

## CHAPTER 6

## Mobile PC 99

This chapter provides a summary of the key PC 99 requirements for mobile PCs, mini-notebooks, docking stations, and mini-docks. Mobile PC systems have thermal, portability, battery run-time and battery life, size, weight, and connectivity tradeoffs required for their design that differ from the tradeoffs made for stationary systems.

For background information about the design issues related to mobile PCs, see Chapter 1, “PC 99 Design Issues.”

**Important:** Unless a specific requirement or exception is defined in this chapter, all requirements apply for mobile PCs as defined in Chapter 3, “PC 99 Basic Requirements” and in Parts 3 and 4 of this guide. If there is a conflict with requirements or recommendations made elsewhere in this guide, the items in this chapter have precedence for mobile PCs.

The system requirements defined in this guide provide guidelines for designing PC systems that will result in the optimal user experience with typical Windows-based applications running under either the Microsoft Windows 98 or Windows 2000 Professional operating systems. These design requirements are *not* the basic system requirements for running any of the Windows operating systems.

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## Mobile PC System Design Requirements

This section summarizes the additional design exceptions and design requirements for mobile PCs.

Unless an explicit exception is stated in this section, the PC 99 requirements apply for mobile PCs as defined in Chapter 1, “PC 99 Basic Requirements,” and in Parts 3 and 4 of this guide. However, if there is any conflict with requirements or recommendations stated elsewhere in this guide, the items in this section have precedence for mobile PCs.

### 6.1. Mobile PC performance meets Mobile PC 99 minimum requirements

#### *Required*

For mobile PC systems based on Intel Architecture compatible processors, minimum PC 99 performance requirements include the following:

- 233 MHz processor with 128K L2 cache.  
This processor requirement does not specify a particular processor form factor or package type.
- 32 MB minimum system memory. The basic PC 99 limitations for memory available to the operating system apply for mobile PCs, as defined in the requirement 3.1.2, “System memory meets PC 99 minimum requirements.”  
Recommended: 64 MB RAM for Windows 2000 installations.

#### *Mini-notebook Note*

For mini-notebook systems, the minimum system performance requirement is 233-MHz processor with no L2 cache and 16 MB RAM.

**PC 99A clarification for unique system ID (PC99:3.5.1):** Only mobile PCs that ship with an integrated network adapter are required to provide the unique system ID in printed form. The initial use of the unique system ID will be for creating a Machine Account Object for the Windows 2000 Remote Installation Services. Currently, no Microsoft operating system supports remote installation using a PC Card network adapter.

### 6.2. Mobile PC supports Smart Battery or ACPI Control Method battery

#### *Required*

**PC 99A clarification:** Every device in a mobile PC system should function fully on both AC and DC power. It is not acceptable for hardware or system firmware to autonomously disable, remove, or force power down of devices on an AC->DC transition. This can cause situations that result in system hangs, lost data, operating system failure of subsequent power management events, or at the least, warning messages displayed to the user. Internal devices must only be powered down, disabled, or removed when commanded to do so by the operating system and device drivers in accordance with bus and device power management specifications.

This clarification does not require port replicators or docking stations to operate on battery power.

Recommended: Smart Battery.

- **6.2.1 Smart Battery meets PC 99 requirements.** If Smart Battery is implemented, the following requirements apply:
  - An ACPI embedded controller-based (EC) System Management Bus (SMBus) interface is required, as described in Section 13 of the ACPI 1.0 specification.
  - The battery must support the complete command set and meet the accuracy requirements defined in *Smart Battery System Specification, Version 1.0*.
  - A Smart Battery Charger, if used, must comply with the command requirements defined in *Smart Battery Charger Specification, Version 1.0*.
  - A single-battery system that does not use a Smart Battery Charger must report the presence or absence of AC power and issue AC state change notifications by way of the EC interface, using Smart Battery Charger commands.
  - A multiple-battery system that does not use a Smart Battery Charger must report the presence or absence of AC and issue AC state change notifications using the EC by emulating a Smart Battery Selector status register.
  - If a multiple-battery system is implemented, the system can use a Smart Battery Selector that complies with the *Smart Battery Selector Specification, Version 1.0*. The battery selection or alternate control scheme that is implemented must comply with the intent of the *Smart Battery Selector Specification*. It must expose emulated Smart Battery Selector registers to the operating system.

The intent is that battery systems returning “Smart Battery System” data by way of the EC SMBus interface do so in a manner consistent with the Smart Battery System specifications. They must return all battery data, the charger status register, and all selector registers in a manner transparent to the operating system, allowing the standard Smart Battery System drivers provided with the operating system to work properly.

All Smart Battery specifications are available at <http://www.sbs-forum.org>.

- **6.2.2 ACPI Control Method Battery meets PC 99 requirements.** If an ACPI Control Method Battery, as defined in Section 11 of the ACPI 1.0 specification, is implemented, the following requirements apply:
  - All data returned must be meaningful and accurate. If the accuracy cannot be guaranteed, return the unknown value, which typically is 0xFFFFFFFF.

- If a multiple-battery system is implemented, it must follow the guidelines defined in the *ACPI Implementers Guide*, which is available from the web site at <http://www.teleport.com/~acpi/>.
- Although most of the data fields returned by a Control Method battery are optional or recommended in the ACPI 1.0 specification, the following data fields are required for PC 99:

Field	Requirements
_BIF field	Power Unit must report 0x00000000. That is, batteries are required to report their Battery Remaining Capacity in mWH and their Battery Present Rate in mW. Design Capacity, reported in mWH. Design Capacity of Low.
_BST	Battery Remaining Capacity, reported in mWH. Battery Present Rate, reported in mW.

Recommended: \_BTP support.

- Batteries must be able to supply at least the capacity they report (Battery Remaining Capacity) at all times, even when the system is running on AC power. It is acceptable to supply more energy than they report, but they must never over-report capacity.
- Batteries must accurately report the Battery Present Rate, providing data that is not stale.

### 6.3. Expansion capabilities of mobile PC are accessible to users

#### *Required*

Expansion capabilities in a mobile PC usually require external connections and, occasionally, additional internal components. The expansion slot is almost always physically blocked by access doors. Such doors are recommended for traveling integrity and to minimize entry of dust. This requirement is met if the user can access such external expansion slots without tools.

Internal expansion capabilities that require internal replacements, such as CPU, memory, built-in modem, and so on, are exempt from this requirement.

### 6.4. Mobile PC connections use icons plus keyed or shrouded connectors

#### *Required*

This requirement is the same as for PC 99 desktop systems, except that for mobile PC designs, with small-height considerations, connector icons might not fit on the back of the case. In such cases, it is acceptable to wrap the icons to the bottom of the unit or place them on the inside of an access door.

Mobile PCs are not required to implement color coding for connectors.

### **6.5. Mobile PC includes one USB port**

#### *Required*

For mobile PCs, one USB port must be built into the PC, not provided solely by docking stations, although these units can provide extra USB connectors. This USB port can be either a high-power or low-power port, or it can be dynamically configurable at the discretion of the OEM, as provided for by Section 7.2.1 of the USB 1.0 specification.

Mobile systems are **not** required to meet the requirement for the USB host controller to be able to wake the system from S3 state, as defined in requirement 3.2, “System design meets ACPI 1.0 specification and PC 99 requirements.”

Mobile systems that have built-in keyboards are **not** required to include BIOS support for USB keyboards and hubs as defined in requirement 3.5, “BIOS meets PC 99 requirements for boot support.”

### **6.6. USB-connected device does not maintain fully on power state**

#### *Required*

An internal device that connects to the mobile PC using USB must not continually maintain the system in a fully-on power state. Such a device will override system power-management settings that control power-saving modes to protect battery life. When any USB device is connected but not active, the driver must allow system power management to suspend the notebook.

### **6.7. Mobile PC includes an IEEE 1394 port**

#### *Recommended*

It might not be possible to meet mobile system design requirements for power control, power budgeting, power state management, and thermal management with designs based solely on the IEEE P1394.a standard and OHCI 1.0 specification. Therefore, implementation of an IEEE 1394 port on a mobile system will not become a requirement until these power issues have been resolved in future versions of the IEEE 1394 standard and OHCI specification.

The implementation of IEEE 1394 on a mobile PC must meet the requirements defined in Chapter 8, “IEEE 1394,” with the following exceptions and additions:

- One external IEEE P1394.a-compliant port is required.
- When the IEEE 1394 node on a mobile system is not active, it must not degrade battery life, system reliability, or CPU performances.
- There are no requirements for a mobile unit to source or sink power. This is an exception to requirement 8.34, “IEEE 1394-enabled PC sources cable power.”

Instead, the mobile PC should declare itself as a Power Class 04 device, defining its specific power source/sink characteristics in the Configuration State Registers (CSR) space. This is an exception to requirement 8.30, “Devices report power source and cable power consumption in Self\_id packet.”

- A mobile unit with a single external port is not required to power its PHY when the system transitions to the Off state. If more than one port is implemented, mechanisms must be implemented to prevent the passing of power from any one port to any other port when the system (and its PHY) transitions to the Off state. This is an exception to requirement 8.25, “Self-powered devices propagate the power bus through each connector,” and requirement 8.29, “Devices provide sufficient power to their PHY at appropriate times.”

Recommended: The IEEE 1394 port on the mobile unit should not be blocked when the system is docked. If, however, the port is blocked (when internal ports have not been implemented), it should be possible to power off the internal link and PHY.

Guidelines for implementing IEEE 1394 on a docking station or mini-dock are defined in “Docking Station Requirements” later in this chapter.

### **6.8. Mobile PC includes CardBus**

*Required*

Recommended: Zoomed Video (ZV) support.

At least one 32-bit Type-2 CardBus slot (not 16-bit) is required. All CardBus implementations must comply with the requirements defined in Chapter 12, “PC Card,” including information about the default initialization of the CardBus controller under both Windows 98 and Windows 2000 operating systems.

**Note:** Each device in a multifunction add-on device—such as a CardBus card—must separately meet the power management device class specifications for its device class and be independently power managed. This means that both device A and device B on the same add-on card do not have to be idle before the devices can be power managed. For information, see Chapter 12, “PC Card.”

### **6.9. Mobile PC keyboard and pointing device meet PC 99 requirements**

*Required*

The internal keyboard and any built-in pointing devices, such as a mouse, stylus, pen, touch pad, touch screen, trackball, stick, and so on, required for a mobile PC should use standard system-board devices. The USB port can be used to support the requirement for external pointing device and keyboard connections. Alternatively, two PS/2-style ports can be implemented for the pointing device and keyboard, or a single PS/2-style port can be provided for both the pointing device and the keyboard.

For more information, see Chapter 13, “I/O Ports and Devices,” which also provides information about implementing the recommended Windows and Application logo keys on mobile PCs.

The BIOS and the driver for the internal pointing device must accommodate standard external pointing devices such that all features of the external device are available when it is attached to the system. At a minimum, if the internal pointing device is a PS/2-type device, the BIOS must provide an option to detect when an external PS/2-type pointing device is connected at startup and disable the internal pointing device. In this case, the driver for the internal pointing device must not load. This should be the default BIOS option.

**PC 99A clarification:** The *required* default BIOS option is to provide an option to disable the internal pointing device when any external PS/2-type pointing device is detected at startup. In this case, the driver for the internal pointing device must not load.

Recommended: The BIOS should provide a user-settable option to enable dual operation of the internal and external pointing device.

#### **6.10. Mobile PC includes IR devices compliant with IrDA specifications**

*Recommended*

IR capabilities are not required for mobile PCs. If implemented, all devices must meet the PC 99 requirements for IrDA devices as defined in the “Wireless Component Requirements” section of Chapter 13, “I/O Ports and Devices.” See also “Wireless Design Issues” in Chapter 2, “PC 99 Design Issues.”

In addition, the software must have access to turning the interface off (D3 power state) and on (D0 power state) using bus-specific methods or the methods defined in Section 3.4 of the ACPI 1.0 specification.

#### **6.11. Mobile PC includes support for installing the operating system**

*Required*

The mobile system, as purchased, might not include all peripherals required for operating system installation. The user might need to access another PC 99 computer using a serial, parallel, or network connection to complete installation.

This basic PC 99 requirement is met as long as it is possible for the user to obtain the required device support for operating system installation, even if it requires a separate purchase.

#### **6.12. Mobile PC includes audio that meets Mobile PC 99 audio requirements**

*Recommended*

If audio is implemented in a mobile PC system, it must meet the requirements for PC 99 audio as defined in Chapter 17, “Audio Components,” with exceptions as defined in this section. These exceptions for mobile PC systems arise from design challenges such as lower power and smaller form factors.

For mobile PCs, the following exceptions and differences are defined for audio requirement 17.4, “Audio performance meets PC 99 requirements”:

- Dynamic range requirements are relaxed by 10 dB FS A
- THD+N requirements are relaxed by 10 dB FS
- Required frequency response is 20 Hz to 15 kHz, measured using 3 dB corners
- Cross-talk requirements are relaxed by 10 dB FS
- For mobile PCs that implement a 3.3 V audio codec in order to decrease system power, the required Full Scale Output Voltage (FSOP) for line output is  $\geq 0.7 V_{rms}$

Notice that frequency response is measured at line out.

It is the intent of the PC 99 design requirements to allow for the audio controller to be implemented on the mobile unit with output capabilities implemented on a docking station. For related audio requirements for the mobile PC/docking station pair, see the “Docking Station Requirements” section later in this chapter.

### 6.13. Mobile PC includes communications device

*Recommended*

Notice that the presence of a CardBus slot on the mobile PC meets the PC 99 requirement for providing either a modem or network adapter with a Mobile PC 99 system, with the following exceptions:

- If modem capabilities are integrated in the base platform, then V.34 or higher is required. All other requirements for modems must be met as defined in Chapter 19, “Modems.”
- For a network adapter, support is optional, rather than required, for remote new system setup capabilities. All other requirements for network communications must be met as defined in Chapter 20, “Network Communications.”

Support for remote wake-up is not required to be built into mobile PCs. However, CardBus implementation that support the power management event (PME) signal meets this capability. For information about PME signal definition, see *PCI Bus Power Management Interface Specification for PCI to CardBus Bridge, Revision 1.0* or later.

### 6.14. Mobile system supports hot-pluggable devices and alternative network connections

*Recommended*

For a mobile system, the following are recommended design considerations:

- The system should support hot-pluggable and warm-pluggable devices that do not require a system reboot for insertion or removal.

Guidelines are defined in requirement 3.19, “Hot-plugging capabilities for buses and devices meet PC 99 requirements.”

- The system should include alternative methods for network connection, because a LAN or dialup connection might not always be available. Methods



can include a floppy boot disk, PC Card network adapter, LAN on the system board, or docking to support remote new system setup.

### **6.15. Mobile system meets Mobile Power Guidelines '99**

*Recommended*

The Mobile PC faces many power challenges in the future. The *Mobile Power Guidelines '99* are part of a comprehensive industry initiative that addresses these challenges to deliver mobile PCs that are high-performance, feature-rich, and power efficient.

For more information, see the *Mobile Power Guidelines '99, Revision 1.0* or later, available at <http://developer.intel.com/design/mobile/intelpower/>. Compliance with *Mobile Power Guidelines* will not become a requirement in future versions of these guidelines.

### **6.16. Mobile system includes CD or DVD drive**

*Recommended*

Because of form factor constraints, a CD or DVD drive might not fit in a mobile PC.

If a CD drive is included in a mobile PC system or is designed as an add-on device to be attached to a mobile PC system, the minimum CD drive media transfer rate must be no less than 600 KB per second when running in the fully on (D0) state.

Recommended: The minimum CD drive media transfer rate for read operations should be 1200 KB per second or greater when running in the D0 state.

If a DVD drive is included in a mobile PC system or designed as an add-on device to be attached to a mobile PC system, there is no requirement for a minimum transfer rate. It is recommended that the device provide no less than 2 MB per second sustained rate anywhere on the disk media for read operations.

### **6.17. Mobile system meets Manageability Baseline requirements**

*Required if Windows 2000 is preinstalled*

Mobile systems that come preinstalled with Windows 2000 must comply with the following PC 99 Manageability Baseline requirements, as defined in Chapter 3, "PC 99 Basic Requirements":

- 3.51, "System supports WHIIG"
- 3.52, "System includes driver support for WMI"
- 3.53, "Management information service provider enabled by default"

The following components of the Manageability Baseline are recommended for mobile PC systems:

- 3.54, "Expansion devices can be remotely managed"

- 3.55, “SMBIOS 2.2 static table support is provided”

## Mobile PC Graphics Requirements

This section defines the specific requirements for graphics display capabilities on a mobile PC 99 system.

Unless an explicit exception is stated in this section, the PC 99 requirements apply for mobile PCs as defined in Chapter 14, “Graphics Adapters.” However, if there is any conflict with requirements or recommendations stated elsewhere in this guide, the items in this section have precedence for mobile PCs.

### 6.18. Built-in display adapter meets Mobile PC 99 minimum capability

#### *Required*

For a mobile PC’s external display support, the graphics subsystem must support the PC 99 requirements as defined in Chapter 14, “Graphics Adapters,” with the exceptions noted in this section.

The built-in (internal) graphics adapter must support 2-D hardware acceleration, and the primary display surface must be a minimum of  $800 \times 600$  resolution, with  $1024 \times 768$  recommended.

If the built-in graphics adapter supports attaching an external display, the display surface must be supported by at least the following:

- All PC 99 required low resolution modes at 60 Hz or better VESA ergonomic timing rates (vertical refresh rate)
- The following minimum resolutions at 60 Hz VESA ergonomic timing rates:
  - $640 \times 480$ : 8 bpp and either 15 bpp or 16 bpp
  - $800 \times 600$ : 8 bpp and either 15 bpp or 16 bpp
  - $1024 \times 768$ : 8 bpp

All minimum required resolutions must be non-interlaced and free from tearing.

Other non-required modes can be implemented at 60 Hz timing rates; double-buffering is not required. It is recognized that implementations of higher non-required resolutions on a mobile system can be interlaced and might not be free from tearing.

#### *Mini-notebook Note*

For mini-notebooks, the minimum required resolution for the primary display surface is  $640 \times 480 \times 8$  bpp.

### **6.19. Built-in display adapter with 3-D hardware acceleration capabilities meets Mobile PC 99 minimum capability**

#### *Required*

Hardware-accelerated 3-D is not a requirement for mobile PC platforms, although some systems are implementing 3-D support in the 1999 time frame. This requirement defines guidelines for mobile chipsets that use Direct3D capabilities.

If a mobile PC platform is designed to support hardware-accelerated 3-D using Direct3D, then the 3-D requirements for performance and features are required as defined in Chapter 14, “Graphics Adapters,” with exceptions as defined in this section.

Mobile 3-D chip sets currently being introduced are limited to 2 MB of local frame buffer memory, and some will have all frame buffer in main memory. To accommodate this, and because of the design constraints in the mobile platform, the following exceptions apply for 3-D hardware acceleration.

- Resolution for mobile PCs is required to be  $640 \times 480$ , rather than  $800 \times 600$  required for desktop systems, 16 bpp, double-buffered with Z-buffer.

No minimum texture cache is required.

Recommended: Mobile systems that include 4 MB of local frame buffer memory should support the 3-D requirements at  $800 \times 600$  resolution.

- Support is recommended but *not* required for alpha blending (both source and destination), specular highlighting, multi-texturing, anti-aliasing, depth-based fog, and per-vertex fog, as defined in requirement 14.27, “Hardware supports PC 99-required RGB rasterization.”
- Hardware texture mapping is *not* required, as defined in requirement 14.31, “Hardware complies with texture size limitations.”

These recommendations and exceptions apply individually; implementing a single recommended 3-D feature on a mobile system does not require implementing other recommended 3-D features.

### **6.20. Mobile system meets Mobile PC 99 requirements for supporting multiple adapters and multiple monitors**

#### *Required*

Multiple adapter support is not required, unless the mobile system supports a full docking station with an additional graphics adapter or user-accessible capabilities for adding one or more graphics adapters.

If a full docking station is implemented, the mobile unit BIOS, graphics adapter, and driver must have support for multiple adapters as defined in the “Multiple-Adapter and Multiple-Monitor Support” section of Chapter 14, “Graphics Adapters.” This support allows a user to add a graphics adapter in the docking station.

If the built-in graphics adapter supports attaching an external display, multiple monitor support is optional for the internal adapter. The primary and secondary display do not need to support independent or simultaneous displays, especially different resolutions of the same image. Compromises are acceptable: other graphics requirements do not need to be met while independent displays are attempted. For example, playing a 3-D game on the internal display while showing an MPEG movie on the external display does not need to perform to normal levels of acceptability or even work at all.

### 6.21. External graphics adapter interface supports DDC monitor detection

#### *Required*

Mobile systems are not required to support detection of the display based on the *Display Data Channel Standard, Version 3.0* (DDC) if the display is permanently attached and connected using an internal interface.

However, mobile systems must support DDC2B if an external graphics interface port is implemented. The complete PC 99 requirements are defined in requirement 14.13, “Adapter supports DDC monitor detection.”

**PC 99A clarification:** Because of the power limitations placed on mobile computers, they are not required to supply +5V power via the external graphics adapter as is currently required by the VESA DDC specification.

**Note:** Some display devices rely on the +5V to power their DDC circuitry, for Plug and Play detection, or both. It is recommended that a mobile PC provide a means to enable the +5V power when necessary.

### 6.22. Mobile system with MPEG-2 or DVD playback features meets Mobile PC 99 requirements for video playback

#### *Required*

MPEG-2, DVD, and DVD playback features are not required for a mobile system.

However, if video playback capabilities are implemented, the mobile system must support the related requirements defined in Chapter 14, “Graphics Adapters,” and Chapter 15, “Video and Broadcast Components,” with the following exceptions:

- Support for the video overlay surface must include the following:
  - Support is required for only one of the YUV formats defined
  - Scaling is not required (including underscan, downscaling, overscan, and arithmetic stretching)
  - Overlay alpha blending in 32 bpp is not required, as defined in requirement 14.16, “Hardware supports alpha blending of graphics and video”
  - Other requirements apply as defined in requirement 14.14, “Hardware supports video overlay surface with scaling”

- IRQ support for a video port is recommended, rather than required. Other requirements apply as defined in requirement 14.17, “Video port meets PC 99 specifications if present on graphics adapter.”
- PAL support is recommended, rather than required.

**Note:** It is not possible to support all video components on PAL with only 2 MB of frame buffer memory.

- At least one of the following minimum video performance capabilities is required, in comparison to the performance requirements defined in Chapter 15, “Video and Broadcast Components”:
  - 80 percent of the fields per second at full frame size
  - 50 percent horizontal and 50 percent vertical reduction in frame size at full fields per second

However, if a mobile system meets the minimum performance requirements defined for an Office PC 99 system, then the performance standards apply as defined in requirements 15.19, “MPEG-2 MP@ML playback meets PC 99 requirements,” and 15.21, “MPEG-2 video decode implementations meet PC 99 quality.”

### **6.23. Mobile system with AGP supports meets Mobile PC 99 requirements**

#### *Required*

If AGP support is implemented in a mobile PC system, it must meet the PC 99 requirements defined in requirement 14.51, “AGP meets PC 99 implementation guidelines,” with these exceptions:

- A minimum speed of 1x is acceptable for mobile PCs.
- GART support is recommended, rather than required.

If GART support is implemented on a mobile PC system, it must comply with the requirements specified in *AGP Interface Specification, Revision 1.0* or later.

Notice that an AGP implementation using a memory-mapped frame buffer (frame AGP) rather than GART does not support bus mastering.

### **6.24. System meets Mobile PC 99 requirements if television output is implemented**

#### *Required*

Television output is not required for a mobile system. If this capability is implemented, the mobile system must support the requirements defined in Chapter 14, “Graphics Adapters,” with the following exceptions:

- The television output adapter must use 2-tap minimum hardware filtering techniques for flicker reduction. All other requirements are as defined in item 14.38, “Adapter supports flicker filter.”

- It is acceptable for television output to be enabled manually. Mobile PCs are not required to support automatic default boot mode as defined in requirement 14.36, “Default boot mode supports appropriate locale.”

#### 6.25. Built-in mobile display supports ICC color management

##### *Required*

This capability is required for mobile flat-panel displays, as defined in requirement 16.2, “Monitor supports Integrated Color Management.”

The OEM must preinstall an INF and International Color Consortium(ICC) profile for the LCD display if it cannot be detected using DDC or other standard mechanisms. Notice that for model variations that use more than one type of panel, the end-user will have to select the correct panel during Setup if the panel is not DDC compliant. For information, see the color management information available from the web site at <http://www.microsoft.com/hwdev/devdes/icm.htm>.

## Docking Station Requirements

Mobile PC docking systems allow docking of a PC, with additional hardware capabilities. A docking station allows the end user to add other devices to the mobile PC system—for example, sound, network adapter, hard disks, CD drive, different display adapter, SCSI, modems, and so on.

Docking systems can support hot, warm, or cold docking. Warm docking refers to docking and undocking the mobile PC while the system is in a low power state (as defined in the ACPI 1.0 specification) but is not powered off. Hot docking refers to docking and undocking the mobile PC while the system is operating at full power and is in an active working state.

Resource conflicts can occur when a mobile PC is paired with a docking station that allows users to add non-proprietary expansion cards to the system. For a mobile PC and docking station pair, the system designer must ensure that the docking system is capable of arbitrating resources for conflicts that might occur if an expansion card is added to the docking station. However, the system designer does not need to add to the mobile PC unit all of the PC 99 resource-arbitration capabilities.

The requirements in this section apply for mobile designs that include a docking station. There is no requirement that a mobile PC must have a docking station.

## Docking Definitions

This section defines the these types of docking modules that interface to a mobile PC platform.

**PC 99A clarification:** These are new definitions for this section of the Mobile guidelines:

- **Port Replicator:** A port replicator is a module that manages external cable connections. It adds no new features, functionality, or devices. All cable connector receptacles on a port replicator are simple extensions of the wiring for connector receptacles on the back panel of the mobile PC platform. An event notification message should be sent and properly handled when the mobile unit is attached to or detached from the port replicator. The module should have mechanisms to determine attach or detach events that do not require active electronics in the port replicator. For example, a switch in the mobile unit might be activated when the port replicator is mated.
- **Mini-Dock:** A mini-dock can perform the same functions as a port replicator, with one additional feature: a mini-dock incorporates some form of active electronics to create extended mobile PC platform features and functions. The added active electronics might provide additional user-accessible PC Card slots, communication receptacles, or both. These slots and receptacles might be RS-232, IEEE 1284, IEEE 1394, and so on. The mini-dock does not provide user-accessible expansion slots other than CardBus slots, but it might provide internal expansion capabilities accessible only to the OEM.

A mini-dock does not have internal user-upgradeable capabilities for adding desktop peripherals or I/O expansion cards. Therefore, a mini-dock can be considered a sealed docking station, where all expansion capabilities are provided using external expansion ports, so that the operating system always knows what to expect about available devices. However, being sealed does not preclude designs that include internal components that can be upgraded by the OEM or trained service personnel. When such upgrades are done, the mini-dock must employ mechanisms that result in the operating system establishing a new configuration for the mini-dock.
- **Docking Station:** A docking station, when interconnected with the mobile PC platform, is typically designed to extend the features and functions of the mobile PC to be equivalent to that of a desktop platform system. Requirements and specifications for features and functions available when a mobile PC platform has been interconnected with a docking station are, typically, the same as those for a desktop platform system.

A docking station incorporates native bus expansion slots. It is user expandable to include desktop peripherals and expansion cards.

## General Docking Requirements

The methods for the following dock identification scenarios can be supported by the system BIOS, which requires a mobile system to be aware of each type of docking station and features it supports, or by the docking station itself, which could contain the ACPI table needed to differentiate the model, unique ID, and features in the dock. Either method would allow the system BIOS to pass this information to the operating system without actually having to support every conceivable combination.

Windows 2000 requires that drivers for devices in a dock must fully support dynamic loading and unloading, as well as all Windows 2000-based power management and Plug and Play messages. In certain designs, some devices that are normally considered system devices can be treated as static devices.

In the case of a desktop system, static devices might not necessarily have to have their driver be capable of dynamically unloading, for example, a custom keyboard driver or custom storage driver. However, in some docking designs, such devices are sometimes “mirrored” in a docking station. Under these conditions, the driver must be able to be unloaded dynamically; otherwise, the operating system cannot stop the device, preventing a mobile ejection.

#### **6.26. System supports PCI docking through a bridge connector**

##### *Recommended*

The system should support docking through a bridge connector, with the actual bridge on the docking station and not on the mobile unit. The bridge can be positive or subtractive decoding. The bridge should create a new bus number, assuring that devices behind the bridge are not on the same bus number as other devices in the system.

After a warm dock, the BIOS should not configure the bridge or any other devices in the docking station. Configuring the docking station devices is the responsibility of the operating system.

Notice that implementing delayed transactions for PCI-to-PCI docking bridges is required in PCI 2.1 or later only when certain timing conditions are not met. For PC 99 design requirements, this is interpreted to mean that delayed transactions are required only when “targets cannot complete the initial data phase within the requirements of this specification,” as stated in PCI 2.1 or later. Delayed transactions, which provide a performance advantage, are a hardware-related timing issue; they are not related to operating system requirements.

#### **6.27. Docked mobile PC supports state change notification using ACPI**

##### *Required*

When a mobile PC is “docked” to a mini-dock or docking station, specific notification must be made using ACPI methods to enable the operating system to properly change states or enumerate new devices that appear in the system. This notification must occur during a “hot” docking event or when the system returns from a warm or cold dock.

All notification events and docking control must be implemented as defined in Sections 5.6.3 and 6.3 of the ACPI 1.0 specification.



**6.28. Docked mobile PC has the ability to identify the specific model of the dock***Required*

The system must be capable of uniquely identifying to the operating system a specific system configuration. Each separate system in the same model line should have a unique ID. This is to prevent the problems with current implementations that require the operating system to “cycle” different docking profiles at every docking event to try to identify what specific model of dock is attached.

**6.29. Docked mobile PC has the ability to uniquely identify the dock***Required*

The system must be capable of uniquely identifying an individual dock. This allows support for users that dock laptops into differently configured docks to have different features or settings at different locations and again prevents the operating system from unnecessary enumeration of the system on docking events.

**6.30. Mobile PC/docking station combination meets PC 99 requirements***Required*

There is no requirement that a mobile PC must have a docking station.

However, if a mobile PC supports a docking station, manufacturers must submit the combined docking station and mobile PC for PC 99 compatibility testing, and this combination must pass testing.

The docking unit must be able to power the mobile system and charge the mobile system’s battery under the control of the mobile system.

Some PC 99 requirements might apply to a mobile PC/docking station combination that do not apply to the mobile PC as a standalone unit. The intent for PC 99 is that such requirements apply only because of facilities present in the docking station. For example, if a docking station provides graphics capabilities that substitute for the graphics capabilities of the mobile unit, the PC 99 graphics requirements apply for the mobile PC/docking station combination when the substituted graphics component is in use. If the mobile PC is supplying all graphics capabilities, then Mobile PC 99 graphics requirements still apply.

This does not require that all new PC 99 mobiles that have docking station support automatically have new docking station designs designed to meet PC 99 requirements. PC 99 mobile PCs can support docking stations that have already been tested to meet earlier design guideline requirements. The combination of a PC 99 mobile and an earlier design docking station must still be submitted for testing, and general system requirements still apply. The relevant requirements in this case are the following:

- The user cannot experience resource conflicts.
- All drivers for earlier docking stations must be updated as necessary to support the pre-installed operating system.

For example, in order for older docking stations to work properly with a PC 99 mobile PC running Windows 2000, all drivers must be updated to support dynamic loading, Plug and Play, and power management messages. This does not imply that new features must be added, but rather that the mobile system/operating system combination must have full control over the features in the docking station.

This exception does not imply that a new docking station can comply with a reduced set of PC 99 requirements based on an earlier design guideline. If a docking station is a new design released during the time that this design guide is in effect, such combinations of mobile and docking station must meet all PC 99 requirements.

### **6.31. Docking station meets all PC 99 system requirements**

#### *Required*

All basic PC 99 requirements must be met by the dock and its devices, as defined in Chapter 3, “PC 99 Basic Requirements.” These include requirements for ACPI, Plug and Play, power management, and bus and device specifications.

The docking station must meet the PC 99 BIOS requirement for multiple adapters and multiple monitors, which allows for the graphics capabilities in the mobile unit to be fully operational (either the LCD panel or external connector) in the event that a user adds another graphics adapter to the docking station.

Many docking stations support VCR-style docking in which the notebook is closed when docked, so the user is prevented from accessing the notebook display. It is recommended that users not be precluded from accessing their notebook display when docked and that users have the option of simultaneously using the main display on the docking station and the notebook display.

Windows 2000 is designed such that all devices on a docking station (whether built in or added on) must be Plug and Play devices, either based on ACPI or a bus standard described in the PC 99 guidelines.

**Note:** ISA slots are not allowed in docking stations, as defined in requirement 3.28, “System does not include ISA expansion devices or slots.”

### **6.32. Mobile/docking station interface is supported using ACPI-defined mechanisms**

#### *Required*

The mobile unit must provide docking notification using mechanisms defined in the ACPI 1.0 specification. Non-Plug and Play devices must be enumerated, configured, and disabled using ACPI-based methods. All notification events and docking control must be implemented as defined in Sections 5.6.3 and 6.3 of the ACPI 1.0 specification.

### **6.33. Mobile PC/docking station combination supports automatic resource assignment and dynamic disable capabilities**

#### *Required*

The mobile PC unit that is part of a docking system does not require all of the resource-arbitration capabilities required for expandable PC systems. However, the system as a whole must be capable of completely and dynamically disabling static onboard and add-on devices, and of freeing all the resources used by that device when the mobile unit is docked.

This requirement applies for all Plug and Play devices, but excludes fixed-resource devices such as the DMA controller, interrupt controller, and so on, as summarized in requirement 3.12, “Each bus and device meets Plug and Play specifications.”

With this capability, individual devices in the mobile PC can be disabled when the unit is docked, allowing the appropriate devices in the docking station to be enabled. The system could fail if an add-on card requires resources that conflict with a device on either the mobile PC or the docking station. The mobile PC/docking station combination must be able to resolve resource conflicts among all the devices in the docking system.

This means that docking station devices must be available to replace disabled devices in the mobile PC, and these devices must meet the basic Plug and Play resource arbitration requirements for PC 99, as described in the “PC 99 General Device Requirements” section in Chapter 3, “PC 99 Basic Requirements.” However, it is up to the design engineer of a mobile PC/docking station combination to determine which component (mobile PC or docking station) will resolve the conflict when the mobile unit is docked.

For more information about resource arbitration when two devices such as two keyboards or two mice are present, see requirement 13.49, “Dynamic resource configuration is supported for all devices.”

**Note:** Under Windows 2000, drive letter assignments will not change when drives are added or removed by way of a docking event. That is, all drives in the mobile PC will retain their originally assigned drive letters. Designers should note this differing capability in comparison with Windows 95/98.

### **6.34. Docking station supports warm docking**

#### *Required*

Recommended: Support hot docking.

Docking or undocking a mobile unit from a docking station must not require powering off the system and must not require a system reboot.

Removable ATA devices in the docking station and the mobile unit are required to report changes using ACPI-based methods.

### 6.35. Docking system supports fail-safe docking

#### *Required*

The system must provide a fail-safe mechanism for attaching and detaching the mobile unit. The mechanism, in combination with operating system capabilities and methods defined in Sections 6.3 and 5.63 of the ACPI 1.0 specification, must ensure the following:

- The undock button signals the user's intent to the system.
- Docking can occur only when the mobile unit is in the correct power state. The power state depends on whether the system is designed to support cold, warm, or hot docking.
- The user can initiate undocking through Windows-based software choices. Notice, however, that a hardware "button" must also be provided, because experience shows that users often do not find the software option and remove mobile units without operating system notification.
- The undock button or software choice sends a signal to the operating system so that the user is warned if resources are in danger of being lost.
- A safe-undock indicator is provided so the user can identify when it is safe to remove the mobile unit. This can be an LED or any other mechanism chosen by the vendor. If a physical mechanism automatically undocks the mobile PC or if hot docking is supported, then the safe-undock indicator is not required.

There is no requirement for mechanical lockout to block the user from removing the mobile unit without operating-system notification.

### 6.36. Docking station includes an IEEE 1394 port

#### *Recommended*

it is recommended that the docking station include at least one IEEE 1394 port, as defined in requirement 3.26, "System includes support for IEEE 1394."

Requirements for implementing IEEE 1394 on a docking station are defined in Chapter 8, "IEEE 1394."

### 6.37. Docking station/mobile pair meets PC 99 audio requirements

#### *Recommended*

**PC 99A clarification:** It is not required that a mobile/docking station pair implement audio. The requirements listed in item 6.37 apply only if audio is implemented.

If audio is implemented, the docking station/mobile PC pair must meet the requirements for PC 99 audio as defined in Chapter 17, "Audio Components," with additional requirements as follows:

- The user must be able to select speakers in the mobile unit or the docking station.

**PC 99A clarification:** System vendors can choose to automate the process either in the docking station or the mobile PC to meet this requirement. For example, instead of offering a UI where the user can select speakers, the system manufacturer can configure the pair to automatically turn on the docking station speakers and turn off the mobile PC speakers when in the docked configuration.

The objective of this requirement is to ensure that users can access the highest quality audio output in any given configuration. If speakers are selected automatically, the vendor should prevent multiple outputs from occurring simultaneously. If speakers are not automatically selected, then a manual selection process must be offered to the user. Additionally, the speakers should be switched off if the headphone or line-out jacks are used.

- The docking station is not required to implement full desktop audio capabilities, but it can supplement the audio capabilities of the mobile unit.

## Mini-Dock Requirements

A mobile PC with a mini-dock does not need to meet the expansion card requirements and does not need to meet all the resource requirements of a mobile PC/docking station combination. A mini-dock is not required to provide an undock or eject button.

However, some mobile PC system designs include a mini-dock that has dedicated features for networking, additional CardBus slots, a CD drive, and so on. This means that the system could have additional resource requirements to the point that all available IRQs in the system are already allocated; in this case, the CardBus slots (for example) would not have any IRQs available, rendering them useless.

In such cases, the mini-dock must contain devices that replace any devices in the mobile PC that do not meet the IRQ, DMA, I/O port, and memory requirements for PC 99. This allows the operating system to disable the device on the mobile PC, to enable the corresponding device on the mini-dock, and then to arbitrate resources among the remaining devices in the mobile unit and on the mini-dock.

The requirements in this section apply for any mini-dock designed for a PC 99 mobile PC. There is no requirement that a mobile PC must have a mini-dock.

### **6.38. Mini-dock supports automatic resource assignment and dynamic disable capabilities for replacement devices**

#### *Required*

A mini-dock that can accept expansion cards must contain devices that replace any devices in the mobile PC not meeting PC 99 requirements for IRQ, DMA, I/O port, and memory resources. This allows the operating system to disable the device on the mobile PC, enable the corresponding device on the mini-dock, and

arbitrate resources among the remaining devices in the mobile unit and on the mini-dock.

Devices in the system must be capable of being dynamically disabled so that the user can choose to free resources in order to allow other devices in the system to function.

**Tip:** To avoid resource shortages, the system designer can take advantage of the capability of Yenta-compliant CardBus controllers' capability to assign a shared PCI interrupt for R2 PC Cards, rather than using IRQs, as defined in requirement 12.23, "PC Card 16 card driver supports sharing of level-mode interrupts." For information, see the related article at <http://www.microsoft.com/hwdev/cardbus/>.

### **6.39. Mini-dock supports warm docking**

*Required*

Docking or undocking a mobile unit from a mini-dock must not require powering off the system and must not require a system reboot.

Removable ATA devices in the mini-dock and the mobile unit are required to report changes using ACPI-based methods.

### **6.40. Mini-dock supports fail-safe docking**

*Required*

The system must provide a fail-safe mechanism for attaching and detaching the mobile unit. The mechanism, in combination with operating system capabilities and methods defined in Sections 5.63 and 6.3 of the ACPI 1.0 specification, must ensure the following:

- Docking can occur only when the mobile unit is in the correct power state. The power state depends on whether the system is designed to support cold, warm, or hot docking.
- The mini-dock has an undock button that signals the user's intent to the system.
- The user can initiate undocking through a Windows-based software choice or the hardware undock button. Either choice must cause a signal to be sent to the operating system so that the user is warned if resources are in danger of being lost.
- A safe-undock indicator must be provided so the user can identify when it is safe to remove the mobile unit. The indicator can be an LED or any other mechanism chosen by the vendor. If a physical mechanism automatically undocks the mobile PC or if hot docking is supported, then the safe-undock indicator is not required.

There is no requirement for mechanical lockout to block the user from removing the mobile unit without operating system notification.

**6.41. Mini-dock includes an IEEE 1394 port***Recommended*

The mini-dock can include a IEEE 1394 port. Requirements for implementing IEEE 1394 on a mini-dock are defined in Chapter 8, "IEEE 1394," with the exceptions defined in requirement 6.7, "Mobile PC includes an IEEE 1394 port."

Recommended: If the mini-dock includes IEEE 1394 capabilities and has a combination of more than one internal and external ports, the mini-dock should maintain its source of power when the mobile PC unit is removed from the mini-dock.

## Mini-notebook Guidelines

This section summarizes specific requirements for mini-notebook mobile PCs. A mini-notebook is defined as a system that has a carry weight of three pounds or less, including all hardware required to run the Windows operating system.

**6.42. Mini-notebook performance meets PC 99 minimum requirements***Required*

For mini-notebook systems, the minimum PC 99 performance requirements consist of the following:

- System includes all functionality required to run the Windows operating system.
- System can support synchronization of personal information management (PIM), file, and e-mail with a PC 99 desktop system.

This connectivity requirement can be satisfied by the inclusion of one or more of the following components: parallel port, serial port, IrDA port, USB, CardBus, modem, LAN, or wireless connection.

- Minimum required CPU performance is 233-MHz processor with no L2 cache.
- Minimum required system memory is 16 MB.

The PC 99 basic system requirements apply: no more than 4 MB of system memory can be locked and unavailable to the operating system.

- Minimum required primary display surface is 640 × 480 × 8 bpp.

Compliance with 15-bpp or 16-bpp specifications is recommended.

All other Mobile PC 99 and PC 99 basic system requirements beyond those listed here as the minimum requirements are optional for mini-notebooks, including the requirement for supporting an external keyboard and point device or ICC color management.

## Mobile PC 99 References

The following represents some of the references, services, and tools available to help build hardware that is optimized to work with Windows operating systems.

*Accelerated Graphics Port Interface Specification, Revision 1.0 and later*  
<http://developer.intel.com/pc-supp/platform/agfxport/>

*Advanced Configuration and Power Interface Specification, Revision 1.0 and later*  
<http://www.teleport.com/~acpi/tech.htm>.

*El Torito—Bootable CD-ROM Format Specification, Version 1.0*  
*Compaq, Intel, Phoenix BIOS Boot Specification, Version 1.01*  
<http://www.ptltd.com/techs/specs.html>

Intel hardware developer site  
<http://developer.intel.com>

Microsoft Windows 98 DDK and Windows 2000 DDK  
 MSDN Professional subscription

*Mobile Power Guidelines '99, Revision 1.0*  
<http://developer.intel.com/design/mobile/intelpower/>

*PCI Revision 2.1 or later*

*PCI Bus Power Management Interface Specification for PCI to CardBus Bridge, Revision 1.0*  
<http://www.pcisig.com>

Plug and Play specifications  
<http://www.microsoft.com/hwdev/respec/pnpspecs.htm>

*Smart Battery Charger Specification, Version 1.0*

*Smart Battery Data Specification, Version 1.0*

*Smart Battery Selector Specification, Version 1.0*

*Smart Battery System Manager Specification, Version 1.0*  
<http://www.sbs-forum.org/specs/index.html>

## Checklist for Mobile PC 99

If a recommended feature is implemented, it must meet the PC 99 requirements for that feature as defined in this document.

6.1. *Mobile PC performance meets Mobile PC 99 minimum requirements*  
 Required

6.2. *Mobile PC supports Smart Battery or ACPI Control Method battery*  
 Required

6.3. *Expansion capabilities of mobile PC are accessible to users*  
 Required



- 6.4. *Mobile PC connections use icons plus keyed or shrouded connectors*  
Required
- 6.5. *Mobile PC includes one USB port*  
Required
- 6.6. *USB-connected device does not maintain fully on power state*  
Required
- 6.7. *Mobile PC includes an IEEE 1394 port*  
Recommended
- 6.8. *Mobile PC includes CardBus*  
Required
- 6.9. *Mobile PC keyboard and pointing device meet PC 99 requirements*  
Required
- 6.10. *Mobile PC includes IR devices compliant with IrDA specifications*  
Recommended
- 6.11. *Mobile PC includes support for installing the operating system*  
Required
- 6.12. *Mobile PC includes audio that meets Mobile PC 99 audio requirements*  
Recommended
- 6.13. *Mobile PC includes communications device*  
Recommended
- 6.14. *Mobile system supports hot-pluggable devices and alternative network connections*  
Recommended
- 6.15. *Mobile system meets Mobile Power Guidelines '99*  
Recommended
- 6.16. *Mobile system includes CD or DVD drive*  
Recommended
- 6.17. *Mobile system meets Manageability Baseline requirements*  
Required if Windows 2000 is preinstalled
- 6.18. *Built-in display adapter meets Mobile PC 99 minimum capability*  
Required
- 6.19. *Built-in display adapter with 3-D hardware acceleration capabilities meets Mobile PC 99 minimum capability*  
Required
- 6.20. *Mobile system meets Mobile PC 99 requirements for supporting multiple adapters and multiple monitors*  
Required
- 6.21. *External graphics adapter interface supports DDC monitor detection*  
Required
- 6.22. *Mobile system with MPEG-2 or DVD playback features meets Mobile PC 99 requirements for video playback*  
Required
- 6.23. *Mobile system with AGP supports meets Mobile PC 99 requirements*  
Required
- 6.24. *System meets Mobile PC 99 requirements if television output is implemented*  
Required
- 6.25. *Built-in mobile display supports ICC color management*  
Required

- 6.26. System supports PCI docking through a bridge connector  
*Recommended*
- 6.27. Docked mobile PC supports state change notification using ACPI  
*Required*
- 6.28. Docked mobile PC has the ability to identify the specific model of the dock  
*Required*
- 6.29. Docked mobile PC has the ability to uniquely identify the dock  
*Required*
- 6.30. Mobile PC/docking station combination meets PC 99 requirements  
*Required*
- 6.31. Docking station meets all PC 99 system requirements  
*Required*
- 6.32. Mobile/docking station interface is supported using ACPI-defined mechanisms  
*Required*
- 6.33. Mobile PC/docking station combination supports automatic resource assignment and dynamic disable capabilities  
*Required*
- 6.34. Docking station supports warm docking  
*Required*
- 6.35. Docking system supports fail-safe docking  
*Required*
- 6.36. Docking station includes an IEEE 1394 port  
*Recommended*
- 6.37. Docking station/mobile pair meets PC 99 audio requirements  
*Recommended*
- 6.38. Mini-dock supports automatic resource assignment and dynamic disable capabilities for replacement devices  
*Required*
- 6.39. Mini-dock supports warm docking  
*Required*
- 6.40. Mini-dock supports fail-safe docking  
*Required*
- 6.41. Mini-dock includes an IEEE 1394 port  
*Recommended*
- 6.42. Mini-notebook performance meets PC 99 minimum requirements  
*Required*

