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.

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.

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.

The PCMCIA 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.

• **Figure 26.22** PC Card slots

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 older 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 (see Figure 26.22).

Although PCMCIA doesn't require that certain sizes perform certain functions, most PC Cards follow their recommendations. Table 26.2 lists the sizes and typical uses of each type of PC Card.

Tech Tip

Keeping Your PC Cards Healthy

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

Slots for **ExpressCard**, the high-performance serial version of the PC Card, have replaced PC Card slots on laptop PCs over the last decade. ExpressCard comes in two widths: 34 mm and 54 mm, called *ExpressCard/34* and *ExpressCard/54*. Figure 26.23 shows both ExpressCard varieties. 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.

Table 26.2 PC Card Types and Their Typical Uses

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

ExpressCards connect to either the USB 2.0 bus or the 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.

Table 26.3 shows the throughput and variations for the parallel and serial PC Cards currently on the market.

PCMCIA announced ExpressCard 2.0 in 2009 with speeds up to 5 Gbps and support for SuperSpeed USB 3.0, and we expected to see devices roll out in 2010, but that's not what happened. PCMCIA has dissolved and shut its offices. The USB Implementer's Forum now manages all PC Card and ExpressCard standards, and there's not likely to be any further development.

• **Figure 26.23** 34-mm and 54-mm ExpressCards

Storage Card Slots

Many portable computers offer one or more flash-memory card slots to enable you to add storage to the portable. These slots also enable the fast transfer of data from the card to the portable, and vice versa. They come in the standard varieties that you already know from Chapter 13, such as SD, CompactFlash, and xD.

You can find ExpressCards that supposedly support USB 3.0. While technically these cards have USB 3.0 ports, they connect to the PCIe bus and therefore aren't capable of true USB 3.0 speeds of up to 5 Gbps.

General-Purpose Ports

Laptops rarely come with all of the hardware you want. 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, while other portables focus on more modern ports like eSATA and FireWire. If you're 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 enable users to connect a device while the PC is running—you won't have to reboot the 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

The small device resting in a stand in Figure 26.24 is called a *personal digital assistant* (*PDA*), a precursor to modern smartphones and tablets such as the Apple iPhone and iPad. You could view pictures, take notes, check a calendar, listen to music, and more on these devices. Expect PDA as an answer choice in exam questions, but most likely as one of the wrong answers. PDAs are rarely used today.

Table 26.3 PC Card Speeds

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

Tech Tip

USB and Handheld Computing Devices

Almost all handheld computing 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!

Cross Check

Modern General-Purpose Ports

You learned about eSATA in Chapter 11. You explored USB and FireWire back in Chapter 3 and in Chapter 20. What kind of connectors do eSATA, USB, and FireWire use? What are the cable length limitations? How many devices can each technology support?

eSATA are three of the more popular methods for attaching peripherals to laptops (see Figure 26.24).

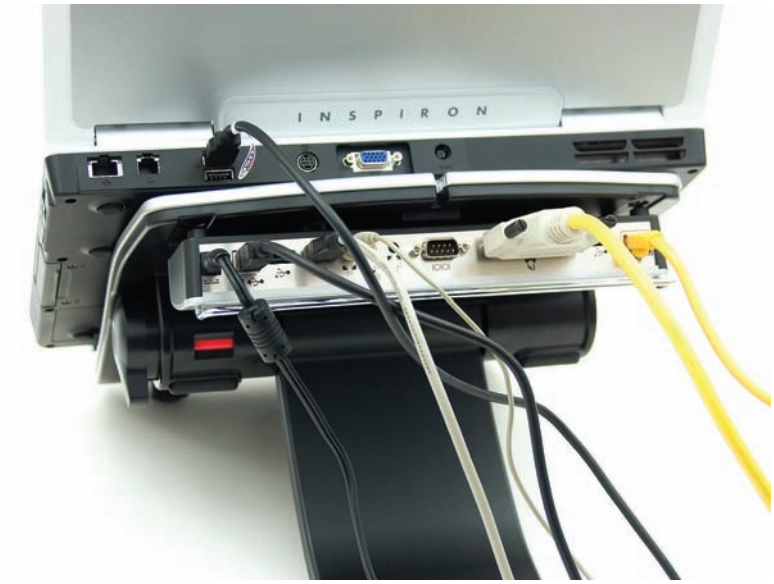
• **Figure 26.24** Devices attached to USB on a portable PC

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.

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 uncommon and common PC ports, such as serial, parallel, USB, network, and PS/2. By plugging the port replicator into your notebook computer, you can instantly connect the computer to nonportable 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 26.25 shows a Dell Inspiron laptop connected to a port replicator.

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



• **Figure 26.25** Port replicator for a Dell portable computer

that only has modern multifunction ports such as USB and FireWire and not parallel or serial ports.

Docking Stations

Docking stations resemble port replicators in many ways, offering legacy and modern single- and multi-function ports (see Figure 26.26). 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 many older small laptops. A docking station makes an excellent companion to such portables.

• **Figure 26.26** Docking station

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. That said, let's look at issues specifically involving portables.

Batteries

Manufacturers have used three types of batteries for portable PCs: **Nickel-Cadmium (Ni-Cd)**, **Nickel-Metal Hydride (Ni-MH)**, and **Lithium-Ion (Li-Ion)**. Today, only Li-Ion is used because that battery chemistry provides the highest energy density for the weight and has few problems with external factors. Let's look at each battery type briefly.

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 26.27 shows a typical Ni-Cd battery.

• **Figure 26.27** Ni-Cd battery

• **Figure 26.28** Ni-MH battery

Nickel-Metal Hydride

Ni-MH batteries were the next generation of mobile PC batteries and are basically 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. Figure 26.28 shows a typical 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 26.29 shows a typical Li-Ion battery.

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, keep the battery charged, at least to 70–80 percent. Third, never drain a battery all the way down unless required to do so as part of a *battery calibration* (where you, in essence, reset the battery according to steps provided by the manufacturer). Rechargeable batteries have only a limited number of charge-discharge cycles before overall battery performance is reduced. Fourth, *never* handle a battery that has ruptured or broken; battery chemicals are very dangerous. Finally, always recycle old batteries.

Tech Tip

Lithium Polymer

Lithium polymer (LiPO) *batteries are a variation of Li-Ion that places the heart of the battery—the electrolyte—into a solid polymer shape rather than an organic solvent. This enables the batteries to take on unusual forms beyond the simple cylinder or rectangle shapes. LiPO batteries haven't replaced Li-Ion in most portable PCs (with the Apple MacBook the obvious exception), but they are used heavily in smaller electronics such as tablets, smartphones, and portable media players.*

• **Figure 26.29** Li-Ion battery

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 and a specialized 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*.

Try This!

Recycling Old Portable PC Batteries

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 Try This!

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.

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, they require an SMM-capable CPU. As virtually all CPUs are SMM-capable, this is easy. Second, they need 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 it uses 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.

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.

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.

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 CompTIA A+ exams and your own practical application:

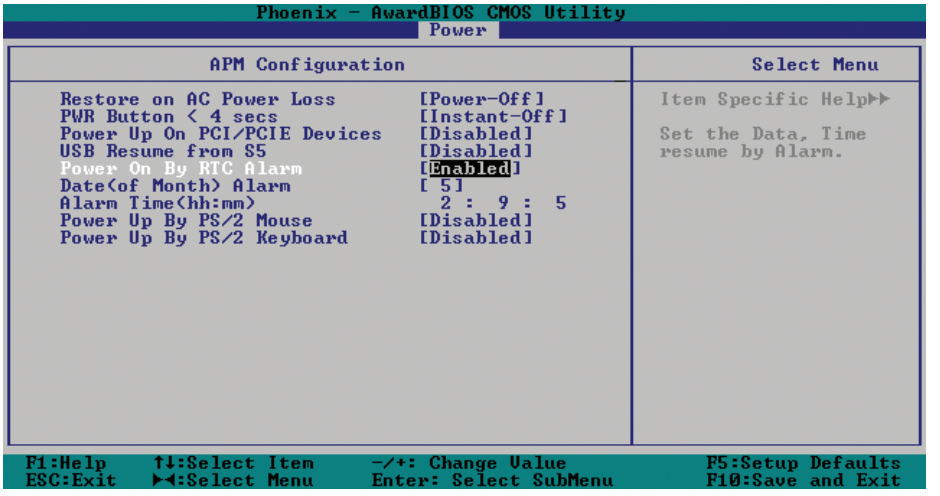
- **G0 (S0)** Working state
- **G1** Sleeping state mode. Further subdivided into four *S* states:
  - **S1** CPU stops processing. Power to CPU and memory (RAM) is maintained.
  - **S2** CPU is powered down.
  - **S3** Sleep or Standby mode. Power to RAM still on.
  - **S4** Hibernation mode. Information 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.

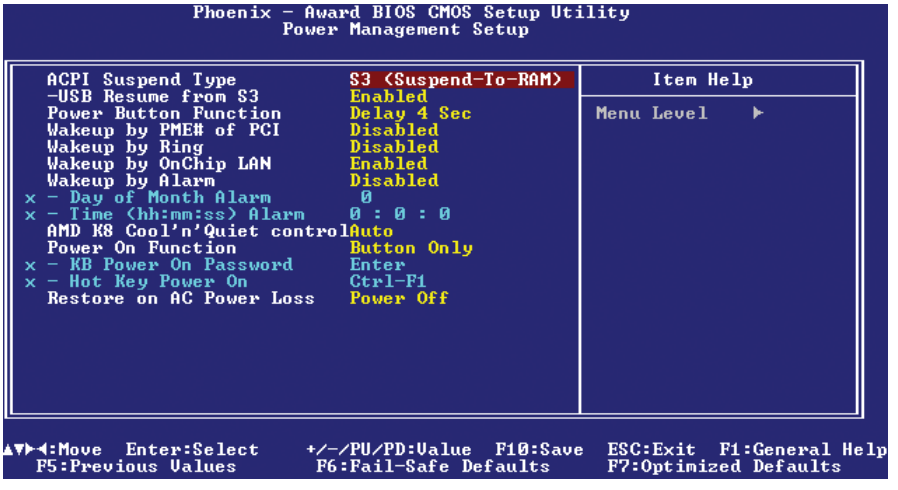
Configuration of APM/ACPI

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 (see Figure 26.30). You'll see this feature as *Wake on LAN*, or something similar. A true ACPI-compliant CMOS provides an ACPI setup option. Figure 26.31 shows a typical modern BIOS that provides this setting.

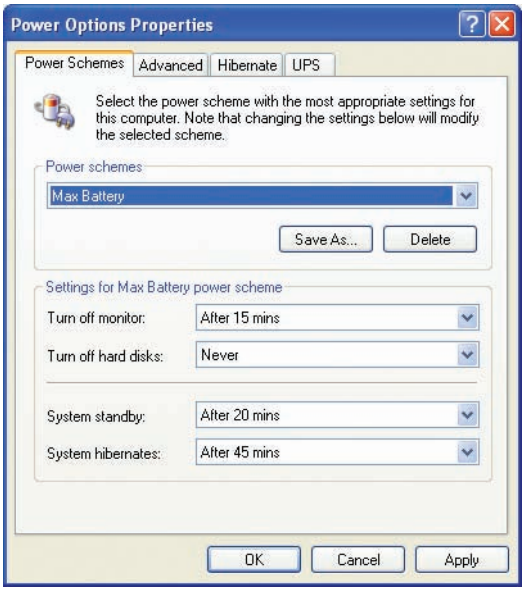


• **Figure 26.30** Setting a wake-up event in CMOS



• **Figure 26.31** CMOS with ACPI setup option

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 and 7, right-click the desktop, select Personalize, select Screen Saver, and then click on the *Change power settings* link.



• **Figure 26.32** The Windows XP Power Options applet's Power Schemes tab

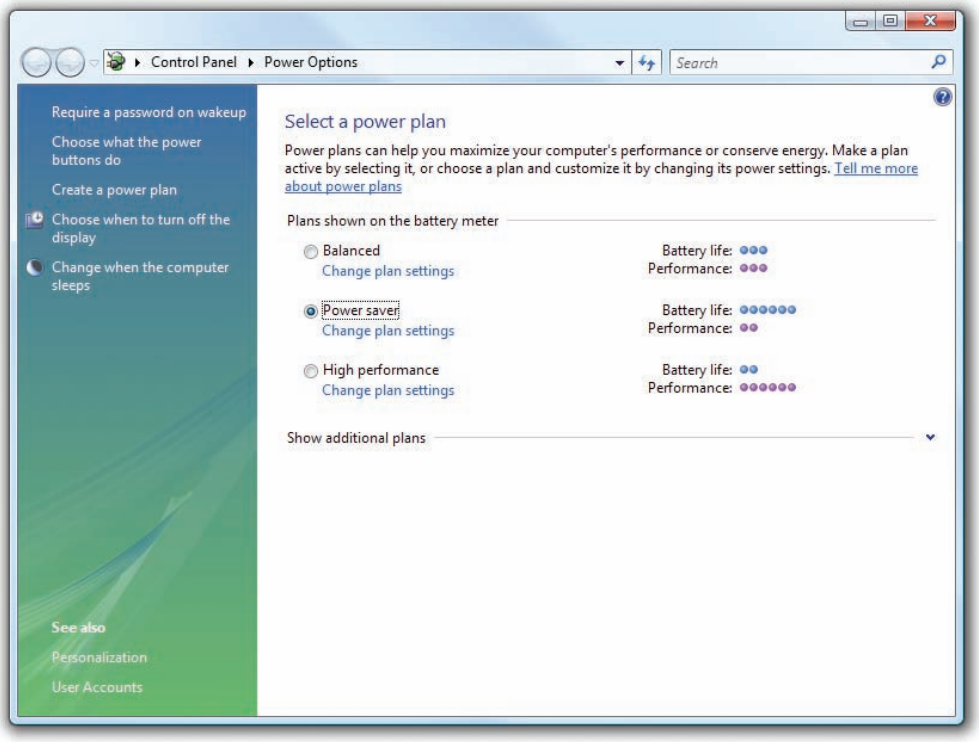
APM/ACPI settings can be found in the Control Panel applet Power Options. In Windows XP, the Power Options applet has several built-in *power schemes* such as Home/Office and Max Battery that put the system into Standby or Suspend after a certain interval (see Figure 26.32). You can also require the 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 and Windows 7 offer **power plans** that enable better control over power use by customizing a balanced, power saver, or high performance power plan (see Figure 26.33). 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 (see Figure 26.34).

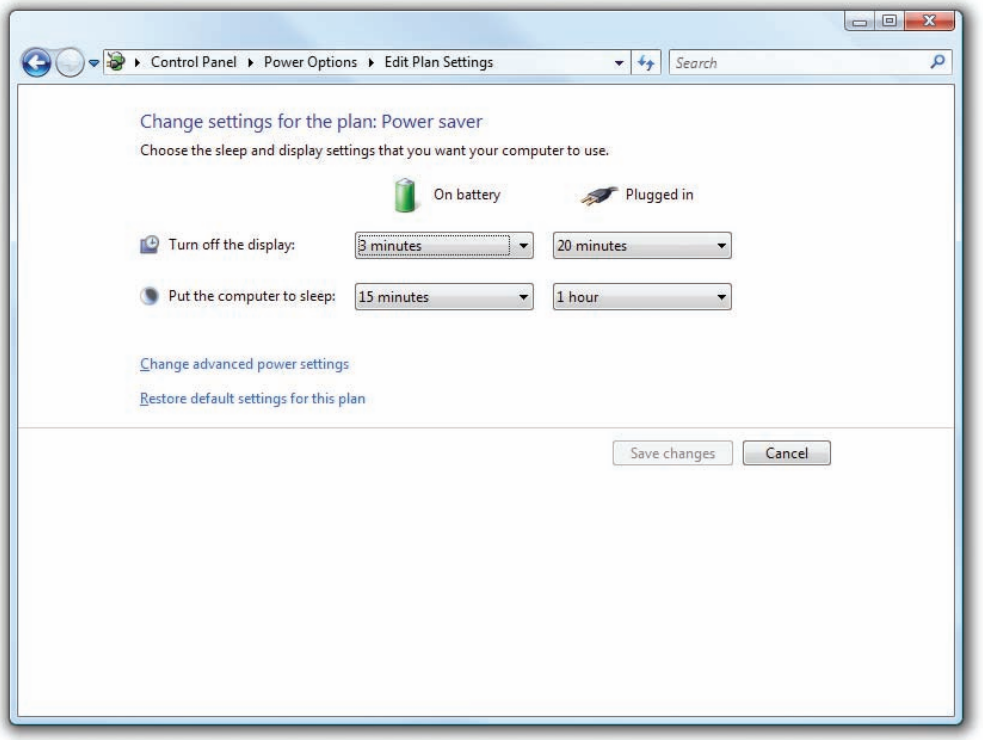
Another feature, Hibernate mode, takes everything in active memory and stores it on the hard drive just before the system powers down. When the PC comes out of hibernation, Windows reloads all the files and applications into RAM. Figure 26.35 shows the Power Options Properties applet in Windows XP.

Manual Control over Power Use

Most portable PCs give you several manual options for reducing battery use in certain circumstances. We've already discussed using the on/off switch or keyboard combination for disabling the Wi-Fi antenna, for example, and shutting off Bluetooth. Laptops with backlit keyboards

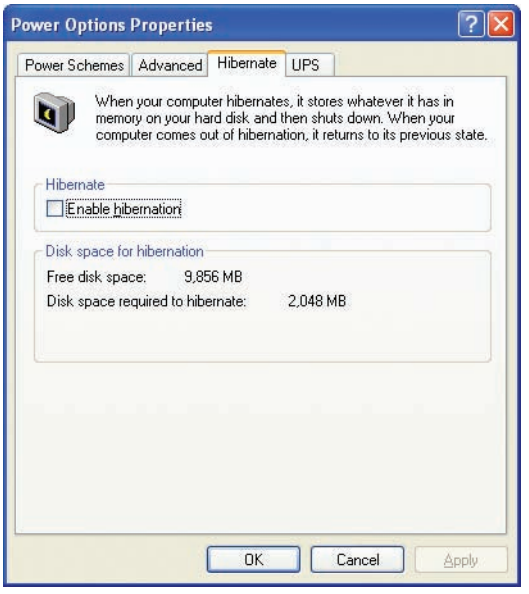


• **Figure 26.33** Windows Vista Balanced, Power saver, and High performance power plan options



• **Figure 26.34** Customizing a laptop power plan in Windows Vista

will have some way you can disable this feature when it's not needed, usually with a keyboard combination. You can also reduce the output of the LCD backlight using a combination of FN and another key to eke out a few more precious minutes of computing time before you have to shut down.



• **Figure 26.35** Windows XP hibernation settings in the Power Options applet

Try This!

Adjusting Your System's Power Management

Go into the Power Options applet and take a look at the various settings. What is the current power scheme for your computer? If you're using a laptop with Windows XP, is your system still using the Home/Office Desktop power scheme? If this is the case, change the power scheme to Portable/Laptop. If you're using a laptop with Windows Vista/7, check to see if you are running a balanced or high performance power plan. If you are, change the power plan to power saver and familiarize yourself with some of the advanced power settings (click on the *Change advanced power settings* link).

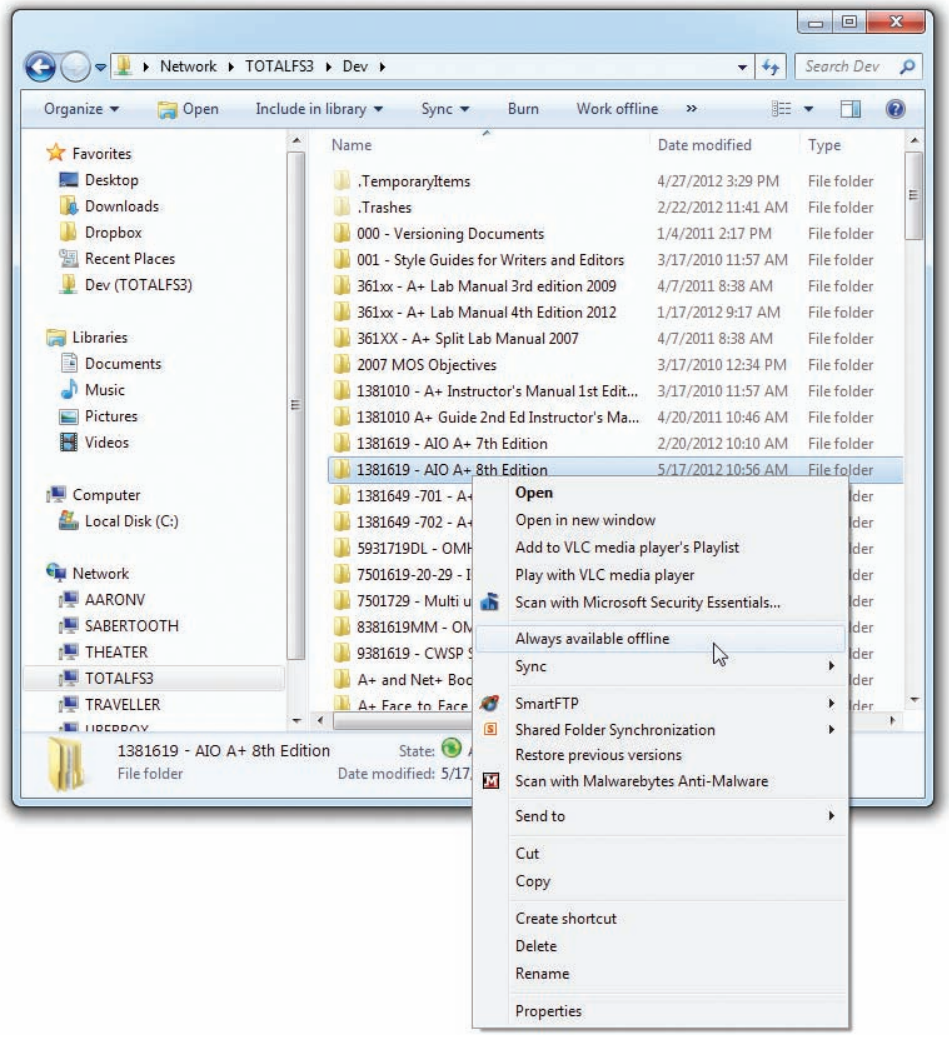
Try changing the individual settings for each power scheme. For instance, set a new value for the *System standby* setting—try making your computer go into standby after five minutes. Don't worry; you aren't going to hurt anything if you fiddle with these settings.

• **Figure 26.36** Keys for adjusting screen brightness

Figure 26.36 shows a close-up of the FN-activated keys for adjusting screen brightness.

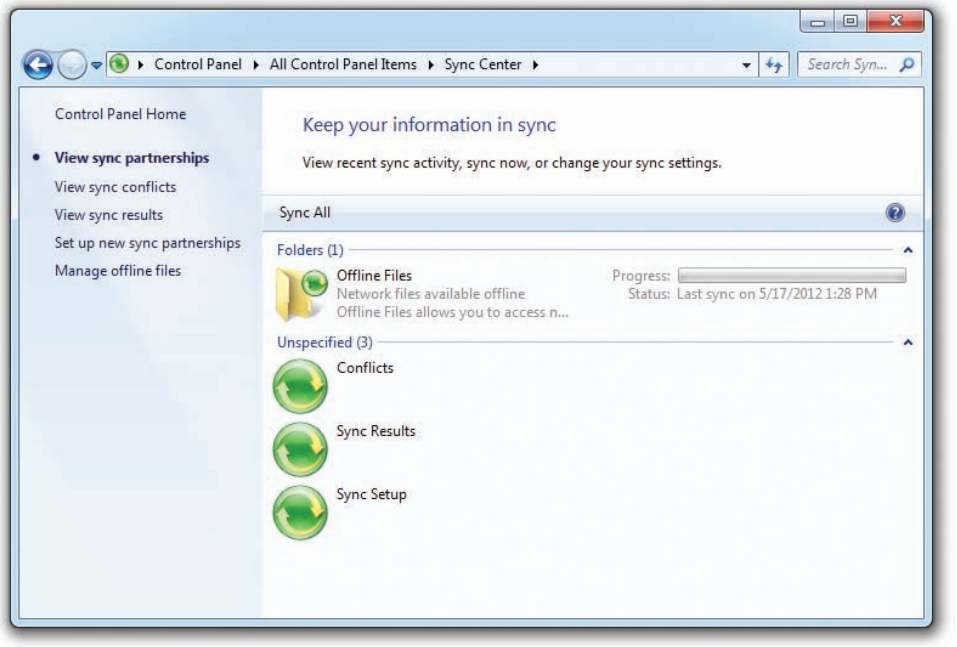
One of the best ways to conserve battery use is to plan ahead for times when you'll be unplugged. When I travel, for example, and know that I'm going to need a certain set of files stored on my file server at the office, I put those files on my laptop before I leave, while it's still plugged into the AC. It's tempting to throw the files on a thumb drive so I don't have to break out my laptop at the office, right? Or to let Dropbox do my syncing for me when I get to a Wi-Fi hotspot, but both USB and Wi-Fi use electricity.

Better than that even, Windows Vista and Windows 7 enable me to designate the files and folders I need as **offline files**, storing a local, duplicate copy of the files and folders on my hard drive. When I connect my laptop into my office network, those offline files are automatically synced with the files and folders on the file server. Anything I changed on the laptop gets written to the server. Anything anyone changed in those folders on the server gets written to my laptop. (If changes were made on both sides, a sync conflict pops up automatically, enabling you to resolve problems without fear of overwriting anything important.)

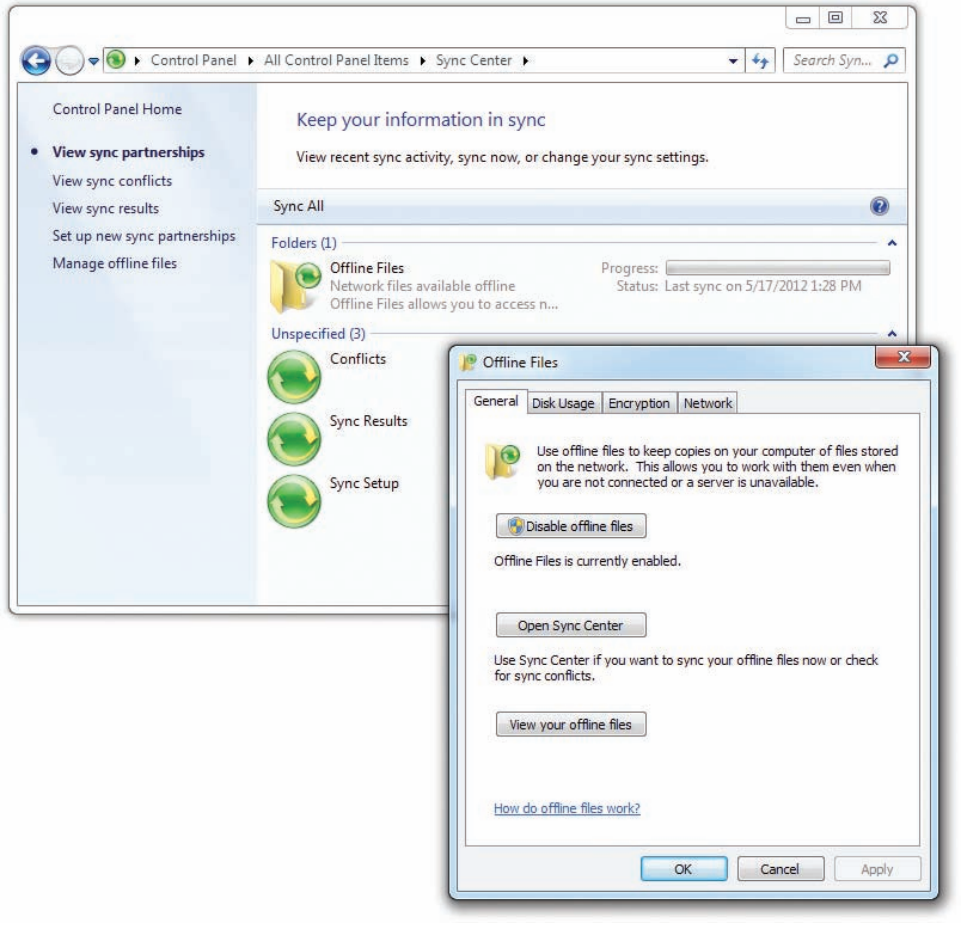


• **Figure 26.37** Setting up offline files

To designate a folder and its contents as offline files, right-click on the folder you want and select *Always available offline* from the menu (see Figure 26.37). The sync will occur and you're done. When you want to open the files offline, go to the Control Panel and open the Sync Center applet (see Figure 26.38). Click the *Manage offline files* link in the Tasks list to open the Offline Files dialog box (see Figure 26.39). Click the *View your offline files* button and you're in.



• **Figure 26.38** Sync Center applet



• **Figure 26.39** Offline Files dialog box

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 21 for specifics.)

If you've had the laptop in a smoky or dusty environment where the air quality alone causes problems, try cleaning it with compressed air. 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.

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.

Protecting 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 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. 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 you're traveling with a laptop, take care to guard against 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 optical or floppies, from their drives. Most importantly—back up any important data before you leave!

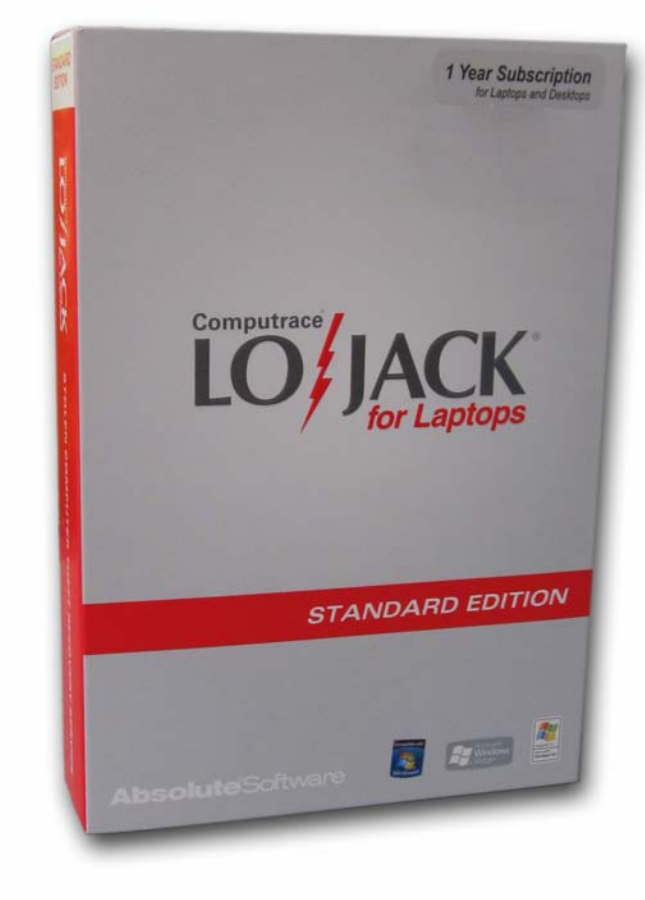
Make sure to have at least a little battery power available. Heightened security at airports means you might have to power on your system to prove it's really a computer and not a transport case for questionable materials. And never let your laptop out of your sight. If going through an x-ray machine, 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 most 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

• **Figure 26.40** Cable lock



• **Figure 26.41** LoJack (photo courtesy of Absolute Software Corporation)

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 (see Figure 26.40). 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. Even LoJack, the company famous for recovering stolen automobiles via its tracking devices, lends its name to a tracking product sold by Absolute Software (see Figure 26.41). The location of the stolen PC can be tracked, and sensitive files can even be deleted automatically with the aid of the stealth signal.

Upgrading and Repairing Laptop Computers

A competent tech can upgrade and repair portable computers to a degree, though true laptop techs are specialists. Upgrading the basics usually means breaking out the trusty screwdriver and avoiding electrostatic discharge (ESD). *Repairing* portables successfully, on the other hand, requires research, patience, organization, special tools, and documentation. Plus you need a ridiculously steady hand. This section provides an overview of the upgrade and repair process.

Disassembly Process

Disassembling a portable PC is pretty easy. Putting it back together in working condition is the hard part! You need to follow a four-step process to succeed in disassembly/reassembly.

First, *document and label every cable and screw location*. Laptops don't use standard connectors or screws. Often you'll run into many tiny screws of varying threads. If you try to put a screw into the wrong hole, you could end up stripping the screw, stripping the hole, or getting the screw wedged into the wrong place.

Second, *organize any parts you extract from the laptop*. Seriously, put a big white piece of construction paper on your work surface, lay each extracted piece out in logical fashion, and clearly mark where each component connects and what it connects to as well.

Third, *refer to the manufacturer's documentation*. I can't stress this point enough. Unlike desktop PCs, portable PCs have no standardization of internal structure. Everything in the portable is designed according to the manufacturer's best engineering efforts. Two portables from the same manufacturer might have a similar layout inside, but it's far more likely that every model differs a lot.

Finally, you need to *use the appropriate hand tools*. A portable PC, especially on the inside, will have a remarkable variety of tiny screws that you can't remove/reinsert without tiny-headed Phillips or Torx drivers. You'll need tiny pry bars—metal and plastic—to open components. Figure 26.42 shows an entry-level toolkit for a laptop tech that you can order from iFixit.com

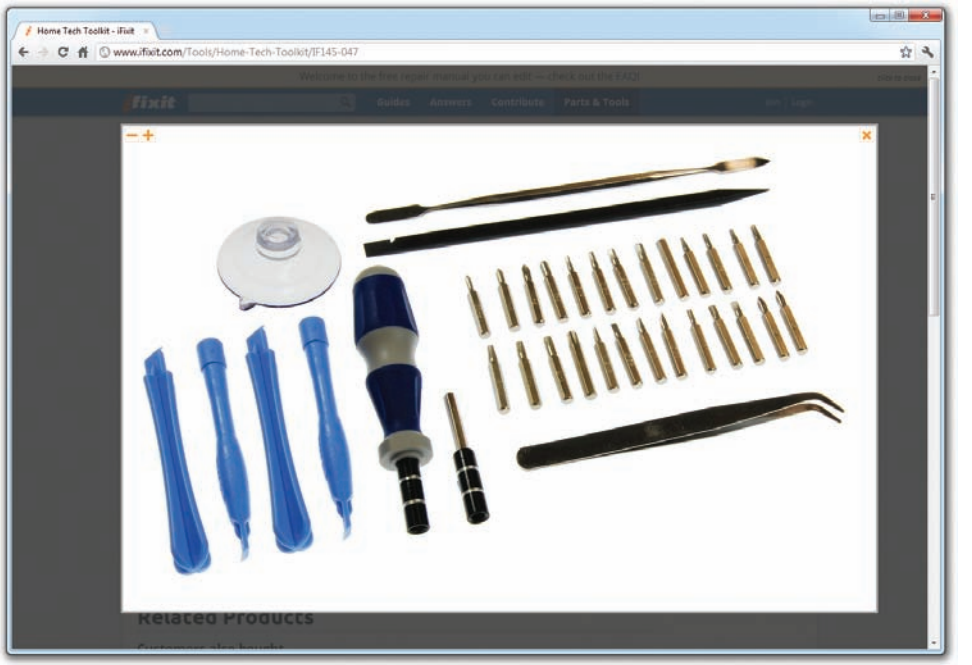
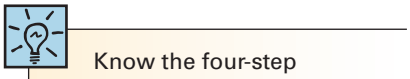


Figure 26.42 Bare-minimum laptop repair tools



Know the four-step disassembly process for the CompTIA A+ 220-802 exam:

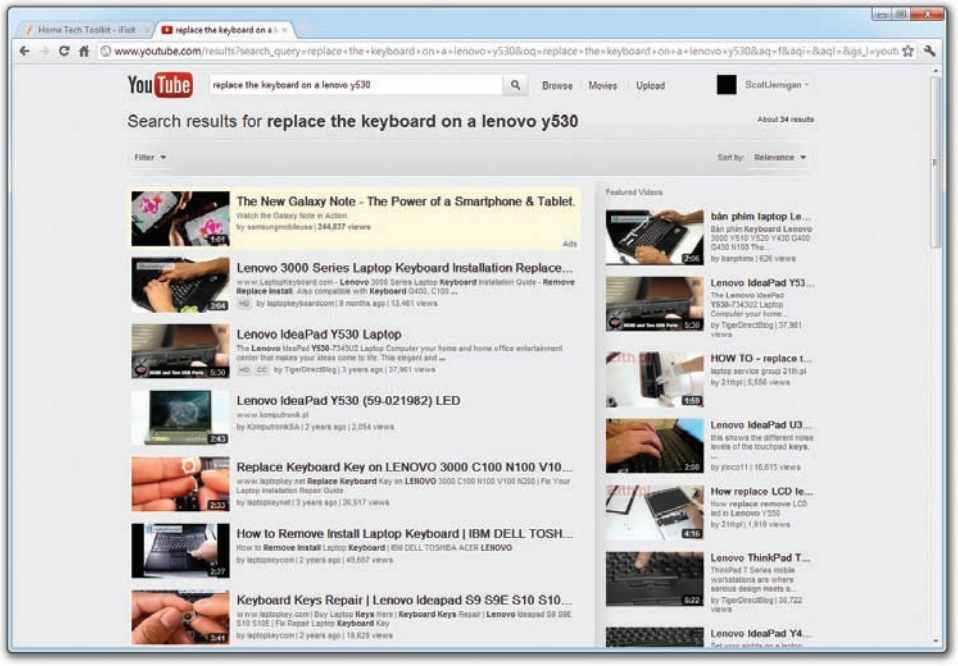
1. Document and label cable and screw locations.
2. Organize parts.
3. Refer to the manufacturer's documentation.
4. Use appropriate hand tools.

(more on this site in a moment). Their professional version of the toolkit has 70 tools, plus there's an expansion kit! Like I said at the beginning of the chapter, portable techs are specialists.

Now that you have the official line on the disassembly process, let's get one thing clear: A lot of manufacturers don't provide documentation to just any tech, but only to authorized repair centers. So what do you do when faced with an unfamiliar laptop that a client brought in for repair?

You have essentially three options. First, you can find a dedicated laptop tech and refer your client to that person. If the problem is exceptionally complicated and the portable in question is mission critical, that's often the best option. If you want to tackle the problem or it looks like something you should be able to do, then you go to the sources: YouTube and iFixit.com.

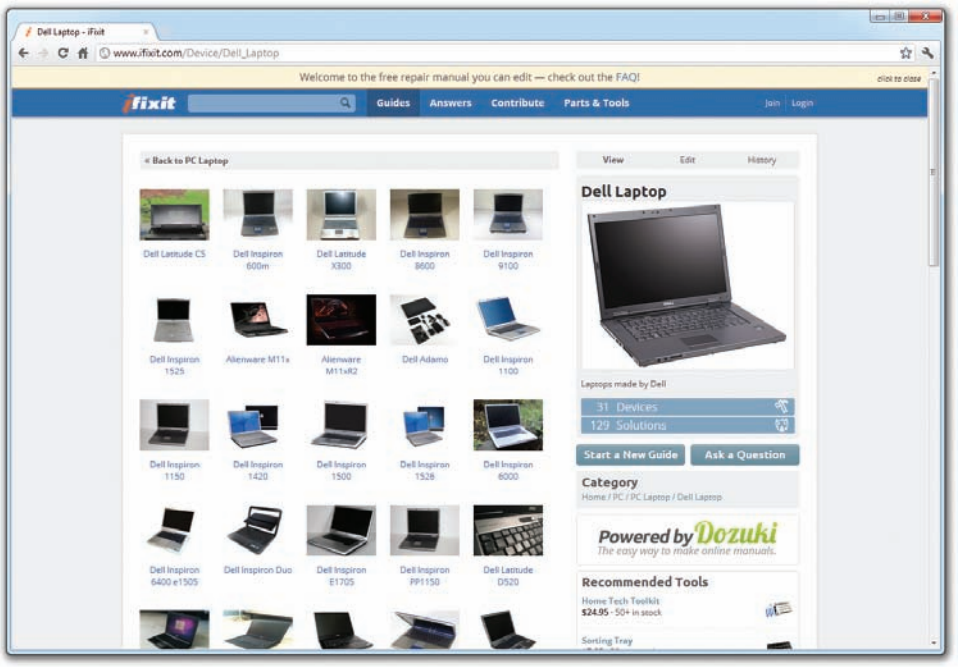
Every portable computer has a specific make and model. Open up a Web browser and go to YouTube. Type in precisely what you want to do, such as "replace the keyboard on a Lenovo y530," and see what pops up (see Figure 26.43). You'll most likely be in shock and awe when you get the results back, especially if the laptop in question is a couple of years old. People all over the world have to deal with broken devices, so you're not alone.



• **Figure 26.43** YouTube search result

Once you've found the appropriate video or something that's close enough to enable the repair attempt, watch it. If it's too difficult for your skill level or requires a set of expensive tools, then fall back to step one and go find that dedicated tech. Otherwise, figure out what tools and parts you need. Parts specific to a laptop (as in that Lenovo keyboard in the preceding example) will need to be purchased from the manufacturer. More generic parts, like hard drives, CPUs, and so on, can be purchased from Newegg (my favorite tech store) or some other online retailer.

For general tools, parts, and a lot of very detailed step-by-step instructions, I highly recommend iFixit.com. Billed as a "free repair manual you can edit," iFixit is built by techs like you who conquer a problem, document the steps, and post the details (see Figure 26.44). This means the next tech along who runs into the same problem doesn't have to reinvent the wheel. Just go to iFixit.com. The proceeds from parts and tools they sell, by the way, go toward supporting the site. It's not a for-profit enterprise.



• **Figure 26.44** Some of the Dell laptop repair walkthroughs at iFixit.com

One of the most striking contrasts between portable PCs and the tablets and smartphones you'll read about in Chapter 27 is in upgradability. You can and should upgrade portable PCs. Mobile devices, on the other hand, offer almost no upgradability at all.

Standard Upgrades

Every CompTIA A+ tech should know how to perform the two standard upgrades to portable computers: adding RAM and replacing a hard drive. Let's go through the steps.

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 7 Home Premium routinely sit on store shelves and go home to consumers with as little as 1 GB 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. Ancient laptops use either 72-pin or 144-pin SO-DIMMs with SDRAM technology. DDR, DDR2, and DDR3 systems primarily use 200-pin SO-DIMMs (see Figure 26.45), although some laptops use micro-DIMMs.

• **Figure 26.45** 200-pin SO-DIMM stick (front and back)

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

Cross Check

How Much RAM Is Enough?

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 1–2 GB, might be adequate. 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. Turn to Chapter 14 and cross check your knowledge about specific OS RAM needs. What's a good minimum for Windows XP? What about Vista? How much for Windows 7?

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 location for RAM placement in portables. More often than not, you need to unscrew or pop open a panel on the underside of the portable (see Figure 26.46). Then you press out on the restraining clips and the RAM stick pops up (see Figure 26.47). Gently remove the old stick of RAM and insert the new one by reversing the steps.

Always remove all electrical power from the laptop before removing or inserting memory. Disconnect the AC cord from the wall outlet. Take out the battery! Failure to disconnect from power can result in a fried laptop.

Shared Memory Some laptops (and desktops) support **shared memory**. Shared memory reduces the cost of video cards by reducing the amount

• **Figure 26.46** Removing a RAM panel

• **Figure 26.47** Releasing the RAM

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).

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.

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

HDD/SSD

You can replace a hard disk drive (HDD) or solid-state drive (SSD) in a portable PC fairly easily, especially if the laptop is only a few years old. 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 1 TB, while the 3.5-inch hard drives can hold more than 3 TB of data!

If you have a much older laptop, it might have a PATA drive, which means you need to pay more attention to cabling and jumpers. 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 (see Figure 26.48).

One of the best upgrades you can make on a laptop is to go from an HDD to an SSD. Obviously, you'll get a lot less storage capacity for the money, but the trade-offs can be worth it. First, the SSD will use a lot less electricity than an HDD, thus extending battery life. Second, any SSD is rip-roaringly faster than an HDD and performance across the board will be boosted.

• **Figure 26.48** The 2.5-inch and 3.5-inch drives are mostly the same.

Try This!

Comparing HDD with SSD Today

As I write this chapter, you can get roughly ten times the storage capacity on an HDD for the same cost as an SSD. In other words, $100 spent on an SSD would give me ~100 GB of storage, whereas I could purchase a 1-TB HDD for the same $100. So do some comparison shopping. What's the price point now? Are the trade-offs worth it for you or for your clients to make the switch from HDD to SSD?

• **Figure 26.49** Removing the drive compartment cover

• **Figure 26.50** Inserting a replacement drive

The process of replacing a hard drive mirrors that of replacing RAM. You find the hard drive hatch—either along one edge or in a compartment on the underside of the computer—and release the screws (see Figure 26.49). Remove the old drive and then slide the new drive into its place (see Figure 26.50). Reattach the hatch or cover and boot the computer. Grab a Windows disc and prepare to reinstall.

Hardware Replacement

Once you get beyond upgrading RAM and replacing a hard drive on a portable PC, you take the plunge into the laptop repair specialty. You can replace some components by lifting them out, detaching a ribbon cable, and then reversing the steps with the replacement part. Other parts require a full teardown of the laptop to the bare bones, which presents a much greater magnitude of difficulty. Because every portable PC differs from every other one, this section provides guidance, but not concrete steps, for replacement.

Components

Replaceable components require more work than the RAM or drive upgrades, but replacing them generally falls into the category of "doable." What I call *components* are the battery, keyboard, optical drive, internal speaker, and plastic parts.

Battery If a battery's performance falls below an acceptable level, you can replace it with a battery from the manufacturer or from an aftermarket vendor. Although this should be a simple swap replacement (and usually is), you might encounter a situation where

the real problem wasn't the battery per se, but an inadequate or malfunctioning charging system. The new battery might not give you any better performance than the old one. Try it.

Keyboard Getting a keyboard off a laptop computer often requires little pry bars, but also look for screws, clips, and so on. Keyboards connect via a tiny, short, and very delicate cable, often held down by tape. Replacing one is tricky, but doable.

Optical Drive Replacing an optical drive can present a challenge. If the drive is part of a modular system, just pop out the old drive and pop in a new one. If the drive is part of the internal chassis of the portable, on the other hand, you're looking at a full dissection. (See the "Integral Parts" section for tips on dismantling the portable.)

Speaker Like the optical drive, replacing the internal speaker or speakers on a laptop can be simple or a total pain, depending on where the speakers connect. Some laptops have speakers mounted on the outside of the chassis. You pry off the covers, pull out the little speakers, disconnect the cable, and then reverse the process for replacement speakers. If the speakers are inside the chassis, on the other hand, you need to dismantle the portable to get to them. (See the "Integral Parts" section.)

Plastic Parts Laptops have a few plastic parts that can get lost or broken. These are slot covers or card blanks designed to keep dust out of the memory card and expansion slots (see Figure 26.51). If you need to replace one of these, simply get a spare from the manufacturer or an aftermarket vendor and replace it.

Expansion Cards Not to be confused with PC Cards, many portable PCs have one or more true expansion slots for add-on cards. The more modular varieties will have a hatch on the bottom of the case that opens like the RAM hatch that gives you access to the slot(s). This enables you to change out an 802.11g wireless card, for example, for an 802.11n card, thus greatly

• **Figure 26.51** ExpressCard blank

enhancing the Wi-Fi experience on this device. Figure 26.52 shows a wide-open laptop with the expansion slot exposed.

Just like when installing RAM in a portable, you must avoid ESD and remove all electricity before you take out or put in an expansion card. Failure to remove the battery and the AC adapter can and probably will result in a shorted-out laptop motherboard, and that just makes for a bad day.

The only other consideration with expansion cards applies specifically to wireless. Not only will you need to connect the card to the slot properly, but you must reattach the antenna connection and often a separate power cable. Pay attention when you remove the card as to the placement of these vital connections.

You'll find one of two types of expansion slot in a portable. The older ones (think 2005 and earlier) use **Mini-PCI**, because PCI dominated that time period. Just about every portable since then uses PCI Express, so the laptops come with **Mini-PCIe** slots.

CPU Replacing a CPU on a modern portable takes a lot more work than replacing RAM or a Mini-PCIe expansion card, but follows the same general steps. Many CPUs mount facing the bottom of the portable, so that the venting goes away from your hands. When sitting properly on a flat surface, the heated air also goes to the back of the laptop and not toward the user. You access the CPU in this sort of system from the bottom of the portable.

As you can see in Figure 26.53, the CPU has an elaborate heat-sink and fan assembly that includes both the CPU and the chipset. Each of the pieces screws down in multiple places, plus the fan has a power connection. Aside from the tiny screws, there's no difference here in process between replacing a mobile CPU and a desktop CPU that you learned way back in Chapter 6.

First, remove all power from the laptop, including the battery. Remove the hatch to expose the CPU. Remove the heat-sink and fan assembly and lift out the CPU. Replace it with another CPU, apply thermal paste, and reattach the heat-sink and fan assembly. Reconnect the fan power connector and you're good to go.

• **Figure 26.52** Mini-PCIe expansion slot on laptop

• **Figure 26.53** CPU heat-sink and fan assembly exposed

Some older laptops use passive cooling and thus have the CPU pointed up rather than down. They have a heat sink beneath the keyboard that cools everything down. With that style laptop, you remove the keyboard and heat sink to expose the CPU.

Integral Parts

Some hardware replacements require you to get serious with the laptop, opening it fully to the outside, removing many delicate parts, and even stripping it down to the bare metal chassis. I leave these repairs to the professional laptop repair folks, simply because they have the specific tools and expertise to do the job efficiently. CompTIA expects you to understand the process, though, so I've outlined it here. This pertains to four components: screen, DC jack, touchpad, and system board.

Portables open in two different ways, depending on the manufacturer. You either peel away layers from the top down, through the keyboard, or from the bottom up, through the base. Either direction requires careful attention to detail, part connectivity, and locations. You'll need a system to keep track of the dozens of tiny screws.

Every one of the replacements here requires you to detach the screen from the main chassis of the portable. Aside from finding the connection points and removing the proper screws, you need to pay attention to the connection points for the data stream to the monitor and the antenna that's in the frame of the display.

Once you have the portable stripped down, you replace whichever component you're in there to replace and then begin the process of building it back up into a coherent unit. Pay incredibly careful attention to getting data cables connected properly as you rebuild. I can't imagine a worse tech experience than replacing a touchpad and rebuilding a laptop only to have missed a connection and having to do it all over again.

The DC jack requires extra-special love when you need to replace one. The part is soldered to the main board, so to replace it means you'll need to not only strip the laptop to the bare metal, but also unsolder the old part and solder the new part. Then you'll rebuild the laptop and hope you got everything right. CompTIA cannot expect a CompTIA A+ technician to know how to do this stuff. Expect a question that explores whether it *can* be done. Rest assured, specialized techs can replace *any* component on a laptop, even the DC jack.

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.

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.
- If you plug a laptop into an external monitor and that monitor does not display, remember that you have both a hardware and an OS component to making dual displays successful. There's usually a combination of FN and another key to toggle among only portable, only external, and both displays. Plus you have the Display applet in the Control Panel to mirror or extend the desktop to a second monitor.

Tech Tip

Battery Won't Charge

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.

- Many manufacturers have switched to LED displays on laptops, which has led to a phenomenon many techs thought long behind us: *flickering displays*. The LED backlights don't work quite the same as CCFL backlights, especially when you lower the brightness. This doesn't affect desktop LED displays, because they're usually so bright it doesn't matter. But portables need to be able to dim to save battery life. One technique for dimming LEDs is to have them turn on and off rapidly enough to keep the pixels lit, but slowly enough that there's a reduction in visible light and electricity use. With some of these panels, that flickering is not only noticeable, but headache and eyestrain inducing.
- There are two things you can do with a flickering LED display: crank up the brightness so that it goes away (and thus live with reduced battery life) or replace the laptop.

Wireless Doesn't Work or Works Intermittently

- If the wireless doesn't work at all, check along the front, rear, or side edges of the laptop for a physical switch that toggles the internal wireless adapter or Bluetooth adapter on and off.
- If a tech has recently replaced a component that required removal of the laptop display, dead wireless could mean simply a disconnected antenna. Most portables have the antenna built into the display panel, so check that connection.
- Try the special key combination for your laptop to toggle the wireless or Bluetooth adapter. You usually press the FN key in combination with another key.
- You might simply be out of range or, if the wireless works intermittently, then right at the edge of the range. Physically walk the laptop over to the wireless router or access point to ensure there are no out-of-range issues.
- With Bluetooth specifically, remember that the pairing process takes action or configuration on both devices to succeed. Turn on the Bluetooth device, actively seek it, and try again.

Input Problems

- 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. The numlock LED should indicate the status. Turn it off.

The troubleshooting issue known as a *ghost cursor* can mean one of two things. First, the display shows a trail of ghost cursors behind your real cursor as you move it. This might point to an aging display or an improperly configured refresh rate. Second, the cursor moves erratically, whether you are touching the touchpad or not. This probably means the touchpad has been damaged in some way and needs to be replaced.

- Laptop keyboards take far more abuse than the typical desktop keyboard, because of all those lunch meetings and café brainstorm sessions. Eating and drinking while over or around a keyboard just begs for problems. If you have a portable with sticking keys, look for the obvious debris in the keys. Use compressed air to clean them out. If you have serious goo and need to use a cleaning solution, disconnect the keyboard from the portable first. Make sure it's fully dried out before you reconnect it or you'll short it out.
- If the touchpad is having problems, a shot of compressed air does wonders for cleaning pet hair out of the touchpad sensors. You might 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

Chapter Summary

After reading this chapter and completing the exercises, you should understand the following about portable computers.

Describe the many types of portable computing devices available

- All portable devices share certain features: video output using LCD screens, some kind of PC sound, and DC battery power. There's no industry standard for naming the vast majority of styles of portable computing devices.
- A portable PC 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. The terms "laptop," "notebook," and "portable" all define the same form factor.
- Portable computers come with a variety of input devices. Most have a fully functional keyboard and a device to control the mouse pointer. The basic QUERTY format is followed, but manufacturers make choices with key size and placement of the non-alphabet characters. Almost every portable keyboard uses a Function (FN) key to enable some keys to perform a third duty.
- By far the most common laptop pointing device found today is the touchpad—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.
- 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. The two most common resolutions are WXGA for the 14- to 15-inch models and HD 1080 for the 17.3-inch models. The common finish is either matte or high-gloss.
- A portable PC can be considered a desktop replacement if it does everything most people want to do with a desktop PC. Desktop replacements appeal to road warriors and people who prefer to tuck computing devices out of sight when not in use.
- Netbook portables normally weigh less than three pounds and are less than an inch in thickness. These machines usually have smaller displays, lower-capacity hard drives, and CPUs that operate at lower speeds than their more full-sized brethren.
- Ultrabooks are for people who can't give up the power of high-end computers but can afford to pay more for a smaller package. Intel set up the Ultrabook specifications in 2011, defining the form factor to use power-sipping Intel processors with integrated graphics.
- Microsoft started the Tablet PC initiative way back in 2001, defining the devices as fully featured portables running a tablet-aware version of Windows and using a stylus to interact directly with the screen. Many Tablet PCs have come to market since then, fulfilling the needs of specific professions, notably medicine.

Explain ways to expand portable computers

- Every portable PC comes with one or more single-function ports. The most common of all is the ubiquitous USB port. Additionally, the single PS/2 port on some laptops supports both keyboards and pointing devices. Most portable computing devices have a speaker port, and some have line in and microphone jacks as well. Laptops invariably provide a video port such as a VGA, HDMI, DisplayPort, or DVI connection for hooking up an external monitor.
- Most laptops support a second monitor, giving the user the option to display Windows on the laptop only, the external monitor only, or both simultaneously. Usually a special Function (FN) key on the keyboard will cycle through the monitor configurations.
- All portables offer some kind of network connectivity, such as 802.11 Wi-Fi to connect to the Internet. Wired Ethernet ports are standard issue. Bluetooth is common for connecting peripherals. Portables have some way to toggle Wi-Fi and Bluetooth off and on to conserve battery life.

- PC Cards are roughly credit card–sized devices that enhance and extend the functions of a portable PC. Still commonly known by their older name, *PCMCIA cards*, PC Cards were standard on mobile computers for years but are slowly disappearing. All PC Cards are hot-swappable.
- Parallel PC Cards come in two flavors, 16-bit and CardBus, and each flavor comes in three different physical sizes, called Type I, Type II, and Type III. Type I, II, and III cards differ only in the thickness of the card (Type I being the thinnest and Type III the thickest). Type II cards are by far the most common. All parallel PC Cards share the same 68-pin interface. The 16-bit PC Cards 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 different functions on a single card. The 16-bit PC Cards will fit into and work in CardBus slots, but the reverse is not true.
- The serial ExpressCard comes in two widths: 54 mm (ExpressCard/54) and 34 mm (ExpressCard/34). 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. ExpressCards connect to either the Hi-Speed USB 2.0 bus (480 Mbps) or a PCI Express bus (2.5 Gbps).
- Most portable PCs have one or more general-purpose expansion ports that enable you to plug in many types of devices. Older portables sport RS-232 serial and IEEE 1284 parallel ports for mice, modems, printers, scanners, external CD-media drives, and more. USB, FireWire, and eSATA are popular and widespread methods for attaching peripherals to laptops. All have easy-to-use connectors and can be hot-swapped.
- Port replicators are devices that plug into a single port (usually USB but sometimes proprietary) and offer common PC ports, such as serial, parallel, USB, network, and PS/2. Docking stations resemble port replicators in many ways, offering legacy and modern single- and multi-function ports, but have extra features built in, such as optical drives or PC Card slots.

Manage and maintain portable computers

- Portable computers use three types of batteries: Nickel-Cadmium (Ni-Cd), Nickel-Metal Hydride (Ni-MH), and Lithium-Ion (Li-Ion). Today, only Li-Ion is used because that battery chemistry provides the highest energy density for the weight and has few problems with external factors.
- Batteries should be stored in a cool place and kept charged, at least to 70–80 percent. Never drain a battery all the way down unless required to do so as part of a battery calibration. Rechargeable batteries have only a limited number of charge-discharge cycles before overall battery performance is reduced. Because batteries contain dangerous chemicals, never handle one that has ruptured. Always recycle old batteries rather than disposing of them in the trash.
- The process of cooperation among the hardware, the BIOS, and the OS to reduce power use is known generically as power management. Early laptops used power continuously, regardless of whether the system was using the device at the time. With power management features, today's laptops can automatically turn off unused devices or can shut down the entire system, leaving the information in RAM ready for a restart. To perform these power management functions requires specialized hardware, BIOS, and an operating system that supports power management.
- Starting with the 386SX, Intel introduced System Management Mode (SMM), a power management system that would make the CPU and all peripherals go to "sleep." In 1992, Intel introduced the improved Advanced Power Management (APM) specification, followed by the Advanced Configuration and Power Interface (ACPI) standard in 1996.
- To use APM or ACPI, the computer must have an SMM-capable CPU, an APM-compliant BIOS, and devices that can be shut off. Referred to as Energy Star devices, these peripherals can shut down without actually turning off. The OS must also know how to request that a particular device be shut down. ACPI extends power-saving to include hot-swappable devices.

- Virtually all laptops and desktops use power management functions. APM defines four power-usage levels, including Full On, APM Enabled, APM Standby, and APM Suspend. ACPI, the successor to APM, handles all these levels plus a few more, totaling four Global (G) and six total (S) states. Support for APM was discontinued in Windows Vista, which uses ACPI.
- Configure APM/ACPI through CMOS or through the Power Options Control Panel applet in Windows, with Windows settings overriding CMOS settings. Many CMOS versions allow configuration of wake-up events.
- Hibernation writes information from RAM to the hard drive. Upon waking up, the data is returned to RAM, and programs and files are in the same state they were in when the computer entered hibernation.
- Laptops with backlit keyboards will have some way you can disable this feature when it's not needed, usually with a keyboard combination. You can also reduce the output of the LCD backlight using a combination of FN and another key to get a few more minutes of computing time before you have to shut down.
- Use an appropriate screen cleaner (not glass cleaner) to clean the LCD screen. Use compressed air around the keyboard and PC card sockets. Never use water around the keyboard.
- To combat the inevitable heat produced by a portable computer, always use power management, keep an air space between the bottom of the laptop and the surface on which it rests, don't use a keyboard protector for an extended period of time, and be aware of your fan.
- Store portable computers in quality cases when traveling. Well-padded backpacks not only keep a laptop protected but also make a system less appealing to would-be thieves. When traveling, don't forget accessories such as AC power cords, additional batteries, or modular devices. Remove all discs from drives and make sure you have enough battery power to boot up for security personnel. If shipping your computer, go with a reputable carrier, keep your tracking number, and request a delivery signature. Use a laptop lock or a software tracking system to protect your laptop when traveling.

Upgrade and repair portable computers

- You need to follow a four-step process to succeed in disassembly/reassembly. First, document and label every cable and screw location. Second, organize any parts you extract from the laptop. Third, refer to the manufacturer's documentation. Finally, you need to use the appropriate hand tools. If you can't get information directly from the manufacturer, try various online sites, such as YouTube or iFixit, for walkthroughs on fixing laptop problems.
- Every CompTIA A+ tech should know how to perform the two standard upgrades to portable computers: adding RAM and replacing a hard drive.
- Laptops use one of four types of RAM. Most older laptops use either 72-pin or 144-pin SO-DIMMs with SDRAM technology. DDR SDRAM systems primarily use 200-pin SO-DIMMs, although you'll also find 172-pin micro-DIMMs. Every decent laptop has upgradeable RAM slots. Get the correct RAM; many portable PC makers use proprietary RAM solutions. No standard exists for RAM placement in portables. More often than not, you need to unscrew or pop open a panel on the underside of the portable and press out on the restraining clips to make the RAM stick pop up so you can remove and replace it. Always disconnect from all electrical sources before removing or inserting RAM.
- Laptops that support shared memory benefit from more affordable video cards. The video card has less built-in RAM and uses a portion of the computer's system RAM to make up the difference. Although this results in a lower cost, system performance suffers because RAM that is shared with the video card is not available to programs. NVIDIA calls their shared memory technology TurboCache and ATI calls theirs HyperMemory.
- SATA drives in the 2.5-inch drive format now rule in all laptops. Currently, the larger 2.5-inch hard drives hold up to 500+ GB, while the larger 3.5-inch hard drives hold more than 3 TB. Upgrading from an HDD to an SSD can bring remarkable gains in battery life and performance.
- Once you get beyond upgrading RAM and replacing a hard drive on a portable PC, you take the plunge into the laptop repair specialty. You

can replace some components by lifting them out, detaching a ribbon cable, and then reversing the steps with the replacement part. Other parts require a full teardown of the laptop to the bare bones, which presents a much greater level of difficulty.

- Standard tech-level repairs you should be able to do are replacing the battery, keyboard, and optical drive (usually—some are tough to get out). Others are replacing the small speakers and missing plastic parts.
- You can also open the hatch on the bottom of the case that opens like the RAM hatch to expose other parts for replacement. The same hatch might hold one or two Mini-PCIe slots, for example, and give you access to the CPU.
- Some hardware replacements require you to open a laptop, remove many delicate parts, and strip it down to the bare metal chassis. Dedicated laptop techs do these jobs, but you should know the process.
- Portables open in two different ways, depending on the manufacturer. You either peel away layers from the top down, through the keyboard, or from the bottom up, through the base. Either direction requires careful attention to detail, part connectivity, and locations. You'll need a system to keep track of the dozens of tiny screws.

Troubleshoot portable computers

- If your laptop won't power on, try a different wall outlet. If it still fails to power up, remove all peripheral devices and try again.
- If the screen doesn't come on properly, verify that the laptop is configured to use the built-in LCD screen by pressing the appropriate key to cycle through the internal and external monitors. If you hear a popping sound, you may have blown an inverter. If the screen is definitely broken, you may use an external monitor to access the laptop. One technique for dimming LEDs is to have them turn on and off rapidly enough to keep the pixels lit, but slowly enough that there's a reduction in visible light and electricity use. With some of these panels, that flickering is not only noticeable, but headache and eyestrain inducing.
- If wireless is not working, check for the physical switch on the side of the laptop that toggles power to the internal network card or Bluetooth adapter. If your laptop doesn't have a switch, check for a key combination or function key that toggles power. You also may be out of range. Physically walk the laptop closer to the wireless router or access point.
- If the keypad or touchpad doesn't work, try a shot of compressed air, reseat the physical internal connection, or reconfigure the driver settings through the Control Panel.

Key Terms

16-bit *(1000)*
Advanced Configuration and Power Interface (ACPI) *(1005)*
Advanced Power Management (APM) *(1005)*
aspect ratio *(989)*
auto-switching power supply *(1013)*
CardBus *(1000)*
desktop replacement *(990)*
docking station *(1003)*
ExpressCard *(1000)*
Function (FN) key *(987)*
hibernation *(1006)*
high-gloss *(990)*
laptop *(987)*
Lithium-Ion (Li-Ion) *(1003)*
matte *(990)*
Mini-PCI *(1022)*
Mini-PCIe *(1022)*
multitouch *(989)*
netbook *(991)*
Nickel-Cadmium (Ni-Cd) *(1003)*
Nickel-Metal Hydride (Ni-MH) *(1003)*
notebook *(987)*
offline files *(1010)*
PC Card *(999)*
PCMCIA card *(1000)*
port replicator *(1002)*
power plan *(1008)*
shared memory *(1018)*
sleep timer *(1008)*

stylus *(992)*
System Management Mode (SMM) *(1005)*
Tablet PC *(992)*
touchpad *(989)*
TrackPoint *(988)*
Ultrabook *(992)*

Key Term Quiz

Use the Key Terms list to complete the sentences that follow. Not all terms will be used.

1. A typical clamshell-style computer with built-in LCD monitor, keyboard, and input device is most commonly called a laptop or _____.
2. The _____ enables laptop keyboards to do more than two functions on a single key.
3. Many newer laptops feature _____ screens offering richer color, higher contrast, and wider viewing angles.
4. Intel set up the _____ specifications for super thin, super light, and super efficient laptops with integrated graphics and no optical drive.
5. The _____ replaced the PC Card as the external expansion slot of choice on laptops.
6. A(n) _____ plugs into a single port on the portable computer and offers uncommon and common PC ports, such as serial, parallel, USB, network, and PS/2.
7. Today's laptops use _____ for batteries because that battery chemistry provides the highest energy density for the weight.
8. Windows Vista and Windows 7 enable _____ for storing and automatically syncing files and folders between a portable and a file server.
9. Laptops using _____ are less expensive because the video card has less built-in memory, but the RAM it borrows from the system results in less memory available to programs.
10. Most laptops today have one or more _____ slots for internal expansion cards such as Wi-Fi NICs.

Multiple-Choice Quiz

1. Which of the following statements best describes hard drives typically found in laptops?
   - **A.** They are 2.5-inch SATA drives, but they do not hold as much data as the 3.5-inch hard drives found in desktop PCs.
   - **B.** They are 3.5-inch ATA drives just like those found in desktop PCs, but they usually require "cable select" settings rather than master or slave.
   - **C.** They are 3.5-inch SATA drives that hold more data than the 2.5-inch hard drives found in desktop PCs.
   - **D.** They are 2.5-inch PCMCIA drives, while desktops usually have 3.5-inch SCSI drives.
2. Which of the following APM power levels writes information from RAM to the hard drive and then copies the data back to RAM when the computer is activated again?
   - **A.** Full On
   - **B.** APM Enabled
   - **C.** APM Standby
   - **D.** Hibernation
3. Portable PCs typically use which of the following kinds of upgradeable RAM?
   - **A.** 68-pin and 72-pin RIMMs
   - **B.** 30-pin and 72-pin SIMMs
   - **C.** 72-pin and 144-pin SO-DIMMs
   - **D.** 30-pin and 72-pin SO-RIMMs
4. Where do you configure APM/ACPI in Windows?
   - **A.** The Power Options applet in the Control Panel
   - **B.** The Display applet in the Control Panel
   - **C.** The Power Management applet in the Control Panel
   - **D.** The Power and Devices applet in the Control Panel

5. Which of the following input devices will you most likely find on a portable PC?
   - **A.** TrackPoint
   - **B.** Touchpad
   - **C.** Trackball
   - **D.** Mouse
6. Which buses do ExpressCards use?
   - **A.** Hi-Speed USB and FireWire
   - **B.** Hi-Speed USB and PCI Express
   - **C.** PCI and PCI Express
   - **D.** Mini-PCI and Parallel
7. *Convertibles* and *slates* describe what type of device?
   - **A.** Multicore processor
   - **B.** Clamshell laptop computer
   - **C.** PDA
   - **D.** Tablet PC
8. If wireless networking is not working, what should you check?
   - **A.** Check the switch on the side of the laptop that toggles power to the network card.
   - **B.** Make sure the Ethernet cable is plugged into the laptop.
   - **C.** Make sure the digitizer has been trained.
   - **D.** Make sure Power Management is enabled.
9. Erin has an older laptop with a switch on the back that says 115/230. What does this indicate?
   - **A.** The laptop has an auto-switching power supply.
   - **B.** The laptop has a fixed-input power supply.
   - **C.** The laptop has a step-down transforming power supply.
   - **D.** The laptop has a step-up transforming power supply.
10. Which of the following display types will you most commonly find on a portable PC today? (Select two.)
    - **A.** LCD
    - **B.** LED
    - **C.** OLED
    - **D.** Plasma
11. Jake has received two replacement memory sticks for his Dell laptop. What should he do first in the upgrade process?
    - **A.** Disconnect the AC cord and remove the battery.
    - **B.** Flip the laptop over and remove the RAM compartment cover.
    - **C.** Remove the memory sticks from their antistatic bags and set them on the antistatic map next to the laptop.
    - **D.** Remove the memory sticks from the laptop.
12. Steve complains that his Windows 7 laptop still isn't snappy enough after doubling the amount of RAM. What might improve system performance?
    - **A.** Add more RAM.
    - **B.** Replace the power supply.
    - **C.** Replace the battery.
    - **D.** Replace the HDD with an SSD.
13. Jim likes his laptop but complains that his wireless seems slow compared to all the new laptops. On further inspection, you determine his laptop runs 802.11g. What can be done to improve his network connection speed?
    - **A.** Replace the regular RAM with 802.11n RAM.
    - **B.** Replace the display with one with a better antenna.
    - **C.** Replace the Mini-PCIe 802.11g card with an 802.11n card.
    - **D.** Get a new laptop, because this one can't be upgraded.
14. Edgar successfully replaced the display on a laptop (a toddler had taken a ballpoint pen to it), but the customer called back almost immediately complaining that his wireless didn't work. What could the problem be?
    - **A.** The problems are unrelated, so it could be anything.
    - **B.** Edgar inadvertently disconnected the antenna from the Mini-PCIe 802.11 card.
    - **C.** Edgar replaced the display with one without an internal antenna.
    - **D.** Edgar failed to reconnect the antenna in the new display.

15. Rafael gets a tech call from a user with a brand new laptop complaining that working on it was causing headaches. What could the problem be?
    - **A.** The laptop uses a plasma display.
    - **B.** The laptop uses a CRT display.
    - **C.** The laptop uses an LED display in power saving mode.
    - **D.** The laptop uses an LED display in full power mode.

Essay Quiz

1. At the upcoming training seminar for new techs, your boss wants to make sure they understand and use power management settings. You've been asked to prepare a short presentation showing the range of power management settings available in Windows XP, Vista, and 7 and demonstrating how to set them. What will you include in your presentation?
2. You've been tasked to advise your group on current portable computer technology so they can purchase ten new laptops by the end of the quarter. In a short essay, weigh the pros and cons of getting desktop replacements versus smaller laptops that would come with docking stations.
3. Your boss has a new portable computer and is planning to take it with him on a business trip to Paris. He's not all that tech-savvy or much of a traveler, so write a memo that tells him what to do or avoid while traveling, especially overseas.
4. Norm wants to upgrade his laptop's hard drive, CPU, and RAM. Because he's upgraded all of these components on his desktop, he doesn't think he'll run into much trouble. What advice will you give him about selecting the components and upgrading the laptop?

Lab Projects

• Lab Project 26.1

This chapter mentioned that, although they are more expensive, portable PCs typically provide less processing power and smaller hard drives, and in general are not as full-featured as desktop computers. Use the Internet to check sites such as www.lenovo.com, www.toshiba.com, www.dell.com, and www.hp.com to compare the best equipped, most powerful laptop you can find with the best equipped, most powerful desktop computer you can find. How do their features and prices compare? Now find a less expensive laptop and try to find a desktop computer that is as similar as possible in terms of capabilities, and compare their prices.

• Lab Project 26.2

Continuing from the previous lab, go to the www.dell.com website and compare one of the better desktop-replacement laptops with one of the more basic laptops. List the features that are of interest to you personally, starting with the most important and continuing down. Then use the site to begin building the perfect laptop for you. Compare your results with others and discuss what's important to you.

chapter 27

Mobile Devices

"I am Loki, of Asgard. And I am burdened with glorious purpose."

—Loki, *The Avengers*

In this chapter, you will learn how to

- **Explain the features and capabilities of smartphones and tablets**
- **Explain how to configure mobile devices**
- **Describe how to secure mobile devices**

Mobile devices have revolutionized the way we work and play in recent years. Devices such as smartphones and tablets enable people to access the Internet from just about anywhere and accomplish essential tasks on the go.

This chapter explores mobile devices in detail. We'll first look at the features and capabilities of devices that are common in the mobile market. The chapter then jumps into the details of configuring the devices for personal use, doing such things as setting up e-mail and adding productivity devices. The chapter wraps with a discussion on securing mobile devices. I'm eager to jump into a topic new to this version of the CompTIA A+ certification, so let's get started.

Features and Capabilities

Modern mobile devices fall into two categories, smartphones and tablets, and both types of device have similar features and capabilities. The primary distinction between the types is that a **smartphone** is a cell phone enhanced to do things formerly reserved for fully grown PCs; a **tablet** embodies those enhanced computing features and capabilities on an expanded format and screen. Tablets generally do *not* have cellular phone capability. This section explores the common features among the devices and highlights major differences as well. We'll first look at the mobile experience, and then look at ways to add programs to and enhance the capabilities of the devices. The section finishes with ways to enhance the hardware of mobile devices, or at least the hardware's capabilities.

Mobile Experience

Mobile devices might seem, at first description, like PCs scaled down to fit in a backpack, purse, or pocket, but they bring a unique experience to users that differs substantially from the standard PC experience. Mobile devices have a default screen—like the desktop in Windows—called the **home screen** and have icons for applications (*apps*) for accomplishing specific tasks. But the first thing that will strike you when you handle one of these devices is that it's *not* the same thing as a small PC (see Figure 27.1). The most obvious difference is the interface, so we'll start there.

• **Figure 27.1** Small PC and tablet—cousins at best

• **Figure 27.2** Mobile devices have a touch interface.

Touch Interface

Mobile devices use a **touch interface**, meaning that to interact with them you touch the screen (see Figure 27.2). They don't come with a physical keyboard for typing or a mouse for clicking. (In fact, you can't add a mouse at all to most mobile devices.)

Different gestures with your fingers accomplish different tasks. To start a program, or app as they're called, you **tap** its icon, which means to poke it with your finger. If you've opened an app with multiple screens, you hold your finger on the screen and slide it across the screen, either right to left or top to bottom, depending on the type of application (see Figure 27.3). This is called a **swipe**.

Holding a finger on the home screen or on an open app screen in many devices brings up a context menu for accomplishing things like changing the background picture (the *wallpaper*), bookmarking a page, or editing. Touching different parts of the screen when in an app can offer other options, such as closing the app or pushing the app to the background (see Figure 27.4).

Many mobile devices enable you to use multiple fingers to do tasks such as expand or shrink an image on the screen (see Figure 27.5). An open long document, such as a word processing document, for example, might give you two different responses when you scroll with one or two fingers. Using one finger might select text to edit, but two-fingered scrolling might move the document up or down. Different vendors call this feature different things, but the common term is **multitouch**.

This multitouch interface enables you to expand or contract some content on the screen. You can **pinch** an image, for example, between two fingers and make that picture bigger or smaller according to the way your fingers move.

• **Figure 27.3** Swiping to move to the next screen

• **Figure 27.4** Getting a context menu by touching and holding

Cross Check

LCD Technology

You read about LCD technology first in Chapter 21 and then again in the discussion of portable computers in Chapter 26. How does TN compare with IPS? What kinds of backlights are common on LCDs?

Screen Technology Current **capacitive** touchscreens use electrical current in your body to determine movement of your fingers across the screen. They measure the difference between the electrical charge in your body and the static charge on the screen, which is quite cool when you think about it. Capacitive touchscreens require physical contact, so gloved fingers won't work. Older technologies used **resistive** touchscreens that responded to the pressure applied to the screen. Fingers worked, but best results came from using a special pointing stick called a *stylus* (see Figure 27.6).

Mobile devices use a variety of screen types. Most tablets use some type of LCD panel, just like portable PCs and desktop monitors. The less expensive ones use twisted nematic (TN); the better ones, like the Apple iPad, use an In-Plane Switching (IPS) panel for richer colors and better viewing angles.

Some smaller devices, like the better smartphones, use a related but different technology called **organic light-emitting diode (OLED)** screens where an organic compound provides the light for the screen. Applying an electric current causes the organic layer to glow in the precise spots desired. Displaying a checkerboard pattern of black and white, in other words, only lights up the white squares. OLEDs don't use backlights at all, which means they can display true black, they're lighter, and they use less electricity than LCDs of any sort. Screens larger than half a dozen inches, as of this writing, are too expensive to make for mainstream consumer devices.

The resistive touchscreen devices required periodic *screen calibration*, which resets the touch screen for improved accuracy. Capacitive touchscreens don't require calibration.

OLED screens use an organic compound exposed to electrical current for lighting; they don't have a traditional backlight.

• **Figure 27.5** Resizing and rotating an image using two fingers

• **Figure 27.6** Older mobile device with stylus

• **Figure 27.7** Switching orientation

Orientation Mobile devices feature rectangular screens, just like desktop displays, but all of them rotate easily. Plus, the orientation of the screen rotates right along with the display, so by default, up is always up. The underlying technology, called an **accelerometer**, enables you to switch easily from portrait view to landscape view. If you want to switch from reading a book to watching a movie, just turn the device on its side (see Figure 27.7). Figure 27.8 shows a wonderful use of the accelerometer in an iPhone, turning the device into an electronic level.

Some devices feature a **gyroscope** that can detect the position of the tablet or phone in 3-D space. This enables more intuitive control over onscreen devices, such as a plane's joystick. Tilting the device forward, for example, would have the effect of pushing the plane's nose down; tilting backward "pulls back" on the stick, easing the plane's nose up. Few applications (and those primarily games) use the gyroscope as of this writing.

Mobile Operating Systems

Two operating systems power the vast majority of mobile devices. Apple **iOS** runs on all Apple devices, such as the iPhone smartphone and the iPad tablet. Google **Android** runs almost every non-Apple product. Microsoft has a very small presence in the mobile devices market, but you'll only find Windows Phone 7 on a few smartphones.

• **Figure 27.8** Hanging a picture properly

Apps

An **app** enables you to accomplish a specific task on a mobile device, such as check e-mail, surf the Web, play games, and so on. (Apps are the same thing as applications. For some reason, it's more hip to use the short term when discussing mobile devices.) Programmers write apps for specific mobile platforms and sometimes for specific devices. So an app written for a Windows Phone 7 phone, for example, won't work on an Apple iPhone, even though both are smartphones. This applies somewhat to apps written for a specific operating system as well. Apps written for an Apple iPhone can run on an Apple iPad, because both devices use Apple iOS for an operating system, but the same app optimized for the iPad will look and run better than a scaled-up iPhone app.

Different apps bring out different features of the mobile device. An electronic book reader, for example, shows an interface that appears like a book (see Figure 27.9). You swipe to change pages. A note-taking application, in contrast, will open a virtual keyboard that enables you to type as if you had a regular keyboard attached (see Figure 27.10). Finally, a racing game will turn the entire mobile device into a steering wheel, relying on the accelerometer to provide accurate turning (see Figure 27.11).

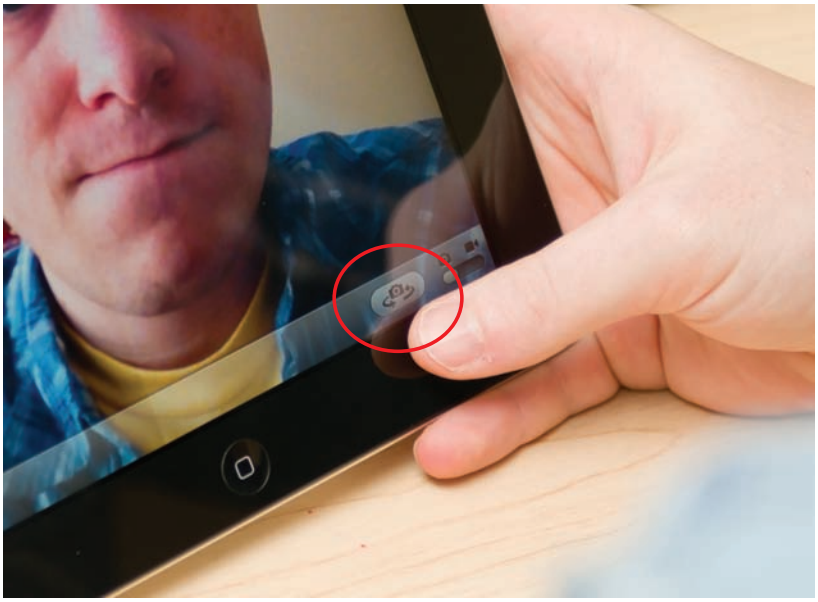
• **Figure 27.9** Reading an eBook

Multimedia

Most mobile devices today come with one or two cameras for taking digital photos and movies and for video conferencing. Manufacturers initially offered low-resolution cameras and camcorders that produced poor-quality photos and grainy videos, but some current devices offer crystal-clear high-definition videos with flash photos and optical zoom.

• **Figure 27.10** Typing on a virtual keyboard

• **Figure 27.11** Racing



• **Figure 27.12** Switching from the rear camera to the front camera

Devices with two cameras, one pointed away and one pointed at the user, have some kind of button to switch when picture taking. The tablet in Figure 27.12, for example, enables the user to swap the focus of the picture-taking software by tapping the double-arrow button in the lower-right corner.

Adding Apps

Mobile devices come from the manufacturer with a certain number of vital apps installed for accessing e-mail, surfing the Web, taking notes, making entries in a calendar, and so on. Almost all of them offer multimedia apps to enable you to listen to music, take pictures, watch YouTube videos, and view photos. You'll find instant messaging tools and, in the case of smartphones, telephone capabilities.

With no exceptions I've encountered, though, you'll want to add capabilities to the mobile device, and that means adding apps. Games are incredibly popular to add, with *Angry Birds* accounting for billions of dollars of lost worker productivity in the United States alone (see Figure 27.13). (And if you haven't played *Angry Birds*, I highly suggest downloading it right now!)

Even when the prebundled tools offer great functionality, often other software developers will take an idea and run with it to create something

Tech Tip

iOS and Flash

The one big gotcha about Apple is that none of their mobile devices support Adobe Flash, making a surprising number of Web sites not available. You simply cannot add an app that makes Flash work on an Apple iPhone or iPad.

The GPS aspect of mobile devices goes both ways. Because mobile devices tap into the Internet or cellular phone networks, the devices have identifying numbers such as a MAC address. The cell phone companies and government agencies can use the ID or MAC address to pinpoint where you are at any given time. This feature, called **geotracking**, clearly has a lot of room for abuse of power, though nothing major has happened as of this writing.

• **Figure 27.13** *Angry Birds* on an ASUS table

wholly unexpectedly cool. All the smartphones and nearly every tablet, for example, include some sort map tool that also includes *positioning software*. This software taps into the **Global Positioning System (GPS)** network of satellites maintained by the U.S. government to pinpoint your current location on a map (see Figure 27.14). This helps you find how to get from where you are to where you want to be.

The Internet has turned the concept of map viewing into something much more powerful courtesy of tools like Google Earth. With Google Earth, you can zoom all over the world, seeing satellite images of cities, towns, and countryside. You can access embedded images of places (see Figure 27.15) and get information via Wikipedia. Adding Google Earth (or any other app) to a mobile device follows different patterns according to the operating system and manufacturer of a specific mobile device.

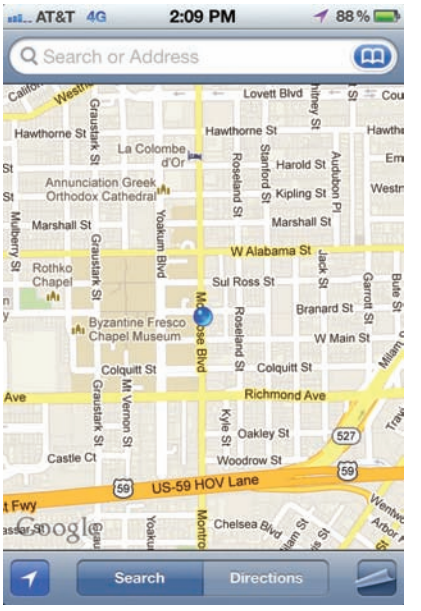
Apple and Closed Source

Apple makes the most popular mobile devices in the iPhone and the iPad (smartphone and tablet, respectively). Both devices use the iOS operating system. Unlike every other manufacturer, Apple tightly controls the user experience, insisting that all developers of apps for iOS follow the same guidelines.

Apple has created a **closed source** or **single source** system, meaning that if you want to get an app for your iPhone or iPad, you can only get it from the Apple App Store (see Figure 27.16). Apple must approve any app before it goes into the App Store, and Apple reserves the right to revoke permission on any app that fails to measure up.

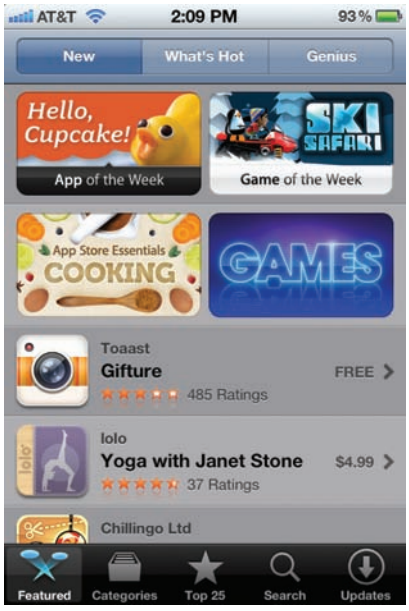
To add an app, select the App Store icon from the home screen. You can select from featured apps or view by category. You can check out the top 25 paid or free apps or simply search for what you want (see Figure 27.17).

• **Figure 27.15** Image in Google Earth

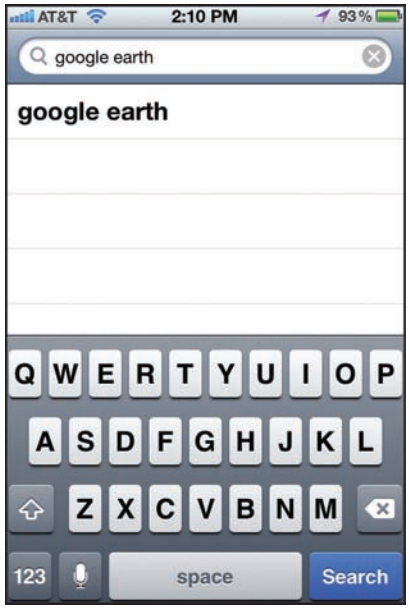


• **Figure 27.14** GPS app showing current location (an excellent café in the Montrose neighborhood of Houston, Texas, in this example)

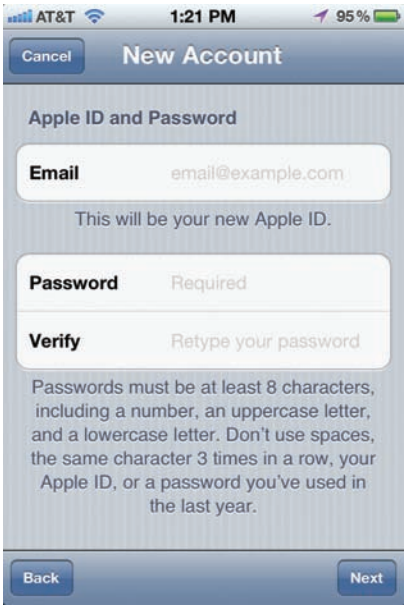
Don't like the idea of Big Brother knowing where you are all the time? Turn off Location Services in iOS or GPS Services on your Android. Keep in mind that turning this off will keep all applications that need this information from working.



• **Figure 27.16** App Store



• **Figure 27.17** Searching for Google Earth



• **Figure 27.18** Creating an iCloud account

The first time you try to purchase an app through the App Store, you'll be prompted to set up an account. You can use an account that you created previously through the Apple iTunes music and video store or create a new account using the Apple iCloud service. Creating a new iCloud account takes a few steps and a lot of typing in of passwords and such (see Figure 27.18), but eventually you'll get the account figured out. You'll need a valid credit card to set up the account.

Android Experience

Google Android powers a majority of smartphones and a solid percentage of tablets, but Android differs greatly from Apple iOS in that Google gives the OS away and developers create versions suited to their devices. That means in practice that when you have a smartphone or tablet that uses Google Android for an OS, you have to amend that description to include the manufacturer as well. A Samsung tablet, in other words, uses an OS that

Try This!

Checking Out Apps

You can see the kind of apps available through Google Apps Marketplace or Google Play, even if you don't have an Android tablet, so try this! Here are the two Web sites:

https://www.google.com/enterprise/marketplace/

https://play.google.com/store

What kinds of apps do they offer? What would you want that you don't see?

differs somewhat from the OS an ASUS tablet uses. HTC, for example, uses a custom interface for its Android devices called HTC Sense that changes the look and feel of Android.

When you want to get an app for an Android device, you have alternative sources for that app. Many vendors offer a store with apps developed or customized to work with their devices. These **vendor-specific** stores enable you to get apps that should work well with your Android smartphone or tablet.

You can also go to an **open source** market for apps developed "for Android" that probably will work with your device, but there's not a guarantee that they'll work on all Android devices. Google Play, for example, offers hundreds of thousands of apps. This Wild West approach to apps makes the Android experience vastly different from the iOS experience when it comes to smartphones and tablets.

The CompTIA A+ 220-802 objectives mention "touch flow" as if it were a standard feature of mobile operating systems. In fact, HTC's TouchFLO preceded HTC's Sense interface. TouchFLO is no longer used on HTC's Android phones.

Microsoft has a small but growing presence in the mobile devices market with Windows Phone 7 and Windows 8. Expect the market share to increase over the coming years. Microsoft embraces an app marketplace somewhere in between that of Apple and Google, with both Microsoft-created apps and those created by other developers available through the Windows Phone Marketplace and other venues.

Mobile devices have no field replaceable units (FRUs) and no upgradeability.

Enhancing Hardware

A mobile device is a computer, just like your desktop PC or laptop, with the same basic components doing the same basic things. The construction centers around a primary circuit board, a *motherboard*, onto which every other component is attached. Each mobile device has a CPU and GPU, though not necessarily based on the same architecture as a portable PC. The Apple iPad uses an ARM processor, for example, rather than an Intel ×86 or ×64 processor. In contrast, the ASUS Transformer featured as the Android model in this chapter uses a processor called a Tegra from NVIDIA, billed as the first mobile super processor. It features two to four CPU cores with integrated GPU, Northbridge, Southbridge, and memory controller for awesome power and serious 3-D capabilities.

Mobile devices use storage, though usually not a traditional hard disk drive (HDD) with spinning platters. More commonly, mobile devices use a *solid state drive* (*SSD*) because SSDs use much less electricity than platter-based drives. Plus they're cooler in general, just like you.

Mobile devices vary from their larger brethren in two very significant areas of importance to techs. First, none of them offer any field-serviceable parts. If something breaks, you send the device back to the manufacturer. Second, you can't upgrade them at all. Even a laptop enables you to upgrade RAM or a hard drive, for example, but the mobile device you buy is exactly what you get. You want something better? Buy a new one.

That said, every mobile device enables you to attach some kind of peripheral or external storage device. But every device offers different expansion capabilities, so it's hard to generalize about them.

The one exception to the rule that you can't generalize about mobile devices relates to sound. Every mobile device has a single 3.5-mm audio jack for plugging in earbuds or speakers (see Figure 27.19). This applies to smartphones and tablets from all vendors.

• **Figure 27.19** Earbuds plugged into a smartphone

• **Figure 27.20** Recharger dongle

Apple Expansion Options

Apple devices offer the least expansion capability of all the mobile devices, so even though they dominate the marketplace, there's not much to say about them. The iPhone and iPad use a single proprietary port that's used to recharge the device and to connect the few external devices available. Figure 27.20 shows the typical use for the port, a dongle that connects to a USB AC adapter for recharging.

Early iPhones and iPads had limited multimedia capabilities, but current devices enable you to mirror the screen to a multimedia device such as a projector. This enables seamless presentations, for example, through the excellent Apple Keynote program (see Figure 27.21). The multimedia connection requires another dongle adapter (see Figure 27.22).

Android Expansion Options

Devices that use Google Android come with a variety of connections and expansion capabilities. Many offer microSD slots for adding storage in the form of the tiny flash memory cards (see Figure 27.23). Some offer bigger slots, and a few feature Micro USB or even full-sized USB ports.

Many Android devices offer a proprietary socket that mimics the functions of Apple's dongle port, providing a way to recharge the tablet or smartphone and get data from a PC to the tablet and vice versa. Figure 27.24 shows a proprietary connector for power.

Finally, many tablets sport a connector for attaching the device to an external monitor, such as a big screen or projector. (Smartphones don't generally have this connector.) Figure 27.25 shows a Micro-HDMI port and connector.

• **Figure 27.21** Apple Keynote on an iPad and a projector

• **Figure 27.22** Apple Digital AV Adapter

• **Figure 27.23** MicroSD card and slot

• **Figure 27.24** ASUS proprietary power connector

Bluetooth

The last way that mobile devices expand their physical capabilities is wirelessly, most often using the Bluetooth standard for adding a keyboard (all) or mouse (not with Apple products). In theory, you could attach all sorts of Bluetooth devices to the mobile device, but the reality seems limited to keyboards, headphones, and headsets. Figure 27.26 shows a diminutive Apple keyboard for the iPad and the iPad resting in a stand to make typing this chapter a little easier than using the virtual keyboard.

• **Figure 27.25** Micro-HDMI port and connector

• **Figure 27.26** Keyboard associated with iPad

See the "Bluetooth" subsection of the "Configuration" section later in this chapter for the steps to set up a tablet with a Bluetooth keyboard.

Configuration

Mobile devices require some setup and configuration to function seamlessly in your online life. That means you need to set up network connectivity, add Bluetooth devices, configure e-mail account(s), and enable the devices to synchronize with a PC. Let's look at all four options.

Network Connectivity

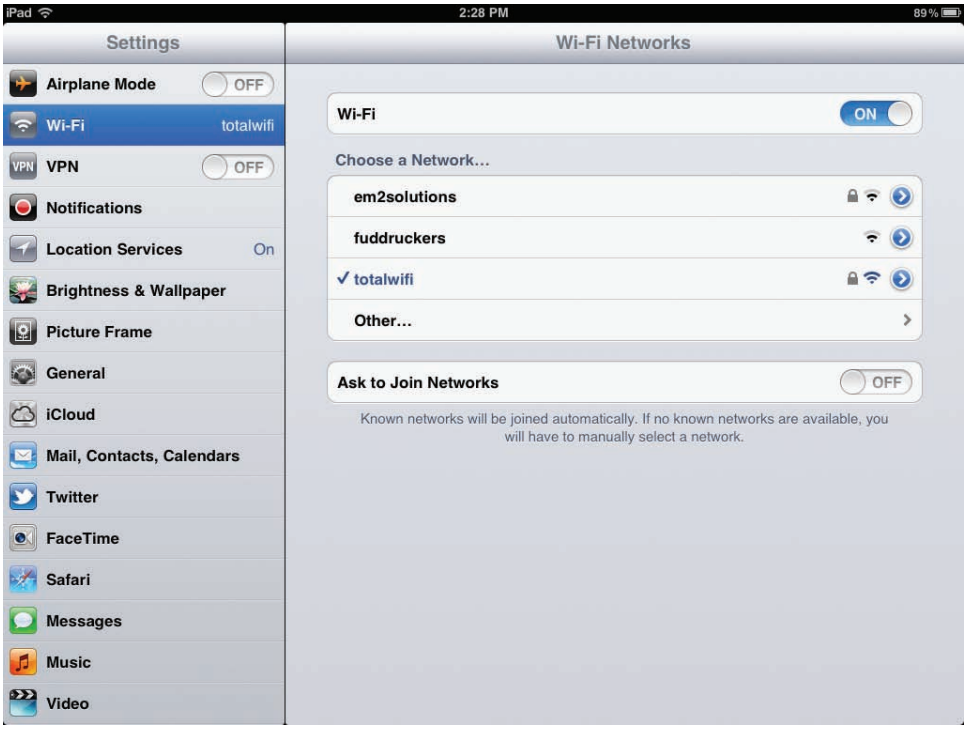
Mobile devices connect to the outside world through the cellular networks or through various 802.11 Wi-Fi standards. You learned specifics about the standards in Chapter 23, so I won't rehash them here. This section looks at standard configuration issues from the perspective of a mobile device.

When you want to connect to a Wi-Fi network, you need to turn Wi-Fi on and then actively connect to a network. If the network is properly configured with WPA or WPA2 encryption, then you also need to have the logon information to access the network. The most common way to connect is through the Settings app (see Figure 27.27). (This applies to all iOS and Android devices.)

Settings enables you to do the vast majority of configuration necessary to a mobile device. To join a network, for example, tap the Wi-Fi (or Networks) option to see available networks (see Figure 27.28). Simply select the one you want to join and type in the passphrase or passcode. Give the mobile device a moment to get IP and DNS information from the DHCP server, and you're on the network.

After you connect to a network successfully, all mobile devices store that network access information automatically, creating a *profile* of that network based on the SSID (the name of the network). This works just like with any other device that connects to a Wi-Fi network. If the SSID of a network

• **Figure 27.27** Selecting the Settings icon



• **Figure 27.28** Browsing available networks

changes after you've connected to that network, your mobile device will fail to connect to the rechristened network. You need to delete the profile and reconnect. You do this through the Settings app by selecting the Wi-Fi network and selecting *Forget this network*.

You can use the Settings app to turn Wi-Fi off or to go into Airplane Mode to stop the device from sending any signals out.

Data

Many mobile devices can use the cellular data services discussed in Chapter 24 to access the Internet. This way you can use your smartphone or tablet to get e-mail or browse the Web pretty much anywhere, even without a Wi-Fi hotspot.

By default, mobile devices that use cellular networks for Internet connectivity use **data roaming**, meaning they'll jump from cell tower to cell tower and from your provider to another provider without obvious notice. This is no big deal when you travel within your own country where competing providers have inexpensive roaming agreements.

Watch out for data roaming outside your country! If you travel outside of your country, your mobile device will also happily and seamlessly connect via some other available cell provider. This can lead to some shockingly huge bills from your cell phone company when you get back from that cruise or out-of-country trip. If you're going outside your cell provider's coverage area, get a plan that specifies that you're traveling. It'll still be more expensive than your regular plan, but not nearly as crazy as an accidental roaming charge.

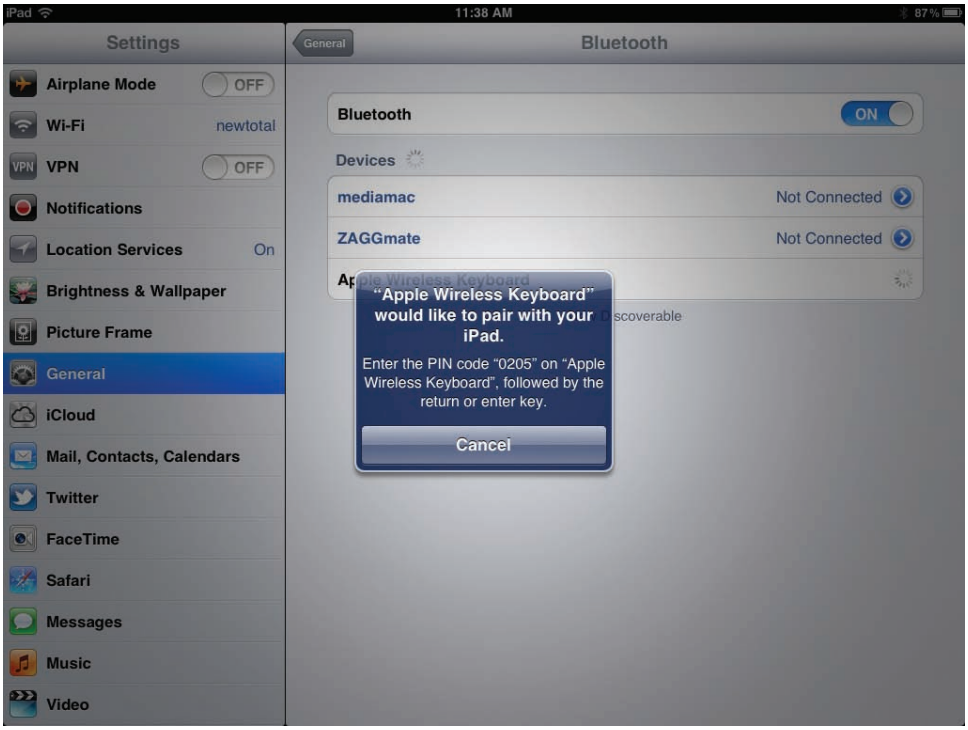
If you don't need to connect when out of the country, turn data roaming off. You'll find the feature in the Settings app, as you might expect. You can also turn off cellular data entirely or only turn off cellular services

selectively if your device can do more than one type. (You would want to turn off cellular data, for example, if you don't have an unlimited data plan and are getting near your limits.)

Not all Bluetooth pairings require a PIN code, but there's always some kind of pairing action to do on both devices to make a pairing. Note also that CompTIA uses the phrase *pin code* in lowercase to describe the pairing mechanism.

Bluetooth

Pairing a Bluetooth device with a mobile device follows a similar, simple pattern through the Settings icon. You turn on Bluetooth on the smartphone or tablet, then power on the Bluetooth device. Return to the mobile device to select to pair with the Bluetooth device, and then enter the appropriate personal identification number (PIN) code. For a keyboard, for example, the smartphone or tablet will display a set of characters for you to type on the keyboard (see Figure 27.29). Once you type in the PIN code, the devices connect.



• **Figure 27.29** Prompting for PIN

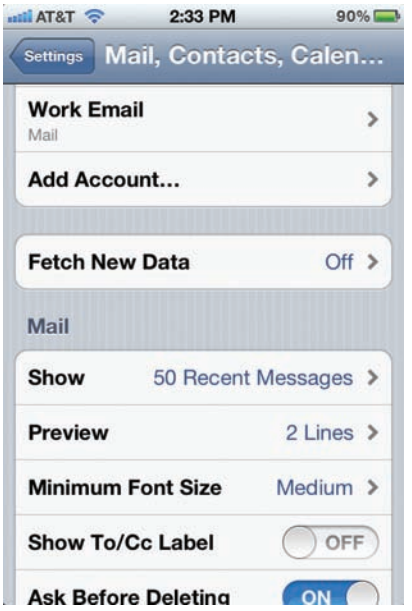
Always test the connectivity between a mobile device and a newly added Bluetooth accessory. If you've added a keyboard, for example, open up a note-taking app and start typing to make sure it works.

Most mobile devices have Bluetooth discovery disabled by default to conserve battery life. Actively seeking pairing uses electricity, as does completed pairing, so use Bluetooth when you need to use it and be prepared for the battery hit.

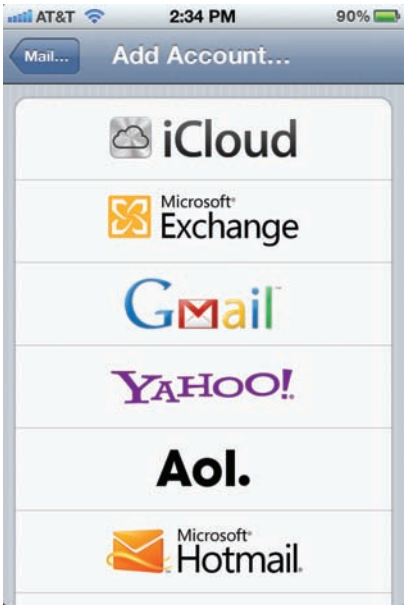
E-Mail

Setting up e-mail offers many levels of complexity with mobile devices, primarily because of the many different types of e-mail servers out there. The process is similar to that of setting up e-mail accounts that you learned about in Chapter 24. Apple devices go through the Settings app, then the Mail, Contacts, Calendars option (see Figure 27.30). Tap the Add Account option to bring up the default e-mail options (see Figure 27.31). If you want to connect to a Microsoft Exchange Server–based e-mail account, tap the appropriate option here and type in your e-mail address, domain, username, password, and description.

If you want a more common POP3 or IMAP account set up, that's not one of Apple's default options, so you'd have to go through the Other option on the initial Add Account screen. Eventually you'll get prompted



• **Figure 27.30** Mail, Contacts, Calendars screen on iPhone

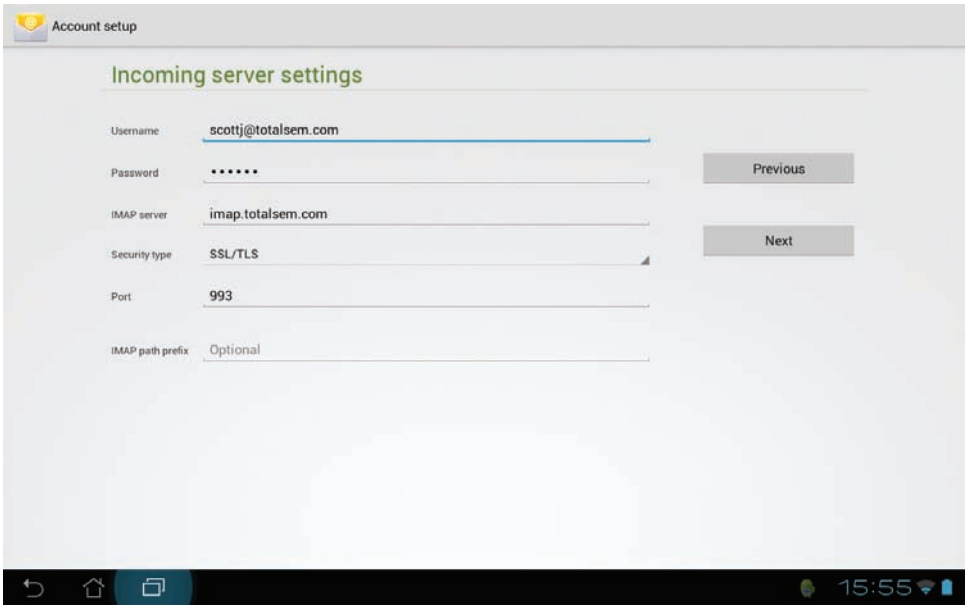


• **Figure 27.31** Default e-mail types on iPhone

as you would expect to choose POP3 or IMAP and type in addresses for the sending and receiving servers.

Android-based tablets assume you'll have a Gmail account as your primary account, so that option is offered as a distinctive icon on the home screen (see Figure 27.32). You'll also have an Email icon for setting up Exchange, POP3, or IMAP accounts. You configure them the same way as you would a desktop e-mail application, including putting in the port setting and security type, such as SSL or TLS (see Figure 27.33).

• **Figure 27.32** Gmail account option



• **Figure 27.33** Setting up a secure IMAP account

Synchronization

Smartphones and tablets can **synchronize**, or **sync**, with local machines or over the Internet with cloud-based servers to keep files and data up-to-date. Older devices, such as BlackBerrys and Palm Pilots, had a specialized sync program that installed onto your PC that you could use to sync contacts, calendars, and so on. Today's devices either use a dedicated program or sync through the cloud.

Most tablets and many smartphones use a proprietary dongle for syncing through a USB port on the computer. This is the same dongle used to recharge the battery. Some devices can sync through Wi-Fi connections. Many smartphones use a micro USB to regular USB cable to connect to the PC.

Apple iTunes will run on just about any Mac OS X machine. On Windows at the time of this writing, you need to be running Windows XP with Service Pack 2 or better or any later Windows OS.

The CompTIA A+ 802 competencies don't discuss hardware requirements. The only thing that's relevant to a tech is that hardware needs to scale up to play more complex media. You can play music with a 1-GHz CPU, for example, but need a 2.4-GHz CPU with two or more cores to play an HD video.

iTunes and iCloud

Apple iPhones and iPads sync through Apple iTunes installed on a Mac or PC, a free program that you download from Apple. Everything, such as music, videos, contacts, pictures, and so on, can be stored locally. You can choose to back up all the apps on your iPhone or iPad to iTunes as well. This single source for backup makes it easy to recover from something catastrophic happening to your Apple device. If you replace an Apple device, for example, you can simply sync that new device and all your files, contact information, and apps copy to the new device.

In late 2011, Apple introduced a cloud-based storage solution called iCloud. With iCloud, you can have all your iPhone or iPad data backed up and thus accessible from anywhere. This includes any media purchased through iTunes and calendars, contacts, reminders, and so forth.

Android and Gmail

Android-based mobile devices don't have a central desktop application like Apple devices. Rather, they sync over the Internet—but only some data. Contacts, calendars, and e-mail (through Gmail) are all that sync by default. For every other type of data or media, you treat the Android device like a fat thumb drive—you drag and drop files into the appropriate folder on the smartphone or tablet.

Sync In, Sync Out

One of the radical differences between an Apple device and an Android device is in the direction of syncing (or even copying, for that matter). With Apple, you can sync files—especially media files—to the iPhone or iPad. You cannot take that Apple device, connect it to another computer, and copy files *from* it to the PC. It's a one-way street.

Android devices, in contrast, happily share like a thumb drive. You can drag and drop from an Android smartphone or tablet to any PC.

Security

Mobile devices almost long to roam freely, so you need to take active steps to secure them against damage, loss, or theft. Let's look at all three issues.

Preventing Damage

Mobile devices cost a fair amount of money and thus aren't disposable media for most people. That means you need to take steps to prevent damage, both physical and software-based.

For physical damage, the first step you must take is to get a protective cover or sleeve for the mobile device. It doesn't help the HD camcorder in your new iPad if you get a scratch across the lens! You'll get a scratched, blurry movie even though the camcorder is capable of much, much more. Apple makes very nice covers for iPhones and iPads, plus you can get many third-party covers and sleeves (see Figure 27.34).

Depending on the amount of money you're willing to spend, you can get covers that help protect your screen from scratches, impacts, and small amounts of water. Like to scuba with your Android device? There are waterproof cases (as opposed to a cover) that enable you to check your Facebook account from 40 feet underwater. (These are specialty devices and not very typical.)

Do the obvious to protect your devices. Don't get them anywhere near liquids. Don't run your smartphone through the wash in your trousers.

• **Figure 27.34** Putting an Apple Smart cover on an iPad