Wireless Network Benefits

People worldwide are learning of the benefits of wireless connectivity for checking e-mail, browsing the Internet, and accessing corporate applications. Ongoing advances in products that include wireless interfaces enable these people to unwire and reap the benefits of mobility and flexibility. The outcomes are higher efficiencies, accuracies, and reliability.

Increasing Efficiency and Accuracy

For compelling reasons to install a wireless network, strongly consider continual productivity benefits. If benefits result in enough savings to counter the costs associated with installing and supporting a wireless network, a wireless network is beneficial. A positive return on investment certainly motivates people to allocate money for new systems.

Office Example

As the basis for increasing productivity, consider purchasing 802.11-equipped laptops. This enables employees to read and respond to e-mail and browse the Internet during office meetings, assuming the users can be responsive when needed at the meeting while plunking away at their laptop. Even though this seems trivial, the productivity gains can be significant.

If a user attends meetings for 3 hours each day and spends approximately 15 minutes per hour responding to e-mail and performing other Internet-related tasks during each meeting, the user has 45 minutes more each day to do other tasks. This seems pretty reasonable, considering the average person and office setting.

A 45-minute productivity gain equates to company cost savings that depend on the person's cost per hour. At $50 per hour, the savings is $37.50 per person per day. A smaller company with 20 users will save $750 per day, $15,000 per month, $180,000 per year, and so on. After including wireless LAN hardware costs of $40,000, a positive return could result in approximately three months! Even after factoring in the cost of new laptops for everyone, a company should still see a positive return in less than one year in this simple example.

In addition to gains in productivity, wireless networks offer the following benefits in offices:

- Users can continue networking when the company moves walls during facility remodeling, which frequently occurs in corporations.
- Visiting employees can easily network with company servers and applications from anywhere within the facility.
- The company can implement additional wireless applications, such as mobile phones, in order to save costs.

Warehouse Example

Mobility provides the basis for getting jobs done faster and with fewer people. Imagine a shipment of auto parts arriving at a distribution center. As clerks unload the trucks, they scan a bar code on each box with a wireless, handheld data collector. The bar code contains a unique tracking number that is automatically and immediately sent to a warehouse management system (WMS) to indicate the reception of the part. The WMS then instructs the clerks, through the data collector's display, whether to place the item in the warehouse or ship the item directly to a particular customer.

If the part is bound for the warehouse, the system prints a label for placement on the box identifying the intended storage position in the warehouse. The system prints route and shipping information on a la-

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bel, which the clerks affix to the box for parts requiring shipment to a customer. The clerks can then deliver the box to the correct location, whether it's the warehouse or an outgoing delivery truck.

The use of this receiving system enables the company to reduce inventories by immediately redirecting received orders to customers. It also eliminates paper records and manual data entry. Most importantly, the company delivers orders to customers sooner. In general, the system enables a company to realize incredible gains in efficiency and accuracy over error-prone, paper-based processes. The tracking of items by paper and the entry of data to the WMS through a desktop terminal significantly increase the likelihood of errors and require larger staffs to accomplish.

Hospital Example

In a hospital, a wireless network can help save lives by improving the speed and accuracy of delivering drugs to patients. Because of government regulations, hospitals must maintain accurate records of narcotics, which prompts administrators to implement stringent, often paper-based, methods to account for the exact numbers of each narcotic. A wireless network, however, enables the use of handheld bar code scanners that make the picking and inventory process up to 300 percent faster and much more accurate.

In addition, a nurse can verify that the correct patient receives the medication by scanning both the drug and the patient's identification bracelet. This significantly reduces the chance of giving the drug to the wrong patient. In addition, the system can verify that the patient doesn't have any adverse allergies for the type of drug that she is receiving. The wireless network makes this application possible in a highly mobile hospital environment.

Many other applications result in enough gains in efficiencies and accuracies to make a wireless network worthwhile. The goal is to care-

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fully quantify and compare the benefits to the system costs.

Improving Reliability

Cables are inherently unreliable because of corrosion and misuse. Improper installation and damage of cables are primary reasons that wired networks fail. A telephone technician, for example, might be repairing a problem with the telephone system and inadvertently cut network cables. This causes system downtime for a relatively long period while network administrators troubleshoot.

Adverse weather, such as hurricanes and tornadoes, can offer major harm to both aerial and underground copper connections between buildings. This type of damage frequently blocks an entire building from accessing important applications. Even though wired networks generally deliver higher performance than wireless counterparts, the susceptibility to outages results in unacceptable availability.

A wireless network appreciably reduces problems related to physical damage. The availability of the system increases, giving users connectivity a higher percentage of time. A wired network might be necessary if it's not possible to meet performance requirements with a wireless network, but a wireless network can provide a back-up link. The combination of wired and wireless communications linkage between buildings offers a reliable high-performance and system.

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Chapter Summary

A wireless network eliminates wiring among computer devices, such as PDAs and laptops, and existing networks. This permits computer devices and users to be highly mobile while still interfacing with the Internet and corporate applications. Whether someone is within an airport, home, or office, the person can stay connected.

The various types of wireless networks offer solutions for a variety of applications in homes, offices, hospitals, and public areas, where users can benefit from having mobile access to network services. The ability to merely enable mobile applications is often enough justification for a wireless network. In some cases, however, a company might need to carefully analyze potential gains in efficiency, accuracy, and reliability to show that the costs of the system will be worthwhile.

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Chapter Review Questions

You can find the answers to the following questions in **Appendix A**, "Answers to Chapter Review Questions."

1:	What is a distinguishing attribute of a wireless network as compared to a general wireless communication system?
2:	What types of information does a wireless network support?
3:	What are the four types of wireless networks?
4:	What is the typical maximum range of a wireless PAN?
5:	True or false: A wireless PAN consumes little power from small handheld computer devices.
6:	What is a common standard for wireless LANs?
7:	What relatively new standard applies to wireless MANs?
8:	Why do wireless WANs not effectively satisfy requirements for indoor wireless networks?
9:	What is a common application of wireless networks in homes and small offices?
10:	What are examples of applications for wireless WANs?

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Chapter 2. Wireless System Architecture: How Wireless Works

What You Will Learn

After reading this chapter, you should be able to

- **Understand the components of a wireless network**
- **Discover general wireless network architectural elements**
- **Understand how information flows through a wireless network**

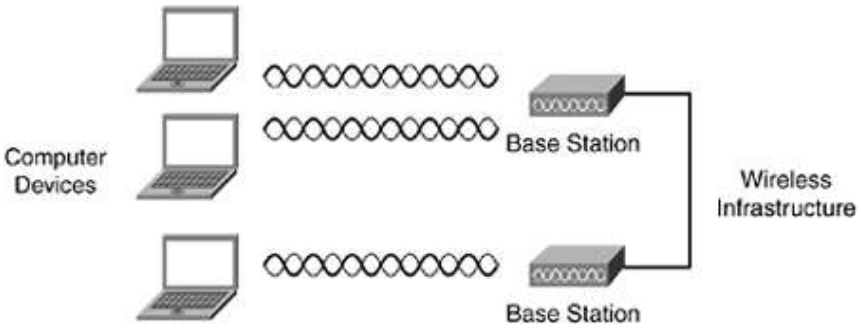
Wireless networks utilize components similar to wired networks; however, wireless networks must convert information signals into a form suitable for transmission through the air **medium**. Even though wireless networks directly contribute only to a portion of the overall network infrastructure, attention to all network functions is necessary to counter impairments resulting from the wireless medium. This chapter discusses concepts common to all types of wireless networks, with emphasis on components and information signals.

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Wireless Network System Components

A wireless network consists of several components that support communications using radio or light waves propagating through an air medium. Some of these elements overlap with those of wired networks, but special consideration is necessary for all of these components when deploying a wireless network. Figure 2-1 illustrates these primary components.

Figure 2-1. Wireless Networks Include Computer Devices, Base Stations, and a Wireless Infrastructure



Users

A user can be anything that directly utilizes the wireless network. One of the most common types of user is a person. For example, a business traveler accessing the Internet from a public wireless LAN at an airport is a user. In some cases, however, the user might not be human. A robot, for example, might receive instructions over a wireless network from a central computer that controls a manu-facturing process. Because the wireless network exists to serve the user, the user is the

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component that receives the benefits of a wireless network. As a result, users are an important part of the wireless network.

The user initiates and terminates use of a wireless network, making the term end-user appropriate. Typically, a user operates a **computer device**, which often performs a variety of application-specific functions in addition to offering an interface to the wireless network.

Users of wireless networks tend to be mobile, constantly moving throughout a facility, campus, or city. Mobility is one of the most prominent benefits of deploying a wireless network. For example, a person walking through a convention center while sending and receiving e-mail from a PDA is exercising mobility. The PDA in this case must have continual or frequent connections to a wireless network infrastructure.

Some users might require only portability; whereby, they stay at a particular location while using the wireless network for a specific period of time. An example of this type of usage is someone operating a laptop wirelessly from a conference room. The user will turn on the laptop after sitting down in the conference room and shut off the laptop before leaving. As a result, the wireless network doesn't need to support continual movement.

Other users might actually be stationary, which means that they operate from one place for an indefinite period of time. An example of this type of user is someone working from a wireless computer in an office. The biggest difference between a stationary and portable user is that the stationary user will not require any form of roaming functions. Roaming functions are difficult to implement in some situations.

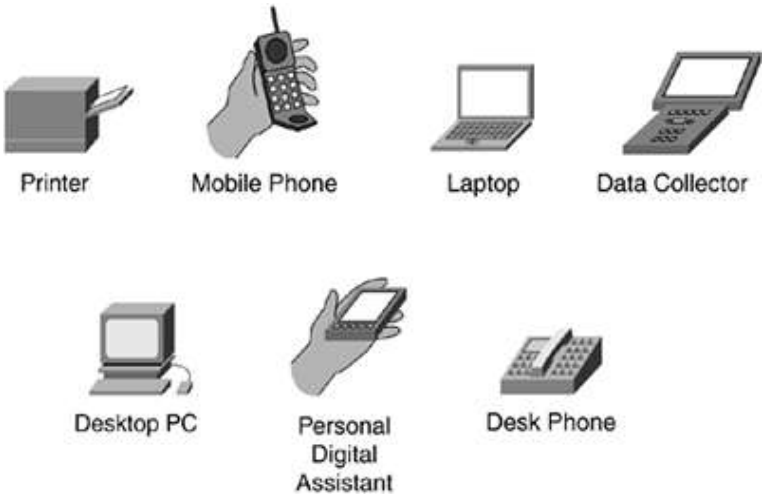
Computer Devices

Many types of computer devices, sometimes referred to as clients, operate on a wireless network. Some computer devices might be specifically designed for users, whereas some computer devices are end sys-

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tems. In generally, any computer device might communicate with any other computer device on the same wireless network. **Figure 2-2** illustrates an assortment of computer devices for wireless networks.

Figure 2-2. Computer Devices for Wireless Networks Satisfy Different Applications



To support mobile applications, computer devices are often small, making them practical for people to carry with them at all times. These devices generally have small screens, limited keyboards, and small batteries. The devices are mobile, but they can support only certain applications.

With portable and stationary applications, however, the computer devices are much larger. These devices generally have larger displays and keyboards, making them more suitable to use when browsing the Internet and other applications requiring relatively high performance. The problem, however, is that these devices weigh more and are difficult to carry from one place to another.

Computer devices within a wireless network also include end systems such as servers, databases, and websites. For example, the

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http://www.cnn.com website includes news that someone can view from a public wireless LAN connection from a hotel room. Similarly, a clerk can wirelessly interface with a warehouse management system, which acts as an end-system computer device.

Users can adapt many existing computer devices to operate on a wireless network. A user, for example, can purchase and install a wireless network interface card (NIC) within his laptop to enable operation on a particular type of wireless network. Some devices, such as a wireless bar code scanner, operate only on a wireless network.

A computer device also has an operating system, such as Windows XP, LINUX, or MAC OS. The operating system runs software needed to realize the wireless network application. In some cases, the operating system has built-in features that enhance wireless networks. For example, Windows XP has the ability to automatically identify and associate with wireless LANs.

NICs

The **network interface card** provides the interface between the computer device and the wireless network infrastructure. The NIC fits inside the computer device, but external network adaptors are available that plug in and remain outside the computer device. **Figure 2-3** shows examples of several types of wireless NICs.

Figure 2-3. Wireless NICs Have Various Types of Form Factors

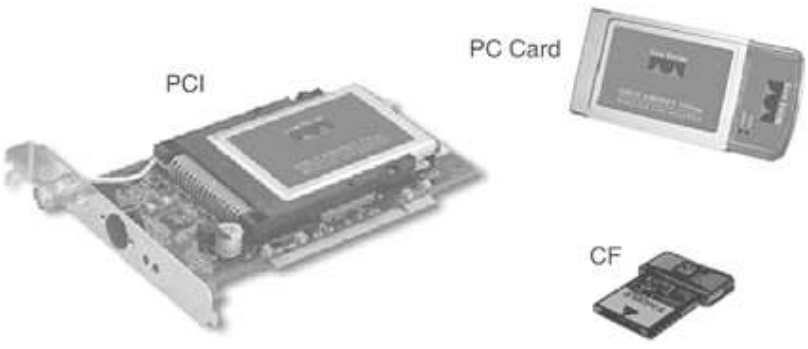


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Wireless network standards define how a wireless NIC operates. For example, a wireless LAN NIC might implement the IEEE 802.11b standard. In this case, the wireless NIC will only be able to interface with a wireless network infrastructure that complies with the 802.11b standard. As a result, users must be careful to ensure that the wireless NIC they choose matches the type of wireless network infrastructure they want to access.

Wireless NICs also comply with a specific form factor, which defines the physical and electrical bus interface that enables the card to communicate with the computer device. Again, the user must consider this to ensure that the chosen wireless NIC will fit within their computer device. The following is a summary of the different internal form factors available for wireless networks:

- Industry-Standard Architecture (ISA)— ISA has been around since the early 1980s. Because of this, the proliferation of the ISA bus has been significant. Despite its limited performance, nearly all PCs manufactured up until recently had at least one ISA bus. The ISA bus has failed, however, to advance at the pace of the rest of the computer world, and other higher-speed alternatives are now available. ISA doesn't impose too much of a performance impact on 802.11b wireless LANs. It's not advisable, however, to purchase new ISA cards because of the possibility of them becoming obsolete.
- Peripheral Component Interconnect (PCI)— The PCI bus is the most popular interface for PCs today and boasts high performance. Intel originally developed and released PCI in 1993, and it satisfies the needs of the recent generations of PCs for multimedia and graphics. PCI cards were the first to popularize “plug-and-play” technology, which makes it easy to install the NIC. PCI circuitry can recognize compatible PCI cards and work with the computer's operating system to set the configurations for each card. This saves time and prevents installation headaches for nontechnical users.

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- PC Card— The PC Card was developed in the early 1990s by the Personal Computer Memory Card International Association (PCMCIA). The **PC Card** is a credit-card-sized device that provides extended memory, modems, connectivity to external devices, as well as wireless LAN capabilities to small computer devices such as laptops and PDAs. In fact, they are the most widely available NICs available. They are more popular than ISA or PCI cards because of use in a growing number of laptops and PDAs.
  It's possible to share a PC Card with a desktop PC by using an adaptor that converts a PC Card into a PCI card. This allows purchasing one NIC for use in both types of computers. You can take the PC Card with you on a business trip— or home from work— and utilize the same card when back in the office using a PC. Some PDAs require a sled device that accommodates the PC Card and mounts underneath the PDA. This is the only way to add wireless network capability to some older PDAs. The combination of the sled, PC Card and PDA, however, adds a lot of bulk and weight that depletes the usability.
- Mini-PCI— A Mini-PCI card is a smaller version of a standard desktop PCI card and fits well within small, mobile computer devices. It has all the same features and functionality of a normal PCI card, but is about one quarter the size. Mini-PCI cards are integrated within laptops as an option to buyers. A strong advantage of this form of radio NIC is that it frees up the PC Card slot for other devices, such as memory extenders and graphics accelerators. In addition, manufacturers can provide Mini-PCI–based wireless NICs at lower costs. The Mini-PCI card is not without disadvantages, however. The replacement of a Mini-PCI card typically requires the disassembly of the laptop, which might void the manufacturer's warranty. Mini-PCI cards might also lead to lower performance because they require the computer to do some, if not all, of the processing. Despite these drawbacks, the Mini-PCI card is becoming a solid technology in the wireless laptop world.
- CompactFlash— SanDisk Corporation first introduced CompactFlash (CF) in 1994, but wireless NICs were not available in

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