

# IT'S A WIRELESS WORLD

## After completing this chapter you should be able to do the following:

- Describe how wireless technology is used in daily activities
- Explain the advantages and disadvantages of wireless technology
- Tell how wireless local area networks are used in applications such as education, business, travel, construction, and other areas



## Real-Life Wireless

According to the U.S. National Highway Traffic Safety Administration, fatigue-related automobile accidents in the United States are on the increase. An estimated 1,500 people die and over 77,000 are injured each year in accidents caused by driver fatigue. The Texas Department of Transportation (TxDOT) came up with a unique way to help reduce driver fatigue—setting up free wireless Internet access at rest stops and travel information centers.

In 2003 TxDOT installed free Internet access at four rest areas along a busy highway. The feedback was so positive that TxDOT is expanding the service to all of its 84 safety rest areas and 12 Travel Information Centers. Wireless access will be free for travelers who bring their own equipment. For patrons who do not have a wireless-equipped laptop or other device, kiosks will be available where they can purchase 15-minute increments of Internet access with a credit card.

Andy Keith, Safety Rest Area Program Manager for TxDOT, says that Texas' highways are seeing an increasing number of business travelers, truckers, and RVers. Because access to e-mail is particularly important to these groups, free Internet service at rest areas will encourage many drivers to make regular stops and help to reduce driver fatigue.

**A**lmost 150 years ago the United States experienced a telecommunications revolution. In 1866 Cyrus Field started this revolution by laying a transatlantic cable between the United States and England. Before the underwater cable was laid, information about events that occurred in Europe took almost one month (the speed of the fastest ship at that time) to reach America. Although this was an improvement over the six weeks that it took in the mid-1700s, there was universal agreement that news had to travel faster if the New World was to grow and prosper. With the transatlantic cable, communication between the two continents took less than a second. News of major international events was quickly broadcast, the deaths of dignitaries were known immediately, and military conflicts were even averted. Even today with satellites orbiting the globe, the transatlantic cable system remains the primary means by which news is instantly flashed across the world.

Right now we are experiencing an equally fascinating telecommunications revolution. It can be summed up in a single word: *wireless*. Never before have individuals been able to communicate from almost anywhere on the planet without wires. Wireless communications have enabled us to talk on cell phones, surf the Web, and check e-mail while standing on a street corner or walking across a college campus. Although wireless voice communication started the revolution in the 1990s, wireless data communications have been the driving force in the 21<sup>st</sup> century.

Wireless data networks are springing up everywhere. Travelers can wirelessly access their e-mail during flights on airplanes or on trains, while waiting in airports, and in their hotel room. At work, businesses have found that employees who have wireless access to data during meetings and in conference rooms can increase productivity up to two hours each day. Free wireless Internet connections are available in restaurants across the country, and in select football and baseball stadiums fans can order concessions wirelessly and have them delivered to their seats. There is hardly a sector of the economy that has not been dramatically affected by wireless data technology.

And statistics bear this out. The number of public **hotspots**, or locations where wireless data services are available, increases at a rate worldwide of almost 350% per year. By 2007 it is estimated that over 155 million wireless data devices will be sold (up from 22 million in 2003), 98% of all laptop computers will be wireless, over 25,000 hotels in the United States will provide wireless data access to their customers, and revenue from hotspots will exceed \$9 billion, according to CMP Media. It is truly becoming a wireless world.

In this chapter you will first explore how wireless is used in everyday life, then take a peek at some popular wireless technologies. You will see how different sectors of the economy are using wireless technology, and learn about its advantages and disadvantages.

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## A DAY IN THE LIFE OF A WIRELESS USER

Sometimes it's easy to overlook the extent to which wireless devices are used today. A day in the life of a typical user, Amanda Lomax, can reveal just how widespread the use of wireless technology has become.

### Home

Amanda heads back to her house after an early morning workout at the gym. As a pharmaceutical sales representative she has a busy day ahead. She grabs her laptop computer to check her e-mail while she drinks her coffee on the deck. Amanda's home laptop computer is connected to the other computers in the house and even to the Internet through a **wireless local area network (WLAN)**.

A WLAN is essentially identical to a standard local area network (LAN) except that the devices are not connected by wires. With a WLAN, Amanda can access the Internet and her home network from any room in her house without any cables between her computer and

the Internet connection. She can even use her laptop computer on the back deck or in the yard. This flexibility makes Amanda more productive because she can take her work with her. Last week while a repairperson was replacing a window in her study, she was still able to participate in a videoconference session while sitting at the kitchen table. Without a WLAN Amanda would have been forced to cancel the session. As she finishes her coffee Amanda hears the front doorbell ring. Because she and her husband have installed a tiny wireless camera over each door, she can open a Web browser and see who's at the door.

**NOTE**

The American Airlines Center in Dallas, an indoor arena, provides its security personnel with wireless handheld devices. As they move around the arena they can access any of the 180 WLAN security cameras that cover more than 1 million square feet of the facility.

## Car

As Amanda drives to her office, she needs to make a quick phone call to confirm her morning appointment. Amanda's car is equipped with hands-free cellular calling based on the **Bluetooth** wireless standard. Amanda first turns on her Bluetooth-enabled cell phone to pair it with the Bluetooth device in the car. She then can control the phone with buttons on her steering wheel. Amanda presses the *Talk* button on the steering wheel and says aloud the name of the person she's calling. Her cell phone dials the number that is stored in the car's phone book. The dialing and caller information as well as signal and battery strength appear on her car's instrument panel. Once the person answers the call, Amanda can talk hands-free. The Bluetooth system also works with the car's navigation system, so Amanda can auto-dial phone numbers associated with local points of interest, such as hotels and restaurants.

**NOTE**

Over 2,000 different computer, telephone, and peripheral vendors have agreed to create products based on the Bluetooth standard.

## Office

Amanda checks in at the main office before calling on her clients. She needs some information stored on a server at another smaller office situated about 25 miles away. She opens up her wireless laptop at her desk, and when the screen prompts her, she presses her index finger on a small scanner that checks her fingerprint to ensure that she has the right to access the corporate network. She logs on and finds the information she needs, and prints it out.

The two offices are connected using **fixed broadband wireless** for data communications. Unlike many wireless technologies that allow for mobility, "fixed" wireless refers to wireless transmissions between devices that *cannot* be mobile—typically between two or more office buildings that obviously cannot be moved. A small customized antenna is located on the roof of both the main building and the smaller office building. The antenna serves as a relay point

between the two buildings. Because the fixed broadband wireless system is part of the computer network in each building, users can transparently access data from remote locations by using their office computers or even portable laptops that are part of the WLAN.

Because of recent growth, Amanda's company had to lease temporary office space in a building across the street from the main office. To connect these two buildings together, Amanda's company installed a technology known as **free space optics (FSO)**. FSO is an alternative to high-speed fiber optic transmissions.

## Field

Amanda heads out to her first appointment. She parks her car in front of the medical center, and as she walks toward the front door she pulls her handheld device out of her purse to see if she received an e-mail with additional information she requested earlier that morning. The device connects to the nearest cell tower, which then connects to the local telephone company, and then calls her local Internet provider to complete the connection to the e-mail server. The e-mail messages are sent back to Amanda and displayed on her device.

## On Site

Amanda is visiting the medical center's director to discuss a new technology her pharmaceutical company is implementing. Drugs will now be shipped from the pharmaceutical warehouse to the medical center in large containers that have **radio frequency identification (RFID)** tags affixed to them. RFID has been called an "electronic barcode." Like traditional barcodes, RFID tags are used to identify items. Unlike barcodes, which must be right next to the scanner and perfectly aligned to be read, RFID tags can be read if they are anywhere within the range of a transmitted radio signal, depending on the device.

Not only will Amanda's pharmaceutical company be using RFID tags to identify shipping containers, it will also be embedding these tags on the underside of individual labels on its drug products. In this way the company hopes to identify counterfeit drugs and to more precisely keep track of its products as they move through the supply chain.

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## A LOOK AT WIRELESS TECHNOLOGIES

Wireless technology is woven throughout Amanda's day. Many of Amanda's tasks could not have been completed—much less attempted—without wireless technology. This section introduces some of the wireless technologies that supported Amanda's day. Before learning in depth about wireless LANs, it will be useful to get an overview of some of the current technologies out there in today's wireless world.

## Wireless Local Area Networks (WLANs)

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Amanda's home WLAN, also known as **Wi-Fi (Wireless Fidelity)**, is based on a standard that transmits at up to 11 **Mbps (millions of bits per second)** over a distance of up to 112 meters (375 feet). Amanda and her husband Brian want to upgrade to a newer standard that will allow their network to transmit up to 108 Mbps and will not receive interference from their portable telephones. (You'll learn about these standards in the next chapter.)

The list of equipment needed for a wireless LAN is actually very short. Each computer on the WLAN must have a **wireless network interface card (wireless NIC)**, also called a **wireless adapter**, installed. This card performs the same basic functions as a standard network interface card in that it allows the device to communicate on the network. Yet there are some differences between a wireless and a wired network interface card. Instead of an RJ-45 connection to accept a patch cable, a wireless network interface card contains an antenna to send and receive the wireless signals. Also, a wireless network interface card performs additional wireless responsibilities such as encrypting and decrypting data. A wireless network interface card is illustrated in Figure 1-1.



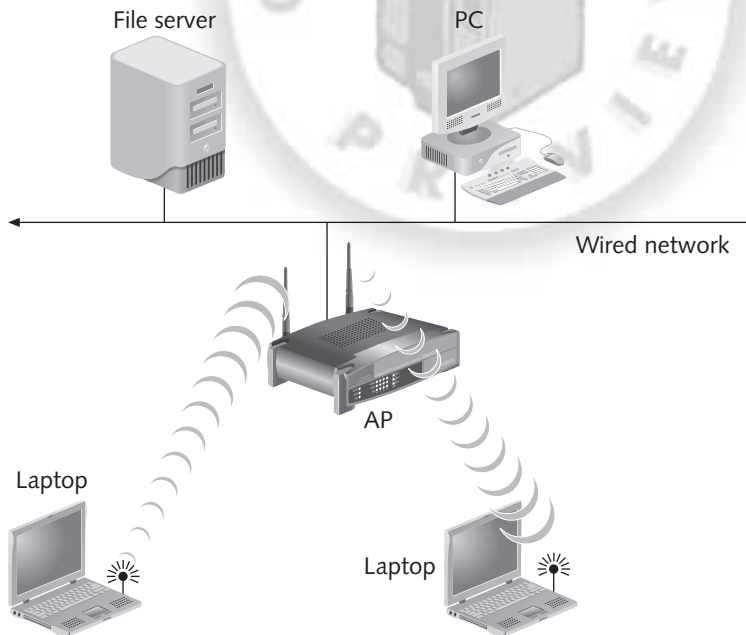
**Figure 1-1** Wireless network interface card

The wireless network interface card sends its signals through radio waves to an **access point (AP)**. The access point acts as a base station to receive the signals and transmit signals back to the wireless network interface cards in the other wireless devices. An access point is illustrated in Figure 1-2.



**Figure 1-2** Access point

A patch cable connects the AP to a wired LAN or to the Internet. Through this wired connection the AP and the wireless devices associated with it are able to communicate with the devices connected to the wired network such as servers, printers, and even other access points and the wireless devices connected to them. The access point is fixed in one place (although it can be moved when necessary) while the devices with wireless network interface cards can move around yet remain connected. A WLAN is illustrated in Figure 1-3.



**Figure 1-3** Wireless LAN

Amanda's WLAN connects her laptop computer, her husband Brian's desktop computer, and their laser printer. It also connects them to the Internet, so Amanda can check her e-mail from any room in their house. When Amanda and Brian upgrade to the faster WLAN they also will wirelessly connect their stereo system and television to the network. This will allow them to view pictures stored on their computer on the larger TV screen and to play MP3 music stored on their computer through the stereo system. Amanda's home WLAN is illustrated in Figure 1-4.

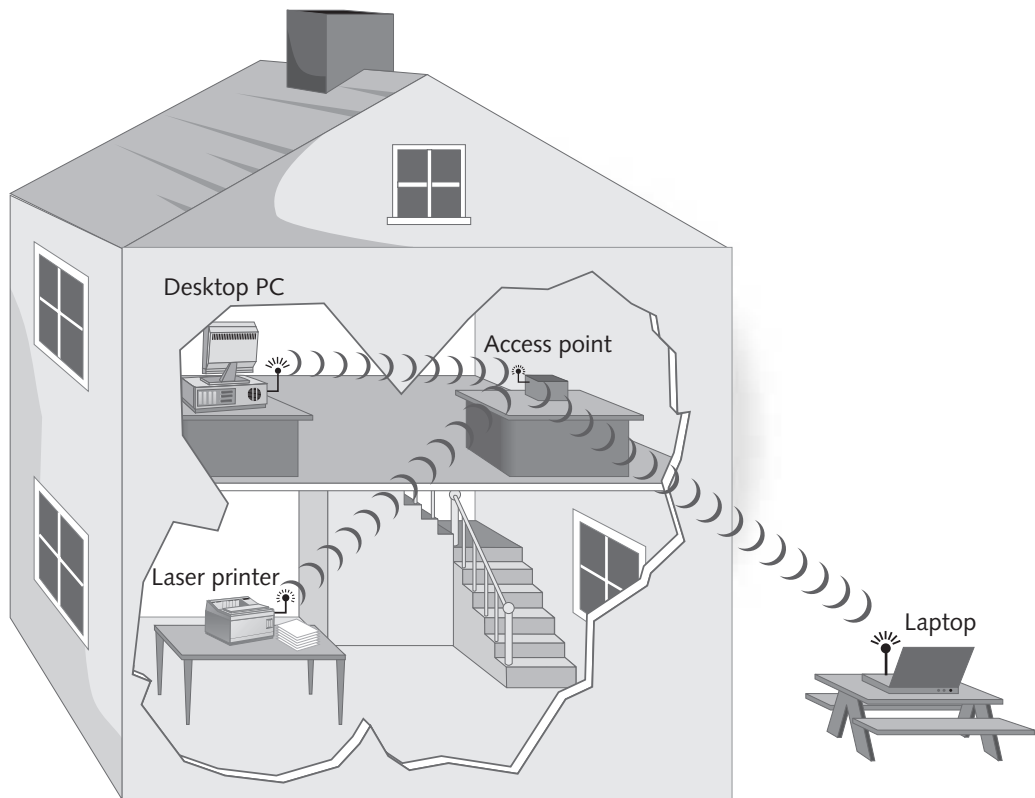


Figure 1-4 Home wireless LAN

## Bluetooth

Amanda used a Bluetooth cell phone in her car. Bluetooth is a low-power wireless data and voice transmission technology. It can be used anywhere a small stream of data needs to flow. Bluetooth devices communicate using small radio transceivers called **radio modules** built onto microprocessor chips. Each Bluetooth device also uses a **link manager**, which is special software that helps identify other Bluetooth devices, creates the links between the devices, and sends and receives data. A Bluetooth device can transmit data at up to 1 Mbps over a distance of 10 meters (33 feet). Bluetooth can send data through physical barriers like walls and can send to one or more devices at the same time. The devices don't even have to be aimed at each other. Figure 1-5 illustrates a Bluetooth device.



Figure 1-5 Bluetooth device



Bluetooth is named after the 10th-century Danish King Harald Bluetooth, who was responsible for unifying Scandinavia.

**NOTE**

When two Bluetooth devices come within range of each other, they automatically make a connection. One device is called the **master**, which controls all of the wireless traffic. The other device is known as a **slave**, which is controlled by the master. A Bluetooth network that contains one master and at least one slave forms a **piconet**.



Bluetooth support is integrated into Microsoft Windows XP Service Pack 2 (SP2).

**NOTE**

## Telecommunications Links

Through the years Amanda's company tried a variety of connections to link their offices. In the early days they used telephone modems, but those were too slow. Next, expensive transmission lines were leased from the local telephone company. **Integrated Services Digital Networks (ISDN)**, which transmit at **256 Kbps (thousand bits, or kilobits, per second)**, were soon replaced with **T-1** lines, which transmit at 1.544 Mbps. However, these lines had to be leased at a cost of several thousand dollars per month. Technologies such as **cable modems**, which use a television cable connection, and **digital subscriber lines (DSL)**, which use telephone lines, were only available in residential areas.

Amanda's company currently uses two main wireless technologies: fixed broadband and free space optics (FSO). With fixed broadband, also known as **WiMax**, the signal is transmitted between the antennas of the buildings at speeds up to 75 Mbps and at distances up to 53 kilometers (35 miles). FSO can transmit at speeds up to 1.25 **Gbps (gigabits, or billion**

**bits, per second**) over a distance of 6.4 kilometers (4 miles). Transmissions are sent by low-powered infrared beams through the open air. These beams, which do not harm the human eye, are received by transceivers shown in Figure 1-6. Because it is a line-of-sight technology, the transceivers are mounted in the middle or upper floors of office buildings to provide a clear transmission path. However, unlike other wireless technologies such as WiMax that require the units to be located on an open roof, transceivers can be mounted behind a window in the existing offices. Amanda's office wireless technologies are illustrated in Figure 1-7.



Figure 1-6 Free space optics transceiver

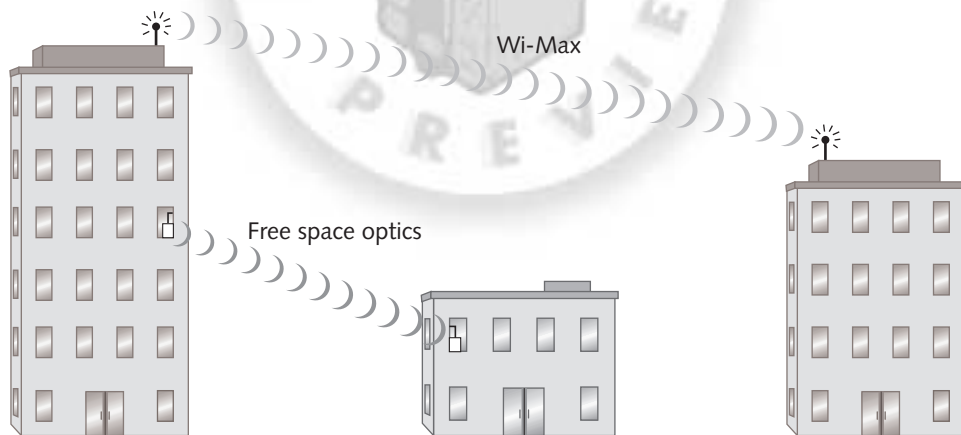
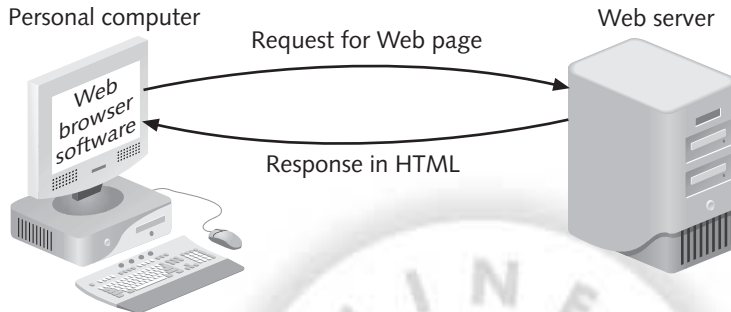


Figure 1-7 Wireless office technologies

## Cellular Telephony

Messages sent to Amanda's handheld device are based on **Global Systems for Mobile (GSM) communications** technology. GSM coverage includes most of the United States as well as parts of Europe and Japan with transmission speeds of up to 9.6 Kbps. The information transmitted is based on the **Wireless Application Protocol (WAP)**. WAP

provides a standard way to transmit, format, and display Internet data for devices like cell phones and handheld devices. With traditional computers, software known as a Web browser runs on a local computer to display Internet data. The Web browser software makes a request from the World Wide Web file server for a Web page. That page is transmitted back to the Web browser in Hypertext Markup Language (HTML), which is the standard language for displaying content on the Internet. This model is illustrated in Figure 1-8.



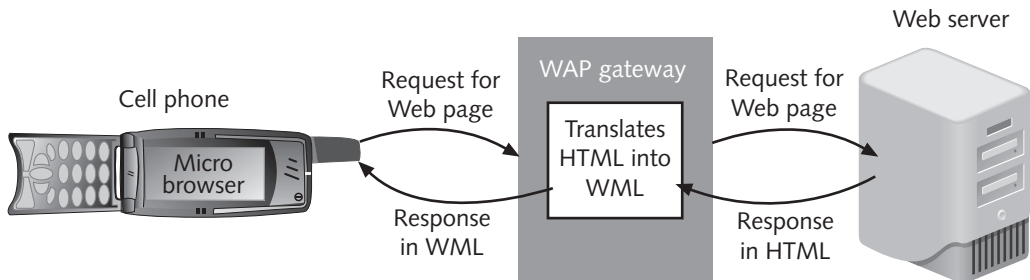
**Figure 1-8** Browsing the World Wide Web



**NOTE**

When a Web server sends a Web page back to a PC, it is only sending HTML code; the Web browser is responsible for interpreting that code and displaying the results on the screen.

WAP follows this standard Internet model with a few variations. A WAP cell phone runs a tiny browser program called a **microbrowser** that uses **Wireless Markup Language (WML)** instead of HTML. WML is designed to display text-based Web content on the small screen of a cell phone or handheld device. However, since the Internet standard is HTML, a **WAP gateway** (sometimes called a **WAP proxy**) must translate between WML and HTML. The WAP gateway takes the Web page sent from the Web server in HTML code and changes it to WML before forwarding it to the cell phone. This WAP model is illustrated in Figure 1-9.



**Figure 1-9** WAP communications

## Radio Frequency Identification (RFID)

As noted earlier, radio frequency identification (RFID) is like an electronic barcode, used to relay information about an object. However, there are several differences between RFID and barcodes. Barcodes contain information that can only identify the manufacturer of the product and the product itself. In order for a barcode to be read, it must be aligned precisely with a barcode reader. RFID tags, on the other hand, can contain larger amounts of information about the item, such as where it was manufactured, its expiration date, where it was purchased, and other information. And unlike printed barcodes, RFID information can be updated. In addition, this information is transmitted via radio waves so that the tag does not have to be precisely aligned with a reader in order for the information to be collected.

An RFID tag is tiny. Figure 1-10 shows an RFID tag relative to the size of a penny. Depending on the type of RFID tag, the range at which it transmits signals is typically about .3 meters (1 foot) at 5 Mbps.

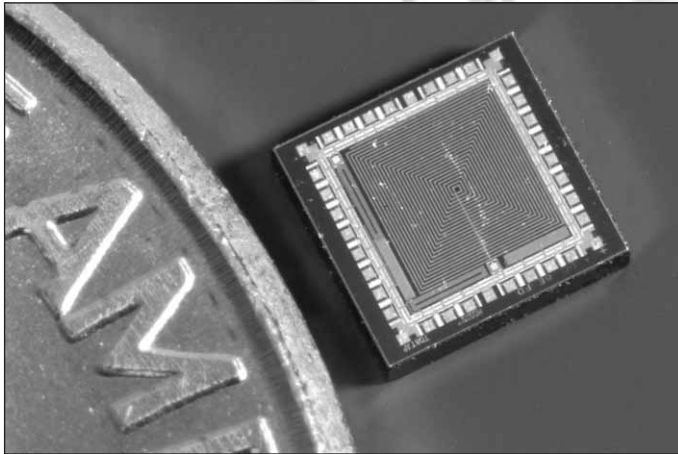


Figure 1-10 RFID tag



**NOTE**

The Mexico City attorney general's office has implanted RFID tags in the upper arm of staff members just under the person's skin. The tag is used to restrict access to the attorney general's headquarters. As a staff member nears a locked door, the tag emits a special code that causes the door to open.

## Wireless Technology Categories

Wireless technologies are generally classified into three categories, based on transmission distance. **Wireless personal area networks (WPANs)** cover technologies where the transmission generally extends up to 3 meters (10 feet). The transmission for wireless local area networks (WLANs) is generally restricted to 112 meters (375 feet). **Wireless wide area networks (WWANs)** transmit from 152 meters (500 feet) to 120 kilometers (75 miles) or more. Table 1-1 summarizes the wireless technologies that Amanda used in her typical day.

Table 1-1 Typical wireless technologies

Wireless Technology	Category	Transmission Distance	Speed
Bluetooth	WPAN	10 meters / 33 feet	1 Mbps
Free space optics	WWAN	6.4 kilometers / 4 miles	1.25 Gbps
Global Systems for Mobile communications	WWAN	Nationwide	9.6 Kbps
Radio frequency identification	WPAN	.3 meter / 1 foot	5 Mbps
WiMax	WWAN	53 kilometers / 35 miles	75 Mbps
Wireless local area network	WLAN	112 meters / 375 feet	11 Mbps

All of the different categories of wireless telecommunications—WPANs, WLANs, and WWANs—are important in today's world and cover a broad range of different technologies. In this book we will focus our attention on the most common wireless telecommunications technology, namely wireless LANs.

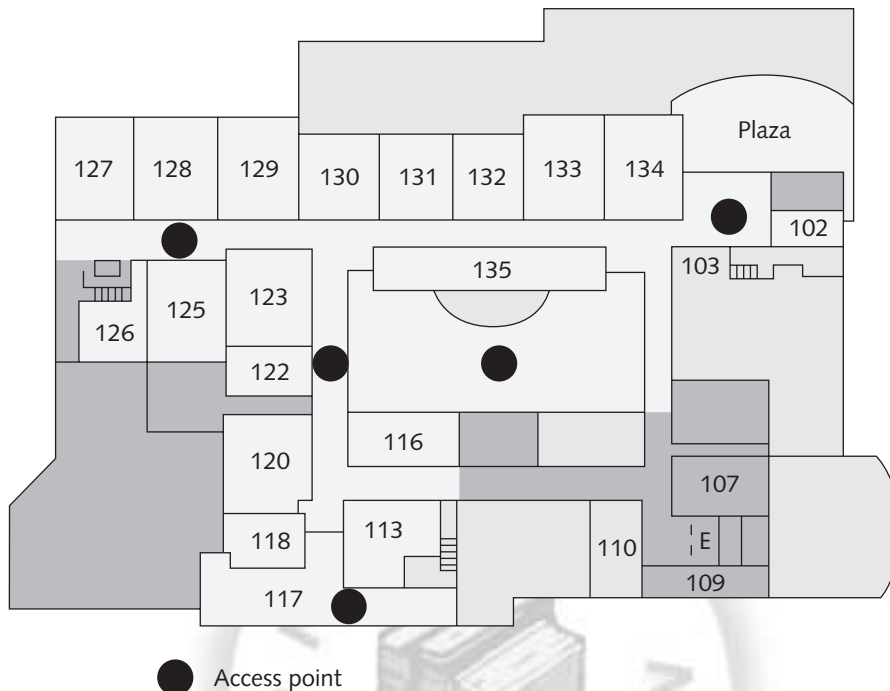
## WIRELESS LAN APPLICATIONS

Wireless LAN applications can be found in every industry with employees who need the freedom to conduct business without being confined to a specific location. This section describes how some leading industries use wireless technology.

### Education

Wireless LANs are an ideal technology for colleges and schools. In fact, educational institutions were some of the first adopters of WLANs because of their dramatic advantages in teaching and learning. Teachers can create classroom presentations on the laptop computer in their office and then carry that computer right into the classroom. They do not have to spend time plugging and unplugging cables to attach to the campus data network. Instead, their laptop device automatically makes the wireless connection as they walk into the classroom. In settings where students bring their own wireless devices to class, teachers can send handouts directly to students sitting in the classroom.

Wireless LAN connections also offer students an important degree of freedom. Students no longer must go to a specific computer lab or the library in order to access the school's computer network. Instead they can access the school network wirelessly from almost any location on campus. And as they move to different classrooms in different buildings they can remain connected to the network. Most schools publish maps like that shown in Figure 1-11 that show the location of wireless access points and the coverage areas in buildings across campus. Schools that require students to own a laptop computer are now requiring that those computers have wireless network interface cards. This wireless education model makes computing resources available from anywhere and at anytime to students.



**Figure 1-11** Campus access point locations

Wireless LAN technology translates into a cost savings for colleges as well. Traditional classrooms become fully accessible computer labs without the expense of additional wiring and infrastructure. And colleges no longer have to consider the expense of adding multiple open computer labs for students since everyone can access the resources no matter where they may be on campus.



**NOTE**

One university issued a policy prohibiting students from running their own private Wi-Fi networks in the school's campus housing. These unregulated hotspots were interfering with the university's own wireless service, according to the university. The policy was later lifted because it was not clear that the university had the legal right to ban the private equipment.

## Business

Wireless LAN technologies have significantly changed how business is conducted. No longer are meetings held only in conference rooms where employees are away from the data that they need to help make decisions. With wireless technologies employees do not have to remember to bring a patch cable or try to find a free port to connect to the network; instead, they can bring their wireless laptop computers to the conference room and remain connected to the network and their data. The ability to access their data to make decisions whenever and wherever the need arises is critical.

Wireless technologies also allow businesses to create an office in a space where the traditional infrastructure doesn't exist. Typically, an office space must be wired with computer cables for network connections in order for it to be useful. With WLAN, this expensive cabling infrastructure no longer is necessary. This means that usable office space can be created almost immediately with little expense. For example, a hotel conference room that may not have the infrastructure to support a wired network can quickly be turned into a wireless networked office environment.

**NOTE**

Because WLANs are becoming so widespread, computer giant IBM and cell-phone vendor Nokia are teaming up to make it easier for a company's employees to move from a WLAN hotspot to an area of GSM coverage transparently while remaining connected to the network.

## Travel

Because traveling is all about mobility, the travel industry has perhaps adopted wireless technologies more than any other sector of the economy. Most large airport terminals provide wireless hotspots. For free or for a nominal fee, waiting passengers with wireless laptops can surf the Internet or read e-mail. Several major airports are also using RFID to keep track of passenger luggage. One airport reported that the number of lost bags in the airport terminal was reduced by 96% by using RFID technology.

**NOTE**

The U.S. airports with the most wireless hotspots are (in order) Dallas-Fort Worth, New York (LaGuardia), Atlanta, Chicago (O'Hare), and Baltimore/Washington.

Even the airplanes themselves are offering wireless connection. Several large airlines are now providing wireless capabilities to passengers during flights. Like their earth-bound counterparts, these passengers can access the Internet or view their corporate data from their seats at 30,000 feet.

Wireless technology, however, goes beyond serving just the passenger. Some airlines use WLAN technology to communicate with the aircraft once it has parked or is taxiing on the ground. This allows the airline to automatically upload and install software updates for onboard computers or the avionics system before the next flight. Other airlines are using wireless LAN technology for flight maintenance information. Aircraft maintenance personnel with a wireless LAN laptop can have immediate access to an online database that stores important information about each type of aircraft and maintenance procedures. This information is much more current than that found in printed manuals.

The communications between air traffic controllers and aircraft typically use voice radio systems that haven't changed much in 50 years. Important communications about the weather or route changes between pilots and company dispatchers or air traffic controllers use overcrowded voice radio circuits that resemble an old-fashioned party line telephone system. Many of these connections are of poor quality. Some airlines are using a new wireless data service to send and receive messages.

## Construction

Although at first glance the construction industry might not seem to be a prime candidate for wireless technologies, in reality it benefits greatly. This is because one part of the construction process must be completed before the next part can begin. For example, if the concrete footings for a new building cannot be poured then the entire project must be put on hold. This often means idling construction employees or trying to reschedule at a moment's notice. In addition, construction employees may often have to travel to several different job sites in one day. This makes paperwork management difficult. Pay sheets must be manually filled out by several different foremen and dropped off at the office late at night. The next day, payroll clerks often wrestle with scrawled or illegible notes and are unable to contact the foremen for clarification.

Wireless technology is a real plus to the construction industry. Foremen can enter time sheet information on a laptop computer and have it immediately transmitted via WLAN to the main office in the construction trailer located on the job site. Information from the job site, such as a tardy subcontractor or a problem with materials, can be instantly relayed back to the main office for rescheduling of workers to other sites to prevent idle time.

In addition, construction equipment such as bulldozers and earth graders are being fitted with wireless terminals in order to turn them into "smart" equipment. A global positioning system (GPS) on a bulldozer can provide location information to within centimeters. The exact location of the bulldozer and where it is to be digging can be transmitted to a terminal on the bulldozer, which displays a color-coded map to guide the operator. Also, smart equipment can be connected through wireless transmissions to the home office, which tracks engine hours and equipment location. The engine's diagnostic system can send wireless alerts for maintenance tasks such as oil changes.

## Warehouse Management

Managing a warehouse stocked with inventory can be a nightmare. New products arrive continuously and must be inventoried and stored. When products are shipped out of the warehouse they must first be located then transferred to the right loading dock so they can be placed on the correct truck. A mistake in any one of these steps can result in a warehouse stocked with products that it cannot locate, customers receiving the wrong items, or a store running out of goods to sell.

Implementing wireless technology is key for warehouse operations. Forklift trucks in the warehouse are outfitted with a wireless device, and employees often have portable wireless devices. All of these devices are connected to the WLAN. Warehouse management system (WMS) software can manage all of the activities from receiving through shipping. And since this network is tied into the front office computer system, managers can have current statistics at any given moment.

Pallet loads arriving from other locations come with RFID or barcoded pallet labels. The information includes product identification numbers, product code dates or expiration dates, originating plants and lines of manufacture, and sequentially assigned serial numbers. As pallets arrive, a forklift truck operator scans the barcode label or receives the RFID signal with a portable wireless device. This device sends the data to the wireless network where the warehouse software immediately designates a storage location for the pallet and relays the information back to the computer on the forklift truck. The computer then either prints a barcode that is affixed to the pallet or updates the pallet's RFID tag. Then, the forklift operator transports the pallet to a storage location in the warehouse. An RFID tag attached to a rack face identifies every storage location. The operator receives the wireless signal from the tag to confirm that the pallets are being put away in the correct location before depositing the load.

In the front office orders are received and entered into the computer that connects to the WLAN in the warehouse. The WMS software manages order picking, balances workloads, and selects pick sequences for lift truck operators. The dock control module then releases orders for picking. A forklift operator locates the correct storage location, scans the barcode of the pallet or receives the RFID tag signal, and then ferries it to the shipping dock to be loaded onto a truck.

## Public Safety

Vehicles owned by public safety departments are moving away from older telecommunications systems to newer wireless networks. These older networks are being replaced by GSM cellular networks that are almost three times as fast. In addition, wireless LAN technology is also being used. Although the GSM cellular network has a broader range of coverage, its speed is much slower than a WLAN. Wireless LAN access points are installed on city-owned buildings or sites such as municipal fuel pumps where the patrol cars are refueled. Here large volumes of data such as building floor plans, photographs of criminal suspects, maps, and other information can be quickly downloaded to the vehicle.



### NOTE

If a dispatch call requires a vehicle to immediately respond to a call before a WLAN download is completed, the software sets a bookmark and will resume from that place when the vehicle returns.

## Health Care

Administering medication in a hospital is one of the major problem areas for the health care industry. It is estimated that incorrectly dispensed medication results in hundreds of thousands of medical emergencies annually. Typically, medication printouts are posted at the medication area. As medications are given, they are crossed off the list and initialed. However, since the paper record cannot always be updated immediately, there is a possibility that a patient could get an extra dose of medication before an order for a new or changed medication is processed. This also forces duplicate documentation. Nurses first check the medication printout to determine the medication to be given. Then, they document on paper that the medication was actually given and later enter the data on the computers.

However, wireless LAN point-of-care computer systems allow medical staff to access and update patient records immediately. Many hospitals use laptop computers on mobile carts with barcode scanners or RFID readers and a wireless network interface card. Health care professionals can document a patient's medication administration immediately in the computer as they move from room to room without connecting and disconnecting cables. Nurses first identify themselves to the computer system by scanning their own personal barcoded ID badge or RFID tag. The patient's barcoded armband or RFID tag is then scanned, and all medications that are currently due for that particular patient are brought up on the screen. The medications to be administered are sealed in RFID-tagged pouches or barcoded bottles. Nurses scan this barcode or RFID tag before opening the package. An alert immediately appears on the screen if the wrong medication or incorrect amount is identified. After giving the medication, the nurse indicates through the wireless network that the medication has been given, essentially electronically signing the distribution form. A hard copy can be printed out as needed.

The system immediately verifies that medication is being administered to the correct patient in the correct dosage, which eliminates potential errors and documentation inefficiencies. The documentation process now takes place at the bedside where care is delivered, which improves accuracy. In addition, all hospital personnel now have real-time access to the latest medication and patient status information.

Wireless technology is also used in other medical areas besides healthcare administration. A video pill is now available for patients to swallow who are experiencing digestive problems. This pill contains a tiny camera and a wireless transmitter. As the pill works its way through the digestive system it takes two pictures each second and transmits those images to a receiving device worn on the patient's belt. At the end of eight hours the device is removed and the doctor can then view the pictures without having to perform invasive surgery. A video pill is illustrated in Figure 1-12.



**Figure 1-12** Video pill

## WIRELESS ADVANTAGES AND DISADVANTAGES

With any technology, there are advantages and disadvantages to be considered. Wireless LANs are no exception. The following is a summary of the advantages and disadvantages of the technology.

### Advantages

There are many advantages to using wireless technology. These include mobility, easier and less expensive network installations, increased network reliability, and disaster recovery.

#### Mobility

The primary advantage of wireless technology is mobility or the freedom to move about without being tethered by wires. Mobility enables individuals to use a device like a laptop computer that is always in contact with the network no matter where the user may roam within range of that network. Many occupations that require workers to be mobile, such as field repair technicians or inventory clerks, find that wireless technology is vital to their work.

With the change in today's business environment even more workers can take advantage of the mobility afforded by a wireless technology. An increasingly mobile workforce is one characteristic of today's business world. Many employees spend large portions of their time away from the office. Workers today are being equipped with laptop computers and other portable communication devices to enable them to be mobile. However, these employees still need immediate access to data on the company network. WLANs fit well in this work environment, giving mobile workers the freedom they need but allowing them to access the network resources that they need. With a wireless network, workers can access information from almost anywhere.

Another characteristic of today's business world is "flatter" organizations. Much of an employee's work is done in teams that cross functional and organizational boundaries. This means that employees are involved extensively in team meetings that occur away from their desks. Yet the need for immediate access to network resources still exists even while these meetings are taking place. WLANs are again the solution to the problem. They give team-based workers the ability to access the network resources that they need while collaborating in a team environment.

#### Easier and Less Expensive Installation

Installing network cabling in older buildings can be difficult and costly. These buildings were constructed long before personal computers and networks were ever thought of. It is very difficult to run cable through thick masonry walls and plaster ceilings. Also, older buildings tended to use asbestos when constructed. Following today's regulations, the asbestos sometimes first has to be completely removed before any major cabling infrastructure can be installed. And often there are local or national restrictions that prevent modifying older facilities that may have an historical value.

In these instances a wireless LAN is the ideal solution because the need to run cables is eliminated. That means that historical buildings can be preserved, dangerous asbestos is not disturbed, and difficult drilling can be avoided by using a WLAN system.

In addition, eliminating the need for installing cabling will result in a significant cost savings. With cable connections costing anywhere from \$1 to \$3 per drop (connection), a wireless network can easily pay for itself by eliminating the need for a network connection in each office. Also the time required to install network cabling is usually significant. Installers must pull wires through the ceiling and then drop cables down walls to network outlets. This can usually take days or even weeks to complete. During that time employees must somehow continue their work in the midst of the construction zone, which is often difficult to do. Using a wireless LAN eliminates any such disruption because there are no cables to be installed.

Wireless networks also make it easier for any office—in either an old or new building—to be modified with new cubicles or furniture. No longer does the design for a remodeled office first have to consider the location of the computer jack in the wall when relocating furniture and setting up a computer. Instead, the focus can be on creating the most effective work environment for the employees. The computer can be connected to the network no matter where it is placed in the cubicle.

### Increased Reliability

One of the most common sources of network problems is network cable failure. Moisture from a leak during a thunderstorm or a coffee spill can erode metallic conductors. A user who shifts the computer on his or her desk may break one or more of the wires in a patch cable. A cable splice that is done incorrectly can cause problems that result in intermittent errors that are very difficult to identify. Using wireless LAN technology eliminates these types of cable failures and increases the overall reliability of the network.

### Disaster Recovery

In today's environment with fires, tornados, hurricanes, floods, and even terrorist attacks, disaster recovery must be a prime concern of every business organization. A documented disaster recovery plan is vital to every business if it is to get back on its feet quickly after a calamity. Any business that is not prepared to recover from these or other disasters will find itself crippled or out of business.

Almost all organizations must have another site from which to run their operations in the event that the primary site is no longer available. A **hot site** is generally run by a commercial disaster recovery service that allows a business to continue computer and network operations to maintain business continuity. A hot site has all the equipment needed for an organization to continue running, including office space and furniture, telephone jacks, computer equipment, and a live telecommunications link. If the organization's data processing center becomes inoperable, it can move all data processing operations to a hot site, often within an hour.

However, the contract for maintaining a hot site is very expensive and not all businesses can easily afford this expense. An alternative is a **cold site**. A cold site provides office space, but the customer must provide and install all the equipment needed to continue operations. A cold site is less expensive, but takes longer to get an enterprise in full operation after the disaster. Many businesses are using cold sites and WLANs as a major piece of their disaster recovery plan. Laptop computers with wireless NIC adapters and access points are kept in reserve along with backup network servers. In the event of a disaster, operations are quickly relocated to the cold site. No consideration has to be given to network cabling; instead, laptop computers are distributed to the resettled employees and access points are quickly installed. The network can be immediately up and running so that business may proceed in as normal a fashion as possible.

**NOTE**

Typically, a business has an annual contract with a company that offers hot site services with a monthly service charge. Some services also offer data backup so that all company data is available regardless of whether a hot site or cold site is used.

## Disadvantages

Along with the many advantages of WLAN technology there are disadvantages and concerns. These include security, radio signal interference, and health risks.

### Security

A wireless signal is not confined to a cable as in a traditional network. Instead, it is broadcast in the open air, making security for wireless LANs a prime concern. Wireless security presents a number of unique challenges. These include:

- *Unauthorized users might access the network*—Because a wireless signal is not confined to the four walls of the building in which the access point (AP) is located, an unauthorized user can often pick up the signal outside the building's security perimeter. It is possible for an intruder to be lurking in the parking lot with a laptop computer and wireless NIC to intercept the signals and access the network. Individuals who actively search for wireless signals to pick up, often by just driving down the street, are participating in an activity known as **war driving**.
- *Attackers might view transmitted data*—In a wired network an attacker would have to gain access to the cabling infrastructure in order to attempt to look at the data that is being transmitted across the network or to gain access to a file server. With a wireless network, an attacker only has to pick up the wireless signal in order to see what is being transmitted or gain access to the network.
- *Employees could install rogue access points*—Many organizations have a policy that prohibits employees from connecting their own personal equipment to the network. This is primarily for security reasons. An employee who purchases an access point and secretly brings it into the office in order to provide personal wireless access has installed what is known as a **rogue access point**. Typically

these rogue access points have no security features implemented. This means that an attacker can pick up the rogue access point's wireless signal and bypass all of the network security that the organization has installed.

- *Attackers could easily crack existing wireless security*—Early types of wireless LANs had basic security features that could be enabled. However, these features were not properly implemented and turned out to be easy to bypass. Although current products have more robust security features, many older products are still in use with very weak security features. Users are sometimes mistaken in their belief that because the security features are turned on they are protected.

Because of the unique security challenges of a wireless LAN and because the security on early WLANs could be easily defeated, wireless security is a major issue. Although newer types of WLANs have improved security features, wireless security must be properly addressed in order to ensure data integrity and privacy.

**NOTE**

Wireless security will be covered in detail in Chapters 8 and 9.

## Radio Signal Interference

Wireless devices operate using radio signals, creating the potential for two types of signal interference. Signals from other devices can disrupt wireless transmissions, or the wireless device may itself be the source of interference for other devices.

For example, there are several different types of devices that transmit a radio signal that may interfere with a WLAN. These devices include microwave ovens, elevator motors, photocopying machines, certain types of outdoor lighting systems, theft protection devices, and cordless telephones. These may cause errors or completely prevent transmission between a wireless device and an access point. And because WLAN devices operate within the same radio frequency, they may return the favor and interfere with other wireless devices.

Interference is nothing new for a computer data network. Even when using cables to connect network devices, interference from fluorescent light fixtures and electric motors can sometimes disrupt data transmission. The solution for wireless devices is the same as that for standard cabled network devices: locate the source of the interference and eliminate it. This usually is solved by moving an access point away from a photocopying machine or microwave oven. In addition, many wireless devices can identify errors in transmission and retransmit data as necessary.

## Health Risks

Wireless LAN devices contain radio transmitters and receivers that emit radio frequency (RF) energy. This is similar to cellular telephones and other mobile wireless devices that emit low levels of RF while being used. It is well documented that high levels of RF can

produce biological damage through heating effects (this is how a microwave oven is able to cook food). However, it is not known if or to what extent lower levels of RF might cause adverse health effects. Although some research has been done to address these questions, no clear picture of the biological effects of this type of radiation has emerged to date.

**NOTE**

Most wireless devices also emit very low levels of RF energy even when in stand-by mode. However, these levels are considered non-significant and do not appear to have health consequences.

In the United States, the Food and Drug Administration (FDA) and the Federal Communications Commission (FCC) set policies and procedures for some wireless devices such as cellular telephones. A recent FDA update stated that “the available science does not allow us to conclude that (wireless devices) are absolutely safe, or that they are unsafe.” However, the report went on to say that “the available scientific evidence does not demonstrate any adverse health effects associated with the use of (wireless devices).” At the present time no scientific studies have revealed health problems associated with the absorption of low levels of RF energy by the human body.

**NOTE**

Questions have been raised about the safety of hand-held mobile phones with a built-in antenna positioned close to the user's head when speaking on the phone. In mobile devices, the antenna is the primary source of RF. The safety of cordless phones, which have a base unit connected to the telephone wiring in a house and which operate at far lower power levels and frequencies, has not been questioned.

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## CHAPTER SUMMARY

- We are in the midst of a wireless revolution. Wireless devices and technologies enable users to roam almost anywhere and remain connected to data and voice networks. The number of public hotspots is dramatically increasing annually, as are the numbers of wireless laptop computers and other mobile devices.
- Home and business users have adopted wireless local area networks (WLANs) to the extent that they are commonplace today. A WLAN, also known as Wi-Fi, functions the same as a standard wired network except devices send radio frequency signals through the air instead of being connected to the network by cabling. In order to function, a WLAN requires that a wireless network interface card be installed in each device. These cards send and receive signals to an access point (AP), which in turn is connected to a wired network or the Internet.
- Bluetooth technology can be used anywhere that a small stream of data needs to flow. Bluetooth devices communicate using small radio transceivers called radio modules that are built into microprocessor chips. Bluetooth devices form what is known as piconet.

- Many organizations are moving away from expensive leased data transmission lines and replacing them with fixed broadband wireless connections. Two popular technologies are WiMax and free space optics (FSO).
- Handheld devices can send and receive wireless signals using the Global System for Mobile (GSM) communications technology. Information is transmitted based on the Wireless Application Protocol (WAP). WAP provides a standard way to transmit, format, and display Internet data for small devices like cell phones and handheld devices.
- Radio frequency identification (RFID) is a relatively new wireless technology. RFID tags function as electronic barcodes. However, RFID tags can contain much more information than a standard barcode and can be easily updated. In addition, because the information is transmitted via radio waves the RFID tags does not have to be precisely aligned with a reader in order for the information to be collected.
- Wireless technologies are generally classified into three categories. Wireless personal area networks (WPANs) cover technologies where the transmission generally extends only a few meters or feet, whereas wireless local area networks (WLANs) are generally restricted to 112 meters (375 feet). Wireless wide area networks (WWANs) transmit over much longer distances.
- Wireless LAN applications can be found in industries in which employees need the freedom to conduct business without being confined to a specific location. Some types of organizations that use wireless extensively include education, business, the travel industry, construction, warehouse management, public safety, and health care.
- Wireless LANs have significant advantages, including increased mobility, easier and less expensive network installations, increased network reliability, and disaster recovery.
- Some of the disadvantages of wireless LANs include security, radio signal interference, and health concerns.

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## KEY TERMS

**access point (AP)** — A wireless device that acts as a base station to receive signals from and transmit signals to wireless network interface cards in other wireless devices.

**Bluetooth** — A low-power wireless data and voice transmission technology.

**cable modem** — A telecommunications technology that sends data over television cable.

**cold site** — A remote site that provides only office space in the event of a disaster.

**digital subscriber lines (DSL)** — A telecommunication technology that uses telephone lines.

**fixed broadband wireless** — A wireless wide area network technology for transmissions between buildings.

**free space optics (FSO)** — A fixed broadband wireless technology that uses low-powered infrared beams and transmits at speeds up to 1.25 Gbps over a distance of up to 6.4 kilometers (4 miles). An alternative to high-speed fiber optic transmissions.

**Gbps** — Billions of bits (gigabits) per second.

**Global Systems for Mobile (GSM) communications** — A wireless wide area network technology used by cellular telephones and handheld devices.

**hot site** — A remote site that contains redundant equipment, supplies, and telecommunications infrastructure for a business, and is ready immediately in the event of a disaster.

**hotspot** — Location where wireless data service is available.

**Integrated Services Digital Networks (ISDN)** — A wide area network technology that transmits at 256 Kbps.

**Kbps** — Thousands of bits (kilobits) per second.

**link manager** — Bluetooth software that helps identify other Bluetooth devices, creates the links with them, and sends and receives data.

**master** — A Bluetooth device that controls wireless traffic.

**Mbps** — Millions of bits (megabits) per second.

**microbrowser** — A small browser program that runs on a cellular telephone or a handheld device.

**piconet** — A Bluetooth network that contains one master and at least one slave.

**radio frequency identification (RFID)** — Small tags that function like electronic barcodes.

**radio module** — Bluetooth radio transceiver built onto a microprocessor chip.

**rogue access point** — A WLAN access point installed without permission.

**slave** — A Bluetooth device that takes commands from the master device.

**T-1** — A wide area network technology that transmits at 1.544 Mbps.

**WAP gateway** — A device that translates between WML and HTML.

**WAP proxy** — Same as WAP gateway.

**war driving** — Driving around with a wireless device searching for a wireless signal.

**Wi-Fi (Wireless Fidelity)** — Another name for a wireless local area network.

**WiMax** — A fixed broadband wireless technology that sends and receives signals between antennas over longer distances.

**wireless adapter** — Another name for a wireless network interface card (NIC).

**Wireless Application Protocol (WAP)** — A standard way to transmit, format, and display Internet data for devices like cell phones or handheld devices.

**wireless local area network (WLAN)** — A local area network (LAN) in which the devices are not connected by wires.

**Wireless Markup Language (WML)** — A programming language designed to display text-based Web content on the small screen of a cell phone or handheld device.

**wireless network interface card (wireless NIC)** — A card that is inserted into a device that enables it to communicate on a wireless network.

**wireless personal area network (WPAN)** — Wireless technologies that have a limited transmission range of up to 3.3 meters (10 feet).

**wireless wide area network (WWAN)** — Wireless technologies that have a transmission range from 152 meters (500 feet) to 120 kilometers (75 miles) or more.

**REVIEW QUESTIONS****1**

1. A location where wireless data services are available is known as a(n)
  - a. access spot
  - b. Global System Availability Location (GSAL)
  - c. access portal
  - d. hotspot
2. A wireless local area network (WLAN) is also called
  - a. Wi-Fi
  - b. WWAN
  - c. Wireless SWAN
  - d. AP
3. The \_\_\_\_\_ acts as a base station to receive and transmit signals to and from wireless NICs in other wireless devices. It also connects to a wired network.
  - a. access point
  - b. wireless network interface card
  - c. FSO
  - d. Wireless Packet Transfer Gateway (WiPTG)
4. \_\_\_\_\_ is a low-power wireless data and voice transmission technology that can be used anywhere a small stream of data needs to flow.
  - a. GSM
  - b. RFID
  - c. Bluetooth
  - d. WAP
5. A Bluetooth link manager performs each of the following functions except
  - a. identifies other Bluetooth devices
  - b. creates links between the devices
  - c. sends and receives data
  - d. connects to a wired network
6. Bluetooth devices communicate using small radio transceivers called radio modules built onto microprocessor chips. True or False?
7. Fixed broadband wireless uses wireless transmissions for data communications over distances less than 15 meters (50 feet). True or False?
8. Free space optics (FSO) is an alternative to high-speed fiber optic transmissions that uses low-powered infrared beams. True or False?

9. Bluetooth is the best technology for sending and receiving e-mail messages on a handheld device. True or False?
10. A WAP gateway is also called a GSM proxy. True or False?
11. \_\_\_\_\_ is a generic classification for network technologies in which the transmissions generally do not extend past 3.3 meters (10 feet).
12. A \_\_\_\_\_ site can be used for disaster recovery but it does not contain any networking or computer equipment.
13. A Bluetooth network that contains one master and at least one slave forms a(n) \_\_\_\_\_.
14. A WAP cell phone runs a small browser program called a(n) \_\_\_\_\_ that uses Wireless Markup Language (WML) instead of HTML.
15. \_\_\_\_\_ is a fixed broadband wireless technology that can transmit up to 53 kilometers (35 miles).
16. List and describe two differences between a wireless and a wired network interface card.
17. What is the difference between a Bluetooth master and slave?
18. Explain what Wireless Application Protocol is and how it works.
19. List and describe two differences between radio frequency identification tags and standard barcodes.
20. Explain how wireless technology can increase the reliability of a network.

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## HANDS-ON PROJECTS



### Project 1-1: Locate Area Hotspots Using Wi-Fi.org

Several Internet tools are available to locate wireless hotspots in your area. In this project you will use one tool to find hotspots.

1. Open a Web browser and go to **<http://www.wi-fi.org/>**.
2. Click **Wi-Fi Zone**.
3. Click **Zone Finder**.
4. Under “Select Your Country” enter **United States** (or your country) and click **Search**.
5. Under “Select your State/Province” choose your state or province and click **Search**.
6. Under “City,” choose your city. If your city is not listed, select the one with which you are most familiar.
7. Select **All Location Types** under “Location Type.”

8. Under “Providers” select **All Providers**.
9. Click **Search**. A list of hotspots will appear as seen in Figure 1-13.

The screenshot shows the Wi-Fi ZONE Finder website interface. The navigation bar includes links for Home, About Wi-Fi, News & Events, Media & Analysts, Become a Member, Contacts, and Wi-Fi ZONE. A sidebar on the left contains a 'Learn about the Wi-Fi ZONE Finder Partner Program' section with a 'Click Here!' button, and a 'Join Wi-Fi ZONE for FREE' section. The main content area features a search bar and a 'Search' button. Below the search bar, there are download links for an Excel Spreadsheet and a Word Document. The search results are displayed in a table with the following data:

Search Returned 21 Results in 0.62 Seconds			
Company (Detail)	Location	Street Address	SSID
Alexis Inn & Suites Airport	Nashville, TN	600 Ermac Drive	LeapNetworks.net
Alexis Inn & Suites Airport	Nashville, TN	600 Ermac Drive	LeapNetworks.net
Courtyard by Marriott	Nashville, TN	1901 West End Ave	LeapNetworks.net
Doubletree Guest Suites Nashville - Airport	Nashville, TN	2424 Abrium Way	PASSYM
Embassy Suites Hotel - Nashville - Airport	Nashville, TN	10 Century Blvd	PASSYM
Hampton Inn	Nashville, TN	210 Crossing Place	LeapNetworks.net
Hampton Inn	Nashville, TN	210 Crossing Place	LeapNetworks.net
Hampton Inn & Suites Airport	Nashville, TN	583 Donelson Pike	LeapNetworks.net

Figure 1-13 Wi-Fi.org Hotspots

10. Under “Download Results” click **Word Document**.
11. When asked “Do you want to open or save this file?” click **Save** and save the document to your computer.
12. When the document has finished downloading click **Open**.
13. Look at the results of the document and see if you can identify any of these locations.
14. Keep your browser open for the next project.



## Project 1-2: Locate Area Hotspots Using Yahoo Maps

Because there is no one central repository that contains all of an area’s hotspots, it is sometimes necessary to look at several different sources. In this project you use another tool to locate area hotspots.

1. Go to **http://maps.yahoo.com**.
2. Under **Address**, enter your street address, city, and state.
3. Click **Get Map**.
4. When the map appears click **Wi-Fi Hotspots** at the bottom as seen in Figure 1-14.

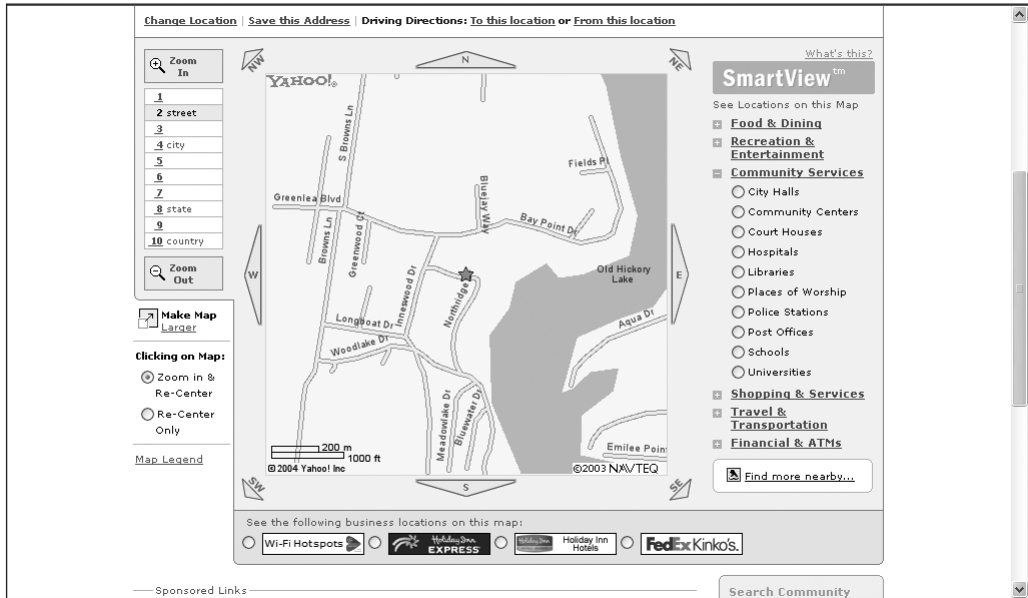


Figure 1-14 Yahoo Maps Hotspots

5. Click on one of the nearest hotspot locations. When the popup menu appears click **Wi-Fi Hotspot Details**.
6. Compare the information that you receive with that from the previous project. Which tool shows you more area hotspots? Which information is more detailed? Why do you think there's a difference?
7. Close your Web browser.



### Project 1-3: View a WAP Emulator

Although using WAP to display textual data like e-mail works well, WAP has difficulty displaying Web-based data. In this project you use a WAP emulator to see what a typical Web page might look like on a WAP cell phone.

1. Open your Web browser and go to <http://www.gelon.net/about/wapalizer.html>.
2. In the **Wapalizer** box enter <http://www.microsoft.com/>.
3. Click **Wapalize**.
4. A window will open that shows how this Web site will look on a WAP-enabled cell phone, as seen in Figure 1-15.
5. Try to navigate through the Web site by clicking on the cell phone buttons in the image and on the screen. How difficult is this?



Figure 1-15 Wapalized Web site

- 6. Close this window and enter another address in the Wapalizer box. Be aware that not all Web sites have been designed with WAP in mind. How difficult would it be to use a WAP-enabled cell phone to surf the Internet?
- 7. Close all windows.

### CASE PROJECTS



### Case Project 1-1: Hot Sites vs. Cold Sites

What would be the cost savings to establish a disaster recovery cold site with WLAN technology as opposed to maintaining a hot site? Using the Internet and other resources, research the cost of purchasing 20 laptop computers, 20 wireless network interface cards, and two access points. Then research approximate costs for leasing 1000 square feet of office space in your area. Finally, use the Internet to research hot sites and what approximate costs may be for the same area. How much of the savings could you realize by using a cold site with WLAN technology?

**CASE  
PROJECTS**

## Case Project 1-2: Wireless Careers

As wireless technology has opened up new ways to be connected to the network, it likewise has created new job opportunities. Using the Internet and print resources, research the types of wireless jobs that are in demand. Create a table that lists the job title, the necessary education and experience for the position, and the approximate starting salary.

**CASE  
PROJECTS**

## Case Project 1-3: Wireless Technology in Other Sectors

Select an area of the economy other than those listed in the chapter, such as finance, logistics, military, etc., and research how this sector is using wireless technology. Write a one-page paper on your findings.

**CASE  
PROJECTS**

## Case Project 1-4: Wireless Health Risks

Conduct your own research regarding the health risks posed by wireless technology. Compare at least two different studies. What is your personal assessment of these risks? How can you minimize risks when you use a cell phone or WLAN technology? Write a one-page paper on your findings.

**CASE  
PROJECTS**

## Northridge Consulting Group

Northridge Consulting is a local firm that assists businesses and organizations to solve their IT problems. Northridge frequently looks to outside experts for assistance. Northridge has hired you to help on a new project. Pickup Packages is a local pickup and delivery service that will go to customers' sites to pick up packages and letters and deliver them in the city within two hours. Out-of-town deliveries are also picked up and taken to the company's main office, where they are transferred to a national package delivery system.

1. Pickup Packages has recently moved into an older building that will be used for offices as well as space for company vehicles, bicycles, and a central location for pickup by the national package delivery systems. The service needs a network of computers in the office as well as in the back work area. Northridge believes that a WLAN may be a good application for this project. Create a PowerPoint presentation of at least 10 slides to deliver to Northridge about WLANs. Be sure to cover the following points:
  - Mobility
  - Ease and cost of installation
  - Easier network modifications
  - Increased network reliability
  - Speedier disaster recovery
  - Radio signal interference
  - Security

2. After your presentation Pickup Packages is interested in WLANs but the president is concerned about the health risks of wireless LANs. Create another presentation that looks at the issues of health risks with WLANs. Compare and contrast those with health risks of other wireless technologies such as cellular telephone and microwave transmissions.
3. Pickup Packages is also interested in providing its drivers or bikers with another means of communication besides pagers and analog cellular telephones. The management team would like the carriers to receive their pickup and delivery messages from the company's Web server. They have asked your opinion regarding using WAP with cellular telephones or handheld devices. Prepare to present your recommendations to Pickup Package's management team by writing a one-page paper.



