Chapter 1

Introduction To Networking

If you're not familiar with networking, read this chapter to learn the basics of a small network. It outlines what you can use the network to do, introduces you to the hardware and software needed for a network, and explains how a small network is different from larger networks and the Internet. If you're already familiar with this basic networking information, you can go directly to the end of the chapter to see how to use this book to help you set up your network.

What is a Network?

A computer network is simply two or more computers connected together so they can exchange information. A small network can be as simple as two computers linked together by a single cable.

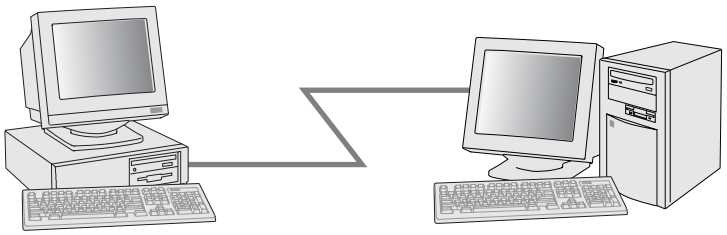

Figure 1.1 Two Networked Computers

Most networks use hubs to connect computers together. A large network may connect thousands of computers and other devices together.

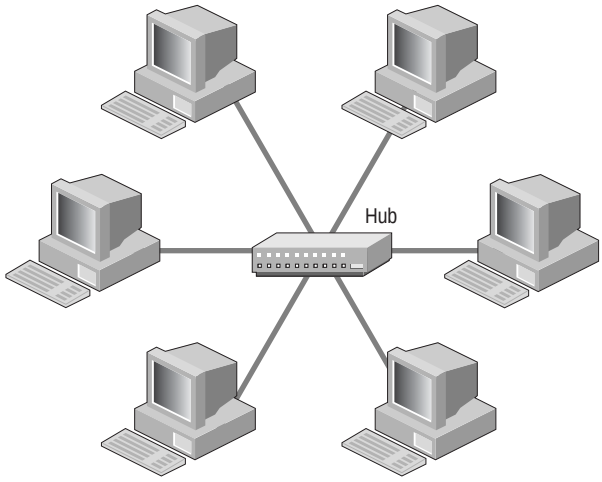

Figure 1.2 Computers Networked With a Hub

A wireless network connects computers without a hub or network cables. Computers use radio communications to send data between each other.

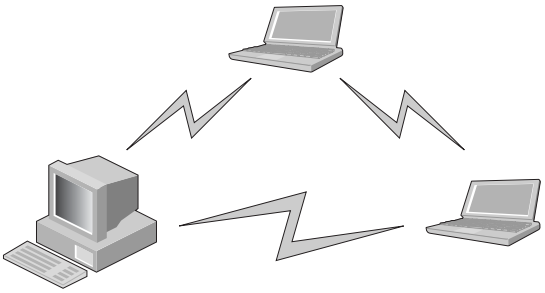

Figure 1.3 Wireless Network

What Can I do With a Simple Network?

Without a network, you can access resources only on your own computer. These resources may be devices in your computer, such as a folder or disk

drive, or they may be connected to your computer, such as a printer or CD-ROM drive. These devices, accessible only to you, are local resources.

Networking allows you to share resources among a group of computer users.

Figure 1.4 Some Resources You Can Share on a Network

Sharing Files and Drives

If your computers are connected to a network, each computer can make its resources available to other computers in your office by *sharing* them over the network. Instead of working in isolation as you do on a single computer not linked to a network, you can work collectively, within a system that shares resources among a group of computer users.

Each computer on your network can share folders, entire disk drives, or a CD-ROM drive. Then other computers on your network can access documents and other files stored in the folders and on the drives. Instead of copying a document to a diskette and giving it to another person to view, anyone can open and view the document using the network.

If you want to view the company's annual report stored on a co-worker's computer, you can use the network to access the document on that computer. If you want to listen to music stored on a computer in another room, you can use the network to access the music files.

Sharing a Printer

If you have a printer connected to your computer, you can share the printer with other computers on the network. Then instead of buying a printer for every computer, all the computers can print across the network to the printer. Suppose you want to print a document on a color laser printer that is connected to another computer in the office. Instead of copying your file to a disk, going to the other computer, and interrupting the person using that computer, you can print directly over the network.

Sharing an Internet Connection

If you already have access to the Internet from one computer on your network, you can share that Internet connection with other computers on the network. Then all the computers on your network can browse the Web at the same time, using this single Internet connection.

Networking Components

To network computers together, you need to install networking hardware and software. Every network includes these three components:

- The computers that are connected together. Computers and similar devices are called *nodes* when connected to a network.
- The networking hardware that connects the computers together, including hardware installed in your computer, network cables, and devices that connect all the cables together.
- Networking software that runs on each computer and enables it to communicate with other computers on the network.

Networking Hardware

Here is the networking hardware you need to set up a small network:

- **Network adapter cards:** expansion cards that provide the physical connection between each computer and the network. The card installs into a slot on your computer, just like a sound card or modem card. Some newer computers have a network adapter already built into the system. Laptop computers often use a card that slides into a PC card slot.

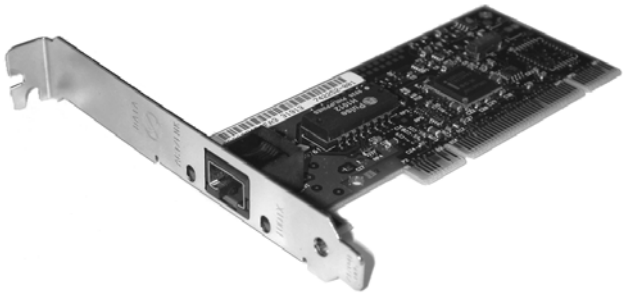

Figure 1.5 Network Adapter Card

- **Network hub:** the central connection point for network cables that connect to computers or other devices on a network. The hub has several network cable jacks or *ports* that you use to connect network cables to computers. The hub contains circuitry that enables each computer to communicate with any other computer connected to the hub.

Figure 1.6 Network Hub

- **Network cables:** special, unshielded twisted-pair (UTP) cables used to connect each computer to the hub. The cable you need is Category 5 UTP cable with a square plastic RJ-45 connector on each end.

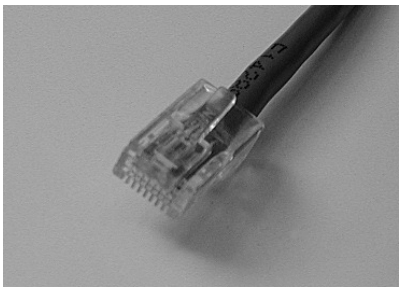

Figure 1.7 Network Cable with RJ-45 Connector

All the networking hardware described here is known as *Ethernet.* Ethernet is the industry-wide standard for computer networks. Standard Ethernet networks transmit data at 10 million bits per second (Mbps). A newer Ethernet standard, called *Fast Ethernet*, transmits data at 100 Mbps. Computer networks often contain a mixture of 10 Mbps and 100 Mbps devices.

Wireless Networking Hardware

You may want to network computers where it is expensive or difficult to run network cables, for example, between two rooms or two buildings. However, recent advances in wireless networking technology make wireless networking practical and affordable. New wireless standards have facilitated the development of wireless products with good performance and the ability to integrate easily into a wired Ethernet network.

The Ethernet standard for wireless networking is the IEEE 802.11b wireless standard. The 802.11b standard supports wireless connections at speeds up to 11 Mps, comparable to 10 Mbps wired Ethernet. Wireless industry leaders formed the Wireless Ethernet Compatibility Alliance (WECA) to certify cross-vendor compatibility with the 802.11b standard. These products display the WECA "Wireless Fidelity" (Wi-Fi†) logo.

Figure 1.8 Wireless Fidelity Logo

Suppose you want to network a few computers together in a small area where it would be expensive to have network cabling installed in an existing

building. Or perhaps you just have a desktop computer and a notebook computer at home and you would like to be able to roam the house with the notebook computer and perhaps even browse the Web from the hammock in the back yard. Wireless Ethernet makes all this possible. You can install wireless adapters in each computer and form a wireless network.

Figure 1.9 PC Card and USB Wireless Adapters

Other Types of Networking Hardware

Other networking technologies are available that enable you to network a small number of computers together in a home or office. These technologies often use the telephone wiring or power lines to connect computers. Some use alternative wireless standards. While it is sometimes easier to install these networking systems, their performance and capabilities are limited. The performance is typically 10 times slower than the current Ethernet capabilities. While Fast Ethernet transmits data at 100 Mbps, these technologies typically transmit data between 1 Mbps and 10 Mbps. Also, the capabilities of these devices are often limited to the capabilities of the devices sold by one manufacturer. You usually cannot mix devices made by different manufacturers. The following table compares Ethernet to some of these different networking technologies.

Table 1.1 Networking Technologies

Technology	Medium	Speed	Notes
Ethernet and Fast Ethernet	Category 5 networking cable	10 Mbps 100 Mbps	IEEE 802.3 standard for networks. Most computer networks use Ethernet, Fast Ethernet or a combination of the two.
Wireless Ethernet	Radio frequency (RF)	11 Mbps	IEEE 802.11b standard for wireless networking. Easily connects to a wired Ethernet network using an access point.
HomePNA (Home Phoneline Networking Alliance)	Telephone wiring	1 Mbps or 10 Mbps	Uses existing home telephone wiring, which can also be used for simultaneous phone service. Easy to install, but is not compatible with Ethernet. Look for products that support 10 Mbps.
HomeRF (Home Radio Frequency Working Group)	Radio frequency (RF)	1.6 Mbps	A wireless networking technology designed to carry voice and data in the home. A new 2.0 version of HomeRF supports 10 Mbps. Not compatible with 802.11b.
Powerline network	Electrical power lines	2 Mbps	New HomePlug Powerline Alliance specification supports 14 Mbps. Few products available.
Bluetooth†	Radio frequency (RF)	700 Kbps	A low-power, short-range wireless technology used for communication between digital devices, or between computers and peripherals.

Recommendations

If you are installing a new network, the best choice is standard Ethernet hardware. This is the same networking hardware used by thousands of businesses and corporations to connect millions of computers together. Ethernet networking components are standardized, inexpensive, dependable, and easy to install and maintain. Ethernet hardware is widely available. You can find network hubs, adapters, and cables at most stores that specialize in computer sales. Because all manufacturers of Ethernet hardware adhere to the

Ethernet standards, you can buy any component from any manufacturer and connect it to Ethernet components you already have.

Wireless Ethernet is the best choice if you are installing a wireless network. To make sure the hardware is 802.11b compatible, look for the Wi-Fi logo on the product box. The Wi-Fi logo indicates the product is certified by the Wireless Ethernet Compatibility Alliance (WECA). Because these products are standardized, you can buy products from different manufacturers and use them together. Wireless Ethernet products have become widely available and continue to drop in price.

If you use standard Ethernet and 802.11 wireless networking products, you can easily connect wireless and wired networks together using a wireless access point.

What is an access point? A stationary wireless device that receives and retransmits data, extending the range of wireless computers on the network. Access points can also connect to an Ethernet network, linking wireless computers to other computers connected with cables.

New Technologies

New Ethernet standards support even higher data rates for both wired and wireless networks.

- **Gigabit Ethernet:** This new Ethernet standard transfers data at 1000 Mbps (1 Gbps) using standard Category 5 networking cables. If you install this cable today, you can migrate to the faster hardware should the need arise. Gigabit adapters, hubs and switches are available today, but Fast Ethernet is likely to provide adequate bandwidth for most networking applications on a small network. In most cases, the Ethernet hardware that you purchase today will be able to interoperate with newer Gigabit hardware.
- **802.11a:** This new wireless standard supports speeds up to 54 Mbps. It uses technology similar to 802.11b, but operates at 5 GHz rather than at the 2.4 GHz band used for 802.11b. The higher frequency makes 802.11a less susceptible to interference from other devices such as cell phones, cordless phones, and microwave ovens. An 802.11a network can operate without interference in the same location as an 802.11b network, or near Bluetooth devices, which operate in the same frequency spectrum as 802.11b.
- **802.11g:** This new wireless standard also supports speeds up to 54 Mbps. It is an extension of 802.11b and operates in the same RF spectrum as 802.11b. While 802.11g offers a clear upgrade path from

802.11b, 802.11a is less likely to be affected by interference. It is likely that one of these two competing technologies will become widely adopted.

These new technologies are likely to be more expensive until their use becomes widespread. If you choose to use any of these new technologies, make sure your new hardware is compatible with any existing hardware you have. If you choose 802.11a or 802.11g, you may want to choose adapters that are compatible with 802.11b. Compatibility with 802.11b will let you connect to networks that don't support the newer technology.

Networking Software

Microsoft Windows† includes the networking software you need to set up a small network of computers that can share documents and printers. All you need to do is install the Windows components for networking, and configure your computer to use these networking features. Most of the software you need will be installed when you install a network adapter in your computer. The information in Chapter 4 of this book can help you configure the networking software in Windows. The information in Chapter 5 tells you how to start using this networking software to share documents and printers.

No matter which networking hardware you choose to install, the information in this book will help you set up and use your network. After you have installed the networking drivers for your network adapter, the networking software built into Windows will work with your hardware. The information about using Windows networking in the rest of this book will help you get the most out of your network.

Types of Networks

The type of network described in this book is a simple local network, often called a *local area network* or LAN. A LAN connects computers together at one location.

Small Peer-to-Peer Networks

You can build a simple, small network without using the complex and expensive equipment used in large networks. On such a network, often called a *peer-to-peer network*, each computer can communicate with any other computer on the network.

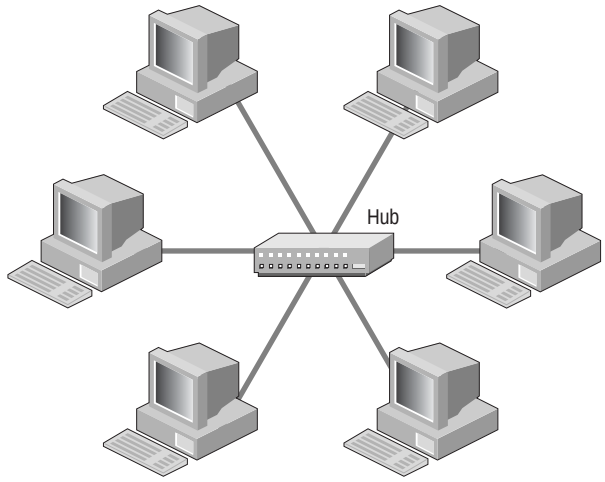

Figure 1.10 Peer-to-Peer Network

You can connect computers together using network cables and a hub, or use wireless technology to network the computers.

The focus of this book is on building a simple peer-to-peer network. Peer-to-peer networks are easy to install and maintain, and they give you many of the advantages of a large network. A peer-to-peer network is the obvious choice for a network in a home or small office. You can set up this network yourself, without buying an expensive server, and without paying for the services of a network administrator to install and manage the network.

Peer-to-peer networking has gained recent popularity on the Internet. Computers connected to the Internet communicate directly with each other and share files. The software to set up a local peer-to-peer network has been included in Windows since the release of Windows 95. People have been building simple peer-to-peer networks since that time, using the software built into Windows.

The Differences Between a Small Network and a Large Network

Large networks are more complex than small networks in several ways.

- Large networks use powerful servers to provide networking services. This type of network is often called a client-server network. The servers control network access and provide services such as file storage, network printing, and Internet access. The computers or

clients on the network access the servers to log on, access files, and print documents. The servers may be running networking software from Novell or Microsoft, or they may be running the UNIX† or Linux† operating systems.

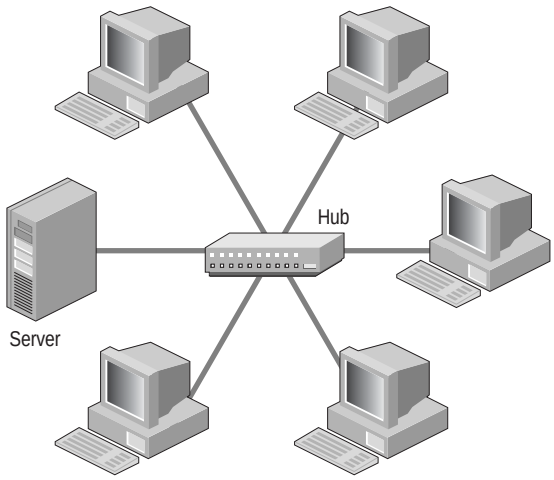

Figure 1.11 Server Connected to a Local Network

- Large networks are usually constructed by connecting several small networks together with special networking equipment that controls communication between the smaller segments of subnetworks or *subnets.*

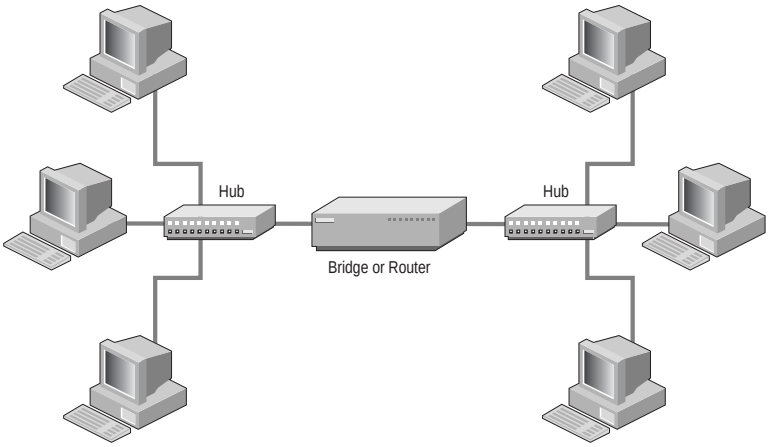

Figure 1.12 Two Subnets Connected by a Bridge or Router

The bridge or router checks the data sent on one network or subnet and determines if it should be sent to the other network. Each subnet might have over 100 computers connected to several interconnected hubs or switches.

- Large networks are often connected across long distances using high-speed telephone lines. A network connected like this is called a *wide area network* or WAN.

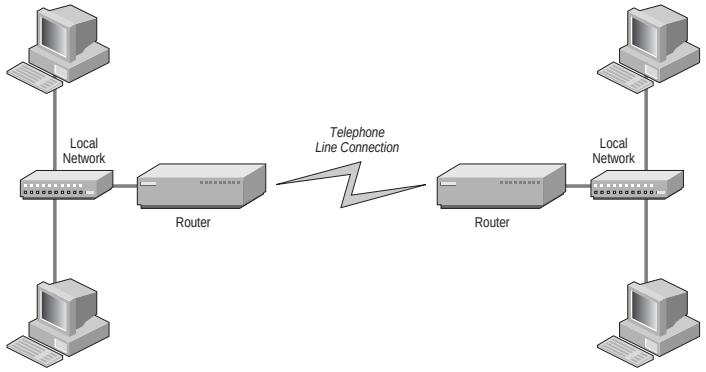

Figure 1.13 Two Local Networks Connected to Form a WAN

The Difference Between a Network and the Internet

A network of a few computers in one building is a local network. The Internet is a world-wide collection of thousands of interconnected computer networks. Because the Internet connects many different kinds of computers together, it is characterized by a number of communication standards that let these different kinds of computers talk to each other. Computers running Windows can communicate with each other on a local network with the simple networking software built into Windows. Windows also includes the software that enables your computer to access the Internet. However, configuring your computer to use the Internet is often complex. It's easier to connect computers together on a local network than it is to connect computers to the Internet.

In addition to connecting your local computers together, you can connect your network to the Internet so that all of the computers on the local network can browse the Web or send e-mail. Newer versions of Windows include the software that routes network traffic from your local network to the Internet. You can also purchase a special device to connect your network to the Internet.

How to Use This Book

Building a Simple Network explains how to set up and use a simple peer-to-peer network, how to expand your network to include more computers, and how to get the most out of your network by extending its capabilities.

Part I explains how to build a simple network. The following chapters in Part I present the steps you need to take to plan and install your network, and then set up the computers and start using the network. Read these chapters in sequence to see how to build your network.

Part II explains how to manage and extend your network. You can browse these chapters and read the sections that help you expand and improve your particular network. When you have a problem with your network, go directly to the Troubleshooting chapter.

If you are looking for technical information about networking, see the Appendixes. The Glossary contains simple explanations of common networking terms.