CHAPTER 21

Portable Computing

In this chapter, you will learn how to

- Describe the many types of portable computing devices available
- Enhance and upgrade portable computers
- Manage and maintain portable computers
- Troubleshoot portable computers

There are times when the walls close in, when you need a change of scenery to get that elusive spark that inspires greatness…or sometimes you just need to get away from your coworkers for a few hours because they're driving you nuts! For many occupations, that's difficult to do. You must have access to your documents and spreadsheets; you can't function without e-mail or the Internet. In short, you need a computer to get your job done.

Portable computing devices combine mobility with accessibility to bring you the best of both worlds; put more simply, portables let you take some or even all of your computing capabilities with you when you go. Some portable computers feature Windows XP/Vista/7 systems with all the bells and whistles and all your Microsoft Office apps for a seamless transition from desk to café table. Even the smallest portable devices enable you to check your appointments and address book, or surf the net during the endless wait at the doctor's office. This chapter takes an in-depth look at portables, first going through the major variations you'll run into and then hitting the tech-specific topics of enhancing, upgrading, managing, and maintaining portable computers. Let's get started!

Essentials

Portable Computing Devices

All portable devices share certain features. For output, they have LCD screens, although these vary from 20-inch behemoths to microscopic 2-inch screens. Portable computing devices employ sound of varying quality, from simple beeps to fairly nice music reproductions. All of them run on DC electricity stored in batteries, although several different technologies offer a range of battery life, lifespan, and cost. Other than screen,

sound, and battery, portable computing devices come in an amazing variety of shapes, sizes, and intended uses.

EXAM TIP Note that this chapter does not have a Historical/Conceptual section. Everything in here is on the CompTIA A+ certification exams, so pay attention!

LCD Screens

Laptops come in a variety of sizes and at varying costs. One major contributor to the overall cost of a laptop is the size of the LCD screen. Most laptops offer a range between 12-inch to 17-inch screens (measured diagonally), while a few offer just over 20-inch screens. Not only are screens getting larger, but also wider screens have become the status quo.

Many manufacturers are phasing out the standard 4:3 aspect ratio screen in favor of the widescreen format. *Aspect ratio* is the comparison of the screen width to the screen height. Depending on screen resolution, widescreens can have varying aspect ratios of 10:6, 16:9, 16:9.5, or 16:10. The 16:9 aspect ratio is the standard for widescreen TVs and 16:10 is the standard widescreen computer display.

Laptop LCD screens come in a variety of supported resolutions, described with acronyms such as XGA, WXGA, WSXGA, and more. The *W* in front of the letters indicates widescreen. Table 21-1 lists commonly supported laptop display resolutions.

Acronym	Name	Native Resolution
XGA	eXtended Graphics Array	1024 × 768
WXGA (16x10)	Wide eXtended Graphics Array	1280 × 800
WXGA (16x9)	Wide eXtended Graphics Array	1366 × 768
SXGA	Super eXtended Graphics Array	1280 × 1024
SXGA+	Super eXtended Graphics Array Plus	1400 × 1050
WSXGA+	Widescreen SXGA Plus	1680 × 1050
UXGA	Ultra eXtended Graphics Array	1600 × 1200
WUXGA	Widescreen UXGA	1920 × 1200

Table 21-1 Screen Resolutions

Laptop screens come with two types of finish: *matte* and *high gloss*. The matte finish was the industry standard for many years and offered a good trade-off between richness of colors and reflection or glare. The better screens have a wide viewing angle and decent response time. The major drawback for matte-finished laptop screens is that they wash out a lot in bright light. Using such a laptop at an outdoor café, for example, is almost hopeless during daylight.

Manufacturers released high-gloss laptop screens in 2006, and they've rapidly taken over many store shelves. The high-gloss finish offers sharper contrast, richer colors, and wider viewing angles when compared to the matte screens. Each manufacturer has a different name for high-gloss coatings. Dell calls theirs TrueLife, Acer calls theirs CrystalBrite, and HP calls theirs BrightView. The drawback to the high-gloss screens is that, contrary to what the manufacturers claim, they pick up lots of reflection from nearby objects, including the user! So although they're usable outside during the day, you'll need to contend with increased reflection as well.

Desktop Replacements

When asked about portable computing devices, most folks describe the traditional clamshell *laptop* computer, such as the one in Figure 21-1, with built-in LCD monitor, keyboard, and input device (a *touchpad*, in this case). A typical laptop computer functions as a fully standalone PC, potentially even replacing the desktop. The one in Figure 21-1, for example, has all of the features you expect the modern PC to have, such as a fast CPU, lots of RAM, a high-capacity hard drive, CD-RW and DVD drives, an excellent sound system, and a functioning copy of Windows. Attach it to a network and you can browse the Internet and send e-mail. Considering that it weighs almost as much as a mini-tower PC (or at least it feels like it does when I'm lugging it through the airport!), such a portable can be considered a *desktop replacement*, because it does everything most people want to do with a desktop PC and doesn't compromise performance just to make the laptop a few pounds lighter or the battery last an extra hour.

Figure 21-1
A notebook PC

NOTE No industry standard exists for the vast majority of styles of portable computing devices, so manufacturers let their marketing folks have fun with naming. What's the difference between a portable, a laptop, and a notebook? Nothing. One manufacturer might call its four-pound portable system with a 12-inch LCD a notebook, while another manufacturer might call its much larger desktop-replacement portable a notebook as well. A laptop refers in general to the clamshell, keyboard-on-the-bottom and LCD-screen-at-the-top design that is considered the shape of mobile PCs.

For input devices, desktop replacements (and other portables) used trackballs in the early days, often plugged in like a mouse and clipped to the side of the case. Other models with trackballs placed them in front of the keyboard at the edge of the case nearest the user, or behind the keyboard at the edge nearest the screen.

The next wave to hit the laptop market was IBM's *TrackPoint* device, a joystick the size of a pencil eraser, situated in the center of the keyboard. With the TrackPoint, you can move the pointer around without taking your fingers away from the "home" typing position. You use a forefinger to push the joystick around, and then click or right-click, using two buttons below the spacebar. This type of pointing device has since been licensed for use by other manufacturers, and it continues to appear on laptops today.

But by far the most common laptop pointing device found today is the *touchpad* (Figure 21-2)—a flat, touch-sensitive pad just in front of the keyboard. To operate a touchpad, you simply glide your finger across its surface to move the pointer, and tap the surface once or twice to single- or double-click. You can also click by using buttons just below the pad. Most people get the hang of this technique after just a few minutes of practice. The main advantage of the touchpad over previous laptop pointing devices is that it uses no moving parts—a fact that can really extend the life of a hard-working laptop. Some modern laptops actually provide both a TrackPoint-type device and a touchpad, to give the user a choice.

Figure 21-2 Touchpad on a laptop

Desktop Extenders

Manufacturers offer *desktop extender* portable devices that don't replace the desktop but rather extend it by giving you a subset of features of the typical desktop that you can take away from the desk. Figure 21-3 shows a portable with a good but small 13.3-inch wide screen. The system has 2 GB of RAM, a 2-GHz processor, a 60-GB hard drive, and a battery that enables you to do work on it for more than five hours while disconnected

Figure 21-3 Excellent mid-sized portable computer

from the wall socket. Even though it plays music and has a couple of decent tiny speakers, you can't game on this computer (Solitaire, perhaps, but definitely not Crysis!). But it weighs only five pounds, nearly half the weight of the typical desktop replacement portable.

Before you get excited about a mere five-pound laptop, know that the numbers can lie. Manufacturers advertise the weight of portable PCs, for the most part, without the weight of the battery or the removable drives. Although this deception is deplorable, it's pretty much universal in the industry because no manufacturer wants to be the first to say that their desktop-replacement portable, including battery and DVD-RW drive, weighs 15 pounds, when their competitor advertises the same kind of machine at 7.5 pounds! They'd lose market share quickly.

So when you shop or recommend portable PCs, take the real weight into consideration. By the time you fill your laptop bag with a power adapter, external mouse, spare battery, and all the extra accessories, you'll definitely be carrying more than the advertised 5–6 pounds.

Desktop extenders enable you to go mobile. When I'm on a roll writing, for example, I don't want to stop. But sometimes I do want to take a break from the office and stroll over to my favorite café for a latté or a pint of fine ale. At moments like these, I don't need a fully featured laptop with a monster 15-inch or 17-inch screen, but just a good word processing system—and perhaps the ability to surf the Internet on the café's wireless network so I can ~~goof off~~ research other important topics once I finish my project for the day. A lightweight laptop with a 12-inch or 13-inch screen, a reasonably fast processor, and gobs of RAM does nicely.

Netbooks

Netbooks are computers that fill the gap between PDAs and the smaller laptops. These machines usually have displays in the 6- to 10-inch range, modest-sized hard drives,

and CPUs geared more for minimal power usage than raw speed. With netbooks, the focus is on small and low priced compared to their more full-featured cousins. This segment of the market is ever evolving, though, and there is quite a bit a blurring between the various classes of laptops.

A prime example of the netbook is the Asus Eee PC, shown in Figure 21-4 sitting on a full-sized laptop. This netbook has a 9-inch screen, a 1.6-GHz Intel Atom CPU, a small solid-state drive, and runs a customized Linux distribution. A key distinguishing feature of these netbooks is the use of Intel's Atom processor. The Atom CPU is very useful for keeping power usage down but has much less computing power than its more power-hungry siblings. Therefore, most netbooks run either Windows XP or some form of Linux that is better suited for their limited resources.

Figure 21-4 Asus Eee PC sitting on a normal laptop

NOTE At the time that this book went to press, some netbooks had started shipping with Windows 7 Starter OS, a stripped-down version of Windows 7 designed to use resources such as RAM and CPU processing as lightly as possible.

PDAs and Smartphones

Having a few computing essentials on hand at all times eases the day and makes planning and scheduling much more likely to succeed. Several companies, such as Palm, Apple, HTC, RIM, and Hewlett-Packard manufacture tiny handheld portable computing devices that hold such data as your address book, appointment schedules, music, movies, and more. Such machines are called *personal digital assistants* (*PDAs*), or smartphones if they have calling capabilities. All modern PDAs have many applications, such as Web browsers for surfing the Web on the go, some sort of note-taking application for jotting down quick notes, and many more. Figure 21-5 shows an Apple iPhone smartphone.

Figure 21-5
Apple iPhone

EXAM TIP Sadly, the heavy Windows-only attitude of the CompTIA A+ exams means you won't get any questions about the Apple iPhone. All the same, the iPhone is a *great* example of what a smartphone should be; I own one.

PDAs don't run Windows XP or Vista but rather require specialized OSs such as Windows Mobile, Google Android, Apple iPhone OS, Palm WebOS, and various forms of Linux. All of these OSs provide a GUI that enables you to interact with the device by touching the screen directly. Many of today's PDAs use handwriting recognition combined with modified mouse functions, usually in the form of a pen-like *stylus* to make a type of input called *pen-based computing*. To make an application load, for example, you would slide the stylus out of its holder in the PDA case and touch the appropriate icon with the stylus tip.

Sync

PDAs make excellent pocket companions because you can quickly add a client's address or telephone number, verify the day's schedule before going to your next meeting, and check your e-mail. Best of all, you can then update all the equivalent features on your desktop PC automatically! PDAs synchronize with your primary PC so you have the same essential data on both machines. Many PDAs come with a cradle, a place to rest your PDA and recharge its battery. The cradle connects to the PC most often through a USB port. You can run software to synchronize the data between the PDA and the main PC. Setting up for a PDA running Windows Mobile, for example, requires you to install a program called Activesync if you're using Windows XP. Vista and Windows 7 drop Activesync and use the built-in *Windows Mobile Device Center* (*WMDC*). This software handles all the synchronization chores. You simply place the PDA in the properly connected cradle to synchronize. Figure 21-6 shows a PDA in the middle of a sync operation.

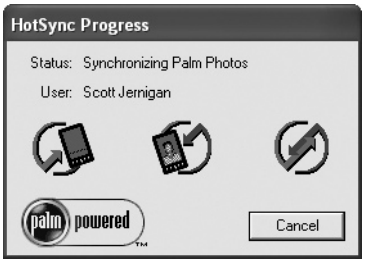


Figure 21-6 WMDC in progress

PDA to PDA Communication

Just about every PDA comes with a way to move data from one PDA to another. The original technology for this is called IrDA and the process is called *beaming*. IrDA uses infrared light just like a TV remote to transmit the data between devices. You can use beaming to quickly transfer contact info or small pictures, but larger files take much longer because of IrDA's slow speed.

Today, the primary way to move data between PDAs is with radio waves, be it Bluetooth, Wi-Fi, or what CompTIA calls *Cellular WAN*. Bluetooth can be thought of as the most direct replacement for the old IrDA tech. When you wish to transfer files between two Bluetooth devices, you first make each device *discoverable*, which allows other devices in the area to see that it exists. On the sending device, you then select the PDA you wish to send to. The receiving device asks you if you wish to accept the file, and once that's granted, you simply stand there and wait for a moment while the PDAs transfer data. Slick!

With Wi-Fi and Cellular WAN, your PDA acts just like any other computer on a network. You will have an IP address and—depending on the OS your PDA is running—the capability to share files and data. Most PDAs today use a touch screen for entering data and use IrDA, Wi-Fi, and/or Bluetooth connections to communicate with other devices.

NOTE Chapter 24, "Wireless Networking," goes into more detail on all these technologies.

PDA Storage

Almost every PDA has both internal flash ROM memory of 1 MB or more and some sort of removable and upgradeable storage medium. Secure Digital (SD) technology has the strongest market share among the many competing standards, but you'll find a bunch of different memory card types out there. SD is by far the most popular, with the cards coming in a variety of physical sizes (SD, Mini SD, and Micro SD) and fitting in a special SD slot. You'll find capacities ranging from 4 MB up to 32 GB—on a card the size of a postage stamp! Figure 21-7 shows some typical memory cards.

Figure 21-7
SD and Micro SD cards

NOTE Memory cards made the leap in 2003 from the exclusive realm of tiny devices such as PDAs and digital photographic cameras to full-featured portable PCs and even desktop models. Many laptop PCs sport SD card slots, for example, and you can expect nearly every Sony PC—portable or otherwise—made in 2003 and later to offer a Memory Stick port.

Tablet PCs

Tablet PCs combine the hand-writing benefits of PDAs with the full-fledged power of traditional portable PCs to create a machine that perfectly meets the needs of many professions. Unlike PDAs and smartphones, tablet PCs use a full-featured PC operating system such as Microsoft Vista Home Premium and up.

Instead of (or in addition to) a keyboard and mouse, tablet PCs provide a screen that doubles as an input device. With a special pen, called a *stylus*, you can actually write on the screen (see Figure 21-8). Just make sure you don't grab your fancy Cross ballpoint pen accidentally and start writing on the screen! Unlike many PDA screens, most tablet PC screens are not pressure sensitive—you have to use the stylus to write on the screen. Tablet PCs come in two main form factors: *convertibles*, which include a keyboard that you can fold out of the way, and *slates*, which do away with the keyboard entirely. The convertible tablet PC in Figure 21-8, for example, looks and functions just like the typical clamshell laptop shown back in Figure 21-1. But here it's shown with the screen rotated 180 degrees and snapped flat so it functions as a slate. Pretty slick!

Figure 21-8
A tablet PC

In applications that aren't "tablet-aware," the stylus acts just like a mouse, enabling you to select items, double-click, right-click, and so on. To input text with the stylus, you can either tap keys on a virtual keyboard (shown in Figure 21-9), write in the writing utility (shown in Figure 21-10), or use speech recognition software. With a little practice, most users find the computer's accuracy in recognizing their handwriting to be sufficient for most text input, although speedy touch-typists will probably still want to use a keyboard when typing longer documents.

NOTE Handwriting recognition and speech recognition are two technologies that benefit greatly from increased CPU power. As multicore CPUs become more common, get ready to see more widespread adoption of these technologies.

Tablet PCs work well when you have limited space or have to walk around and use a laptop. Anyone who has ever tried to type with one hand while walking around the factory floor and holding the laptop with the other hand will immediately appreciate the beauty of a tablet PC. In this scenario, tablet PCs are most effective when combined with applications designed to be used with a stylus instead of a keyboard. An inventory control program, for example, might present drop-down lists and radio buttons to the user, making a stylus the perfect input tool. With the right custom application, tablet PCs become indispensable tools.

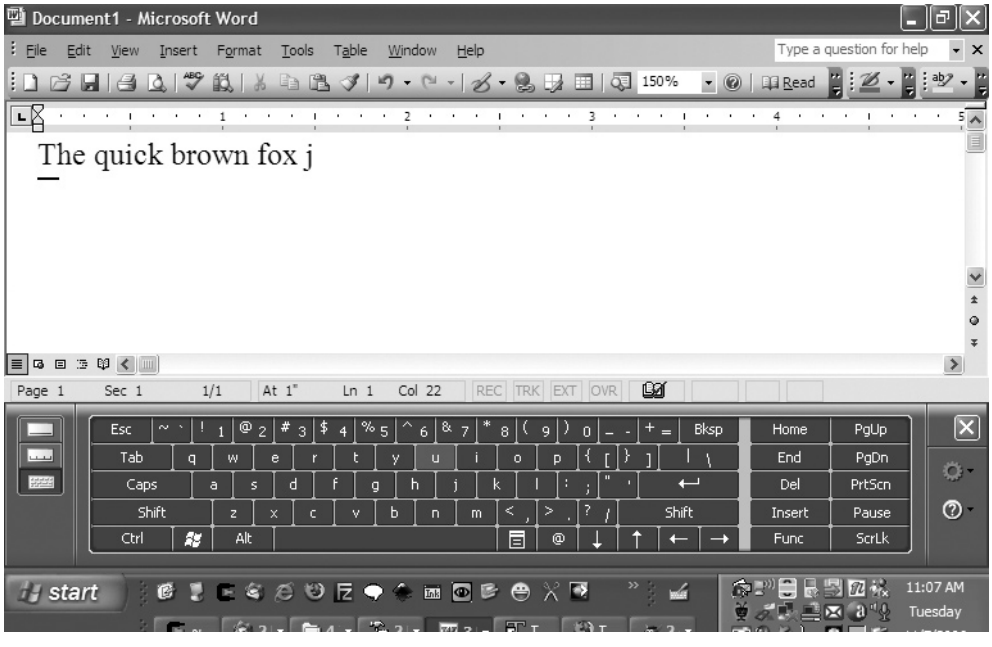


Figure 21-9 The virtual keyboard

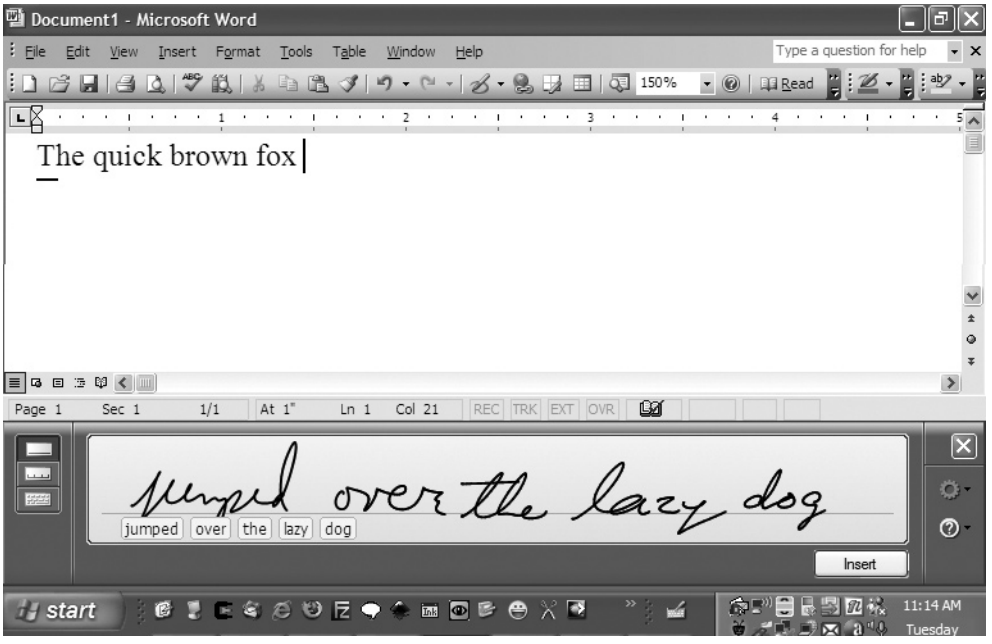


Figure 21-10 The writing pad

Microsoft encourages software developers to take advantage of a feature they call *digital ink*, which allows applications to accept pen strokes as input without first converting the pen strokes into text or mouse-clicks. In Microsoft Journal, which comes with Windows-based tablet PCs, you can write on the screen just as though you were writing on a paper legal pad (see Figure 21-11). Many other applications, including Microsoft Office, allow you to add ink annotations. Imagine sitting on an airplane reviewing a Microsoft Word document and simply scribbling your comments on the screen (Figure 21-12). No more printing out hard copy and breaking out the red pen for me! Imagine running a PowerPoint presentation and being able to annotate your presentation as you go. In the future, look for more applications to support Microsoft's digital ink.

Many useful third-party applications are designed specifically to take advantage of the tablet PC form-factor. In fields such as law and medicine, where tablet PCs have been especially popular, the choices are endless. One handy free utility that anyone who spends time in front of an audience (teachers, salespeople, cult leaders, and so on) will appreciate is InkyBoard (www.cfcassidy.com/Inkyboard). InkyBoard provides a virtual dry-erase board, eliminating the need to find a flip chart or dry-erase board when holding meetings. Ever wished you could have a record of everything that was written on the chalkboard in a class (or business meeting)? If the professor had used InkyBoard, creating and distributing a copy would be a snap.

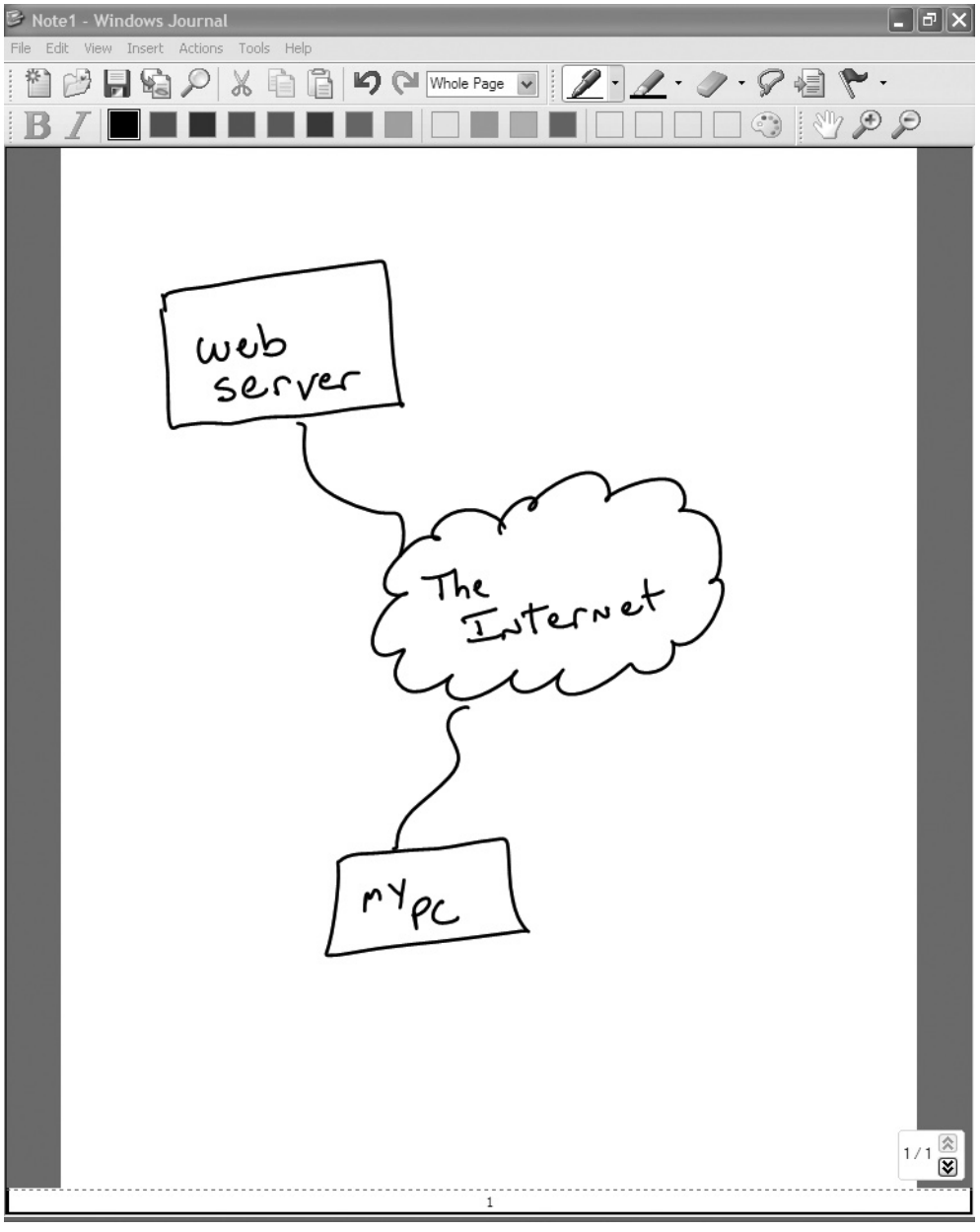


Figure 21-11 Microsoft Journal preserves pen strokes as digital ink.

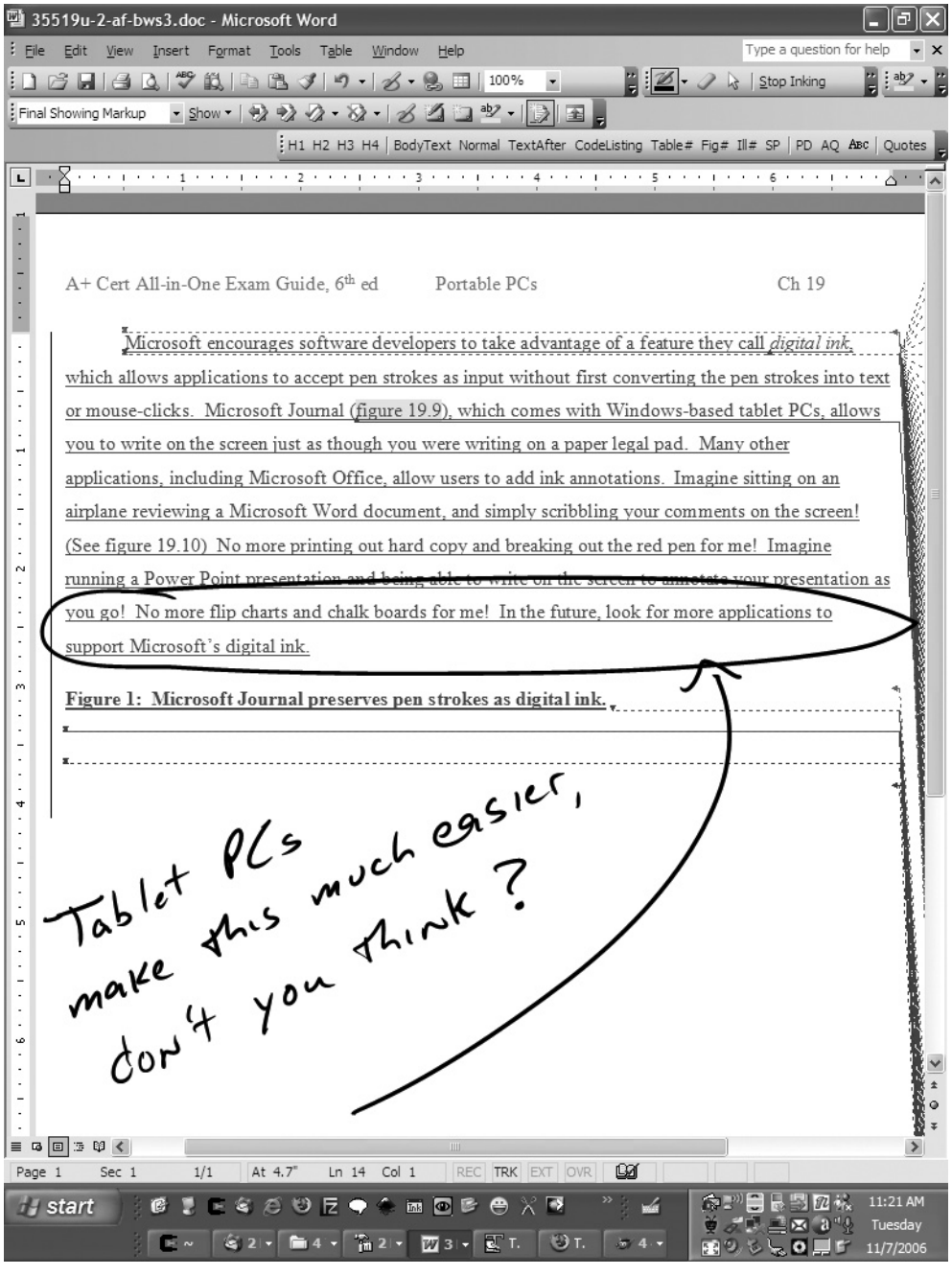


Figure 21-12 Microsoft Office supports digital ink.

Portable Computer Device Types

Sorting through all the variations of portable computing devices out there would take entirely too much ink (and go well beyond CompTIA A+). Table 21-2 lists the seven most common styles of portable computing devices, some of their key features, and the intended use or audience for the product. This table is in no way conclusive, but lists the highlights.

	Screen Size	Weight	Features	Uses
Desktop replacements	14–20 inch+	8–12+ lbs	Everything on a desktop.	Mobile multimedia editing, presentations, mobile gaming.
Desktop extenders	10–14 inch	4–7 lbs	Almost everything you'll find on a desktop. Better battery life than desktop replacements.	Presentations, note-taking in class or meetings, t raveling companion for business folks.
Netbooks	6–10 inch	2–3 lbs	Ultimate mobility without sacrificing full PC status. Excellent battery life. No optical drives, limited SSD storage or modest HDD storage.	Long-term traveling companion and small enough to fit in a purse or backpack. Perfect for Web browsing or doing e-mail on the road.
Tablet PCs	10–12 inch	4 lbs	Pen-based interface so you can use them like a paper notepad; no optical drives but integrated wireless networking.	Niche market for people who need handwritten notes that have to be transcribed to the PC.
Ultra mobile PCs	4–7 inch	1–2 lbs	A variation of tablet PCs, UMPCs have Windows XP (Tablet or Home edition), pen-based or touch pad interface, and no optical drives.	More of a niche market than tablet PCs, UMPCs have been overshadowed by netbooks.
PDAs	Up to 4 inches	1 lb	Light, multifunctional devices that carry address book, scheduler, and such features as MP3 and video playback.	Helps busy people stay organized. Classic PDAs (without telephone functions) are rare today except for specialized uses (hospitals, point-of-sale).
Smartphones	Up to 4 inches	< 1 lbs	Tiny PDAs built into a cell phone; offer Web browsing, SMS, and other Internet connectivity features.	Reduces the number of gadgets some folks carry. Have all but replaced standard PDAs.

Table 21-2 Portable Computing Devices

Portables come in such a dizzying variety of sizes, styles, features, and shapes that a simple table in a book cannot do justice to the ingenuity and engineering of the manufacturers of these devices. If you want to wander into the realm of extremes, check out www.dynamism.com. This company specializes in bringing Japanese-only products to the English-speaking market. You'll find the hottest desktop replacement laptops and the sleekest subnotebooks at the site, with all the details beautifully converted from native Japanese to English.

Practical Application

Enhancing and Upgrading Portable Computers

In the dark ages of mobile computing, you had to shell out top dollar for any device that would unplug, and what you purchased was what you got. Upgrade a laptop? Add functions to your desktop replacement? You had few if any options, so you simply paid for a device that would be way behind the technology curve within a year and functionally obsolete within two.

EXAM TIP With fully 1 in 5 questions covering laptops and portables, pay attention to this chapter when studying for the CompTIA A+ certification!

Portable PCs today offer many ways to enhance their capabilities. Internal and external expansion buses enable you to add completely new functions to portables, such as attaching a scanner or mobile printer or both. You can take advantage of the latest wireless technology breakthrough simply by slipping a card into the appropriate slot on the laptop. Further, modern portables offer a modular interior. You can add or change RAM, for example—the first upgrade that almost every laptop owner wants to make. You can increase the hard drive storage space and, at least with some models, swap out the CPU, video card, sound card, and more. Gone forever are the days of buying guaranteed obsolescence! Let's look at four specific areas of technology that laptops use to enhance functions and upgrade components: PC Cards, single- and multiple-function expansion ports, and modular components.

PC Cards

The *Personal Computer Memory Card International Association* (*PCMCIA*) establishes standards involving portable computers, especially when it comes to expansion cards, which are generically called PC Cards. *PC Cards* are roughly credit-card sized devices that enhance and extend the functions of a portable PC. PC Cards are as standard on today's mobile computers as the hard drive. PC Cards are easy to use, inexpensive, and convenient. Figure 21-13 shows a typical PC Card.

Figure 21-13
PC Card

EXAM TIP CompTIA uses the older term PCMCIA cards to describe PC Cards. Don't be shocked if you get that as an option on your exams! You'll hear many techs use the phrase as well, though the PCMCIA trade group has not used it for many years.

Almost every portable PC has one or two PC Card slots, into which you insert a PC Card. Each card has at least one function, but many have two, three, or more! You can buy a PC Card that offers connections for removable media, for example, such as combination SD and CF card readers. You can also find PC Cards that enable you to plug into multiple types of networks. All PC Cards are hot-swappable, meaning you can plug them in without powering down the PC.

EXAM TIP Many manufacturers use the term *hot-pluggable* rather than hot-swappable to describe the ability to plug in and replace PC Cards on the fly. Look for either term on the exams.

The PCMCIA has established two versions of PC Cards, one using a parallel bus and the other using a serial bus. Each version, in turn, offers two technology variations as well as several physical varieties. This might sound complicated at first, but here's the map to sort it all out.

Parallel PC Cards

Parallel PC Cards come in two flavors, *16-bit* and *CardBus*, and each flavor comes in three physical sizes, called Type I, Type II, and Type III. The 16-bit PC Cards, as the name suggests, are 16-bit, 5-V cards that can have up to two distinct functions or devices, such as a modem/network card combination. CardBus PC Cards are 32-bit, 3.3-V cards that can have up to eight (!) functions on a single card. Regular PC Cards fit into and work in CardBus slots, but the reverse is not true. CardBus totally dominates the current PC Card landscape, but you might still run into older 16-bit PC Cards.

Type I, II, and III cards differ only in the thickness of the card (Type I being the thinnest, and Type III the thickest). All PC Cards share the same 68-pin interface, so any PC Card will work in any slot that accepts that card type. Type II cards are by far the most common of PC Cards. Therefore, most laptops have two Type II slots, one above the other, so the computer can accept two Type I or II cards or one Type III card (Figure 21-14).

Figure 21-14 PC Card slots

Although PCMCIA doesn't require that certain sizes perform certain functions, most PC Cards follow their recommendations. Table 21-3 lists the sizes and typical uses of each type of PC Card.

Type	Length	Width	Thickness	Typical Use
Type I	85.6 mm	54.0 mm	3.3 mm	Flash memory
Type II	85.6 mm	54.0 mm	5.0 mm	I/O (Modem, NIC, and so on)
Type III	85.6 mm	54.0 mm	10.5 mm	Hard drives

Table 21-3 PC Card Types and Their Typical Uses

NOTE PC Cards typically come with a hard plastic storage case. Always be sure to use this case to store the cards when you're not using them. If dust, dirt, or grime gets into the array of contacts at the end of the card, the card won't work when you try to use it next. Also, be careful when using PC Cards that extend out of the PC Card slot past the edge of your laptop. One dark night I set my laptop on the floor with a PC Card NIC sticking out of it while I went to get a drink of water. On my way back, I accidentally stepped on the card sticking out of my laptop and nearly snapped it in half. Luckily, my laptop wasn't damaged, but the card was toast!

ExpressCard

ExpressCard, the high-performance serial version of the PC Card, has begun to replace PC Card slots on newer laptop PCs. Although ExpressCard offers significant performance benefits, keep in mind that ExpressCard and PC Cards are incompatible. You cannot use your PC Card in your new laptop's ExpressCard socket. The PC Card has had a remarkably long life in portable PCs, and you can still find it on some new laptops, but get ready to replace all of your PC Card devices. ExpressCard comes in two widths: 54 mm and 34 mm. Figure 21-15 shows a 34-mm ExpressCard. Both cards are 75 mm long and 5 mm thick, which makes them shorter than all previous PC Cards and the same thickness as a Type II PC Card.

Figure 21-15 34-mm and 54-mm ExpressCards

ExpressCards connect to either the Hi-Speed USB 2.0 bus or a PCI Express bus. These differ phenomenally in speed. The amazingly slow-in-comparison USB version has a maximum throughput of 480 Mbps. The PCIe version, in contrast, roars in at 2.5 Gbps in unidirectional communication. Very nice!

Table 21-4 shows the throughput and variations for the parallel and serial PC Cards currently or soon to be on the market.

Software Support for PC Cards

The PCMCIA standard defines two levels of software drivers to support PC Cards. The first and lower level is known as *socket services*. Socket services are device drivers that support the PC Card socket, enabling the system to detect when a PC Card has been inserted or removed, and providing the necessary I/O to the device. The second and higher level is

Standard	Maximum Theoretical Throughput
PC Card using 16-bit bus	160 Mbps
CardBus PC Card using PCI bus	1056 Mbps
ExpressCard using USB 2.0 bus	480 Mbps
ExpressCard using PCIe bus	2.5 Gbps

Table 21-4 PC Card Speeds

known as *card services*. The card services level recognizes the function of a particular PC Card and provides the specialized drivers necessary to make the card work.

In today's laptops, the socket services are standardized and are handled by the system BIOS. Windows itself handles all card services and has a large preinstalled base of PC Card device drivers, although most PC Cards come with their own drivers.

NOTE ExpressCards don't require either socket or card services, at least not in the way PC Cards do. The ExpressCard modules automatically configure the software on your computer, which makes them truly plug and play.

Single-Function Ports

All portable PCs and many PDAs come with one or more ports. You'd have a hard time finding a portable computing device that doesn't have a speaker port, and this includes modern PDAs. My Apple iPhone functions as an excellent MP3 player, by the way, a feature now included with most PDAs and smartphones. Some portables have line in and microphone jacks as well. Laptops invariably provide a video port such as a VGA or DVI connection for hooking up an external monitor and a PS/2 port for a keyboard or mouse. Finally, most current portable PCs come with built-in NICs or modems for networking support. (See the "Modular Laptops" section later in this chapter for more on networking capabilities.)

Ports work the same way on portable PCs as they do on desktop models. You plug in a device to a particular port and, as long as Windows has the proper drivers, you will have a functioning device when you boot. The only port that requires any extra effort is the video port.

Most laptops support a second monitor via an analog VGA port or a digital DVI, HDMI, or DisplayPort port in the back of the box. With a second monitor attached, you can display Windows on only the laptop LCD, only the external monitor, or both simultaneously. Not all portables can do all variations, but they're more common than not. Most portables have a special Function (FN) key on the keyboard that, when pressed, adds an additional option to certain keys on the keyboard. Figure 21-16 shows a close-up of a typical keyboard with the Function key; note the other options you can access with the Function key, such as indicated on the F2 key. To engage the second monitor or to cycle through the modes, hold the Function key and press F2.

Figure 21-16 Laptop keyboard showing Function (FN) key that enables you to access additional key options, as on the F2 key

NOTE Although many laptops use the Function key method to cycle the monitor selections, that's not always the case. You might have to pop into the Display applet in the Control Panel to click a checkbox. Just be assured that if the laptop has a VGA or DVI or HDMI port, you can cycle through monitor choices!

General-Purpose Ports

Laptops rarely come with all of the hardware you want. PC Cards/Express cards certainly help, but today's laptops usually include at least USB ports to give you the option to add more hardware. Some laptops still provide legacy general-purpose expansion ports (PS/2, RS-232 serial ports, and so on) for installing peripheral hardware. If you're lucky, you might even get a FireWire port so you can plug in your fancy new digital video camera. If you're really lucky, you will have a docking station or port replicator so you don't have to plug in all of your peripheral devices one at a time.

USB, FireWire, and eSATA

Universal serial bus (USB), FireWire (or more properly, IEEE 1394), and eSATA feature easy-to-use connectors and give users the ability to connect or insert a device into a system while the PC is running—you won't have to reboot a system to install a new peripheral. With USB, FireWire, and eSATA, just plug the device in and go! Because portable PCs don't have a desktop's multiple internal expansion capabilities, USB, FireWire, and eSATA are three of the more popular methods for attaching peripherals to laptops (see Figure 21-17).

NOTE Almost all PDAs and other handheld devices—such as iPod music players—connect to PCs through USB ports. Most come with a USB cable that has a standard connector on one end and a proprietary connector on the other. Don't lose the cable!

Port Replicators

A *port replicator* plugs into a single port on the portable computer—often a USB port but sometimes a proprietary port—and offers common PC ports, such as serial, parallel,

Figure 21-17 Devices attached to USB and FireWire connectors on portable PC

USB, network, and PS/2. By plugging the port replicator into your notebook computer, you can instantly connect the computer to non-portable components such as a printer, scanner, monitor, or a full-sized keyboard. Port replicators are typically used at home or in the office with the nonportable equipment already connected. Figure 21-18 shows a Dell Inspiron laptop connected to a port replicator.

Figure 21-18 Port replicator for a Dell portable computer

The computer can access any devices attached to the port replicator; you don't need to connect each individual device to the PC. As a side bonus, port replicators enable you to attach legacy devices, such as parallel printers, to a new laptop that only has modern multifunction ports such as USB and FireWire and not parallel or serial ports.

NOTE Although portable PCs most often connect to port replicators via USB ports, some manufacturers have proprietary connections for proprietary port replicators. As long as such a portable PC has a USB port, you can use either the proprietary hardware or the more flexible USB devices.

Docking Stations

Docking stations resemble port replicators in many ways, offering legacy and modern single- and multi-function ports (see Figure 21-19). The typical docking station uses a proprietary connection but has extra features built in, such as a DVD drive or PC Card slot for extra enhancements. You can find docking stations for most laptop models, but you'll find them used most frequently with the desktop extenders. A docking station makes an excellent companion to such portables.

Figure 21-19 Docking station

The Modular Laptop

For years, portable PC makers required completely proprietary components for each system model they developed. For the most part, this proprietary attitude prevails, but manufacturers have added some modularity to today's portable PCs so you can make basic replacements and upgrades without going back to the manufacturer for expensive proprietary components. You need to surf the Web for companies that sell the components, because very few storefronts stock them. The most common modular components are RAM, hard drives, CPUs, video cards, optical drives, and network cards.

RAM

Stock factory portable PCs almost always come with a minimal amount of RAM, so one of the first laptop upgrades you'll be called on to do is to add more RAM. Economy laptops running Windows XP Home routinely sit on store shelves and go home to consumers with as little 256 MB of RAM, an amount guaranteed to limit the use and performance of the laptop. The OS alone will consume more than half of the RAM! Luckily, every decent laptop has upgradeable RAM slots. Most older laptops use either 72-pin or 144-pin SO-DIMMs with SDRAM technology. DDR, DDR2, and DDR3 systems primarily use 200-pin SO-DIMMs, although some laptops use micro-DIMMs (Figure 21-20).

Figure 21-20 200-pin SO-DIMM stick (front and back)

TIP The amount of RAM needed to run a PC—portable or otherwise—smoothly and stably depends on both the type of applications that it will run and the needs of the OS. When making a recommendation to a client about upgrading a laptop's memory, you should ask the basic questions, such as what the client plans to do on the laptop. If the laptop will be used for e-mail, word processing, and Web surfing, a medium level of RAM, such as 1 GB, might be adequate for a Vista machine. If the user travels, uses a high-end digital camera, and wants to use Photoshop to edit huge images, you'll need to augment the RAM accordingly. Then add the needs of the OS to give a good recommendation.

How to Add or Replace RAM Upgrading the RAM in a portable PC requires a couple of steps. First, you need to get the correct RAM. Many older portable PCs use proprietary RAM solutions, which means you need to order directly from Dell, HP, or Sony and pay exorbitant prices for the precious extra megabytes. Most manufacturers have taken pity on consumers in recent years and use standard SO-DIMMs or micro-DIMMs. Refer to the manufacturer's Web site or to the manual (if any) that came with the portable for the specific RAM needed.

Second, every portable PC offers a unique challenge to the tech who wants to upgrade the RAM, because there's no standard for RAM placement in portables. More often than not, you need to unscrew or pop open a panel on the underside of the portable (Figure 21-21). Then you press out on the restraining clips and the RAM stick pops up (Figure 21-22). Gently remove the old stick of RAM and insert the new one by reversing the steps.

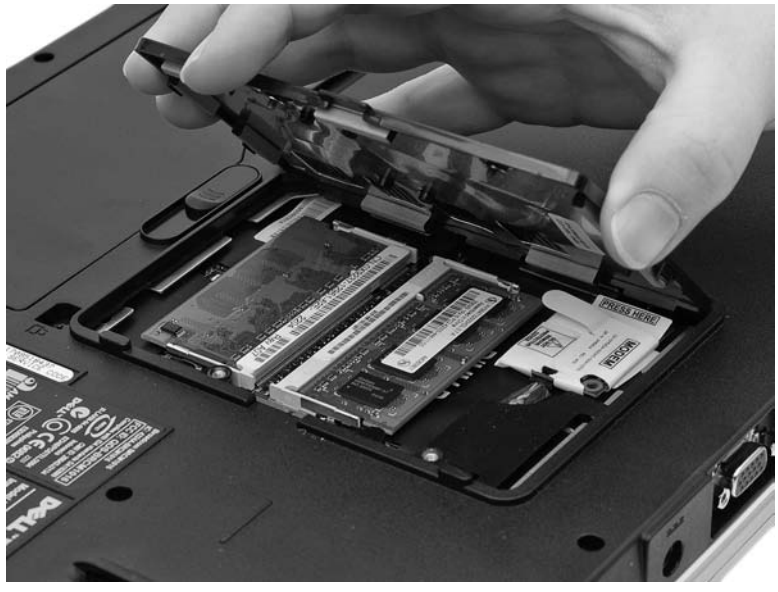


Figure 21-21 Removing a RAM panel

Figure 21-22 Releasing the RAM

Shared Memory Some laptops (and desktops) support *shared memory*. Shared memory reduces the cost of video cards by reducing the amount of memory on the video card itself. Instead of having 256 MB of RAM, the video card might have only 64 MB of RAM but be able to borrow 192 MB of RAM from the system. This equates to a 256 MB video card. The video card uses regular system RAM to make up for the loss.

The obvious benefit of shared memory is a less expensive video card (and a less expensive laptop!) with performance comparable to its mega-memory alternative. The downside is that your overall system performance will suffer because a portion of the system RAM is no longer available to programs. (The term *shared* is a bit misleading because the video card takes control of a portion of RAM. The video portion of system RAM is *not* shared back and forth between the video card processor and the CPU.) Shared memory technologies include TurboCache (developed by NVIDIA) and HyperMemory (developed by ATI).

NOTE You cannot tell if a laptop is using shared memory in Windows. You have to go to CMOS to be sure.

Some systems give you control over the amount of shared memory, while others simply allow you to turn shared memory on or off. The settings are found in CMOS setup and only on systems that support shared memory. Shared memory is not reported to Windows, so don't panic if you have 1 GB of RAM in your laptop but Windows only sees 924 MB—the missing memory is used for video.

Adding more system RAM to a laptop with shared memory will improve laptop performance. Although it might appear to improve video performance, that doesn't tell the true story. It'll improve overall performance because the OS and CPU get more usable RAM. On some laptops, you can improve video performance as well, but that depends on the CMOS setup. If the shared memory is not set to maximum by default, increasing the overall memory and upping the portion reserved for video will improve video performance specifically.

Hard Drives

SATA drives in the 2.5-inch drive format now rule in all laptops. Although much smaller than regular, 3.5-inch hard drives, they use all the same features and configurations. These smaller hard drives have suffered, however, from diminished storage capacity as compared to their 3.5-inch brothers. Currently, large 2.5-inch hard drives hold up to 500 GB, while the 3.5-inch hard drives can hold more than 2 TB of data! Some PATA drive manufacturers may require you to set the drive to use a cable-select setting as opposed to master or slave, so check with the laptop maker for any special issues. Otherwise, no difference exists between 2.5-inch drives and their larger 3.5-inch brethren (Figure 21-23).

Modular CPUs

You know from Chapter 5, "Microprocessors," that both AMD and Intel make specialized laptop CPUs that produce less heat and consume less power, yet only now are folks realizing that they can sometimes upgrade their laptops by removing the old CPU and replacing it with a new one. Be very careful to follow manufacturer's specifications! You should keep in mind, however, that replacing the CPU in a laptop often requires you to disassemble the entire machine. This can be a daunting task, even for professionals. If you want to upgrade the CPU in your laptop, it's often best to let the professionals take care of it.

Figure 21-23 The 2.5-inch and 3.5-inch drives are mostly the same.

Video Cards

Some video card makers make modular video cards for laptops. Although no single standard works in all systems, a quick phone call to the tech support department of the laptop maker often reveals upgrade options (if any). Modular video cards are the least standardized of all modular components, but as manufacturers adopt more industry-wide standards, we'll be able to replace video cards in laptops more readily.

Going Inside

To reach most modular components on a laptop, you need to do more than remove an exterior panel. You need to go inside to get access to devices directly connected to the motherboard. Many laptops have an easily removable keyboard that, once removed, gives you access to a metal heat spreader (just a plate that sits over the motherboard) and a half-dozen or more tiny screws. You'll need a special screwdriver to avoid stripping the screws—check a watch or eyeglass shop if your local hardware store doesn't carry anything appropriate.

You need to take major precautions when you remove the keyboard and heat spreader. The keyboard will be attached to a small cable that can easily disconnect if you pull hard. Don't forget to check this connection before you reinsert the keyboard at the end of the procedure! Avoid ESD as you would with any other PC, and definitely unplug the laptop from the wall and *remove the battery* before you do any work inside!

Modular Drives

To add functionality to laptops, many manufacturers include "modular drives" with their portable machines. CD, DVD, and Blu-ray Disc drives are most common. The beauty of modular drives is that you can swap back and forth easily between different types of drives. Need more storage space? Pull out the DVD drive and put in another

hard drive. Many laptops enable you to replace a drive with a second battery, which obviously can extend the time you can go before you have to plug the laptop into an AC outlet.

I have a laptop that allows me to swap out my CD/DVD drive for a second battery. If I don't need to access any CDs and don't need super-extended battery life, I just take out the component that's currently installed and put a blank faceplate into the empty slot. Traveling with an empty bay makes my hefty laptop weigh a little bit less, and every little bit helps!

Most modular drives are truly hot-swappable, enabling you to remove and insert devices without any special software. Many still require you to use the Hardware Removal Tool (also known as Safely Remove Hardware) located in the system tray or notification area (Figure 21-24). When in doubt, always remove modular devices by using this tool. Figure 21-25 shows the Safely Remove Hardware dialog box. To remove a device, highlight it and click the Stop button. Windows will shut down the device and tell you when it's safe to remove the device.

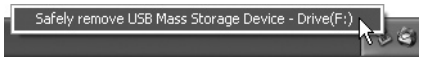


Figure 21-24 Hardware Removal Tool in system tray

Figure 21-25 Safely Remove Hardware dialog box

Mobile NICs and Mini PCI

Every laptop made in the last few years comes with networking capabilities built in. They have Ethernet ports for plugging into a wired network and Wi-Fi for wireless networking, and some have Cellular WAN radios so you can access the Internet over a cell

phone network. Laptops run Windows just like a desktop system, so they have all the networking software ready to go.

NOTE See Chapter 23, "Local Area Networking," for the scoop on dial-up networking and Ethernet.

Many of these integrated network cards are installed in a Mini PCI slot on the laptop motherboard. The *Mini PCI* bus is an adaptation of the standard PCI bus and was developed specifically for integrated communications peripherals such as modems and network adapters. Built-in networking support means you don't need an additional PC Card to provide a network adapter. The Mini PCI bus also provides support for other integrated devices, such as Bluetooth, modems, audio, or hard drive controllers. One great aspect of Mini PCI is that if some new technology eclipses the current wireless technology or some other technology that uses the bus, you can upgrade by swapping a card.

EXAM TIP A typical reason to upgrade a Mini PCI Wi-Fi NIC is to gain access to improved security options such as better encryption.

Officially released in 1999, Mini PCI is a 32-bit 33-MHz bus and is basically PCI v2.2 with a different form factor. Like PCI, it supports bus mastering and DMA. Mini PCI cards are about a quarter the size of regular PCI cards and can be as small as 2.75 inches by 1.81 inches by .22 inches. They can be found in small products such as laptops, printers, and set-top boxes.

To extend battery life, you can toggle built-in communication devices such as Wi-Fi and Bluetooth adapters on and off without powering down the computer. Many laptops come with a physical switch along the front or side edge allowing you to power the communications adapter on or off. Similarly, you can often use a keyboard shortcut for this, generally by pressing the Function (FN) key along with some other key. The FN key, when pressed, allows other keys to accomplish specific tasks. For example, on my laptop, pressing FN-F2 toggles my Wi-Fi adapter on and off; pressing FN-F10 ejects my CD-ROM drive.

NOTE Chapter 24 covers wireless networking in great detail.

Managing and Maintaining Portable Computers

Most portable PCs come from the factory solidly built and configured. Manufacturers know that few techs outside their factories know enough to work on them, so they don't cut corners. From a tech's standpoint, your most common work on managing and maintaining portables involves taking care of the batteries and extending the battery life through proper power management, keeping the machine clean, and avoiding excessive heat.

Everything you normally do to maintain a PC applies to portable PCs. You need to keep current on Windows patches and Service Packs and use stable, recent drivers. Run Check Disk with some frequency, and definitely defragment the hard drive. Disk Cleanup is a must if the laptop runs Windows XP or Windows Vista. That said, let's look at issues specifically involving portables.

Batteries

Manufacturers use three types of batteries for portable PCs and each battery type has its own special needs and quirks. Once you have a clear understanding of the quirks, you can *usually* spot and fix battery problems. The three types of batteries commonly used in mobile PCs are *Nickel-Cadmium* (*Ni-Cd*), *Nickel-Metal Hydride* (*Ni-MH*), and *Lithium-Ion* (*Li-Ion*) batteries. Manufacturers have also started working with *fuel cell* batteries, although most of that work is experimental at this writing.

Nickel-Cadmium

Ni-Cds were the first batteries commonly used in mobile PCs, which means the technology was full of little problems. Probably most irritating was a little thing called *battery memory*, or the tendency of a Ni-Cd battery to lose a significant amount of its rechargeability if it was charged repeatedly without being totally discharged. A battery that originally kept a laptop running for two hours would eventually only keep that same laptop going for 30 minutes or less. Figure 21-26 shows a typical Ni-Cd battery.

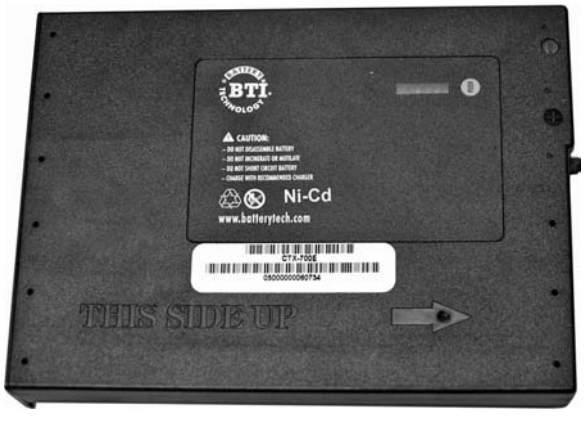


Figure 21-26
Ni-Cd battery

To prevent memory problems, a Ni-Cd battery had to be discharged completely before each recharging. Recharging was tricky as well, because Ni-Cd batteries disliked being overcharged. Unfortunately, there was no way to verify when a battery was fully charged without an expensive charging machine, which none of us had. As a result, most Ni-Cd batteries lasted an extremely short time before having to be replaced. A quick fix was to purchase a *conditioning charger*. These chargers would first totally discharge the Ni-Cd battery and then generate a special "reverse" current that, in a way, cleaned internal parts of the battery so it could be recharged more often and would run

longer on each recharge. Ni-Cd batteries would, at best, last for 1,000 charges, and far fewer with poor treatment. Ni-Cds were extremely susceptible to heat and would self-discharge over time if not used. Leaving a Ni-Cd in the car in the summer was guaranteed to result in a fully discharged battery in next to no time!

But Ni-Cd batteries didn't stop causing trouble after they died. The highly toxic metals inside the batteries made it unacceptable simply to throw them in the trash. Ni-Cd batteries should be disposed of via specialized disposal companies. This is very important! Even though Ni-Cd batteries aren't used in PCs very often anymore, many devices, such as cellular and cordless phones, still use Ni-Cd batteries. Don't trash the environment by tossing Ni-Cds in a landfill. Turn them in at the closest special disposal site; most recycling centers are glad to take them. Also, many battery manufacturers/distributors will take them. The environment you help preserve just might be yours—or your kids'!

EXAM TIP You *must* use disposal companies or battery recycling services to dispose of the highly toxic Ni-Cd batteries.

Nickel Metal Hydride

Ni-MH batteries were the next generation of mobile PC batteries and are still quite common today. Basically, Ni-MH batteries are Ni-Cd batteries without most of the headaches. Ni-MH batteries are much less susceptible to memory problems, can tolerate overcharging better, can take more recharging, and can last longer between rechargings. Like Ni-Cds, Ni-MH batteries are susceptible to heat, but at least they are considered less toxic to the environment. A special disposal is still a good idea. Unlike Ni-Cds, it's usually better to recharge an Ni-MH with shallow recharges as opposed to a complete discharge/recharge. Ni-MH is a popular replacement battery for Ni-Cd systems (Figure 21-27).

Figure 21-27 Ni-MH battery

Lithium Ion

The most common battery used today is Li-Ion. Li-Ion batteries are powerful, completely immune to memory problems, and last at least twice as long as comparable Ni-MH batteries on one charge. Sadly, they can't handle as many charges as Ni-MH types, but today's users are usually more than glad to give up total battery lifespan in return for longer periods between charges. Li-Ion batteries will explode if they are overcharged, so all Li-Ion batteries sold with PCs have built-in circuitry to prevent accidental overcharging. Lithium batteries can only be used on systems designed to use them. They can't be used as replacement batteries (Figure 21-28).

Figure 21-28
Li-Ion battery

Other Portable Power Sources

In an attempt to provide better maintenance for laptop batteries, manufacturers have developed a new type of battery called the *smart battery*. Smart batteries tell the computer when they need to be charged, conditioned, or replaced.

The Care and Feeding of Batteries

In general, keep in mind the following basics. First, always store batteries in a cool place. Although a freezer is in concept an excellent storage place, the moisture, metal racks, and food make it a bad idea. Second, use a charger for your Ni-Cd and Ni-MH batteries that also conditions the batteries; they'll last longer. Third, keep battery contacts clean with a little alcohol or just a dry cloth. Fourth, *never* handle a battery that has ruptured or broken; battery chemicals are very dangerous. Finally, always recycle old batteries.

NOTE Got an old portable PC battery lying around? Well, you need to get rid of it, and there are some pretty nasty chemicals in that battery, so you can't just throw it in the trash. Sooner or later, you'll probably need to deal with such a battery, so here are some suggestions:

1. Do an online search to find the battery recycling center nearest to you.
2. Sometimes, you can take old laptop batteries to an auto parts store that disposes of old car batteries—I know it sounds odd, but it's true! See if you can find one in your area that will do this.
3. Many cities offer a hazardous materials disposal or recycling service. Check to see if and how your local government will help you dispose of your old batteries.

Power Management

Many different parts are included in the typical laptop, and each part uses power. The problem with early laptops was that every one of these parts used power continuously, whether or not the system needed that device at that time. For example, the hard drive continued to spin even when it was not being accessed, and the LCD panel continued to display, even when the user walked away from the machine.

The optimal situation would be a system where the user could instruct the PC to shut down unused devices selectively, preferably by defining a maximum period of inactivity that, when reached, would trigger the PC to shut down the inactive device. Longer periods of inactivity would eventually enable the entire system to shut itself down, leaving critical information loaded in RAM, ready to restart if a wake-up event (such as moving the mouse or pressing a key) told the system to restart. The system would have to be sensitive to potential hazards, such as shutting down in the middle of writing to a drive, and so on. Also, this feature could not add significantly to the cost of the PC. Clearly, a machine that could perform these functions would need specialized hardware, BIOS, and operating system to operate properly. This process of cooperation among the hardware, the BIOS, and the OS to reduce power use is known generically as *power management*.

System Management Mode

Intel began the process of power management with a series of new features built into the 386SX CPU. These new features enabled the CPU to slow down or stop its clock without erasing the register information, as well as enabling power saving in peripherals. These features were collectively called *System Management Mode* (*SMM*). All modern CPUs have SMM. Although a power-saving CPU was okay, power management was relegated to special "sleep" or "doze" buttons that would stop the CPU and all of the peripherals on the laptop. To take real advantage of SMM, the system needed a specialized BIOS and OS to go with the SMM CPU. To this end, Intel put forward the *Advanced Power Management* (*APM*) specification in 1992 and the *Advanced Configuration and Power Interface* (*ACPI*) standard in 1996.

Requirements for APM/ACPI

To function fully, APM and ACPI require a number of items. First is an SMM-capable CPU. As virtually all CPUs are SMM-capable, this is easy. Second is an APM-compliant BIOS that enables the CPU to shut off the peripherals when desired. The third requirement is devices that will accept being shut off. These devices are usually called Energy Star devices, which signals their compliance with the EPA's Energy Star standard. To be an Energy Star device, a peripheral must be able to shut down without actually turning off and show that they use much less power than the non–Energy Star equivalent. Last, the system's OS must know how to request that a particular device be shut down, and the CPU's clock must be slowed down or stopped.

ACPI goes beyond the APM standard by supplying support for hot-swappable devices—always a huge problem with APM. This feature aside, it is a challenge to tell the difference between an APM system and an ACPI system at first glance.

NOTE Don't limit your perception of APM, ACPI, and Energy Star just to laptops. Virtually all desktop systems and many appliances also use the power management functions.

APM/ACPI Levels

APM defined four power-usage operating levels for a system. These levels are intentionally fuzzy to give manufacturers considerable leeway in their use; the only real difference among them is the amount of time each takes to return to normal usage. These levels are as follows:

- **Full On** Everything in the system is running at full power. There is no power management.
- **APM Enabled** CPU and RAM are running at full power. Power management is enabled. An unused device may or may not be shut down.
- **APM Standby** CPU is stopped. RAM still stores all programs. All peripherals are shut down, although configuration options are still stored. (In other words, to get back to APM Enabled, you won't have to reinitialize the devices.)
- **APM Suspend** Everything in the PC is shut down or at its lowest power-consumption setting. Many systems use a special type of Suspend called *hibernation*, where critical configuration information is written to the hard drive. Upon a wake-up event, the system is reinitialized, and the data is read from the drive to return the system to the APM Enabled mode. Clearly, the recovery time between Suspend and Enabled will be much longer than the time between Standby and Enabled.

ACPI, the successor to APM, handles all these levels plus a few more, such as "soft power on/off," that enables you to define the function of the power button. You should familiarize yourself with the following ACPI global (G) and sleeping (S) system power state specifications for both the A+ exams and your own practical application:

- **G0 (S0)** Working state
- **G1** Sleeping state mode. Further subdivided into four *S* states.
  - **S1** CPU stops processing. Power to CPU and memory (RAM) is maintained.
  - **S2** CPU is powered down.
  - **S3** Sleep or Standby mode. Power to RAM still on.
  - **S4** Hibernation mode. Information in RAM is stored to nonvolatile memory or drive and powered off.
- **G2 (S5)** Soft power off mode. Certain devices used to wake a system—such as keyboard, LAN, USB, and other devices—remain on, while most other components are powered to a mechanical off state (G3).
- **G3** Mechanical off mode. The system and all components, with the exception of the real-time clock (RTC), are completely powered down.

Configuration of APM/ACPI

You configure APM/ACPI via CMOS settings or through Windows. Windows settings override CMOS settings. Although the APM/ACPI standards permit a great deal of flexibility, which can create some confusion among different implementations, certain settings apply generally to CMOS configuration. First is the ability to initialize power management; this enables the system to enter the APM Enabled mode. Often CMOS then presents time frames for entering Standby and Suspend modes, as well as settings to determine which events take place in each of these modes.

Many CMOS versions present settings to determine wake-up events, such as directing the system to monitor a modem or a NIC (Figure 21-29). You'll see this feature as *Wake on LAN* or something similar. A true ACPI-compliant CMOS provides an ACPI setup option. Figure 21-30 shows a typical modern BIOS that provides this setting.

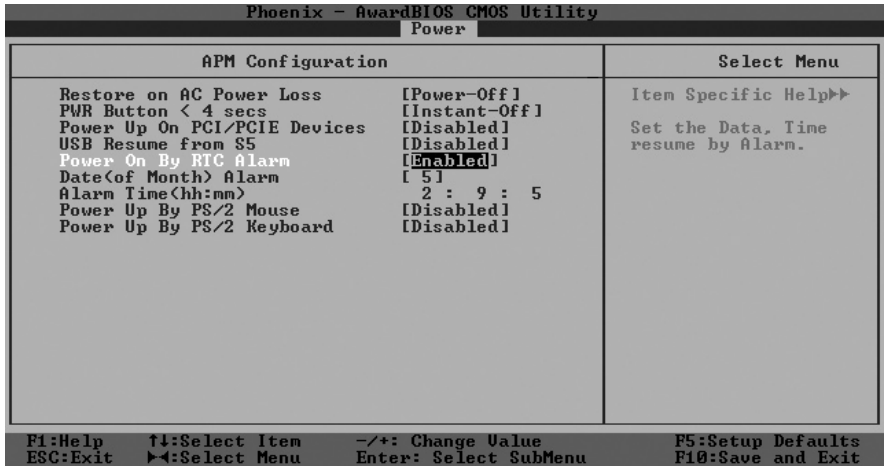


Figure 21-29 Setting a wake-up event in CMOS

APM/ACPI settings can be found in the Windows 2000/XP/Vista Control Panel applet Power Options. In Windows XP, the Power Options applet has several built-in *power schemes* such as Home/Office and Max Battery that put the system into Standby or Suspend after a certain interval (Figure 21-31). You can also require the system to go into Standby after a set period of time or to turn off the monitor or hard drive after a time, thus creating your own custom power scheme. This is technically called adjusting the *sleep timers*.

Windows Vista's built-in power schemes are similar to Windows XP, though you can better control power utilization by customizing a Balanced, Power saver, or High performance power plan (Figure 21-32). You can customize a power saver plan for your laptop, for example, and configure it to turn off the display at a certain time interval while on battery or plugged in and configure it to put the computer to sleep as desired (Figure 21-33).

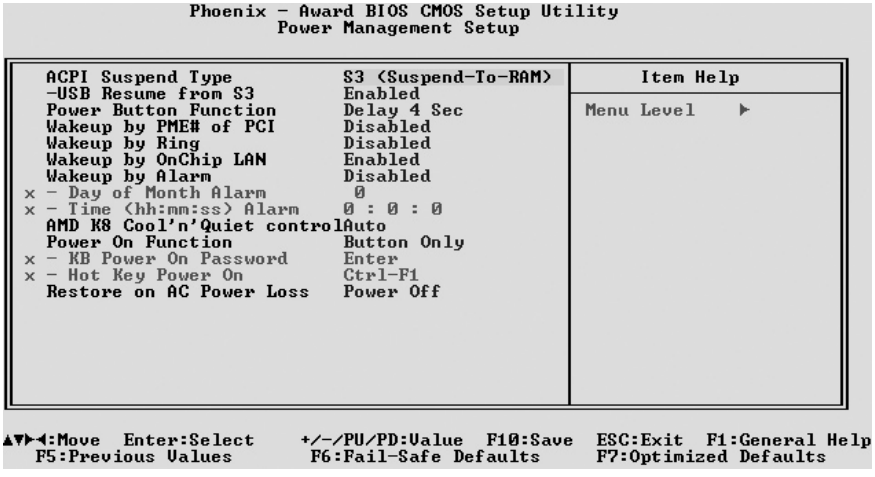
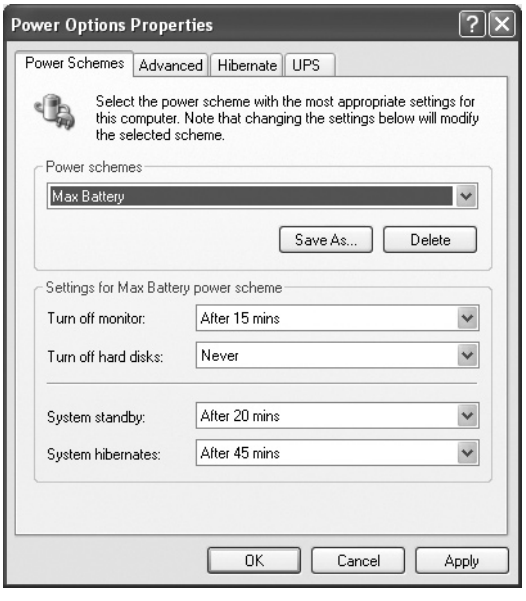


Figure 21-30 CMOS with ACPI setup option

Figure 21-31 The Windows XP Power Options applet's Power Schemes tab



NOTE In Windows XP you can also access your power options by right-clicking on the desktop, selecting Properties, and then clicking the Power button in the Monitor power section of the Screen Saver tab. In Windows Vista, right-click the Desktop, select Personalize, select Screen Saver, and then click on the *Change power settings* link.

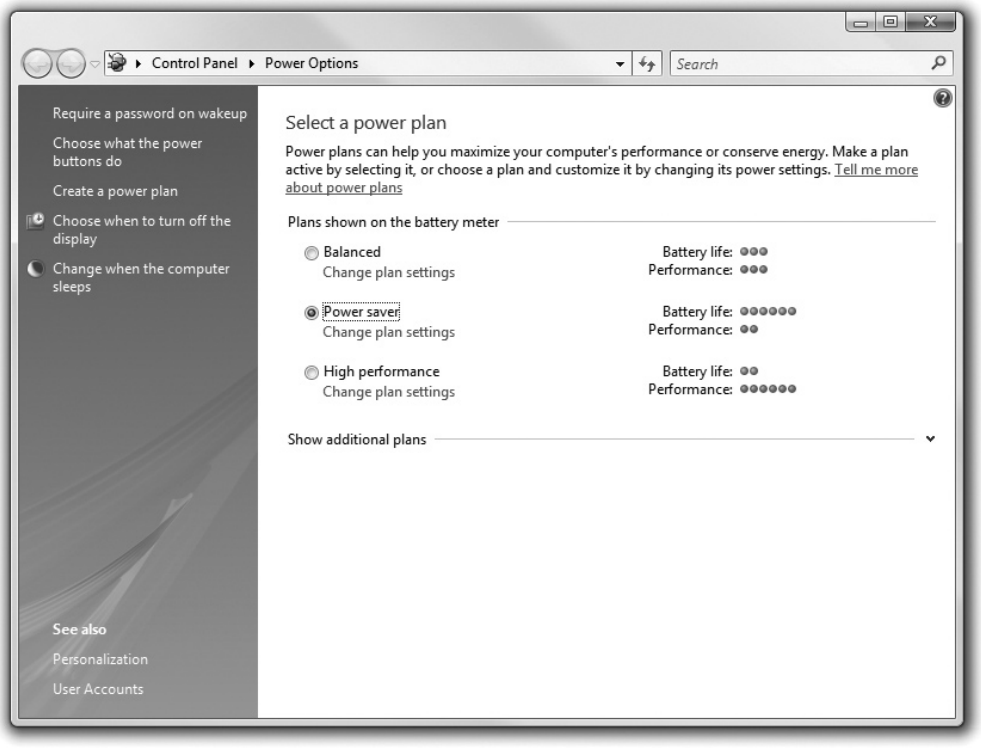


Figure 21-32 Windows Vista Balanced, Power saver, or High performance power plans

Another feature, Hibernate mode, takes everything in active memory and stores it on the hard drive just before the system powers down. When the PC comes out of hibernation, Windows reloads all the files and applications into RAM. Figure 21-34 shows the Power Options Properties applet in Windows XP.

Cleaning

Most portable PCs take substantially more abuse than a corresponding desktop model. Constant handling, travel, airport food on the run, and so on can radically shorten the life of a portable if you don't take action. One of the most important things you should do is clean the laptop regularly. Use an appropriate screen cleaner (not a glass cleaner!) to remove fingerprints and dust from the fragile LCD panel. (Refer to Chapter 19, "Video," for specifics.)

If you've had the laptop in a smoky or dusty environment, try compressed air for cleaning. Compressed air works great for blowing out the dust and crumbs from the keyboard and for keeping PC Card sockets clear. Don't use water on your keyboard! Even a minor amount of moisture inside the portable can toast a component.

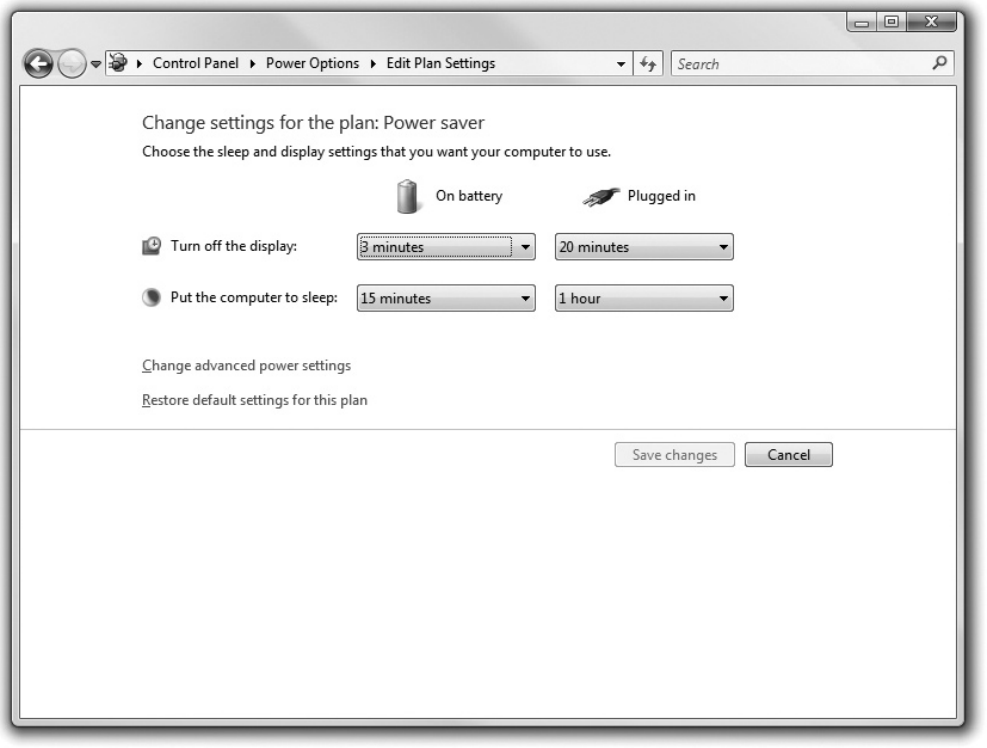
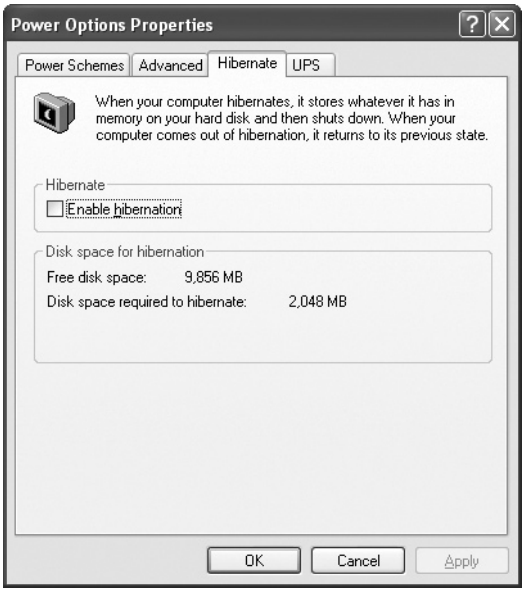


Figure 21-33 Customizing a laptop power plan in Windows Vista

Figure 21-34 Windows XP hibernation settings in the Power Options applet



Heat

To manage and maintain a healthy portable PC, you need to deal with issues of heat. Every portable has a stack of electronic components crammed into a very small space. Unlike their desktop brethren, portables don't have lots of freely moving air space that enables fans to cool everything down. Even with lots of low-power-consumption devices inside, portable PCs crank out a good deal of heat. Excessive heat can cause system lockups and hardware failures, so you should handle the issue wisely. Try this as a starter guide.

- Use power management, even if you're plugged into the AC outlet. This is especially important if you're working in a warm (more than 80 degrees Fahrenheit) room.
- Keep air space between the bottom of the laptop and the surface on which it rests. Putting a laptop on a soft surface, such as a pillow on your lap, creates a great heat-retention system—not a good thing! Always use a hard, flat surface.
- Don't use a keyboard protector for extended amounts of time.
- Listen to your fan, assuming the laptop has one. If it's often running very fast—you can tell by the high-pitched whirring sound—examine your power management settings and your environment, and change whatever is causing heat retention.
- Speaking of fans, be alert to a fan that suddenly goes silent. Fans do fail on laptops, causing overheating and failure. All laptop fans can be replaced easily.

Protect the Machine

Although prices continue to drop for basic laptops, a fully loaded system is still pricey. To protect your investment, you'll want to adhere to certain best practices. You've already read tips in this chapter to deal with cleaning and heat, so let's look at the "portable" part of portable computers.

Tripping

Pay attention to where you run the power cord when you plug in a laptop. One of the primary causes of laptop destruction is people tripping over the power cord and knocking the laptop off of a desk. This is especially true if you plug in at a public place such as a café or airport. Remember, the life you save could be your portable PC's!

Storage

If you aren't going to use your laptop or PDA for a while, storing it safely will go a long way toward keeping it operable when you do power it up again. Investing in a quality case is worth the extra few dollars—preferably one with ample padding. Smaller devices such as PDAs are well protected inside small shock-resistant aluminum cases that clip onto your belt, while laptops do fine in well-padded cases or backpacks. Not only will this protect your system on a daily basis when transporting it from home to office, but it will keep dust and pet hair away as well. Lastly, protect from battery leakage by removing the battery if you'll be storing your device for an extended time.

Travel

If traveling with a laptop, take care to protect yourself from theft. If possible, use a case that doesn't look like a computer case. A well-padded backpack makes a great travel bag for a laptop and appears less tempting to would-be thieves. Don't forget to pack any accessories you might need, like modular devices, spare batteries, and AC adapters. Make sure to remove any disks, such as CD/DVD or floppies, from their drives. Most importantly—back up any important data before you leave!

Make sure to have at least a little battery power available. Heightened security at airports means you might have to power on your system to prove it's really a computer and not a transport case for questionable materials. And never let your laptop out of your sight. If going through an x-ray machine, request a manual search. The x-ray won't harm your computer like a metal detector would, but if the laptop gets through the line at security before you do, someone else might walk away with it. If flying, stow your laptop under the seat in front of you where you can keep an eye on it.

If you travel to a foreign country, be very careful about the electricity. North America uses ~115 V power outlets, but the most of the rest of the world uses ~230 V outlets. Many portable computers have *auto-switching power supplies*, meaning they detect the voltage at the outlet and adjust accordingly. For these portables, a simple plug converter will do the trick. Other portable computers, however, have *fixed-input power supplies*, which means they run only on ~115 V or on ~230 V power. For these portables, you need a full-blown electricity converting device, either a step-down or step-up *transformer*. You can find converters and transformers at electrical parts stores, such as Radio Shack in the United States.

Shipping

Much of the storage and travel advice can be applied to shipping. Remove batteries and optical discs from their drives. Pack the laptop well and disguise the container as best you can. Back up any data and verify the warranty coverage. Ship with a reputable carrier and always request a tracking number and, if possible, delivery signature. It's also worth the extra couple of bucks to pay for the shipping insurance. And when the clerk asks what's in the box, it's safer to say "electronics" rather than "a new 20-inch laptop computer."

Security

The fact is, if someone really wants to steal your laptop, they'll find a way. There are, however, some things you can do to make yourself, and your equipment, less desirable targets. As you've already learned, disguise is a good idea. Although you don't need to camouflage your laptop or carry it in a brown grocery bag on a daily basis, an inconspicuous carrying case will draw less attention.

Another physical deterrent is a laptop lock. Similar to a steel bicycle cable, there is a loop on one end and a lock on the other. The idea is to loop the cable around a solid object, such as a bed frame, and secure the lock to the small security hole on the side of the laptop. Again, if someone really wants to steal your computer, they'll find a way. They'll dismantle the bed frame if they're desperate. The best protection is to be vigilant and not let the computer out of your sight.

An alternative to physically securing a laptop with a lock is to use a software tracking system. Software makers, such as Computer Security Products, Inc., at www.computersecurity.com, offer tracking software that transmits a signal to a central office if the computer is stolen and connected to a phone line or the Internet. The location of the stolen PC can be tracked, and sensitive files can even be deleted automatically with the aid of the stealth signal.

Troubleshooting Portable Computers

Many of the troubleshooting techniques you learned about for desktop systems can be applied to laptops. For example, take the proper precautions before and during disassembly. Use the proper hand tools, and document, label, and organize each plastic part and screw location for reassembly. Additionally, here are some laptop-specific procedures to try.

Laptop Won't Power On

- Verify AC power by plugging another electronic device into the wall outlet. If the other device receives power, the outlet is good.
- If the outlet is good, connect the laptop to the wall outlet and try to power on. If no LEDs light up, you may have a bad AC adapter. Swap it out with a known-good power adapter.
- A faulty peripheral device might keep the laptop from powering up. Remove any peripherals such as USB or FireWire devices.

NOTE If you have a laptop with a battery that won't charge up, it could be one of two things: the battery might be cooked or the AC adapter isn't doing its job. To troubleshoot, replace the battery with a known-good battery. If the new battery works, you've found the problem. Just replace the battery. Alternatively, remove the battery and run the laptop on AC only. If that works, you know the AC adapter is good. If it doesn't, replace the AC adapter.

Screen Doesn't Come On Properly

- If the laptop is booting (you hear the beeps and the drives), first make sure the display is turned on. Press the FN key and the key to activate the screen a number of times until the laptop display comes on. If that doesn't work, check the LCD cutoff switch—on many laptops, this is the small nub somewhere near the screen hinge that shuts the monitor off when you close the laptop—and make sure it isn't stuck in the down position.

- If the laptop display is very dim, you may have lost an inverter. The clue here is that inverters never go quietly. They can make a nasty hum as they are about to die and an equally nasty popping noise when they actually fail. Failure often occurs when you plug in the laptop's AC adapter, as the inverters take power directly from the AC adapter. It's also possible that the backlights in the LCD panel have died, though this is much less common than a bad inverter.
- If the screen won't come on or is cracked, most laptops have a port for plugging in an external monitor, which you can use to log into your laptop.

Wireless Networking Doesn't Work

- Check along the front, rear, or side edges of the laptop for a physical switch that toggles the internal wireless adapter on and off.
- Try the special key combination for your laptop to toggle the wireless adapter. You usually press the FN key in combination with another key.
- You might simply be out of range. Physically walk the laptop over to the wireless router or access point to ensure there are no out-of-range issues.

Handwriting Is Not Recognized

- If your PDA or tablet PC no longer recognizes your handwriting or stylus, you may need to retrain the digitizer. Look for an option in your PDA OS settings to align the screen. On Windows-based tablet PCs, you will find a similar option under Start | Settings | Control Panel.

Keypad Doesn't Work

- If none of the keys work on your laptop, there's a good chance you've unseated the keypad connector. These connectors are quite fragile and are prone to unseating from any physical stress on the laptop. Check the manufacturer's disassembly procedures to locate and reseat the keypad.
- If you're getting numbers when you're expecting to get letters, the number lock (NUMLOCK) function key is turned on. Turn it off.

Touchpad Doesn't Work

- A shot of compressed air does wonders for cleaning pet hair out of the touchpad sensors. You'll get a cleaner shot if you remove the keyboard before using the compressed air. Remember to be gentle when lifting off the keyboard and make sure to follow the manufacturer's instructions.
- The touchpad driver might need to be reconfigured. Try the various options in the Control Panel | Mouse applet.

Chapter Review Questions

1. What is the name of the lower level of software drivers that support PC Cards?
   - **A.** PCMCIA services
   - **B.** Socket services
   - **C.** Card services
   - **D.** I/O services
2. How many Type III cards can typically fit into a laptop at one time?
   - **A.** 1
   - **B.** 2
   - **C.** 3
   - **D.** 4
3. Parallel PC Cards come in ____-bit and ____-bit versions. The latter is called CardBus.
   - **A.** 8, 16
   - **B.** 16, 32
   - **C.** 32, 64
   - **D.** 64, 128
4. What is the typical use for Type II PC cards?
   - **A.** Additional RAM
   - **B.** Hard drives
   - **C.** Flash memory
   - **D.** I/O devices such as modems and NICs
5. Which of the following are good ideas when it comes to smart batteries? (Select two.)
   - **A.** Keep the contacts clean by using alcohol and a soft cloth.
   - **B.** Store them in the freezer if they will not be used for a long period of time.
   - **C.** Toss them in the garbage when they wear out.
   - **D.** Store them in a cool, dry place.
6. What's the typical input device for a PDA?
   - **A.** Keyboard
   - **B.** Mouse
   - **C.** Stylus
   - **D.** Voice

7. Tablet PCs come in which of the following form factors? (Select two.)
   - **A.** Convertible
   - **B.** Desktop
   - **C.** Secure Digital
   - **D.** Slate
8. ExpressCards connect to which buses? (Select two.)
   - **A.** ISA
   - **B.** PCI
   - **C.** PCIe
   - **D.** Hi-Speed USB
9. Clara's laptop has a DVI connector to which she has connected a projector. As she prepares to make her presentation, however, nothing comes on the projector screen. The laptop shows the presentation and the projector appears to be functional, with a bright white bulb making a blank image on the screen. What's most likely the problem?
   - **A.** She needs to plug in the projector.
   - **B.** She's running the laptop on batteries. You need to plug in laptops to use the DVI connector.
   - **C.** She needs to update her PC Card services to support projectors.
   - **D.** She needs to press the Function key combination on her keyboard to cycle through monitor modes.
10. What is the primary benefit to adding more RAM to a laptop that uses shared memory? (Select the best answer.)
    - **A.** Improved battery life
    - **B.** Improved system performance
    - **C.** Improved video performance
    - **D.** None. Adding more RAM is pointless with systems that use shared memory.

Answers

1. **B.** The lower level of software drivers for PC Cards is known as socket services.
2. **A.** Due to their thickness, only one Type III PCMCIA card can fit into a laptop at a time.
3. **B.** Parallel PC Cards come in 16-bit and 32-bit varieties.
4. **D.** The typical use for Type II PC cards is for I/O devices such as modems and NICs.

5. **A, D.** Keeping a battery in the freezer is a good idea in theory, but not in practice. All batteries contain toxic chemicals and should *never* be treated like regular trash.
6. **C.** PDAs (and tablet PCs) use a stylus for input.
7. **A, D.** Tablet PCs come in convertible and slate form factors.
8. **C, D.** ExpressCards connect to either the PCI Express or Hi-Speed USB buses.
9. **D.** Clara needs to press the Function key combination on her keyboard to cycle through monitor modes.
10. **B.** Improved overall system performance is the primary benefit to adding more RAM to a laptop that uses shared memory.