

# Chapter

# 1

## Introducing Wireless Networking

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Wireless networks allow you to connect computers together and access the Internet without using wires or cables. You can use wireless networks in many different locations, businesses of all types and sizes, the military, schools, churches, and municipalities.

Over the past ten or so years, wireless networking technology has improved so much that workers are now mobile, yet they can stay connected to the workplace networks. This ensures that workers can remain in contact with other workers through e-mail, Web sites, file sharing, and shared calendaring even while physically away from the office.

Another interesting facet of wireless networking is a technology called *mesh networking*, which allows a wireless network to “cover” an entire municipality. With a mesh network, all users in the area can access the wireless network as long as they have an account to access the network. This means that a city, such as Atlanta, can offer wireless networking services to its general population.

In this chapter, you learn about the different types of wireless networks and other important issues, such as security concerns.

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# Discover Wireless Networks

A wireless network enables a group of connected computers and devices to communicate without being physically connected to a network. It eliminates the cables used in wired networks. The most popular wireless networks are called *Wi-Fi*, or Wireless Fidelity, networks.

One of the main problems in the past with wireless networks has been the speed with which users could communicate with each other. Because of new standards and emerging technologies, wireless networks now have similar connectivity speeds as hard-wired networks.

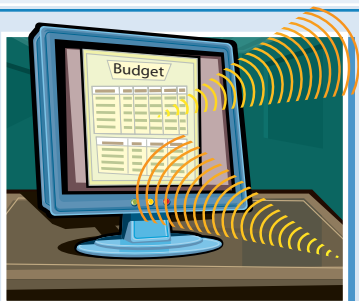


## Radio Signals

Wireless networks use radio signals, similar to those in radio and television broadcasting, to transmit data between devices. Wi-Fi networks operate on the 2.4 GHz or 5 GHz frequency band. These networks can send data at speeds up to 54 Mbps (megabits per second).

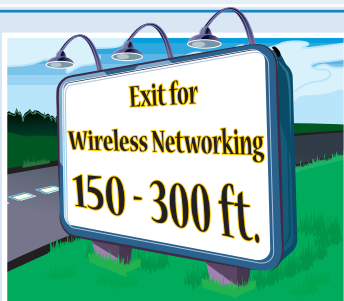
## Radio Transceivers

A radio transceiver sends and receives radio signals. Each device in a wireless network has a radio transceiver to send and receive information to and from the network. A transceiver can be located inside or outside a computer.



### Mobility of Network

You can move laptop computers and other wireless-enabled devices while remaining connected to the network. Depending on the technology and other factors, a wireless network has a range of 150 to 350 feet. In addition, as a laptop computer user, you can connect to other wireless networks while traveling.



### Speed

The faster the network speed, the faster that files and other data move from one computer to another computer. Newer wireless network technologies enable faster data transmissions than some wired networks. However, Fast Ethernet and gigabit Ethernet networks can move at least twice the data of the fastest wireless network technologies.

### Cost

Prices for wireless networking equipment are rapidly falling, making it possible to create an inexpensive, fast, and reliable wireless network. While wired networks can be much faster, they often involve intrusive wiring throughout a home or office.



# Understanding What a Network Is

A network is a group of connected computers and devices that allow people to share information and equipment.

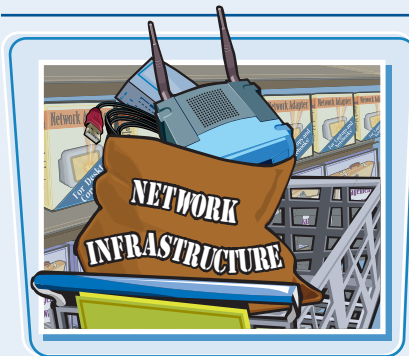
A network comprises many different components. Some of these components include a network adapter (also called a network interface card, or NIC), cables, routers, servers, hubs, switches, and network operating systems.

For wireless networks, you can have the same components, except the cables are not necessary. However, most wireless

networks do include some wired components for speed or cost concerns. For example, a large company connects its regular desktop computers to a local area network (LAN) using conventional wired technologies. Users who roam around the building or company campus, on the other hand, may rely on laptops or other mobile devices that can access the company-wide network using wireless technologies.

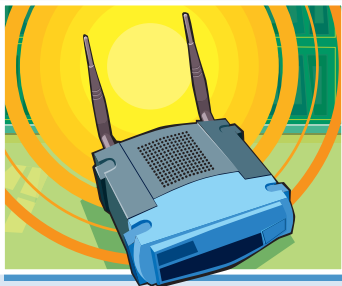
## Communication

Networks enable different computers and devices to exchange information such as files and documents. If a network is connected to the Internet, the network also enables connected devices to access information available on the Internet. A network can consist of many different components or as few as two.



## Infrastructure

The *infrastructure* of a network is the term used to describe the physical bits and pieces across which information travels. Cabling, routers, hubs, and switches are all considered part of the network infrastructure. A small home network can consist of very few components, while large networks can consist of thousands of pieces of equipment and require a full-time team of personnel to maintain them.

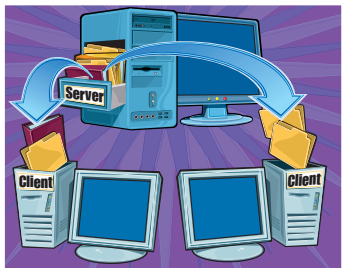


### Access Points

*Access points* are the locations on a network that provide access to the network for devices and computers. When used with wireless technology, a network can use a single access point to allow multiple wireless devices to access the network.

### Servers

*Servers* are computers that are dedicated to performing one or a few tasks on a network. Most business networks use dedicated servers for services such as file storage, Internet access, and running applications such as a database program. It is possible to run multiple servers on one physical computer. For example, a single computer on a network may be an e-mail server and a Web server at the same time.



### Clients

*Clients* are computers that require services from the network. Most computers require communication with network servers using applications called client applications. For example, a Web browser is the client application for accessing information from a Web server.



# Understanding What a Network Is *(continued)*

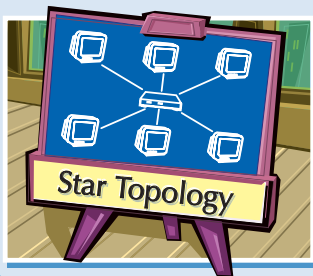
## Peripherals

A *peripheral* refers to a device you can connect either directly to the network or to computers that are connected to a network. Once you have connected a device to a network, anyone on the network can access the device with the appropriate authorization. Some examples of the numerous types of devices you can connect to a network are printers, scanners, storage devices, and cameras.



## Topology

The *topology* of a network determines the physical layout of the network. The most common topology is the star topology that has a device such as a hub or router as the center of the *star*, connected to different devices. Other lesser-used topologies are the *bus* and the *tree* topologies.



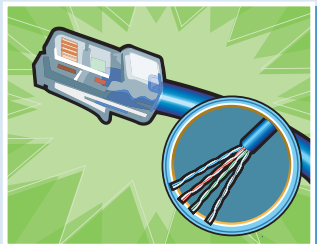
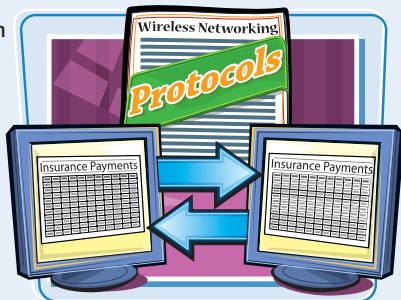
## Backbone

The *backbone* of a network is the term used to describe the main cable within a network where most network traffic traverses. A backbone is typically connected to many other devices such as routers and switches, rather than to single computers. The backbone of a network must be able to handle large amounts of information or bandwidth. Large networks typically use fiber-optic cables and very fast network devices.



### Network Protocols

Computers and other devices connected to a network can communicate with each other because they all agree to use the same method of exchanging information called a *protocol*. A network can use many different protocols simultaneously. For example, a Web browser communicates with a Web site using a protocol that specifies how Web information is exchanged, while two network cards exchange messages over a cable using a different protocol that dictates how information is transmitted via electrical signals on a cable.



### Cables

Apart from very simple wireless networks, all networks contain cabling, which exchanges information between computers and devices such as switches. The most common type of cable is *twisted-pair* cable, which contains four pairs of wires (eight wires total) that are entwined with each other. The end of the cable terminates with a connector in the shape of a large telephone connector.

### Size

The size of a network determines how the network is referenced. A network within a single building is called a *local area network*, or *LAN*. Networks that connect across a larger area or even across a country are called *wide area networks*, or *WANs*. LANs that contain wireless technologies are referred to as *Wireless LANs*, or *WLANs*.



## Discover the Benefits of Wireless Networking

Because of the wide range of benefits wireless networks provide, both business and home users are using networks more and more.

The main benefit of a wireless network is how easily users can become mobile and still access network resources at the same time. A corporate manager, for example, can carry her laptop computer to a scheduling meeting and access e-mails, shared calendars, and other resources using the wireless network, eliminating network cable connections.

Another way workers can become mobile is using handheld devices, such as a personal digital assistant (PDA). PDAs are small devices that the user can carry in a pocket, purse, or hip holder, and that include software for accessing e-mail, Web services, shared files, and more. A common use of PDAs is accessing e-mail accounts while away from the office. A worker can connect to the wireless network, download unread e-mails, create new e-mails, read and respond to messages, and manage e-mail content.

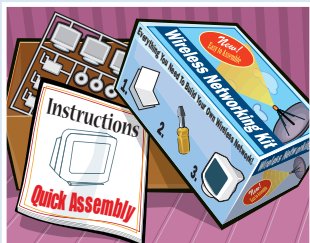


### Remain Mobile

One of the major benefits of wireless networking is being able to remain mobile while using a computer, but still have access to all the services and resources made available from a network, such as the Internet. You can even use a laptop computer while you move in a car or plane, as long as the computer is in range of the wireless network.

### Fast Setup

Once you set up the infrastructure for a wireless network, you can add more computers and devices to the network quickly. Once you add a wireless network adapter to a computer and configure the computer to use wireless networking, the computer can connect to the network immediately.



### Cost

As opposed to networks that use cables, wireless networks can be much cheaper to set up. Apart from the costs associated with equipment like hubs and repeaters, the installation of cable through an existing building may be very difficult and expensive. Wireless networks also allow networks to travel across objects, such as roads, that require a lot of work and money to cross with cables.



### Easy to Move

In traditional networks that require the use of cable, you cannot easily move a computer to a new location, because you must attach the computer to a nearby outlet using a cable. It is sometimes difficult to move a network computer to a new location within the same room. A wireless network allows you to move any computer anywhere, as long as the computer is in range of the wireless network.

### Expandability

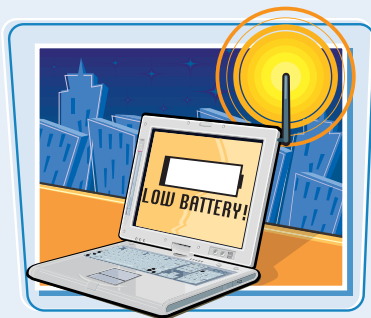
Adding a new computer or device to a wireless network is as simple as turning the computer on. Most wireless devices, such as access points, can support many different devices, and as long as you do not exceed the maximum number of devices, the access point quickly accepts new connections. If needed, you can add multiple access points to a wireless network to facilitate large numbers of computers.



# Understanding the Disadvantages of Wireless Networking

While wireless networks have a wide range of benefits, there are also unique disadvantages, some of which include speed, battery life of mobile devices, interference, security issues, and cost. Another problem with wireless networks is interruptions in services. Companies and cities that rely on wireless networks have to test for and fix problems in areas where wireless services are interrupted due to buildings blocking transmissions or stronger radio signals interfering with transmissions.

A major concern for companies that deal in personal information and data is wireless networking security. Because wireless networks use radio frequencies, it is difficult to control access to these frequencies. In fact, anyone in the area with a wireless device can access the frequencies. This means the company must use access privileges to control access to a network via a wireless device. Only those people and devices with authorized usernames, device IDs, and passwords are allowed on the network.

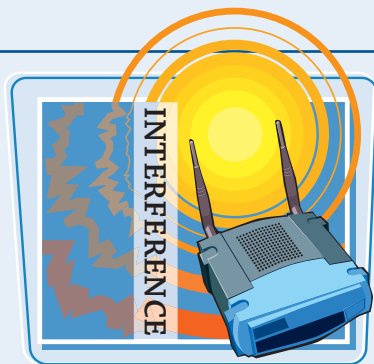


## Power Consumption

Each wireless device in a computer, such as a laptop or a handheld computer, has a radio transmitter and receiver. Radio devices require a relatively large amount of power to operate effectively. Using wireless adapters on portable devices can greatly reduce the length of time that the devices can operate using battery power.

## Interference

Wireless networks use radio signals to transmit information. Unfortunately, there are many types of devices that use radio waves to operate. These other devices can interfere with the signals that the wireless network uses. Tracking down and eliminating interference sources can be difficult.



### Network Security

By their very nature, wireless networks are more susceptible to unauthorized access. A network may be accessible from a location not under the control of a network administrator, such as a parking lot next to the building housing the wireless network. While cable networks have the same concerns, they are not as easy to access as wireless networks.

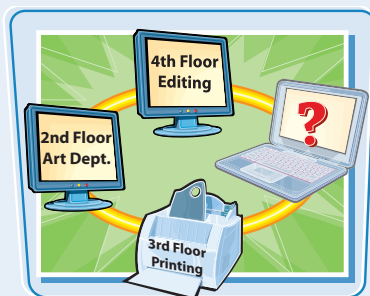


### Inconsistent Connections

With cable networks, computers are ensured a direct, stable connection to the network. However, moving a computer to another location or items blocking the path of transmission can interrupt wireless network connections. While many applications, such as Web browser applications, are adversely affected by temporary connection loss, other applications, such as database-based applications, may result in information loss.

### Lack of Management

With a wired network, network administrators can exercise very tight control of the physical components of the network. For example, network administrators can ensure that all cables are the correct distance from devices that may cause disruptions, such as light systems or photocopiers. With wireless networks, short of physically inspecting each wireless device, there is no way that administrators can determine or control the exact physical layout of the network.



## Discover the Types of Wireless Technology

Wireless technology enables computers and devices to communicate with each other without the use of wires. There are many different types of wireless technologies, each one with its own set of strengths and weaknesses.

Companies or municipalities may settle on one type of technology, such as infrared, for their network. Or they may employ

two or more types of wireless technologies depending on their needs. For example, a company that has a campus setting with several buildings may use microwave and infrared. The microwave technology can transfer data from building to building, while you can use the infrared devices inside the building.



### Wi-Fi

*Wireless Fidelity*, or Wi-Fi, is becoming the preferred technology for creating wireless networks both at home and at work. Wi-Fi allows computers and devices, such as printers and hubs, to communicate without using cables. Most new wireless networking devices in use are Wi-Fi devices. Wi-Fi is also used to facilitate Internet access in public places, such as airports.

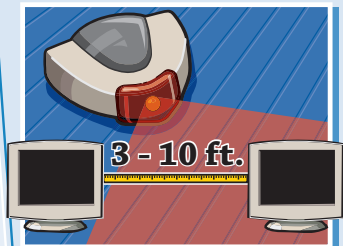
### Bluetooth

*Bluetooth* is the name of the wireless technology that is used primarily to allow individual devices to communicate with each other over short distances. For example, handheld computers can transmit a phone number from an address book to a mobile phone, which then dials the number. While it is possible to use Bluetooth to network computers together, this is not generally done.



### Infrared

*Wireless infrared technology* allows two devices to communicate using infrared light and you most commonly find them in remote controls. Infrared devices need to maintain a constant line of sight between the devices and are more reliable over short distances. The most common use of infrared technology is allowing handheld computers to exchange data with each other and with laptop computers. Most handheld devices and laptops have a built-in infrared port.

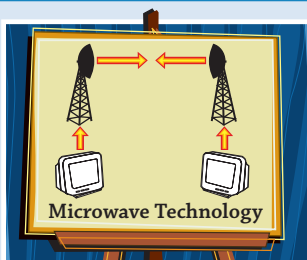


### Cellular

*Cellular wireless technology* is most commonly associated with mobile telephones. Each telephone communicates with a nearby transmitter, which changes as the phone moves around a location. Laptop computers routinely use cellular phones as modems to provide dial-up access from remote locations.

### Microwave

*Microwave technology* enables two devices to communicate using microwave dishes that are aligned with each other. You can use microwave systems to connect the networks of two buildings that are separated by obstructions such as wide roads. Microwave systems are very expensive but can transfer large amounts of information.



# Discover Applications for Wireless Networks

You can increase the efficiency of many specific applications using wireless networking.

By far, the main application for wireless networking is person-to-person communication. All types of users use e-mail and messaging applications, from the president of a Fortune 500 company sending quarterly company

results, to a youth baseball coach sending messages to players about upcoming practices.

Another application more and more in common use in wireless networking is scheduling software. With scheduling software, groups of people, departments, and families can share calendars to help manage meeting times and appointments.



## E-mail

E-mail is by far the most popular networking application, and wireless networking now makes it possible to access e-mail constantly. You can use laptop computers, and, increasingly, handheld computers, to access e-mail wirelessly at work and elsewhere with more frequency at public locations, such as airports and cafes.

## Messaging

Most operating systems provide a messaging application that allows you to communicate instantly using text. Even inexpensive handhelds now have the capability to provide messaging services and, when coupled with wireless networking, allow you to stay in constant communication with your colleagues and friends wherever you are.



### Scheduling

The ability for people to schedule activities and notify others of their activities greatly increases the efficiency with which they can work together. Allowing workers to update their schedules and exchange that information immediately using wireless technologies only further increases the efficiency of the scheduling system.

• ANNE	• JIM	• JOYCE
• 8:00 editing	• 8:30 art due	• 8:00 sales call
• 9:00 mtg.	• 9:00 mtg.	• 9:00 mtg.
• 2:00 printers	• 10:00 brunch	• 12:00 lunch
	• 1:00 sales call	• 2:00 client mtg.



### Data Collection

Making computers mobile increases the speed at which you can update data in applications such as inventory control systems. For example, a person in the warehouse can immediately update information about the number of products on a shelf instead of waiting until one has access to a computer.

### Web Browsing

For most home users, the primary use of wireless networks is the ability to use a mobile computer, such as a laptop, to connect to the Internet, regardless of where they are in the house. Most wireless networks used at home are easily connected to the Internet and can provide access not only in the house, but also in the area outside of the house, such as a deck or patio.



# Review System Requirements

To connect to a wireless network, you must equip your computer with minimal hardware and software. Doing so makes your network faster and more dependable.

Another reason to review system requirements is to ensure your computer, handheld device, or other component meets the wireless networking standards that your company, school, or home uses.

For example, to communicate with other computers on a wireless network, your computer must use the same wireless standard as another computer on the network. This is analogous to you speaking English and your friend speaking Spanish; one or the other must be able to understand and speak the other person's language or your communication shuts down.

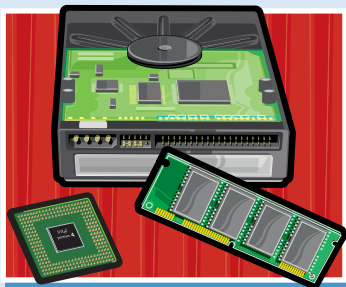


## Operating System

You need a PC running Microsoft Windows XP to follow what is in this book, either the Home or the Professional version. Windows XP is an operating system that controls your computer. Windows XP has built-in wireless networking support that makes it easy to create and maintain wireless networks. However, you do not need Windows XP to go wireless.

## Hardware

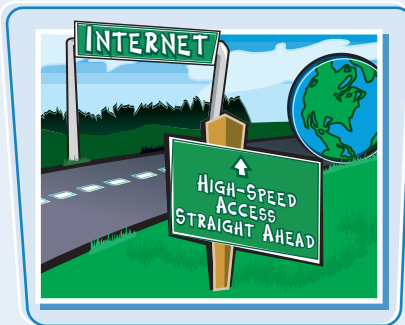
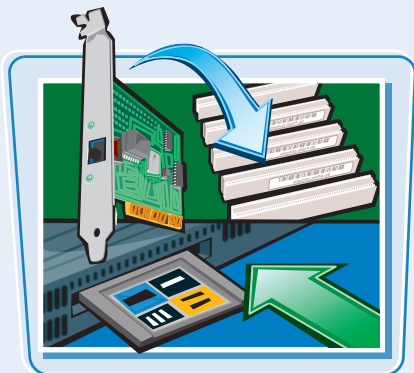
You must equip your desktop PC or a laptop computer with a Pentium 4 1.2 GHz processor, 256 megabytes of memory, and a 40GB hard drive.



### PC Ports

You need to install some basic networking equipment on your computer. To start, your computer needs some empty slots where the equipment is connected. Your desktop PC should have an available PCI slot. Your laptop computer should have a PC card slot. If neither of these is available, it is also possible to use the USB port with some equipment. For more information about attaching networking equipment to your computer, see Chapter 3.

One advantage of using USB ports for networking equipment is the ease at which you can connect the equipment. With USB you simply plug in the equipment, such as a network interface adapter. You do not have to open up the computer case to make the connection.



### Internet Access

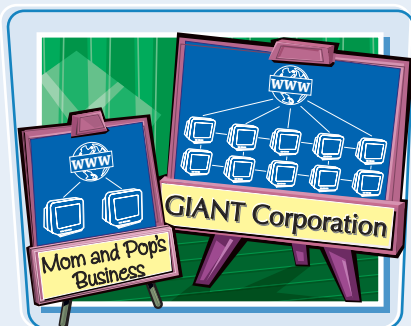
If you want to connect to the Internet with your wireless network, you need Internet access. To get the full benefit of a wireless network, you need high-speed, or broadband, access. This is available through a local telephone company's DSL service or a cable TV system's cable modem service. You can access the Internet directly or through another computer if that computer is using the Internet Connection Sharing feature available with Microsoft Windows XP.

# Consider Your Networking Requirements

Before deciding the type of wireless network to build, consider how many computers will connect to the network and what operations you want the network to provide.

One way to know what your wireless network needs is to take inventory of the types of services, applications, and connections you use now, and then adapt

those things that can go wireless into your wireless network design. For example, if you currently use e-mail, scheduling, data warehousing, and spreadsheet applications, consider making all those available over the wireless network. You can store your spreadsheets, for example, on a central server that you can access by wired and wireless computers.

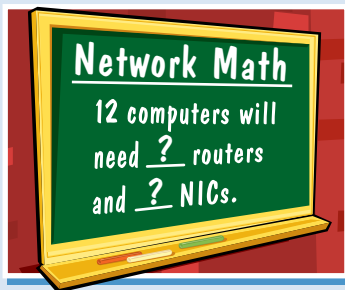


## Set Up Home or Office

The simplest wireless network is one home computer connected to a broadband Internet connection. In a larger family, there may be several desktop and laptop PCs connecting to the Internet and to each other through a wireless network. In an office environment, you may want to choose one of the newer, faster networking technologies that use the 802.11g standard.

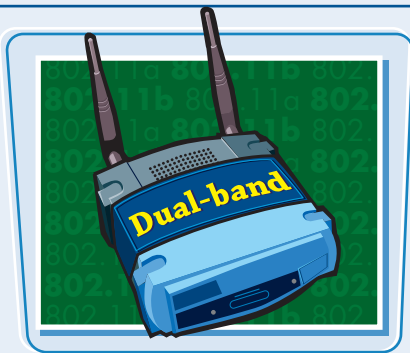
## Number of Computers

The number of desktop PCs, laptop computers, and other network-enabled devices determines how much wireless networking equipment like routers and network interface cards — NICs — you need to purchase, install, and configure. Your wireless network may consist of one to dozens of computers connecting to the Internet and to each other.



### Mobile Access

If you want to access wireless networks while traveling, you need a laptop PC or personal digital assistant, or PDA. These devices let you connect to available Wi-Fi hot spots in many places you visit. You also can use the devices to connect to your wireless network when you are at home or in your office. Laptops come in several different varieties, including lightweight, durable, high-performance, large screen, and so on. The one you pick should match the type of work you plan to do. For example, if you travel a great deal and want a lightweight model, look for one that weighs 4-6 pounds. However, if you need a high-performance laptop that can handle graphics-intensive software, you may need to opt for a heavier laptop that weighs over 10 pounds.



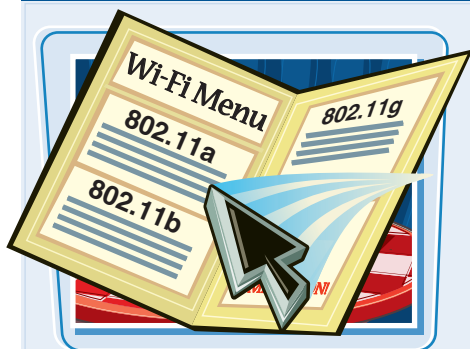
### Mixing Wi-Fi Standards

If you connect computers and equipment that use multiple standards, you need *dual-band* capability. This allows you to mix and match wireless technologies. For example, if one network uses equipment with the 802.11a standard and another operates under the 802.11b standard, you can connect them together using a dual-band router.

## Discover Wireless Standards

The most popular wireless networking technologies today are based on the 802.11 standard, which governs how devices on the network communicate with each other. The Institute of Electrical and Electronic Engineers (IEEE) developed the standard, popularly known as Wi-Fi, of which there are several variations.

When you set up purchasing requirements for your home or office wireless network infrastructure, take the time to understand the wireless standards that each component supports. If you use Wi-Fi, for example, all your components that connect to that Wi-Fi device must be Wi-Fi compatible.

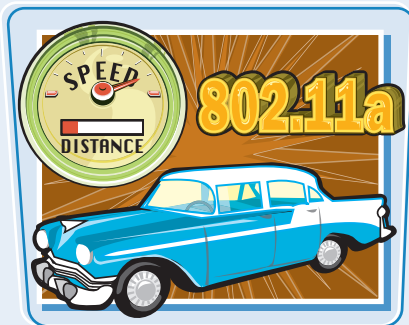


### Wi-Fi

Wi-Fi stands for *Wireless Fidelity*. It now generally refers to all the 802.11 wireless networking standards, which specify how devices communicate using wireless networks, although it originally identified networks that used the 802.11b standard. The Wi-Fi Alliance, a nonprofit industry association, works to ensure interoperability among the various 802.11 wireless technology standards.

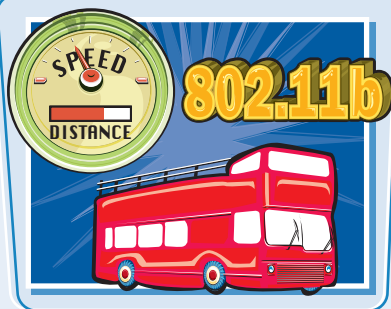
### 802.11a

The 802.11a standard is the least popular of the Wi-Fi technologies. While it is beneficial for some office networks with high-bandwidth needs and closely located computers, it has a short range. Dual-range equipment allows 802.11a equipment to network with the more popular 802.11b standard and the newer 802.11g standard. Otherwise, the 802.11a standard is incompatible with the 802.11b and 802.11g standards.



### 802.11b

The 802.11b standard is the most popular of the Wi-Fi technologies. It transmits data at a slower speed than both the 802.11a and 802.11g standards. Unlike 802.11a networks, 802.11b radio waves can penetrate most walls but are susceptible to interference from cordless phones, baby monitors, and microwave ovens.



### 802.11g

The 802.11g is the newest Wi-Fi standard with the same range as the 802.11b standard but with the ability to transmit data at a much faster rate. It can communicate with 802.11b networks, but requires dual-band equipment to interact with networks based on the 802.11a standard. It suffers from interference problems similar to networks using the 802.11b standard, such as cordless phones, baby monitors, and microwave ovens.

### 802.11i

The 802.11i is an emerging standard that will increase the security of Wi-Fi networks. When it is available, you may be able to upgrade some older equipment to this newer standard.



# Discover Network Configurations

You must choose which type of wireless network configuration you need. The two general types are infrastructure and computer-to-computer, or ad hoc.

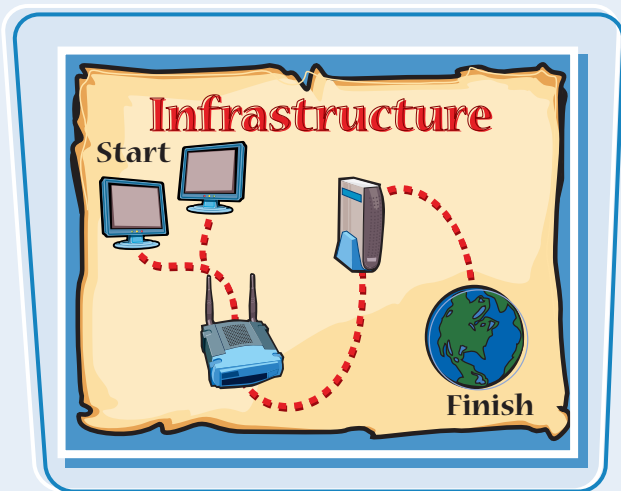
The *configuration* is the way in which the network is laid out to allow all computers on the network to communicate with each other and the servers. How you configure your network depends on a few factors, including size of network, costs, resources

you want to access, and the number of users who will be accessing your network. Some wireless networks need a centralized access point that several computers will use to “jump” to a larger network (such as the Internet). Other wireless networks may be small enough where a single computer can act as a shared device that can then allow the other computers to access other networks.

## Infrastructure

An *infrastructure* network is the most widely used wireless network configuration. It uses a wireless router, also called an access point or gateway, to connect to the Internet through a

broadband modem. The wireless router then communicates with other wireless-enabled devices on the network. Infrastructure networks can bridge wireless networks with existing wired, or Ethernet, networks.



### Computer to Computer

A computer-to-computer, or *ad hoc*, network allows computers to communicate with each other without the use of an access point, such as a router. This basic network configuration permits you to exchange files among computers. In addition, one computer in a network can directly connect to the Internet and permit other computers to share the connection.

Computer to computer networks are the easiest types of wireless networks to create and manage. As long as one computer is set up as a host computer, other computers can connect to the host as client computers. From there, all the computers on the network can communicate with each other, enabling them to share files, share printers, and communicate with e-mail.

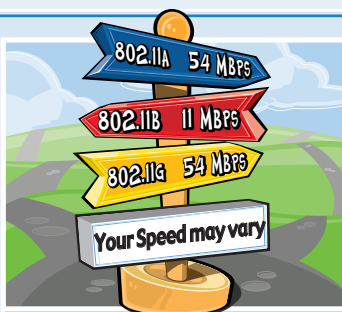


# Discover Networking Speeds

The speed of your network depends on many factors, such as the technology you use and the layout of your home or office. You may choose to use a technology that gives you a faster speed but less range.

Unfortunately, there are no wireless technologies available that allow extremely high speeds over great distances. Perhaps

in the future there will be technologies that allow users to connect to their offices halfway around the world using laptops and wireless network cards. At the present time, you can be several hundred feet away and get high-speed connections. However, as your distance increases, your speeds deteriorate and eventually fade out.

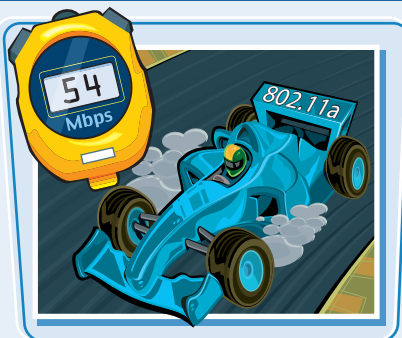


## Reality Check

You will find that theoretical network speeds and real network speeds are not the same. Your wireless network's actual speed — that is, the rate at which it transfers data — depends on the distance between computers, which standard you choose, and the manufacturer of your equipment.

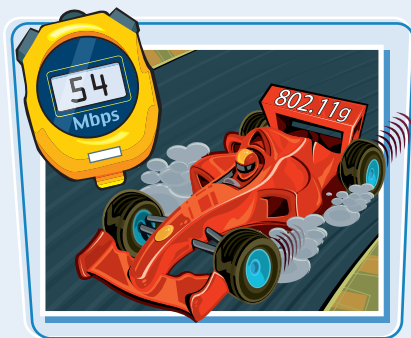
## 802.11a Speed

The 802.11a standard has a potential speed of 54 Mbps.



### 802.11b Speed

The 802.11b standard, the most popular wireless networking mode, has a potential speed of 11 Mbps.



### 802.11g Speed

The 802.11g standard, while operating in the same frequency band as the 802.11b standard, has a potential speed of 54 Mbps.

### Ethernet Speeds

In contrast to wireless networking speeds, wired Ethernet networks are still the speed winners. Ethernets operate at only 10 Mbps, less than Wi-Fi speed. However, Fast Ethernets operate at 100 Mbps, and the newer gigabit Ethernets are even faster. While you gain in speed with the faster wired networks, you lose the freedom of mobility that Wi-Fi technology provides.

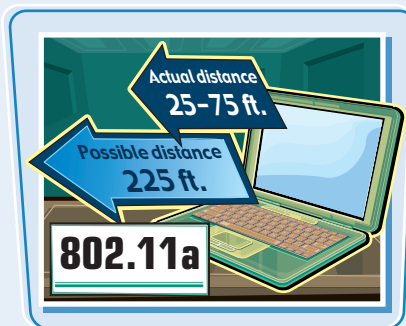


## Estimate Coverage Range

The technology you use and your environment determine how far your wireless network can reach. Walls and metal structures reduce the range.

Planning for the coverage range of your wireless network can be an inexact science. You can measure the distance between buildings, compare your location

with others in your area, and research all the standards out there. However, you will not know exactly how far your wireless network reaches until you install it and start working on it. In some cases, you may end up relocating wireless switches and servers to eliminate or reduce obstacles in their way.

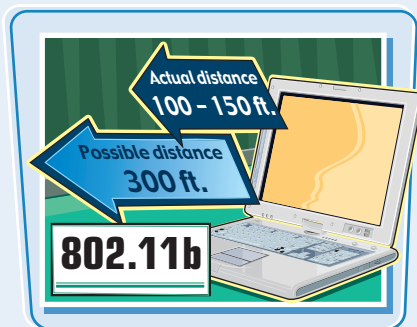


### 802.11a Range

Operating in the 5 GHz frequency range, the 802.11a standard is best suited for dense networks with high bandwidth needs. In a typical office environment, 802.11a networks have a possible range of up to 255 feet. The typical range is 25 to 75 feet indoors. Coverage is limited to one room.

### 802.11b Range

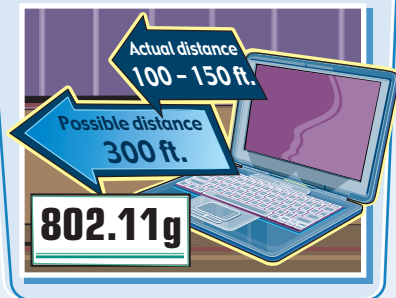
Wireless networks operating on the 802.11b standard have a greater range than those using 802.11a. As the most popular standard, it often is used for public access locations, or hot spots. Its signals, operating in the 2.4 GHz frequency band, penetrate most walls and have a possible range of up to 300 feet. The typical range is up to 100 to 150 feet indoors.



### 802.11g Range

802.11g, the newest standard in the Wi-Fi networking family, has the same range as the 802.11b standard: up to 300 feet, but typically 100 to 150 feet indoors. However, it is much faster than networks using the 802.11b standard. Operating in the 2.4 GHz frequency range, 802.11g network signals can penetrate most walls.

This allows homes and small businesses to add 802.11 g devices in central locations and provide wireless access to most of their users. In addition, because of the high connection speeds of 802.11 g devices, multiple computers can connect to the same 802.11 g device (such as a router) without noticeable performance issues.



### Other Range Factors

Some cordless phones, baby monitors, and microwave ovens can interfere with Wi-Fi networks using the 802.11b and 802.11g standards, decreasing their range. Keep this in mind when you position your wireless networks around children's rooms, kitchens, and break rooms. You may also find that cellular phone towers interfere with your wireless devices. If you are near one of these towers and interference is an issue, consider using a combination of conventional wired devices and wireless devices for your network.