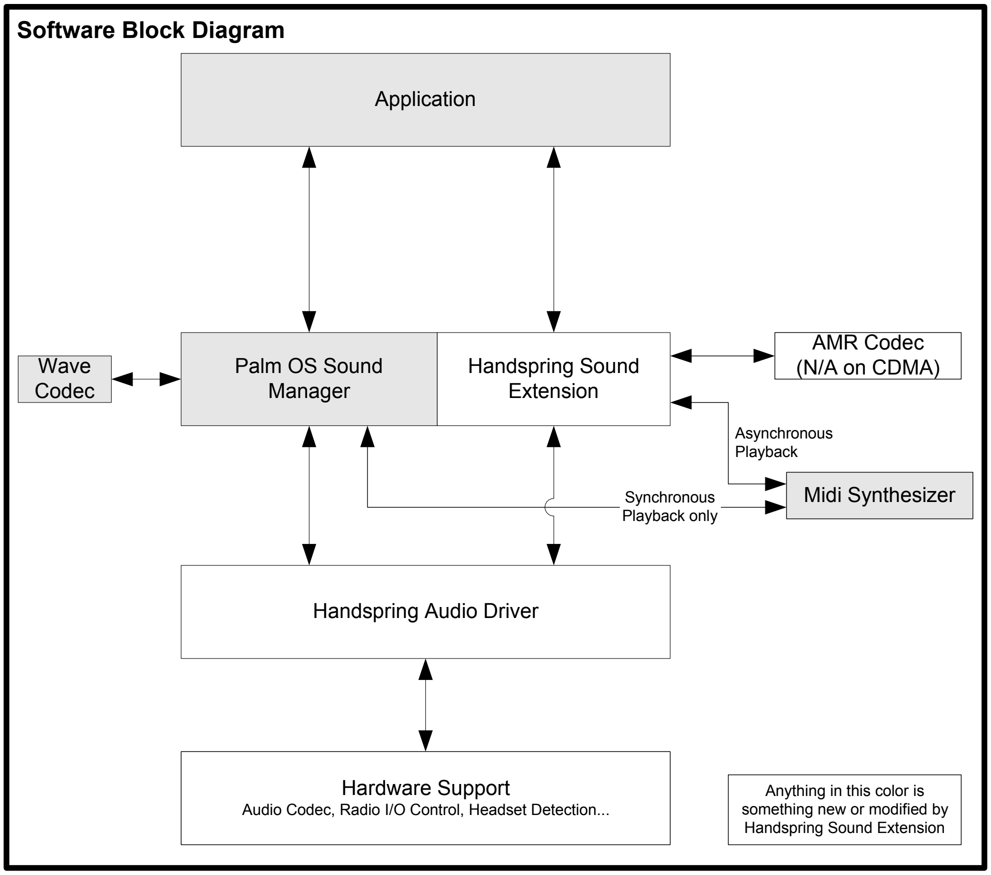
3. **Ring Tone Manager -** Controls ring tone playback when a call is received.

It's also possible to redirect the radio module audio output to the SDIO connector so that an external card could make use of it. For example, the audio output could be sent to a headset using Bluetooth® wireless technology.

The following figure shows the Treo smartphone audio subsystem hardware.



The following figure shows the Treo smartphone audio subsystem software.


Software Block Diagram
Application
Wave Codec
Palm OS Sound Manager
Handspring Sound Extension
AMR Codec (N/A on CDMA)
Asynchronous Playback
Synchronous Playback only
Midi Synthesizer
Handspring Audio Driver
Hardware Support
Audio Codec, Radio I/O Control, Headset Detection...
Anything in this color is something new or modified by Handspring Sound Extension

The usual software interface for playing sound is the standard Palm OS Sound Manager. Palm has added special controls that automatically direct the sound playback to the right output, as described in the following tables.

The only other APIs you need are found in the *API Guide*. These enable control of the audio stream when it is needed. As mentioned earlier, Palm® extension to the Palm OS should automatically take care of switching the right input/output, depending on usage.

The usage scenarios in the following tables show how the Treo 600 smartphone system interacts with the audio subsystem when playing or recording audio stream(s) (that is, what types of sounds are routed to which inputs and outputs). Some of the supported scenarios are not currently used by Palm, but could be created by a third party (6, 7, 10–24).

	Usage scenario	Voice sound in	Voice sound out	If phone sounds*	If system sounds**
1	Voice call using smartphone only	Built-in mic	Built-in receiver	Mixed-in, built-in speaker	Built-in speaker
2	Voice call using headset	Headset mic	Headset speaker	Headset speaker	Built-in speaker
3	Headset plugged in, not on a call	N/A	N/A	Headset speaker and built-in speaker	Built-in speaker
4	Stereo headphone plugged in, not on a call	N/A	N/A	Headset speaker and built-in speaker	Built-in speaker
5	Voice call using speakerphone	Built-in mic	Built-in speaker	Mixed-in, built-in speaker	Mixed-in, built-in speaker
6	Voice call using other type of headset	OT headset mic	OT headset speaker	OT headset speaker	Mixed in OT headset speaker
7	Other type of headset in use, not on a call	N/A	N/A	OT headset speaker & built-in speaker	Built-in speaker
8	Car kit on a call	Car kit mic	Car kit speaker	Mixed-in car kit speaker	Built-in speaker
9	Car kit off a call	N/A	N/A	Car kit speaker	Built-in speaker
10	PTT voice call using headset	Headset mic	Headset speaker	Headset speaker and built-in speaker	Built-in speaker
11	PTT voice call using speakerphone	Built-in mic	Built-in speaker	Mixed-in, built-in speaker	Mixed-in, built-in speaker
12	Voice record memo	Built-in mic	N/A	Built-in speaker—priority	Built-in speaker
13	Voice command using smartphone only	Built-in mic	N/A	Built-in speaker	Built-in speaker
14	Voice command using headset	Headset mic	N/A	Headset speaker and built-in speaker	Built-in speaker
15	Voice command using car kit	Car kit mic	N/A	OT headset speaker	Built-in speaker
16	MP3 music playback—smartphone only	N/A	N/A	Mixed-in, built-in speaker	Mixed-in, built-in speaker
17	MP3 music playback—headset	N/A	N/A	Mixed-in headset and built-in speaker	Mixed-in headset and built-in speaker
18	MP3 music playback—stereo headphone	N/A	N/A	Mixed-in headphone and built-in speaker	Mixed-in headphone and built-in speaker

	Usage scenario	Voice sound in	Voice sound out	If phone sounds*	If system sounds**
19	Playing games—smartphone only	N/A	N/A	Mixed-in, built-in speaker	Mixed-in, built-in speaker
20	Playing games—headset	N/A	N/A	Mixed-in headset and built-in speaker	Mixed-in headset and built-in speaker
21	Playing games—stereo headphones	N/A	N/A	Mixed-in headphone and built-in speaker	Mixed-in headphone and built-in speaker
22	Voice memo playback—smartphone only	N/A	N/A	Mixed-in, built-in speaker	Mixed-in, built-in speaker
23	Voice memo playback—headset	N/A	N/A	Mixed-in headset and built-in speaker	Mixed-in headset and built-in speaker
24	Voice memo playback—stereo headphones	N/A	N/A	Mixed-in headphone and built-in speaker	Mixed-in headphone and built-in speaker

Usage scenario notes

- Input
  - **Built-in mic -** The microphone contained in the handset for use when the headset is held to one’s ear.
  - **Headset mic -** The microphone contained in the headset.
  - **Other headset or car kit mic -** The microphone contained in the appropriate peripheral kit.
- Output
  - **Built-in receiver -** The speaker on the front of the handset that is used when the handset is held next to the ear. Generally used for listening to voice calls.
  - **Built-in speaker -** The louder speaker located on the back of the handset. Generally used for system sounds and speakerphone mode.
  - **Headset, OT, or car kit speaker -** The speaker built in to the appropriate peripheral.
- *“If phone sounds”: This refers to how the audio is routed if the audio from a class of sounds dedicated to phone usage interrupts the current usage scenario. This includes the following types of sounds:
  - Ring tones.
  - Call progress tones.
  - DTMF (dual tone multi-frequency).
  - Low battery. This is technically a system sound, because it is generated by the PDA. It is treated as an exception because a low battery warning is critical phone-related information that must be heard when on an active call, regardless of what the system sound settings are.
- **”If system sounds”: All system sounds will be played through both the headset/headphone and built-in speaker except the system sounds for alarms, SMS alerts, and Mail alerts.

The usage scenarios in the following table show how the Treo 650 smartphone system interacts with the audio subsystem when playing or recording audio stream(s).

	Usage scenario	Ringer switch sound on/off	On active call?	Telephony audio	Alerts (Attention Manager)	MP3 (application audio)	High-priority system sounds
1	Base mic/speaker	OFF	YES	Receiver	No sound[a]	No sound	No sound
2	Base mic/speaker	OFF	NO	No sound	No sound	No sound	No sound
3	Base mic/speaker	ON	YES	Receiver	Receiver[a]	Mute/hold	Receiver[a]
4	Base mic/speaker	ON	NO	No sound	Speaker	Speaker	Speaker
5	Speakerphone mode	OFF	YES	No sound	No sound[a]	No sound	No sound
6	Speakerphone mode	OFF	NO	N/A	N/A	N/A	N/A
7	Speakerphone mode	ON	YES	Speaker	Speaker[a]	Mute/hold	Speaker[a]
8	Speakerphone mode	ON	NO	N/A	N/A	N/A	N/A
9	Headset inserted	OFF	YES	Headset	Headset[a]	Mute/hold	Headset
10	Headset inserted	OFF	NO	No sound	Headset	Headset	Headset
11	Headset inserted	ON	YES	Headset	Headset[a]	Mute/hold	Headset[a]
12	Headset inserted	ON	NO	No sound	Speaker and mute MP3	Headset	Speaker and mute MP3
13	Bluetooth® headset in use	OFF	YES	Bluetooth®	No sound	Mute/hold	Bluetooth®
14	Bluetooth® headset in use	OFF	NO	No sound	No sound	No sound	No sound
15	Bluetooth® headset in use	ON	YES	Bluetooth®	Speaker	Mute/hold	Bluetooth®
16	Bluetooth® headset in use	ON	NO	No sound	Speaker	Speaker	Speaker

Usage scenario notes

a - Alerts should be sound mixed-in at a lower volume than the active call in progress.

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