CHAPTER 6

Telecommunications and Networking

CHAPTER OUTLINE	LEARNING OBJECTIVES
6.1 What Is a Computer Network?	**6.1** Compare and contrast the major types of networks.
6.2 Network Fundamentals	**6.2** Describe the wireline communications media and transmission technologies.
6.3 The Internet and the World Wide Web	**6.3** Describe the most common methods for accessing the Internet.
6.4 Network Applications: Discovery	**6.4** Explain the impact that discovery network applications have had on business and everyday life.
6.5 Network Applications: Communication	**6.5** Explain the impact that communication network applications have had on business and everyday life.
6.6 Network Applications: Collaboration	**6.6** Explain the impact that collaboration network applications have had on business and everyday life.
6.7 Network Applications: Educational	**6.7** Explain the impact that educational network applications have had on business and everyday life.

Opening Case

Can Slack Really Replace E-mail?

MIS E-mail has presented a productivity problem for employees for some time. Over 200 billion e-mail messages are sent and received every day. Employees receive some 122 e-mails per day. Dealing with those e-mails consumes 23 percent of the average employee's workday. In response, an increasing number of organizations are finding that limiting, or even eliminating, e-mail actually increases employee productivity.

Slack (**www.slack.com**) may provide one answer to the problems with e-mail. Launched in 2013, Slack is a cloud-based team communication and collaboration software program that helps company employees communicate in real time. Slack allows different parts of a business to set up different channels for discussions. One channel might be for the information technology group, another for the marketing group, and so on. Anytime someone wants to alert you about something, he or she tags your name to a message. You can follow your colleagues' exchanges in real time, or you can return to that conversation later.

Slack offers many features, including chat rooms (called channels) organized by topic, private groups, and direct messaging. All content inside Slack is searchable, including files, comments, conversations, and people. Channels enable team members to communicate without the use of e-mail or texting. They are open to everyone

in the chat by invitation only. Private channels allow for private conversation between smaller subsets of an original group. Direct messages allow users to send private messages to a specific user rather than to a group of people. Slack is also developing a do-not-disturb feature. People will not be interrupted by messages between, for example, the hours of 10 P.M. and 8 A.M. If someone sends a message to another person during this time, that message will not appear in that colleague's Slack account until his or her do-not-disturb hours have ended.

Another useful feature of Slack is the Slackbot, a personal software assistant that helps users in several ways. Slackbots can:

- Help you complete your account profile and add new apps.
- Answer questions about Slack.
- Answer other questions, such as when a meeting is scheduled or what is for lunch in the company cafeteria.
- Add customized, automatic responses to messages.
- Monitor your e-mail inbox (most companies still use e-mail along with Slack).

Slack has partnered with IBM to develop the next iteration of Slackbot. Slackbot will utilize Watson Conversation, a software tool that helps bots interact through natural language. For example, at the *New York Times,* Slackbots predict for the newspaper's editors what stories will perform best with readers on social media.

Slack is growing very rapidly. Since the service appeared, more than 4 million people have become daily users who spend an average of 10 hours each weekday accessing the application. Seventy-seven of the Fortune 100 companies use Slack, as do many technology companies, including Airbnb, Stripe, Spotify, Salesforce, and BuzzFeed. Companies pay $6.67 to $12.50 per month per user.

Companies use Slack in a variety of ways. For example, at the Weaver Street Market (**www.weaverstreetmarket.coop**), a North Carolina community-owned natural foods grocery, workers use Slack to find out the latest on strawberry shipments, for example. At Hendrick Automotive (**www.hendrickauto.com**), the largest privately held automotive dealership group in the United States, Slack enables employees in Canada and Turkey to stay connected to colleagues at company headquarters in Charlotte, North Carolina.

In June 2016, Slack announced that it was partnering with 12 companies to introduce "message buttons." The idea is that key functions from outside apps—like using Kayak to search for a flight—can be accomplished from within Slack, with the click of a button. With these message buttons, Slack is competing directly with Facebook, the market leader in this technology.

Perhaps as a response to message buttons and perhaps as a response to Slack's rapid growth, in October 2016 Facebook launched its business chat product called Workplace by Facebook. Furthermore, in November 2016 Microsoft launched a rival workplace messaging service called Teams.

Slack does present challenges. Consider Slack's searchable archive: Most office workers worry that Slack records their every comment and conversation. That process can create problems as workers leave a record of comments that they may regret.

Slack helps text-based communication replace face-to-face interaction. In her book, *Reclaiming Conversation: The Power of Talk in a Digital Age,* Sherry Turkle cautions against the dangers of this transformation. She notes that research has found that empathy is lost when we emphasize connectivity over conversation.

Instead of an overflowing e-mail inbox, users can suffer from notification overload. Also, the transition to Slack can cause problems for older employees, who might feel more comfortable with traditional communications channels such as e-mail, telephones, or talking face to face.

Although Slack was designed for organizational communication, people are using Slack to form new communities around common interests. Slack is not as invasive as a Facebook group, where users have to go to a different website. Therefore, while using Slack at work, employees may be participating in community discussions that are not work-related.

Sources: Compiled from H. Taylor, "Flattered by Microsoft's Launch of 'Slack Killer,'" *CNBC*, November 15, 2016; A. Balakrishnan, "Microsoft Announces Slack Rival, Teams," *CNBC*, November 2, 2016; T. Warren, "Slack Shows It's Worried about Microsoft Teams with a Full-Page Newspaper Ad," *The Verge,* November 2, 2016; R. Hackett, "IBM Watson Lends Brains to Slack's Chatbot," *Fortune,* October 26, 2016; R. Hof, "If You Can't Beat Slack, Here's How Your Startup Can Join It," *Forbes,* August 15, 2016; A. LaFrance, "Slack, the Facebook Slayer," *The Atlantic,* June 21, 2016; C. Locke, "Finally, Slack Is Living Up to Its Name," *Wired,* June 9, 2016; R. Greenfield, "Slack Consultants Are Bringing the Chat App to Corporate America," *Bloomberg.com,* May 31, 2016; L. Gomes, "10 Breakthrough Technologies 2016: Slack," *MIT Technology Review,* 2016; S. Jacobs, "Email Killer," *Time,* November 9, 2015; J. Novet, "Slack Launches User Groups, Hits 1.7M Daily Active Users and 470K Paid Seats," *Venture Beat,* October 29, 2015; www.slack.com, accessed November 16, 2016; www.slack.com, accessed November 15, 2016.

Questions

1. Is it possible for an organization to completely eliminate e-mail through the use of Slack? Why or why not? Support your answer.
2. Why does Slack appear to be more effective for organizational communications than e-mail?

Introduction

In addition to networks being essential in your personal lives, there are three fundamental points about network computing you need to know. First, in modern organizations computers do not work in isolation. Rather, they constantly exchange data with one another. Second, this exchange of data—facilitated by telecommunications technologies—provides companies with a number of very significant advantages. Third, this exchange can take place over any distance and over networks of any size.

Without networks, the computer on your desk would be merely another productivity-enhancement tool, just as the typewriter once was. The power of networks, however, turns

your computer into an amazingly effective tool for accessing information from thousands of sources, thereby making both you and your organization more productive. Regardless of the type of organization (profit/not-for-profit, large/small, global/local) or industry (manufacturing, financial services, healthcare), networks in general, and the Internet in particular, have transformed—and will continue to transform—the way we do business.

Networks support new and innovative ways of doing business, from marketing to supply chain management to customer service to human resources management. In particular, the Internet and private intranets—a network located within a single organization that uses Internet software and TCP/IP protocols—have an enormous impact on our lives, both professionally and personally.

For all organizations regardless of their size, having a telecommunications and networking system is no longer just a source of competitive advantage. Rather, it is necessary for survival.

Computer networks are essential to modern organizations for many reasons. First, networked computer systems enable organizations to become more flexible so that they can adapt to rapidly changing business conditions. Second, networks allow companies to share hardware, computer applications, and data across the organization and among different organizations. Third, networks make it possible for geographically dispersed employees and workgroups to share documents, ideas, and creative insights. This sharing encourages teamwork, innovation, and more efficient and effective interactions. Networks are also a critical link between businesses, their business partners, and their customers.

Clearly, networks are essential tools for modern businesses. But why do *you* need to be familiar with networks? The simple fact is that if you operate your own business or work in a business, you cannot function without networks. You will need to communicate rapidly with your customers, business partners, suppliers, employees, and colleagues (see the chapter-opening case). Until about 1990, you would have used the postal service or the telephone system with voice or fax capabilities for business communication. Today, however, the pace of business is much faster—almost real time. To keep up with this incredibly fast pace, you will need to use computers, e-mail (see the chapter-opening case), the Internet, smartphones, and other mobile devices. Furthermore, all of these technologies will be connected through networks to enable you to communicate, collaborate, and compete on a global scale.

Networking and the Internet are the foundations for commerce in the twenty-first century. Recall that one important objective of this book is to help you become an informed user of information systems. Knowledge of networking is an essential component of modern business literacy. In fact, as you see in **IT's About Business 6.1**, a robust telecommunications infrastructure is essential for entire nations as well.

You begin this chapter by learning what a computer network is and by identifying the various types of networks. You then study network fundamentals, and you next turn your attention to the basics of the Internet and the World Wide Web. You conclude by examining the many network applications available to individuals and organizations—that is, what networks help you do.

6.1 What Is a Computer Network?

A computer network is a system that connects computers and other devices (e.g., printers) through communications media so that data and information can be transmitted among them. Voice and data communication networks are continually becoming faster—that is, their bandwidth is increasing—and cheaper. **Bandwidth** refers to the transmission capacity of a network; it is stated in bits per second. Bandwidth ranges from narrowband (relatively low transmission capacity) to broadband (relatively high network capacity).

The telecommunications industry itself has difficulty defining the term *broadband.* The Federal Communications Commission's (FCC) new rules define **broadband** as the transmission capacity of a communications medium (discussed later in this chapter) faster than 25 megabits per second (Mbps) for download (transmission speed for material coming to you from an Internet server, such as a movie streamed from Netflix) and 4 Mbps for upload (transmission speed for material that you upload to an Internet server such as a Facebook post or YouTube video).

IT's About Business 6.1

The Least Connected Country on Earth

MIS

Eritrea, a nation of six million people, is located in eastern Africa, surrounded by Sudan, Ethiopia, and Djibouti. The country has been ruled by a dictatorship since it achieved independence in 1993. Since 2009, Reporters Without Borders (**www.rsf.org**) has placed Eritrea at the bottom of its press freedom index.

Eritrea is also the world's most isolated country when it comes to telecommunications access, according to the United Nations International Telecommunication Union (ITU; **www.itu.int**). Eritreans are allowed to place international phone calls and to use the Internet. However, according to the ITU, only 1 out of 100 Eritreans have a landline, and only 7 in 100 have a cell phone. Both of these proportions are among the lowest around the globe.

The country's only telecommunications provider, Eritrea Telecommunication Services (EriTel; **www.eritel.com.er**), is controlled by the government. Customers must receive approval from local authorities to own a cell phone, and it costs 200 nakfa ($13.29) to request permission. Citizens who are performing mandatory military service aren't given permission to have a cell phone. To activate their phone, customers pay EriTel the equivalent of $33.60. When they add minutes to their phone, that costs a minimum of $3.65 every time. Because the average Eritrean earns roughly $500 a year, this expense is prohibitive to most.

Robert Van Buskirk, a Fulbright scholar from the United States, launched Eritrea's first informal e-mail service in the mid-1990s. He used international phone calls to send data messages between a computer at the University of Asmara—Eritrea's capital city—and a computer in California. For a short time, he singlehandedly operated the entire country's e-mail service.

As of September 2016, less than 1 percent of Eritreans are online, according to the ITU. Access is available in just a few places. Internet connections are also almost exclusively through dial-up modem, and they are extremely slow. Eritrea was also the last African nation to establish a satellite connection to the Internet. Furthermore, the country is one of only two African coastal nations with no fiber-optic network. Only about 150 landline broadband connections exist, and only a smattering of homes have Internet access, mostly dial-up connections costing about $200 a month.

Eritreans can get public Internet access in about 100 Internet cafes throughout the country. There is often a wait to use one of about 10 computers in each cafe. Users pay roughly $1.34 to be online for an hour, which costs about the same as seven loaves of bread. Some Internet cafés show American movies and TV shows in the evenings and charge customers to watch.

In October 2016, the government ordered Internet service providers to maintain detailed information on their customers. Other than that, there seems to be little censorship of the Internet. One likely reason is that high costs and long download times have marginalized the use of the Internet as a protest vehicle. Another possible reason is that the country is experiencing severe economic difficulties, and the government may recognize that strengthening the country's telecommunications would help improve the economy. The government also wants to improve tourism. This goal would require a greatly improved telecommunications infrastructure as well.

Sources: Compiled from A. Harnet, "Eritrea Orders Internet Service Providers to Keep Detailed Records of Their Customers," *Eritrea-beligerance.com*, October 6, 2016; B. Bruton, "It's Bad in Eritrea, But Not That Bad," *New York Times*, June 23, 2016; "Areas the Eritrean Government Should Improve Upon," *Madote.com*, February 2, 2016; "Eritrea—Telecoms, Mobile, and Broadband—Statistics and Analyses," *budde.com.au*, June 4, 2015; Y. Abselom, "Eritrea Blossoming Beautifully at 24," *Geeska Afrika Online*, May 10, 2015; "Sadly, Eritrea Remains at Tail of All World Indexes," *harnnet.org*, January 12, 2015; "Eritrea Telecommunication Report 2015," *Business Monitor International*, December 24, 2014; "Eritrea: Stronger Private Sector, Qualified Workforce, International Integration Needed, Says AFDB," *Caperi.com*, October 8, 2014; C. Winter and B. Haile, "The World . . . Eritrea," *Bloomberg BusinessWeek*, June 30–July 6, 2014; C. Winter, "Eritrea's Communications Disconnect," *Bloomberg Business Week*, June 26, 2014; R. Atkinson and L. Stewart, "The Economic Benefits of Information and Communications Technology," *Information Technology & Innovation Foundation*, May 14, 2013.

Questions

1. **Describe the impacts of a lack of telecommunications infrastructure on Eritrea.**
2. **Besides improving the economy, what other areas of Eritrean life would be impacted by a greatly improved telecommunications infrastructure?**
3. **Can the government of Eritrea allow an improved telecommunications infrastructure while maintaining strict control over communications and information? Why or why not? Support your answer.**

Interestingly, some FCC commissioners feel that the definition of broadband should be 100 Mbps for download. The definition of broadband remains fluid, however, and it will undoubtedly continue to change to reflect greater transmission capacities in the future.

You are likely familiar with certain types of broadband connections such as *digital subscriber line (DSL)* and cable to your homes and dorms. DSL and cable fall within the range of transmission capacity mentioned here and are thus defined as broadband connections.

The various types of computer networks range from small to worldwide. They include (from smallest to largest) personal area networks (PANs), local area networks (LANs), metropolitan area networks (MANs), wide area networks (WANs), and the ultimate WAN, the Internet. PANs are short-range networks—typically a few meters—that are used for communication among devices close to one person. They can be wired or wireless. (You will learn about wireless PANs in

Chapter 8.) MANs are relatively large computer networks that cover a metropolitan area. MANs fall between LANs and WANs in size. WANs typically cover large geographical areas; in some cases, they can span the entire planet and reach from Earth to Mars and beyond.

Local Area Networks

Regardless of their size, networks represent a compromise among three objectives: speed, distance, and cost. Organizations typically must select two of the three. To cover long distances, organizations can have fast communication if they are willing to pay for it, or cheap communication if they are willing to accept slower speeds. A third possible combination of the three trade-offs is fast, cheap communication with distance limitations. This is the idea behind local area networks.

A **local area network (LAN)** connects two or more devices in a limited geographical region, usually within the same building, so that every device on the network can communicate with every other device. Most LANs today use Ethernet (discussed later in this chapter). **Figure 6.1** illustrates an Ethernet LAN that consists of four computers, a server, and a printer, all of which connect through a shared cable. Every device in the LAN has a *network interface card (NIC)* that allows the device to physically connect to the LAN's communications medium. This medium is typically unshielded twisted-pair wire (UTP).

Although it is not required, many LANs have a file server or network server. The server typically contains various software and data for the network. It also houses the LAN's network operating system, which manages the server and routes and manages communications on the network.

Wide Area Networks

When businesses have to transmit and receive data beyond the confines of the LAN, they use wide area networks. The term *wide area network* did not even exist until local area networks appeared. Before that time, what we call a wide area network today was simply called a "network."

A **wide area network (WAN)** is a network that covers a large geographical area. WANs typically connect multiple LANs. They are generally provided by common carriers such as telephone companies and the international networks of global communications services providers. Examples of these providers include AT&T (**www.att.com**) in

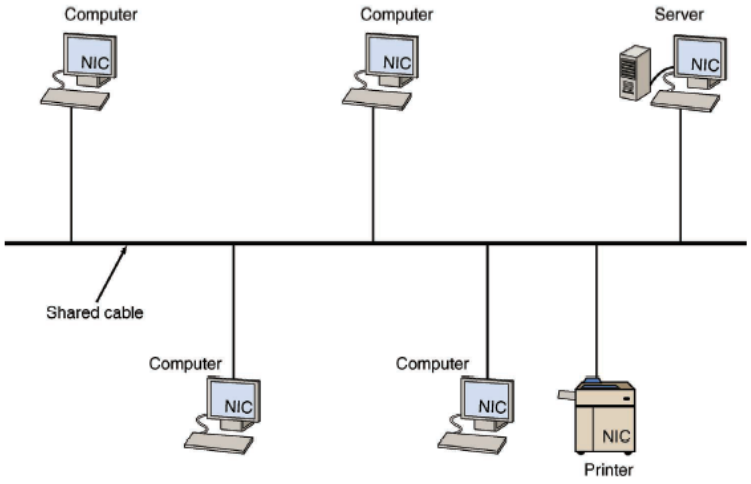


FIGURE 6.1 **Ethernet local area.**

the United States, Deutsche Telekom in Germany (**www.telekom.com**), and NTT Communications (**www.ntt.com**) in Japan.

WANs have large capacities, and they typically combine multiple channels (e.g., fiber-optic cables, microwave, and satellite). WANs also contain **routers**—a communications processor that routes messages from a LAN to the Internet, across several connected LANs, or across a WAN such as the Internet. The Internet is an example of a WAN.

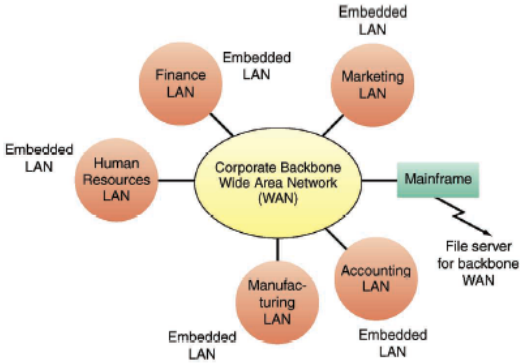


FIGURE 6.2 **Enterprise network.**

Enterprise Networks

Organizations today have multiple LANs and may have multiple WANs. All of these networks are interconnected to form an enterprise network. **Figure 6.2** displays a model of enterprise computing. Note that the enterprise network in the figure has a backbone network. Corporate **backbone networks** are high-speed central networks to which multiple smaller networks (such as LANs and smaller WANs) connect. The LANs are called *embedded LANs* because they connect to the backbone WAN.

Unfortunately, traditional networks can be rigid and lack the flexibility to keep pace with increasing business networking requirements. The reason for this problem is that the functions of traditional networks are distributed across physical routers and devices (i.e., hardware). This process means that to implement changes, each network device must be configured individually. In some cases, devices must be configured manually. *Software-defined networks (SDN)* are an emerging technology that is becoming increasingly important to help organizations manage their data flows across their enterprise networks.

With SDN, decisions controlling how network traffic flows across network devices are managed centrally by software. The software dynamically adjusts data flows to meet business and application needs.

Think of traditional networks as the road system of a city in 1920. Data packets are the cars that travel through the city. A traffic officer (physical network devices) controls each intersection and directs traffic by recognizing the turn signals, and size and shape of the vehicles passing through the intersection. The officers can direct only the traffic at their intersection. They do not know the overall traffic volume in the city nor do they know traffic movement across the city. Therefore, it is difficult to control the city's traffic patterns as a whole and to manage peak-hour traffic. When problems occur, the city must communicate with each individual officer by radio.

Now think of SDN as the road system of a modern city. Each traffic officer is replaced by a traffic light and a set of electronic vehicle counters, which are connected to central monitoring and control software. As such, the city's traffic can be instantly and centrally controlled. The control software can direct traffic differently at various times of the day (say, rush hours). The software monitors traffic flow and automatically changes the traffic lights to help traffic flow through the city with minimal disruption.

Before you go on . . .

1. What are the primary business reasons for using networks?
2. What are the differences between LANs and WANs?
3. Describe an enterprise network.

6.2 Network Fundamentals

In this section, you will learn the basics of how networks actually operate. You begin by studying wireline communications media, which enable computers in a network to transmit and receive data. You conclude this section by looking at network protocols and types of network processing.

Today, computer networks communicate through digital signals, which are discrete pulses that are either on or off, representing a series of *bits* (0s and 1s). This quality allows digital signals to convey information in a binary form that can be interpreted by computers.

The U.S. public telephone system (called the plain old telephone system or POTS) was originally designed as an analog network to carry voice signals or sounds in an analog wave format. For this type of circuit to carry digital information, that information must be converted into an analog wave pattern by a *dial-up modem.* Dial-up modems are almost extinct in most parts of the developed world today.

Cable modems are modems that operate over coaxial cable—for example, cable TV. They offer broadband access to the Internet or corporate intranets. Cable modem speeds vary widely. Most providers offer bandwidth between 1 and 6 million bits per second (Mbps) for downloads (from the Internet to a computer) and between 128 and 768 thousand bits per second (Kbps) for uploads. Cable modem services share bandwidth among subscribers in a locality. That is, the same cable line connects to many households. Therefore, when large numbers of neighbors access the Internet at the same time, cable speeds can decrease significantly.

DSL modems operate on the same lines as voice telephones and dial-up modems. DSL modems always maintain a connection, so an Internet connection is immediately available.

Communications Media and Channels

Communicating data from one location to another requires some form of pathway or medium. A **communications channel** is such a pathway. It is comprised of two types of media: cable (twisted-pair wire, coaxial cable, or fiber-optic cable) and broadcast (microwave, satellite, radio, or infrared).

Wireline media or **cable media** use physical wires or cables to transmit data and information. Twisted-pair wire and coaxial cables are made of copper, and fiber-optic cable is made of glass. The alternative is communication over **broadcast media** or **wireless media.** The key to mobile communications in today's rapidly moving society is data transmissions over electromagnetic media—the "airwaves." In this section, you will study the three wireline channels. **Table 6.1** summarizes the advantages and disadvantages of each of these channels. You will become familiar with wireless media in Chapter 8.

TABLE 6.1 Advantages and Disadvantages of Wireline Communications Channels

Channel	Advantages	Disadvantages
Twisted-pair wire	Inexpensive	Slow (low bandwidth)
	Widely available	Subject to interference
	Easy to work with	Easily tapped (low security)
Coaxial cable	Higher bandwidth than twisted-pair	Relatively expensive and inflexible
	Less susceptible to electromagnetic interference	Easily tapped (low to medium security)
		Somewhat difficult to work with
Fiber-optic cable	Very high bandwidth	Difficult to work with (difficult to splice)
	Relatively inexpensive	
	Difficult to tap (good security)	

Twisted-Pair Wire. The most prevalent form of communications wiring—twisted-pair wire—is used for almost all business telephone wiring. As the name suggests, it consists of strands of copper wire twisted in pairs (see **Figure 6.3**). Twisted-pair wire is relatively inexpensive to purchase, widely available, and easy to work with. However, it also has some significant disadvantages. Specifically, it is relatively slow for transmitting data, it is subject to interference from other electrical sources, and it can be easily tapped by unintended recipients to gain unauthorized access to data.

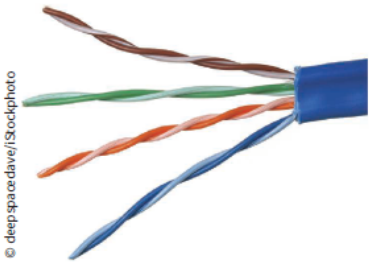
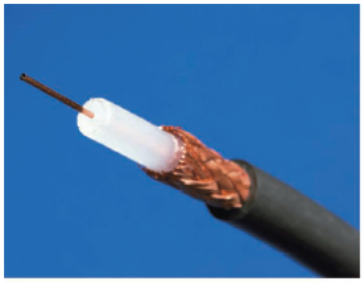


FIGURE 6.3 **Twisted-pair wire.**

Coaxial Cable. Coaxial cable (**Figure 6.4**) consists of insulated copper wire. Compared with twisted-pair wire, it is much less susceptible to electrical interference, and it can carry much more data. For these reasons, it is commonly used to carry high-speed data traffic as well as television signals (thus the term *cable TV*). However, coaxial cable is more expensive and more difficult to work with than twisted-pair wire. It is also somewhat inflexible.

Fiber Optics. Fiber-optic cable (**Figure 6.5**) consists of thousands of very thin filaments of glass fibers that transmit information through pulses of light generated by lasers. The fiber-optic cable is surrounded by cladding, a coating that prevents the light from leaking out of the fiber.

Fiber-optic cables are significantly smaller and lighter than traditional cable media. They also can transmit far more data, and they provide greater security from interference and



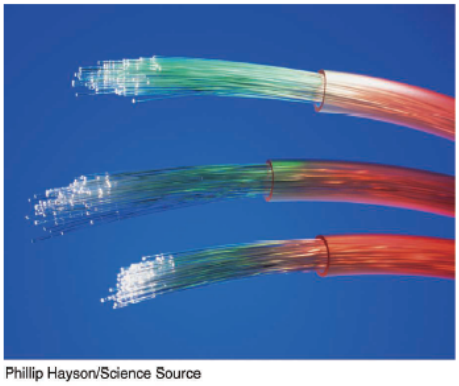
GIPhotoStock/Science Source

Cross-section view

©Piotr Malczyk/iStockphoto

How coaxial cable looks to us

FIGURE 6.4 **Two views of coaxial cable.**



Phillip Hayson/Science Source

Cross-section view

Chris Knapton/Science Source

How fiber-optic cable looks to us

FIGURE 6.5 **Two views of fiber-optic cable.**

tapping. Fiber-optic cable is typically used as the backbone for a network, whereas twisted-pair wire and coaxial cable connect the backbone to individual devices on the network. In 2016, FASTER, the aptly named 5,600-mile undersea fiber optic cable connecting Japan and the United States became operational. FASTER transmits data at 60 terabits per second across the Pacific Ocean.

Network Protocols

Computing devices that are connected to the network must access and share the network to transmit and receive data. These devices are often referred to as *nodes* of the network. They work together by adhering to a common set of rules and procedures—known as a **protocol**—that enable them to communicate with one another. The two major protocols are the Ethernet and Transmission Control Protocol/Internet Protocol.

Ethernet. A common LAN protocol is Ethernet. Many organizations use 100-gigabit Ethernet, through which the network provides data transmission speeds of 100 gigabits (100 billion bits) per second. The 400-gigabit Ethernet is projected to be in service in 2017.

Transmission Control Protocol/Internet Protocol. The **Transmission Control Protocol/Internet Protocol (TCP/IP)** is the protocol of the Internet. TCP/IP uses a suite of protocols, the main ones being the Transmission Control Protocol (TCP) and the Internet Protocol (IP). The TCP performs three basic functions: (1) it manages the movement of data packets (see further on) between computers by establishing a connection between the computers, (2) it sequences the transfer of packets, and (3) it acknowledges the packets that have been transmitted. The **Internet Protocol (IP)** is responsible for disassembling, delivering, and reassembling the data during transmission.

Before data are transmitted over the Internet, they are divided into small, fixed bundles called *packets*. The transmission technology that breaks up blocks of text into packets is called *packet switching*. Each packet carries the information that will help it reach its destination—the sender's IP address, the intended recipient's IP address, the number of packets in the message, and the sequence number of the particular packet within the message. Each packet travels independently across the network and can be routed through different paths in the network. When the packets reach their destination, they are reassembled into the original message.

It is important to note that packet-switching networks are reliable and fault tolerant. For example, if a path in the network is very busy or is broken, packets can be dynamically ("on the fly") rerouted around that path. Also, if one or more packets do not get to the receiving computer, then only those packets need to be re-sent.

Why do organizations use packet switching? The main reason is to achieve reliable end-to-end message transmission over sometimes-unreliable networks that may have short-acting or long-acting problems.

The packets use the TCP/IP protocol to carry their data. TCP/IP functions in four layers (see **Figure 6.6**). The *application layer* enables client application programs to access the other layers, and it defines the protocols that applications use to exchange data. One of these application protocols is the **Hypertext Transfer Protocol (HTTP)**, which defines how messages are formulated and how they are interpreted by their receivers. (We discuss hypertext in Section 6.3.) The *transport layer* provides the application layer with communication and packet services. This layer includes TCP and other protocols. The *Internet layer* is responsible for addressing, routing, and packaging data packets. The IP is one of the protocols in this layer. Finally, the *network interface layer* places packets on, and receives them from, the network medium, which can be any networking technology.

Two computers using TCP/IP can communicate even if they use different hardware and software. Data sent from one computer to another proceed downward through all four layers, beginning with the sending computer's application layer and going through its network interface layer. After the data reach the receiving computer, they travel up the layers.

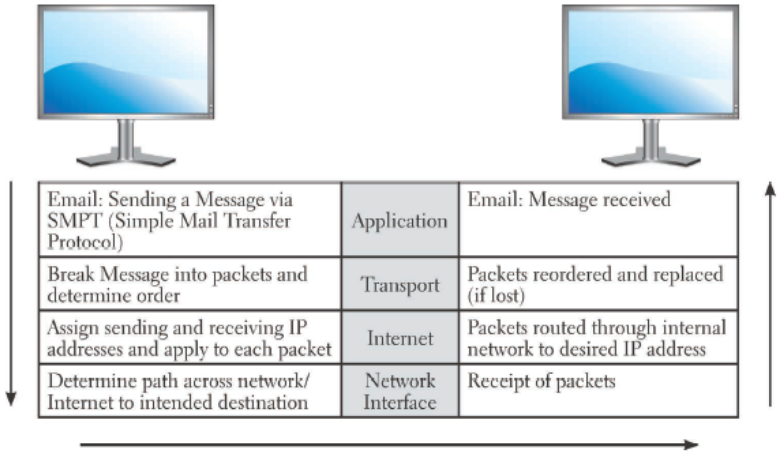


FIGURE 6.6 The four layers of the TCP/IP reference model.

TCP/IP enables users to send data across sometimes-unreliable networks with the assurance that the data will arrive in uncorrupted form. TCP/IP is very popular with business organizations because of its reliability and the ease with which it can support intranets and related functions.

Let's look at an example of packet switching across the Internet. Figure 6.7 illustrates a message being sent from New York City to Los Angeles over a packet-switching network. Note that the different colored packets travel by different routes to reach their destination in Los Angeles, where they are reassembled into the complete message.

Types of Network Processing

Organizations typically use multiple computer systems across the firm. Distributed processing divides processing work among two or more computers. This process enables computers in different locations to communicate with one another through telecommunications links. A common type of distributed processing is client/server processing. A special type of client/server processing is peer-to-peer processing.

Client/Server Computing.

Client/server computing links two or more computers in an arrangement in which some machines, called *servers*, provide computing services for user PCs, called *clients*. Usually, an organization performs the bulk of its processing or

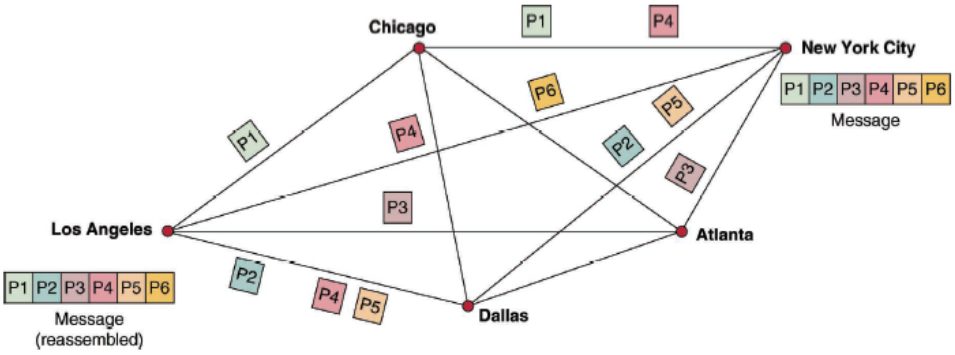


FIGURE 6.7 Packet switching.

application/data storage on suitably powerful servers that can be accessed by less powerful client machines. The client requests applications, data, or processing from the server, which acts on these requests by "serving" the desired commodity.

Client/server computing leads to the ideas of "fat" clients and "thin" clients. As discussed in Technology Guide 1, *fat clients* have large storage and processing power and therefore can run local programs (such as Microsoft Office) if the network goes down. In contrast, *thin clients* may have no local storage and only limited processing power. Thus, they must depend on the network to run applications. For this reason, they are of little value when the network is not functioning.

Peer-to-Peer Processing. **Peer-to-peer (P2P) processing** is a type of client/server distributed processing in which each computer acts as *both* a client and a server. Each computer can access (as assigned for security or integrity purposes) all files on all other computers.

There are three basic types of peer-to-peer processing. The first type accesses unused CPU power among networked computers. An application of this type is SETI@home (**http://setiathome.ssl.berkeley.edu**). These applications are from open-source projects, and they can be downloaded at no cost.

The second form of peer-to-peer is real-time, person-to-person collaboration, such as Microsoft SharePoint Workspace (**http://office.microsoft.com/en-us/sharepoint-workspace**).

This product provides P2P collaborative applications that use buddy lists to establish a connection and allow real-time collaboration within the application.

The third peer-to-peer category is advanced search and file sharing. This category is characterized by natural language searches of millions of peer systems. It enables users to discover other users, not just data and web pages. One example of this category is BitTorrent.

BitTorrent (**www.bittorrent.com**) is an open-source, free, peer-to-peer file-sharing application that simplifies the problem of sharing large files by dividing them into tiny pieces, or "torrents." BitTorrent addresses two of the biggest problems of file sharing: (1) downloading bogs down when many people access a file at once, and (2) some people leech, meaning they download content but refuse to share it. BitTorrent eliminates the bottleneck by enabling all users to share little pieces of a file at the same time—a process called *swarming*. The program prevents leeching because users must upload a file while they download it. Thus, the more popular the content, the more efficiently it travels over a network.

Before you go on . . .

1. Compare and contrast the three wireline communications channels.
2. Describe the various technologies that enable users to send high-volume data over any network.
3. Describe the Ethernet and TCP/IP protocols.

6.3 The Internet and the World Wide Web

The **Internet ("the Net")** is a global WAN that connects approximately 1 million organizational computer networks in more than 200 countries on all continents. It has become so widespread that it features in the daily routine of some 5 billion people.

The computers and organizational nodes on the Internet can be of different types and makes. They are connected to one another by data communications lines of different speeds. The primary network connections and telecommunications lines that link the nodes are referred to as the **Internet backbone**. For the Internet, the backbone is a fiber-optic network that is operated primarily by large telecommunications companies.

As a network of networks, the Internet enables people to access data in other organizations and to communicate, collaborate, and exchange information seamlessly around the world, quickly and inexpensively. Thus, the Internet has become a necessity for modern businesses.

The Internet grew out of an experimental project of the Advanced Research Project Agency (ARPA) of the U.S. Department of Defense. The project began in 1969 as the *ARPAnet*. Its purpose was to test the feasibility of a WAN over which researchers, educators, military personnel, and government agencies could share data, exchange messages, and transfer files.

Today, Internet technologies are being used both within and among organizations. An **intranet** is a network that uses Internet protocols so that users can take advantage of familiar applications and work habits. Intranets support discovery (easy and inexpensive browsing and search), communication, and collaboration inside an organization.

In contrast, an **extranet** connects parts of the intranets of different organizations. It also enables business partners to communicate securely over the Internet using virtual private networks (VPNs) (explained in Chapter 4). Extranets offer limited accessibility to the intranets of participating companies, as well as necessary interorganizational communications. They are widely used in the areas of business-to-business (B2B) electronic commerce (see Chapter 7) and supply chain management (SCM) (see Chapter 11).

No central agency manages the Internet. Instead, the costs of its operation are shared among hundreds of thousands of nodes. Thus, the cost for any one organization is small. Organizations must pay a small fee if they wish to register their names, and they need to install their own hardware and software to operate their internal networks. The organizations are obliged to move any data or information that enter their organizational network, regardless of the source, to their destination, at no charge to the senders. The senders, of course, pay the telephone bills for using either the backbone or regular telephone lines.

Accessing the Internet

You can access the Internet in several ways. From your place of work or your university, you can use your organization's LAN. A campus or company backbone connects all of the various LANs and servers in the organization to the Internet. You can also log on to the Internet from your home or on the road, using either wireline or wireless connections.

Connecting through an Online Service. You can also access the Internet by opening an account with an Internet service provider. An **Internet service provider (ISP)** is a company that provides Internet connections for a fee. Large ISPs include Comcast (**www.comcast.com**), AT&T (**www.att.com**), Time Warner Cable (**www.timewarnercable.com**), and Verizon (**www.verizon.com**).

ISPs connect to one another through **network access points (NAPs)**. NAPs are exchange points for Internet traffic. They determine how traffic is routed. NAPs are key components of the Internet backbone. **Figure 6.8** displays a schematic of the Internet. The white links at the top of the figure represent the Internet backbone; the white dots where the white links meet are the NAPs.

Connecting through Other Means. There have been several attempts to make access to the Internet cheaper, faster, and easier. For example, terminals known as Internet kiosks have been located in such public places as libraries and airports (and even in convenience stores in some countries) for use by people who do not have their own computers. Accessing the Internet from smartphones and tablets is common, and fiber-to-the-home (FTTH) is growing rapidly. FTTH involves connecting fiber-optic cable directly to individual homes. **Table 6.2** summarizes the various means of connecting to the Internet. Satellite connections and Google Fiber are worth noting in more detail.

Connecting through satellite. See our discussion in Section 8.1.

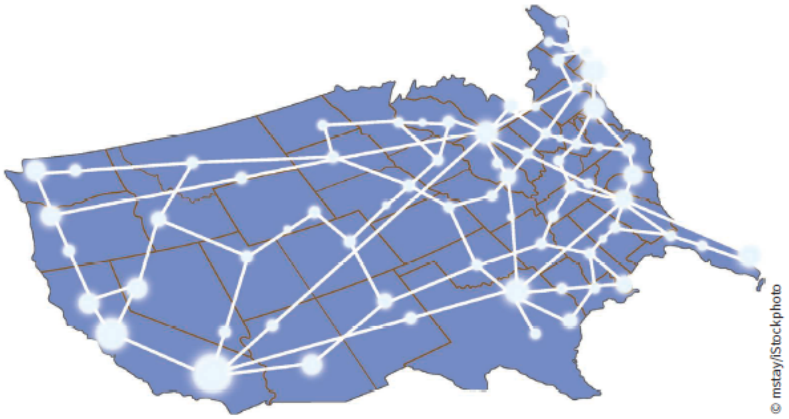


FIGURE 6.8 Internet (backbone in white).

TABLE 6.2 Internet Connection Methods

Service	Description
Dial-up	Still used in the United States where broadband is not available
DSL	Broadband access through telephone companies
Cable modem	Access over your cable TV coaxial cable. Can have degraded performance if many of your neighbors are accessing the Internet at once
Satellite	Access where cable and DSL are not available
Wireless	Very convenient, and WiMAX will increase the use of broadband wireless
Fiber-to-the-home (FTTH)	Expensive and usually placed only in new housing developments

Connecting through other means. See Google Project Loon and Facebook solar-powered drones in Section 8.1.

Google Fiber (FTTH). Google Fiber is a service that provides fiber-to-the-home. In November 2016, Google Fiber provided broadband Internet and cable television to approximately 453,000 customers in eight U.S. cities. As you see in **IT's About Business 6.2**, Google has faced stiff competition in deploying the service, with a surprising outcome.

Addresses on the Internet. Each computer on the Internet has an assigned address, called the **Internet Protocol (IP) address**, that distinguishes it from all other computers. The IP address consists of sets of numbers, in four parts, separated by dots. For example, the IP address of one computer might be 135.62.128.91. You can access a website by typing this number in the address bar of your browser.

Currently, there are two IP addressing schemes. The first scheme, IPv4, is the most widely used. IP addresses using IPv4 consist of 32 bits, meaning that there are 2^{32} possibilities for IP addresses, or 4,294,967,295 distinct addresses. Note that the IP address in the preceding paragraph (135.62.128.91) is an IPv4 address. At the time that IPv4 was developed, there were not as many computers that needed addresses as there are today. Therefore, a new IP addressing scheme has been developed, IPv6, because we have run out of available IPv4 addresses.

IP addresses using IPv6 consist of 128 bits, meaning that there are 2^{128} possibilities for distinct IP addresses, which is an unimaginably large number. IPv6, which is replacing IPv4, will accommodate the rapidly increasing number of devices that need IP addresses, such as smartphones and devices that constitute the Internet of Things (see Section 8.4).

IT's About Business 6.2

The Rise and Fall of Google Fiber

MIS

Cable distribution giants such as Verizon (**www.verizon.com**), Time Warner Cable (**www.timewarnercable.com**), and Comcast (**www.comcast.com**) enjoy healthy profit margins on their Internet services. None of these companies, however, appears to have had plans to extend fiber-to-the-home services to additional geographical areas. Rather, their business goal was to sign up more people in their existing service areas. They have adopted this strategy because focusing on existing service areas adds the most revenue without increasing the companies' capital costs. Essentially, there are no compelling business incentives for the established cable companies to expand their service offerings. This policy is unfortunate because most Americans have no choice but to do business with their local cable company. To compound this problem, few outside companies have the money to compete with the existing, cash-heavy telecommunications companies that control existing cable networks.

In direct competition with cable Internet providers, Google began installing and operating ultrafast fiber-optic cable service, known as Google Fiber (**http://fiber.google.com**), in U.S. cities. Google Fiber was first deployed to homes in Kansas City (Kansas and Missouri). By May 2016, Google Fiber was operating in eight U.S. cities.

Google Fiber competitors responded. In February 2016, AT&T announced that its GigaPower service (**www.att.com/internet/gigapower.html**) was available to residents in Kansas City. Just like Google Fiber, GigaPower offered download speeds of 1 gigabit per second (1 Gbps) and cost $70 per month. For $120 per month, AT&T offered 1 Gbps Internet service along with a free television package. AT&T also began offering GigaPower in Austin, Texas, another Google Fiber city. Interestingly, customers had to pay $29 per month more to opt out of AT&T's Internet Preferences program, or AT&T would have tracked everything they did and then sold that information to third-party providers.

Another cable company joined the competition. Just months after Charlotte, North Carolina, was announced as a potential city for Google Fiber, Time Warner Cable announced that the cable company was increasing download speeds up to 300 megabits per second at no charge.

In early 2016, Louisville, Kentucky's Metro Council voted to permit Google (or any other Internet Service Provider) to set up its equipment on utility poles owned by third parties, including AT&T. In response, AT&T, Charter Communications, and Frontier Communications launched a lawsuit against the city. The cable providers argued that they should not have to piggyback Google's equipment on poles that they own and maintain. Using existing poles would be the fastest, easiest, and cheapest way to launch Google Fiber in Louisville.

Google could bury its fiber optic cables. That process would address the issues in the lawsuit and build a service more resilient to bad weather and natural disasters. However, the process would be much more expensive and time-consuming. In November 2016, the lawsuit had not yet been settled or come to trial.

In a startling turn of events in August 2016, Google placed its Google Fiber project on hold. First, it seemed that Google thought that laying fiber was too expensive to be a viable business model. Second, Google was involved in legal battles with large Internet service providers over access to their telephone poles. Most importantly, very fast Wi-Fi transmitters can be mounted on the tops of tall buildings to beam Internet access directly to users far more cheaply than laying fiber optic cable.

In June 2016, Google announced that it would buy Webpass (**www.webpass.net**), which provides gigabit residential Internet access through wireless technology. In November 2016, it appeared that the next two cities scheduled for Google Fiber—San Jose, California, and Portland, Oregon—would instead receive gigabit Internet wirelessly.

Sources: Compiled from C. Forrest, "Why Google Fiber Failed: 5 Reasons," *TechRepublic*, December 20, 2016; S. Fiegerman, "Google Puts the Brakes on Fiber and Plans for Layoffs," *CNN Money*, October 26, 2016; J. Brodkin, "Google Fiber Division Cuts Staff by 9%, 'Pauses' Fiber Plans in 11 Cities," *Ars Technica*, October 25, 2016; D. Wakabayashi, "Google Curbs Expansion of Fiber Optic Network, Cutting Jobs," *New York Times*, October 25, 2016; J. Brodkin, "Charter, Like AT&T, Sues Louisville to Stall Google Fiber," *Ars Technica*, October 5, 2016; M. Reilly, "Google Fiber Stalls as the Industry Gears Up for Ultrafast Wireless," *MIT Technology Review*, August 15, 2016; D. Morris, "Frontier Lines Up Against Google Fiber in AT&T Fight over Utility Pole Access," *Fortune*, July 2, 2016; T.C. Sottek, "Comcast Is Afraid of Google Fiber," *The Verge*, March 17, 2016; D. Patterson, "Google and AT&T: Fighting Fiber with Fiber," *TechRepublic*, March 4, 2016; C. Forest, "AT&T Goes to War with Google Fiber in Louisville: Why Ma Bell Could Win and What It Could Mean," *TechRepublic*, March 1, 2016; A. Burlacu, "Google Fiber Wins Another Round in Battle with Time Warner Cable and AT&T," *Tech Times*, February 18, 2016; **http://fiber.google.com**, accessed November 15, 2016.

Questions

1. **Describe the competitive reactions of the cable companies to Google Fiber.**
2. **When the cable companies matched Google Fiber's cost and speed at no extra charge, do you think they had a public relations problem? Why or why not? Support your answer.**
3. **Discuss how this case illustrates the difficulty in keeping up with rapid advances in information technology.**

IP addresses must be unique so that computers on the Internet know where to find one another. The Internet Corporation for Assigned Names and Numbers (ICANN) (**www.icann.org**) coordinates these unique addresses throughout the world. Without that coordination, we would not have one global Internet.

Because the numeric IP addresses are difficult to remember, most computers have names as well. ICANN accredits certain companies called *registrars* to register these names, which are derived from a system called the domain name system (DNS). Domain names consist of multiple parts, separated by dots, that are read from right to left. For example, consider the domain

name *business.auburn.edu*. The rightmost part (or zone) of an Internet name is its top-level domain (TLD). The letters *edu* in business.auburn.edu indicate that this is an educational site. The following are popular U.S. TLDs:

com	commercial sites
edu	educational sites
mil	military government sites
gov	civilian government sites
org	organizations

To conclude our domain name example, *auburn* is the name of the organization (Auburn University), and *business* is the name of the particular machine (server) within the organization to which the message is being sent.

A TLD is the domain at the highest level in the hierarchical Domain Name System of the Internet. The top-level domain names are located in the root zone (rightmost zone) of the name. Management of most TLDs is delegated to responsible organizations by ICANN. ICANN operates the Internet Assigned Numbers Authority (IANA), which is in charge of maintaining the DNS root zone. Today, IANA distinguishes the following groups of TLDs:

- Country-code top-level domains (ccTLD): Two-letter domains established for countries or territories. For example, *de* stands for Germany, *it* for Italy, and *ru* for Russia.
- Internationalized country code top-level domains (IDN ccTLD): These are ccTLDs in non-Latin character sets (e.g., Arabic or Chinese).
- Generic top-level domains (gTLD): Top-level domains with three or more characters. gTLDs initially consisted of .gov, .edu, .com, .mil, .org, and .net. In late 2000, ICANN introduced .aero, .biz, .coop, .info, .museum, .name, and .pro.

The U.S. National Telecommunications & Information Administration (NTIA), a part of the U.S. Commerce Department, announced that it would turn over control of the Internet Domain Name System to the California-based nonprofit, Internet Corporation for Assigned Names and Numbers on October 1, 2016. Until September 30, 2016, ICANN was contracted by the Department of Commerce to administer the Internet Assigned Numbers Authority (IANA) under oversight of the NTIA. IANA manages changes to the top-level domains of the DNS, which is maintained by Verisign.

After October 1, 2016, ICANN will be doing its work on behalf of an international "multi-stakeholder community" composed predominantly of technology companies. The U.S. government states that if the U.S. does not turn these functions over to ICANN, such a move could lend weight to arguments from nations such as China and Russia that Internet governance should be nationalized or turned over to the United Nations.

The Future of the Internet

Researchers assert that if Internet bandwidth is not improved rapidly, then within a few years the Internet will be able to function only at a much-reduced speed. The Internet is sometimes too slow for data-intensive applications such as full-motion video files (movies) and large medical files (X-rays). The Internet is also unreliable and is not secure. As a result, Internet2 has been developed by many U.S. universities collaborating with industry and government. **Internet2** develops and deploys advanced network applications such as remote medical diagnosis, digital libraries, distance education, online simulation, and virtual laboratories. It is designed to be fast, always on, everywhere, natural, intelligent, easy, and trusted. Note that Internet2 is not a separate physical network from the Internet. For more details, see **www.internet2.edu**.

The World Wide Web

Many people equate the Internet with the World Wide Web. However, they are not the same thing. The Internet functions as a transport mechanism, whereas the World Wide Web is an

application that uses those transport functions. Other applications, such as e-mail, also run on the Internet.

The **World Wide Web (The Web, WWW, or W3)** is a system of universally accepted standards for storing, retrieving, formatting, and displaying information through a client/server architecture. The web handles all types of digital information, including text, hypermedia, graphics, and sound. It uses graphical user interfaces (GUIs) (explained in Technology Guide 2), so it is very easy to navigate.

Hypertext is the underlying concept defining the structure of the World Wide Web. Hypertext is the text displayed on a computer display or other electronic device with references, called *hyperlinks,* to other text that the reader can immediately access, or where text can be revealed progressively at additional levels of details. A **hyperlink** is a connection from a hypertext file or document to another location or file, typically activated by clicking on a highlighted word or image on the screen, or by touching the screen.

Organizations that wish to offer information through the web must establish a *home page,* which is a text and graphical screen display that usually welcomes the user and provides basic information on the organization that has established the page. In most cases, the home page will lead users to other pages. All the pages of a particular company or individual are collectively known as a **website**. Most web pages provide a way to contact the organization or the individual. The person in charge of an organization's website is its *webmaster.* (*Note: webmaster* is a gender-neutral title.)

To access a website, the user must specify a **uniform resource locator (URL)**, which points to the address of a specific resource on the web. For example, the URL for Microsoft is **http://www.microsoft.com**. Recall that HTTP stands for *hypertext transport protocol.* The remaining letters in this URL—**www.microsoft.com**—indicate the domain name that identifies the web server that stores the website.

Users access the web primarily through software applications called "browsers." **Browsers** provide a graphical front end that enables users to point and click their way across the web, a process called *surfing.* Web browsers became a means of universal access because they deliver the same interface on any operating system on which they run. As of November 2016, Google Chrome was the leading browser, with 49 percent of users worldwide. Microsoft Edge's share fell to 37 percent of users worldwide.

Before you go on . . .

1. Describe the various ways that you can connect to the Internet.
2. Identify each part of an Internet address.
3. Describe the difference between the Internet and the World Wide Web.
4. What are the functions of browsers?

6.4 Network Applications: Discovery

Now that you have a working knowledge of what networks are and how you can access them, the key question is: How do businesses use networks to improve their operations? In the next four sections of this chapter, we explore four network applications: discovery, communication, collaboration, and education. These applications, however, are merely a sampling of the many network applications currently available to users. Even if these applications formed an exhaustive list today, they would not do so tomorrow when something new will be developed. Furthermore, placing network applications in categories is difficult because there will always be borderline cases. For example, telecommuting combines communication and collaboration.

The Internet enables users to access, or *discover information,* located in databases all over the world. By browsing and searching data sources on the web, users can apply the Internet's

discovery capability to areas ranging from education to government services to entertainment to commerce. Although having access to all this information is a great benefit, it is critically important to realize that there is no quality assurance for information on the web. The web is truly democratic in that *anyone* can post information to it. Therefore, the fundamental rule about information on the web is "User beware!"

Think about discovery in 1960. How did you find information? You probably had to go to the library to check out a physical book. Contrast that process with how you would discover that information today. In fact, the overall trends in discovery have been:

- In the past, you had to go to the information (the library). Today, the information comes to you through the Internet.
- In the past, only one person at a time could have the information (the book he or she checked out of the library). Today, the information is available to multiple, concurrent users.
- In the past, you may not have been able to access the information you needed (e.g., if the book was already checked out). Today, the information is available to all, simultaneously.
- In the past, you may have had to have your book translated if it were written in a different language. Today, automatic translation software tools are improving very rapidly.

The web's major strength—the vast stores of information it contains—also presents a major challenge. The amount of information on the web can be overwhelming, and it doubles approximately each year. As a result, navigating through the web and gaining access to necessary information are becoming more and more difficult. To accomplish these tasks, people are increasingly using search engines, directories, and portals.

Search Engines and Metasearch Engines

A **search engine** is a computer program that searches for specific information by keywords and then reports the results. A search engine maintains an index of billions of web pages. It uses that index to find pages that match a set of user-specified keywords. Such indexes are created and updated by *webcrawlers,* which are computer programs that browse the web and create a copy of all visited pages. Search engines then index these pages to provide fast searches.

In mid-2016, four search engines accounted for almost all searches in the United States. They are, in order, Google (**www.google.com**), Bing (**www.bing.com**), Yahoo! (**www.yahoo.com**), and Ask (**www.ask.com**). The leading search engine in China is Baidu (**www.baidu.com**), which claimed approximately three-fourths of the Chinese market in mid-2016.

For an even more thorough search, you can use a metasearch engine. **Metasearch engines** search several engines at once and then integrate the findings to answer users' queries. Examples are Surf-wax (**www.surfwax.com**), Metacrawler (**www.metacrawler.com**), Mamma (**www.mamma.com**), KartOO (**www.kartoo.com**), and Dogpile (**www.dogpile.com**).

Publication of Material in Foreign Languages

The World Bank (**www.worldbank.org**) estimates that 80 percent of online content is available in only 1 of 10 languages: English, Chinese, Spanish, Japanese, Arabic, Portuguese, German, French, Russian, and Korean. Roughly 3 billion people speak one of these as their first language. However, more than half of all online content is written in English, which is understood by only 21 percent of the world's population. Consider India, whose citizens speak roughly 425 languages and dialects. Industry analysts estimate that less than 0.1 percent of all web content is composed in Hindi, the first language of approximately 260 million people.

Not only is there a huge amount of information on the Internet, but it is also written in many different languages. How, then, do you access this information? The answer is that you use an *automatic translation* of web pages. Such translation is available to and from all major languages, and its quality is improving over time.

Companies invest resources to make their websites accessible in multiple languages as a result of the global nature of the business environment. That is, multilingual websites are now a competitive necessity. When companies are disseminating information around the world, getting that information correct is essential. It is not enough for companies to translate web content. They must also localize that content and be sensitive to the needs of the people in local markets.

At 20 cents and more per word, translation services are expensive. Companies supporting 10 languages can spend $200,000 annually to localize information and another $50,000 to maintain the websites. Translation budgets for major multinational companies can run to millions of dollars.

Some major translation products are Microsoft's Translator app (**http://www.microsofttranslator.com**) and Google (**https://translate.google.com**) (see **Figure 6.9**), as well as products and services available at Trados (**www.translationzone.com**) and Systran S.A. (**www.systransoft.com**).

In September 2016, Google announced its new translation service, which is based on deep learning (see Technology Guide 4). In a competition that compared the new translation system with human translators, the system came very close to matching the fluency of humans for some languages, such as translating between English and Spanish and between English and French. Google is expanding the system to multiple languages.

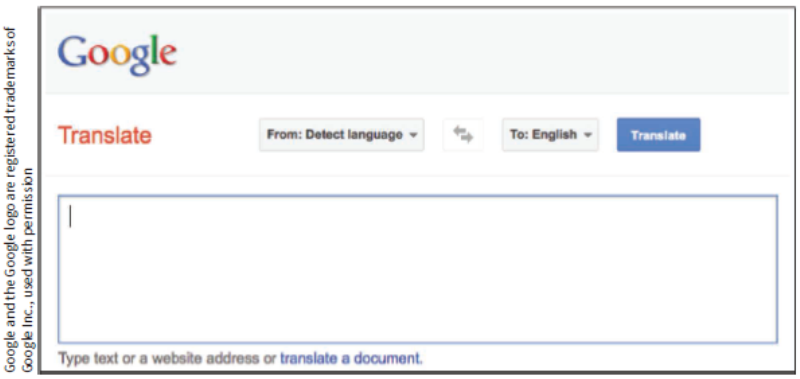
In December 2016, Microsoft launched its Translator app. With spoken conversation, the app can accommodate a group of up to 100 speakers and nine languages: Arabic, Mandarin Chinese, Spanish, English, French, German, Russian, Portuguese, and Italian.

Portals

Most organizations and their managers encounter information overload. Information is scattered across numerous documents, e-mail messages, and databases at different locations and systems. Finding relevant and accurate information is often time-consuming and may require users to access multiple systems.

One solution to this problem is to use *portals*. A **portal** is a web-based, personalized gateway to information and knowledge that provides relevant information from different IT systems and the Internet using advanced search and indexing techniques. After reading the next section, you will be able to distinguish among four types of portals: commercial, affinity, corporate, and industrywide. The four types of portals are differentiated by the audiences they serve.

A **commercial (public) portal** is the most popular type of portal on the Internet. It is intended for broad and diverse audiences, and it offers routine content, some of it in real time (e.g., a stock ticker). Examples are Lycos (**www.lycos.com**) and Microsoft Network (**www.msn.com**).



Google and the Google logo are registered trademarks of Google Inc., used with permission

FIGURE 6.9 **Google Translate. (Google and the Google logo are registered trademarks of Google Inc., used with permission.)**

In contrast, an **affinity portal** offers a single point of entry to an entire community of affiliated interests, such as a hobby group or a political party. Your university most likely has an affinity portal for its alumni. **Figure 6.10** displays the affinity portal for the University of West Georgia. Other examples of affinity portals are **www.techweb.com** and **www.zdnet.com**.

As the name suggests, a **corporate portal** offers a personalized, single point of access through a web browser to critical business information located inside and outside an organization. These portals are also known as *enterprise portals, information portals,* and *enterprise information portals.* Besides making it easier to find needed information, corporate portals offer customers and employees self-service opportunities.

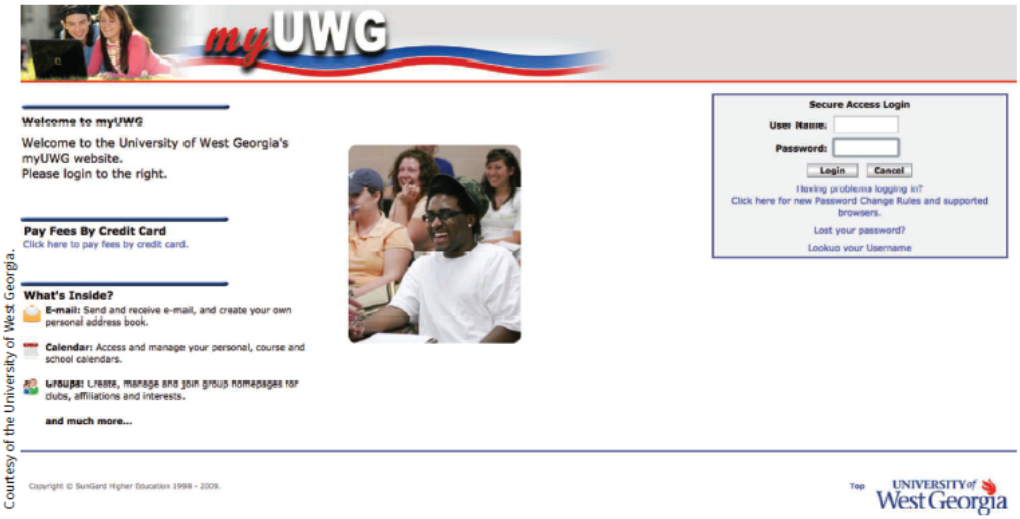
Whereas corporate portals are associated with a single company, an **industrywide** portal serves entire industries. An example is TruckNet (**www.truck.net**), a portal for the trucking industry and the trucking community, including professional drivers, owner/operators, and trucking companies.

Before you go on . . .

1. Differentiate between search engines and metasearch engines.
2. What are some reasons why publication of material in a number of languages is so important?
3. Describe the various reasons that portals are useful to us.

6.5 Network Applications: Communication

The second major category of network applications is communication. There are many types of communication technologies, including e-mail, call centers, chat rooms, and voice. Furthermore, we discuss an interesting application of communication: telecommuting. Note: You will read about other types of communication, blogging, and microblogging in Chapter 9.



Courtesy of the University of West Georgia.

FIGURE 6.10 University of West Georgia affinity portal. (Courtesy of the University of West Georgia.)

Electronic Mail

Electronic mail (e-mail) is the largest-volume application running over the Internet. Studies have found that almost all companies conduct business transactions through e-mail, and the vast majority confirm that e-mail is tied to their means of generating revenue. On the other hand, the amount of e-mail that managers receive has become overwhelming. In fact, too much e-mail can lead to a loss of productivity. (See this chapter's opening case.)

Web-Based Call Centers

Effective personalized customer contact is becoming an important aspect of web-based customer support. Such service is provided through *web-based call centers,* also known as *customer care centers.* For example, if you need to contact a software vendor for technical support, you will usually be communicating with the vendor's web-based call center, using e-mail, a telephone conversation, or a simultaneous voice and web session. Web-based call centers are sometimes located in foreign countries such as India. Such *offshoring* is an important issue for the U.S. companies. (We discuss offshoring in Chapter 13.)

Significantly, some of the U.S. companies are moving their call center operations back to the United States, for several reasons. First, they believe they have less control of their operations when the centers are located overseas. They must depend on the vendor company to uphold their standards, such as quality of service. A second difficulty is language differences, which can create serious communication problems. Third, companies that manage sensitive information risk breaching customer confidentiality and security. Finally, the call center representatives typically work with many companies. As a result, they may not deliver the same level of customer services that each company requires.

Electronic Chat Rooms

Electronic chat refers to an arrangement in which participants exchange conversational messages in real time in a *chat room.* Chat programs allow you to send messages to people who are connected to the same channel of communication at the same time as you are. Anyone can join in the conversation. Messages are displayed on your screen as they arrive.

There are two major types of chat programs. The first type is web based, which allows you to send messages to Internet users by using a web browser and visiting a web chat site (e.g., **http://messenger.yahoo.com**). The second type is e-mail based (text only). It is called *Internet Relay Chat* (IRC). A business can use IRC to interact with customers, provide online experts for answers to questions, and so on.

Voice Communication

The plain old telephone service (POTS) has been largely replaced by Internet telephony. With **Internet telephony**, also known as **Voice-over-Internet Protocol** or **VoIP**, phone calls are treated as just another kind of data. That is, your analog voice signals are digitized, sectioned into packets, and then sent over the Internet.

Consider Skype (**www.skype.com**), which provides several VoIP services for free: voice and video calls to users who also have Skype, instant messaging, short message service, voice mail, one-to-one and group chats, and conference calls. Skype offers full-screen, high-definition video calling; Skype Access (to access Wi-Fi hotspots); call transfer to a Skype contact on either a mobile or a landline phone; improved quality of calls; and ease of use. It also provides additional functions for which users must pay. For example, SkypeOut allows you to make calls to landline phones and mobile phones. SkypeIn provides a number that your friends can call from any phone, and you pick up the call in Skype.

Unified Communications

In the past, organizational networks for wired and wireless data, voice communications, and videoconferencing operated independently, and the IT department managed each network separately. This arrangement increased costs and reduced productivity.

Unified communications (UC) simplifies and integrates all forms of communications—voice, voice mail, fax, chat, e-mail, instant messaging, short message service, presence (location) services, and videoconferencing—on a common hardware and software platform. *Presence services* enable users to know where their intended recipients are and if they are available, in real time.

UC unifies all forms of human and computer communications into a common user experience. For example, UC allows an individual to receive a voice mail message and then read it in his or her e-mail inbox. In another example, UC enables users to seamlessly collaborate with another person on a project, regardless of where the user is located. One user could quickly locate the other user by accessing an interactive directory, determining whether that user is available, engaging in a text messaging session, and then escalating the session to a voice call or even a video call, all in real time.

Telecommuting

Knowledge workers are being called the distributed workforce, or "digital nomads." This group of highly prized workers is now able to work anywhere and any time, a process called **telecommuting**. Distributed workers are those who have no permanent office at their companies, preferring to work at home offices, in airport lounges, or client conference rooms, or on a high school stadium bleacher. The growth of the distributed workforce is driven by globalization, extremely long commutes to work, ubiquitous broadband communications links (wireline and wireless), and powerful computing devices.

HRM Telecommuting offers a number of potential advantages for employees, employers, and society. For employees, the benefits include reduced stress and improved family life. Telecommuting also offers employment opportunities for housebound people such as single parents and persons with disabilities. Benefits for employers include increased productivity, the ability to retain skilled employees, and the ability to attract employees who do not live within commuting distance.

HRM However, telecommuting also has some potential disadvantages. For employees, the major disadvantages are increased feelings of isolation, possible loss of fringe benefits, lower pay (in some cases), no workplace visibility, the potential for slower promotions, and lack of socialization. In a 2013 study, researchers at Stanford University found that telecommuting employees are 50 percent less likely to receive a promotion than onsite workers. The researchers concluded that a lack of "face time" with bosses caused careers to stall.

Telecommuting employees also often have difficulties "training" their families to understand that they are at work even though they are physically at home. Families have to understand that they should not disturb the telecommuter for anything that they would not have disturbed him or her about in a "real" office. The major disadvantages to employers are difficulties in supervising work and potential data security problems.

Yahoo! CEO Marissa Mayer banned telecommuting in her company in February 2013. Best Buy and HP followed suit that same year. Despite being banned at these three large companies, telecommuting continues to grow.

Before you go on . . .

1. Discuss the advantages and disadvantages of electronic mail.
2. Why are many companies bringing their call centers back to the United States?
3. Describe Voice-over-Internet Protocol.
4. What are the advantages and disadvantages of telecommuting to you as an individual?

6.6 Network Applications: Collaboration

The third major category of network applications is collaboration. **Collaboration** refers to efforts by two or more entities—that is, individuals, teams, groups, or organizations—who work together to accomplish certain tasks. The term **workgroup** refers specifically to two or more individuals who act together to perform a task.

Workflow is the movement of information as it progresses through the sequence of steps that make up an organization's work procedures. Workflow management makes it possible to pass documents, information, and tasks from one participant to another in a way that is governed by the organization's rules or procedures. Workflow systems are tools for automating business processes.

If group members are working in different locations, they constitute a **virtual group (team)**. Virtual groups conduct *virtual meetings*—that is, they "meet" electronically. **Virtual collaboration** (or *e-collaboration)* refers to the use of digital technologies that enable organizations or individuals who are geographically dispersed to collaboratively plan, design, develop, manage, and research products, services, and innovative applications. Organizational employees frequently collaborate virtually with one another. Some organizations collaborate virtually with customers, suppliers, and other business partners to become more productive and competitive.

Collaboration can be *synchronous,* meaning that all team members meet at the same time. Teams may also collaborate *asynchronously* when team members cannot meet at the same time. Virtual teams, whose members are located throughout the world, typically must collaborate asynchronously.

Although a variety of software products are available to support all types of collaboration, many organizations feel that they have too many software tools being used in collaborative efforts. These firms want a single place to know what was shared, who shared it with whom, and when. Firms also want smarter collaboration tools that are capable of anticipating workers' needs.

Collaborative software products include Google Drive (**http://drive.google.com**), Microsoft SharePoint Workspace (**http://sharepoint.com**), Jive (**www.jivesoftware.com**), IBM Verse (**http://www-03.ibm.com/software/products/en/ibm-verse**), Microsoft's Delve for Office 365, Glip (**https://glip.com**), Slack (**www.slack,com**) (see this chapter's opening case), and HipChat (**www.hipchat.com**), as well as many others. In general, these products provide online collaboration capabilities, workgroup e-mail, distributed databases, electronic text editing, document management, workflow capabilities, instant virtual meetings, application sharing, instant messaging, consensus building, voting, ranking, and various application development tools.

Two of these tools use analytics for more effective collaboration. IBM's Verse combines e-mail, social media, calendars, and file-sharing with analytics in one software package designed to overhaul e-mail and increase productivity for organizations. Microsoft's Delve for Office 365 uses analytics to display information that is most relevant for each user.

Consider multinational banking and financial services company BNY Mellon (**www.bnymellon.com**). The bank uses a proprietary, in-house-developed enterprise social networking tool, called MySource Social, to share ideas and expertise. The social network is integrated with BNY Mellon's communication and collaboration tools, such as e-mail, calendar, and instant messaging systems. MySource Social is an intranet site within which users can explore business partner groups featuring blogs and information from executives; special-interest groups; and ad hoc groups, such as those created for project teams. More than 90 percent of the 55,000 BNY Mellon employees worldwide have accessed the site in some way, and some 40 percent are hands-on participants.

Collaboration is so important that companies are using information technology to enable the process as much as possible. **IT's About Business 6.3** shows how Raytheon uses CAVEs to maximize collaboration.

Crowdsourcing

One type of collaboration is **crowdsourcing**, in which an organization outsources a task to an undefined, generally large group of people in the form of an open call. Crowdsourcing provides

IT's About Business 6.3

The Collaboration Environment at Raytheon

MIS POM

The Raytheon Company (**www.raytheon.com**) is a U.S. defense contractor that manufactures weapons and military and commercial electronics. Raytheon's design and development process was high-tech in that it involved computer-aided design (CAD). But it was still low-tech when it came to collaboration. Raytheon engineers would sit together and look at each other's laptops in an extremely time-consuming process. Now, Raytheon engineers designing missiles work with the company's manufacturing and IT departments, as well as partners and suppliers, using stereoscopic 3-D (S3D) and augmented reality technologies.

Raytheon engineers produce CAD product drawings, which become 3-D models. In a manner that could be from *Star Trek*, the models are displayed on S3D screens called Cave Automatic Virtual Environments, or CAVE. A CAVE is a series of 72 ultrahigh-definition 3-D television sets, stacked eight feet high and arranged side by side, stretching over 320 degrees.

There are also portable versions of CAVEs that can be used offsite. Regardless of the physical form, engineers wear 3-D eyewear and enter the CAVE, becoming immersed in a virtual reality world. They and others around the globe can share in seeing products such as missiles in a three-dimensional environment, such as simulated combat.

The CAVE allows technical blueprints to come to life, so engineers can not only see an object, but can touch it and handle it as well. CAVE users can make quick changes to technical specifications. Potential Raytheon customers, such as military personnel, can walk into a CAVE and adjust equipment according to their needs. CAVE translates the abstract into the real, using what Raytheon calls "the common language of visualization."

The CAVE technology has changed the way that Raytheon works with clients. Instead of giving a presentation to clients, Raytheon engineers sit with them in a CAVE videoconference and they explore the 3-D models together. The technology allows Raytheon designers to show clients their work in progress on the CAVE screens as easily as if they were being displayed on a boardroom table.

One benefit of CAVEs is that it is far more economical to design virtual missile prototypes than it is to create physical prototypes. Another plus is that CAVEs accelerate the design process and launch the products faster. If engineers suspect that something is wrong with the wiring inside a missile prototype, for example, they can examine the 3-D model inside a CAVE and make adjustments fast, such as moving wires farther away from a part that gets very hot. That would be expensive and slow to do with a physical missile prototype.

CAVEs have increased the level of teamwork both inside Raytheon and with business partners and suppliers. Interestingly, CAVEs have energized client demonstrations. Raytheon can put customers right in the field, using CAVEs to simulate a combat environment, including a desert, mountains, or ocean, for the ultimate in product demonstration. This helps customers focus on what they're interested in. It can also help Raytheon with a classic "upsell" move—showing customers how one product can serve needs they didn't even know they had. As an example, the company used S3D to simulate a battleship at sea to demonstrate a ship-based missile for a client. The customer was so impressed with that missile's capabilities that it ordered a land-based missile with similar functions. The land-based missile was not on the customer's shopping list before the presentation.

Raytheon also takes its CAVEs on the road, encouraging middle school students to get involved in STEM (science, technology, engineering, mathematics). The S3D technology isn't just good for product prototypes, either. Raytheon used it to create and test a missile factory in Huntsville, Alabama. The factory itself produces missiles with state-of-the-art robotics and computer-controlled features.

CAVEs do present some obstacles. Converting Raytheon's conventional 2-D images to 3-D images involves time and effort. It's also not possible to entirely escape the physical world, as the company must invest in the space and TV screens needed to construct the large CAVEs.

The benefits of S3D are many. The technology has allowed Raytheon to avoid potential design and mock-up mistakes, saving considerable amounts of time and money. It's shaved countless hours off the time to engineer and manufacture products. It's cut down on the amount of travel for Raytheon engineers to visit suppliers. It's enabled Raytheon to analyze and finish designs faster. And it's helped identify possible mechanical defects that might have gone undetected until the product was on the production line.

Raytheon's S3D technology is providing competitive advantages to the defense contractor. Raytheon is in position to receive large contracts for helping to develop Israel's missile defense system. Much of the development work will be performed in the CAVE.

What's next for Raytheon's S3D? It's working on the next generation of the technology, for which CAVE users won't have to don eyewear. The firm is evaluating the virtual-reality headsets from Oculus Rift (**www.oculus.com**).

Sources: Compiled from B. Opall-Rome, "Boeing, Raytheon Assured Half of Surging U.S. Support for Israeli Missile Defense," *Defense News*, August 11, 2016; J. Meister, "Raytheon Animators Create Simulated Defense Situations," *PDDNet*, September 2, 2015; D. Adams, "Now Showing at Raytheon: Missiles in 3-D," *Boston Globe*, November 10, 2014; A. Shaheed, "Missile Makers Use Virtual 'CAVE' to Test Weapons," *Fox News*, June 26, 2014; A. Barrie, "Next-Gen Missile Killers Created in a Virtual 'Batcave'," *Fox News*, April 11, 2014; S. O'Neill, "Raytheon Uses Augmented Reality to Speed Missile Design," *InformationWeek*, April 2, 2014; J. Underwood, "Futuristic Raytheon Alabama Factory Makes Missile with Robots," *madeinalabama.com*, June 18, 2013; www.raytheon.com, accessed September 18, 2016.

Questions

1. Describe the use of information technologies in Raytheon's CAVEs.
2. What are potential disadvantages of using CAVEs in the product design process?

many potential benefits to organizations. First, crowds can explore problems—and often resolve them—at relatively low cost, and often very quickly. Second, the organization can tap a wider range of talent than might be present among its employees. Third, by listening to the crowd, organizations gain firsthand insight into their customers' desires. Finally, crowdsourcing taps into the global world of ideas, helping companies work through a rapid design process. Let's look at some examples of crowdsourcing.

- **MIS** Crowdsourcing help desks: IT help desks are a necessary service on college campuses because students depend on their computers and Internet access to complete their schoolwork and attend class online. At Indiana University at Bloomington, new IT help desks use crowdsourcing to alleviate the cost and pressure of having to answer so many calls. Students and professors post their IT problems on an online forum, where other students and amateur IT experts answer them.
- Recruitment: Champlain College in Vermont developed a Champlain For Reel program, inviting students to share through YouTube videos recounting their experiences at the school and the ways they benefited from their time there. The YouTube channel serves to recruit prospective students and even updates alumni on campus and community events.
- Scitable (**www.nature.com/scitable**) combines social networking and academic collaboration. Through crowdsourcing, students, professors, and scientists discuss problems, find solutions, and swap resources and journals. Scitable is a free site that lets each individual user turn to crowdsourcing for answers even while helping others.
- Procter & Gamble (P&G) uses InnoCentive (**www.innocentive.com**), in which company researchers post their problems. P&G offers cash rewards to problem solvers.
- SAP's Idea Place (**https://ideas.sap.com**) generates ideas for not-yet-developed software improvements and innovation. Any person can view the content in the Idea Place. The Idea Place is organized into numerous sessions, or categories, under which the ideas are organized. Once you have posted your idea, other users can vote on it and add comments. Status updates on your idea allow you to follow it as it progresses through the Idea Place. Every idea is reviewed by a team of experts made up of engineers, product managers, and community managers who evaluate the potential for implementation. The ideas with the most votes will receive a higher level of attention from SAP.

Although crowdsourcing has numerous success stories, there are many questions and concerns about this system, including the following:

- Should the crowd be limited to experts? If so, then how would a company go about implementing this policy?
- How accurate is the content created by the nonexperts in the crowd? How is accuracy maintained?
- How is crowd-created content being updated? How can companies be certain the content is relevant?
- The crowd may submit too many ideas, with most of them being worthless. In this scenario, evaluating all of these ideas can be prohibitively expensive. For example, during the BP oil spill in 2010, crowds submitted more than 20,000 suggestions on how to stem the flow of oil. The problem was very technical, so there were many poor suggestions. Nevertheless, despite the fact that BP was under severe time constraints, the company had to evaluate all of the ideas.
- Content contributors may violate copyrights, either intentionally or unintentionally.
- The quality of content (and therefore subsequent decisions) depends on the composition of the crowd. The best decisions may come if the crowd is made up of people with diverse opinions and ideas. In many cases, however, companies do not know the makeup of the crowd in advance.

Teleconferencing and Video Conferencing

Teleconferencing is the use of electronic communication technology that enables two or more people at different locations to hold a conference. There are several types of teleconferencing. The oldest and simplest is a telephone conference call, with which several people talk to one another from multiple locations. The biggest disadvantage of conference calls is that they do not allow the participants to communicate face to face nor can they see graphs, charts, and pictures at other locations.

To overcome these shortcomings, organizations are increasingly turning to video teleconferencing, or videoconferencing. In a **videoconference**, participants in one location can see participants, documents, and presentations at other locations. The latest version of videoconferencing, called *telepresence,* enables participants to seamlessly share data, voice, pictures, graphics, and animation by electronic means. Conferees can also transmit data along with voice and video, which allows them to work together on documents and to exchange computer files.

Telepresence systems range from on-premise, high-end systems to cloud-based systems. (We discuss on-premise computing and cloud computing in Technology Guide 3). On-premise, high-end systems are expensive and require dedicated rooms with large high-definition screens to show people sitting around conference tables (see **Figure 6.11**). These systems have advanced audio capabilities that let everyone talk at once without canceling out any voices. These systems also require technical staff to operate and maintain. Examples of high-end systems include Cisco's TelePresence system (**www.cisco.com**) and Polycom's RealPresence Immersive system (**www.polycom.com**).

Interestingly, in 2006, Cisco's telepresence system cost approximately $340,000 per installation, but in September 2016 the company offered its system for approximately $34,000. This steep decline in pricing is a good example of Moore's Law in action. (See Technology Guide 1.)

However, having dedicated rooms where telepresence meetings take place is not particularly useful when so many employees work remotely. As a result, companies such as Fuze (**www.fuze.com**) and BlueJeans Nework (**www.bluejeans.com**) offer telepresence systems that utilize cloud computing. The cloud delivery model means that Fuze and BlueJeans provide systems that are cheaper, more flexible, and require fewer in-house technical staff to operate and maintain. Fuze and BlueJeans can also deliver their telepresence systems to any device, including smartphones, tablets, and laptop and desktop computers.

Monthly telepresence subscription fees for Fuze and BlueJeans cost $10 to $15 per user per month. In response, Cisco is now offering cloud-based telepresence systems at monthly rates of $25 per user and high-end, conference room telepresence systems at monthly rates of $5,100 per user.

H.O Marketwire Photos/NewsCom

FIGURE 6.11 **Telepresence system.**

Before you go on . . .

1. Describe virtual collaboration and why it is important to you.
2. Define crowdsourcing and provide two examples of crowdsourcing not mentioned in this section.
3. Identify the business conditions that have made videoconferencing more important.

6.7 Network Applications: Educational

The fourth major category of network applications consists of education applications. In this section, we discuss e-learning, distance learning, and virtual universities.

E-Learning and Distance Learning

E-learning and **distance learning** are not the same thing, but they do overlap. E-learning refers to learning supported by the web. It can take place inside classrooms as a support to conventional teaching, such as when students work on the web during class. It also can take place in virtual classrooms, in which all coursework is completed online and classes do not meet face to face. In these cases, e-learning is a part of distance learning. Distance learning (DL) refers to any learning situation in which teachers and students do not meet face to face.

Today, the web provides a multimedia interactive environment for self-study. Web-enabled systems make knowledge accessible to those who need it, when they need it, any time, anywhere. For this reason, e-learning and DL can be useful for both formal education and corporate training.

There are many benefits of e-learning. For example, online materials can deliver very current content that is of high quality (created by content experts) and consistent (presented the same way every time). It also gives students the flexibility to learn at any place, at any time, and at their own pace. In corporate training centers that use e-learning, learning time generally is shorter, which means that more people can be trained within a given time frame. This system reduces training costs and eliminates the expense of renting facility space.

Despite these benefits, e-learning has some drawbacks. For one, students must be computer literate. Also, they may miss the face-to-face interaction with instructors and fellow students. Accurately assessing students' work can also be problematic because instructors really do not know who completed the assignments.

E-learning does not usually replace the classroom setting. Rather, it enhances it by taking advantage of new content and delivery technologies. Advanced e-learning support environments, such as Blackboard (**www.blackboard.com**), add value to traditional learning in higher education.

A new form of distance learning has recently appeared, called *massive open online courses* or *MOOCs*. MOOCs are a tool for democratizing higher education. Several factors have contributed to the growth of MOOCs, including improved technology and the rapidly increasing costs of traditional universities. MOOCs are highly automated, complete with computer-graded assignments and exams.

MOOCs have not yet proved that they can effectively teach the thousands of students who enroll in them. They also do not provide revenues for universities. Furthermore, MOOCs can register a mixture of high school students, retirees, faculty, enrolled students, and working professionals. Designing a course that adequately meets the needs of such a diverse student population is difficult. Finally, although initial registrations for a MOOC might exceed 100,000 students, completion rates in any one MOOC tend to be less than 10 percent of that.

Hundreds of thousands of students around the world who lack access to universities are using MOOCs to acquire sophisticated skills and high-paying jobs without having to pay tuition or obtain a college degree. **IT's About Business 6.4** takes a closer look at MOOCs in India.

IT's About Business 6.4

Massive Open Online Courses in India

MIS

There are 3.2 million students attending India's 35,000 universities. Professors are in such short supply that there aren't enough to teach everyone in person. Some rural universities cannot even provide essential courses. In many universities, first-year courses are taught by instructors with just a bachelor's degree. Furthermore, a degree from most of India's post-secondary institutions does not mean a great deal to international employers. India's best hope to address this problem is a greater role for online education.

Today, many fields, particularly ones in technical areas, are embracing online education for career advancement. Indian students account for about 8 percent of global enrollment in Coursera (**www.coursera.org**) and 12 percent in edX (**www.edx.org**), the top suppliers of massive open online courses, or MOOCs. Enrollment is the highest among students from the United States, which also produces the most popular MOOCs. Coursera's most popular course in India teaches students how to develop mobile Android applications, courtesy of the University of Maryland. After that course, come Python programming courses from the University of Michigan and Rice University, followed by a Stanford University class on machine learning.

When MOOCs became popular in 2012, they were expected to be revolutionary, but the reality is different in the United States and Europe. Instead of replacing traditional undergraduate programs, MOOCs in developed countries are most popular among people keen to study specific subjects.

Among college students and recent graduates in India, online courses from the United States and Europe are immensely popular. They see studying certain technical subjects as a means of advancing in their careers. They are also often willing to pay $20 to $250 for a certificate demonstrating they passed a final exam.

Consider one Indian student who took his country's most difficult college placement test, the Indian Institutes of Technology (IIT) Joint Entrance Exam. Fewer than 3 percent of the more than 300,000 people who took the test were offered a place at one of the elite Indian Institutes of Technology. This student's score, which placed him in the top 1 percent of exam-takers, gained him entrance to IIT Delhi (**www.iitd.ac.in**). But he didn't place high enough to qualify for the institute's most competitive degree program, computer science. As a result, he was advised to take civil engineering instead.

He took civil engineering courses, but he didn't want to be a civil engineer, so he took several management courses as well. As a result, when he graduated, he landed a job at Wipro (**www.wipro.com**), a top Indian high-tech firm. He then enrolled in three data science MOOCs from Coursera, all offered by Johns Hopkins professors. By completing certificates from the courses, he gained the attention of Dunnhumby (**www.dunnhumby.com**), one of England's biggest customer-analytics companies. He was hired by them as a senior analyst, located in Delhi.

Companies such as Google, Wipro, Infosys, Infineon, and Microsoft have hired Indian engineers who completed online courses. Thousands of Indian engineers count prestigious U.S. institutions such as Stanford, MIT, and Carnegie Mellon among their credentials, based entirely on their having completed MOOCs taught by professors at those universities.

Wanting to prove that India can offer its own advanced online courses that could compete with those from the United States, in 2014 the Ministry of Human Resources Development announced intentions to launch its own MOOC service, called Swayam. As of June 2015, Swayam had rolled out only three courses. By way of comparison, Coursera and edX each offers more than 500 courses.

Significantly, Indian professors have noted several limitations in MOOCs. They maintain that the technology is the easy part. The greater challenge is to free up time in their schedules so that India's best professors can create worthwhile MOOCs. Another problem is institutions' hesitation to grant academic credit for online learning.

Indian professors have also found that it is difficult to assess the level of their students' grasp of the material. The MOOC necessitates that professors develop assignments and exams that can be marked by machine, which biases the material to be more superficial than would be the case in a traditional classroom. The professors have determined that people taking a MOOC mostly gain an "awareness" of a topic rather than acquiring in-depth knowledge.

The All India Council for Technical Education is working to revise its regulations so that students could take up to 15 percent of their credits online. One guideline would permit remote colleges to use a hybrid approach, in which online education enhances live lectures. That model has been incorporated into the 2015–2016 academic year, with 50 Indian institutes partnering with IIT Bombay to offer hybrid MOOCs in three subjects: Introduction to Computer Programming, Thermodynamics, and Quantum Mechanics and Quantum Computation.

MOOCs continue to gain in importance in India. In 2016, there were 1.3 million people in India taking Coursera classes.

Sources: Compiled from A. Lequerica, "MOOCWatch May 2016: MOOCs Rapidly Expanding in India," *Class Central*, May 31, 2016; "Bengaluru Tops the Chart of Online Learning in India: Coursera," *The Indian Express*, May 2, 2016; P. Newton, "How MOOCs Are Impacting India's Business Education," *IntelligenceHQ*, August 12, 2015; G. Anders, "India Loves MOOCs," *MIT Technology Review*, July 27, 2015; "SWAYAM—MOOC Initiative by India," *EduWire*, June 7, 2015; "Can MOOCs Improve India's Higher Education?" *discover.isif.asia*, May 26, 2015; F. Nisha and V. Senthil, "MOOCs: Changing Trend Towards Open Distance Learning with Special Reference to India," *Journal of Library & Information Technology*, March 2015; P. Bharti, "Indian HRD Ministry Launches a MOOC Platform—SWAYAM," *EdTechReview*, October 16, 2014; D. Shah, "India Announces Official MOOC Platform 'Swayam'," *Class Central*, August 26, 2014; A. Vishnoi, "MOOCs Platform: PM Narendra Modi's Gift to Nation on I-Day," *India Today*, August 12, 2014; C. Fox, "Higher, Open Education for India," *OpenSource.com*, August 29, 2013; M. Nair, "MOOCs Click with Indians," *The Times of India*, August 18, 2013.

Questions

1. **Discuss possible quality control issues with MOOCs in India. For each issue, explain how you would solve the problem.**
2. **Discuss the possible impacts of MOOCs on traditional higher education in India.**
3. **Would you be willing to enroll in a MOOC as a full-time student at your university? Why or why not?**
4. **Would you be willing to enroll in a MOOC after you graduate? Why or why not?**

Virtual Universities

Virtual universities are online universities in which students take classes on the Internet either at home or in an offsite location. A large number of existing universities offer online education of some form. Some universities, such as the University of Phoenix (**www.phoenix.edu**), California Virtual Campus (**www.cvc.edu**), and the University of Maryland (**www.umuc.edu**), offer thousands of courses and dozens of degrees to students worldwide, all of them online. Other universities offer limited online courses and degrees, but they employ innovative teaching methods and multimedia support in the traditional classroom.

Before you go on . . .

1. Describe the differences between e-learning and distance learning.
2. What are virtual universities? Would you be willing to attend a virtual university? Why or why not?

What's in IT for me?

ACCT For the Accounting Major

Accounting personnel use corporate intranets and portals to consolidate transaction data from legacy systems to provide an overall view of internal projects. This view contains the current costs charged to each project, the number of hours spent on each project by individual employees, and an analysis of how actual costs compare with projected costs. Finally, accounting personnel use Internet access to government and professional websites to stay informed on legal and other changes affecting their profession.

FIN For the Finance Major

Corporate intranets and portals can provide a model to evaluate the risks of a project or an investment. Financial analysts use two types of data in the model: historical transaction data from corporate databases through the intranet and industry data obtained through the Internet. Financial services firms can also use the web for marketing and to provide services.

MKT For the Marketing Major

Marketing managers use corporate intranets and portals to coordinate the activities of the sales force. Sales personnel access corporate portals through the intranet to discover updates on pricing, promotion, rebates, customer information, and information about competitors. Sales staff can also download and customize presentations for their customers. The Internet, particularly the web, opens a completely new marketing channel for many industries. Just how advertising, purchasing, and information dispensation should occur appears to vary from industry to industry, product to product, and service to service.

POM For the Production/Operations Management Major

Companies are using intranets and portals to speed product development by providing the development team with three-dimensional models and animation. All team members can access the models for faster exploration of ideas and enhanced feedback. Corporate portals, accessed through intranets, enable managers to carefully supervise their inventories as well as real-time production on assembly lines. Extranets are also proving valuable as communication formats for joint research and design efforts among companies. The Internet is also a great source of cutting-edge information for POM managers.

HRM For the Human Resources Management Major

Human resources personnel use portals and intranets to publish corporate policy manuals, job postings, company telephone directories, and training classes. Many companies deliver online training obtained from the Internet to employees through their intranets. Human resources departments use intranets to offer employees healthcare, savings, and benefit plans, as well as the opportunity to take competency tests online. The Internet supports worldwide recruiting efforts; it can also be the communications platform for supporting geographically dispersed work teams.

MIS For the MIS Major

As important as the networking technology infrastructure is, it is invisible to users (unless something goes wrong). The MIS function is responsible for keeping all organizational networks up and running all the time. MIS personnel, therefore, provide all users with an "eye to the world" and the ability to compute, communicate, and collaborate any time, anywhere. For example, organizations have access to experts at remote locations without having to duplicate that expertise in multiple areas of the firm. Virtual teaming allows experts physically located in different cities to work on projects as though they were in the same office.

Summary

1. Compare and contrast the two major types of networks.

The two major types of networks are local area networks (LANs) and wide area networks (WANs). LANs encompass a limited geographical area and are usually composed of one communications medium. In contrast, WANs encompass a broad geographical area and are usually composed of multiple communications media.

2. Describe the wireline communications media and channels.

Twisted-pair wire, the most prevalent form of communications wiring, consists of strands of copper wire twisted in pairs. It is relatively inexpensive to purchase, widely available, and easy to work with. However, it is relatively slow for transmitting data, it is subject to interference from other electrical sources, and it can be easily tapped by unintended recipients.

Coaxial cable consists of insulated copper wire. It is much less susceptible to electrical interference than is twisted-pair wire and it can carry much more data. However, coaxial cable is more expensive and more difficult to work with than twisted-pair wire. It is also somewhat inflexible.

Fiber-optic cables consist of thousands of very thin filaments of glass fibers that transmit information by way of pulses of light generated by lasers. Fiber-optic cables are significantly smaller and lighter than traditional cable media. They can also transmit far more data, and they provide greater security from interference and tapping. Fiber-optic cable is often used as the backbone for a network, whereas twisted-pair wire and coaxial cable connect the backbone to individual devices on the network.

3. Describe the most common methods for accessing the Internet.

Common methods for connecting to the Internet include dial-up, DSL, cable modem, satellite, wireless, and fiber to the home.

4. Explain the impact that discovery network applications have had on business and everyday life.

Discovery involves browsing and information retrieval, and provides users the ability to view information in databases, download it, and process it. Discovery tools include search engines, directories, and portals. Discovery tools enable business users to efficiently find needed information.

5. Explain the impact that communication network applications have had on business and everyday life.

Networks provide fast, inexpensive *communications,* through e-mail, call centers, chat rooms, voice communications, and blogs. Communications tools provide business users with a seamless interface among team members, colleagues, business partners, and customers.

Telecommuting is the process whereby knowledge workers are able to work anywhere and any time. Telecommuting provides flexibility for employees, with many benefits and some drawbacks.

6. Explain the impact that collaboration network applications have had on business and everyday life.

Collaboration refers to mutual efforts by two or more entities (individuals, groups, or companies) that work together to accomplish tasks. Collaboration is enabled by workflow systems. Collaboration tools enable business users to collaborate with colleagues, business partners, and customers.

7. Explain the impact that educational network applications have had on business and everyday life.

E-learning refers to learning supported by the web. Distance learning refers to any learning situation in which teachers and students do not meet face to face. E-learning provides tools for business users to facilitate their lifelong learning aspirations.

Virtual universities are online universities in which students take classes on the Internet at home or an offsite location. Virtual universities make it possible for students to obtain degrees while working full time, thus increasing their value to their firms.

Chapter Glossary

affinity portal A website that offers a single point of entry to an entire community of affiliated interests.

analog signals Continuous waves that transmit information by altering the amplitude and frequency of the waves.

backbone networks High-speed central networks to which multiple smaller networks (e.g., LANs and smaller WANs) connect.

bandwidth The transmission capacity of a network, stated in bits per second.

broadband The transmission capacity of a communications medium faster than 25 Mbps.

broadcast media (also called wireless media) Communications channels that use electromagnetic media (the "airwaves") to transmit data.

browsers Software applications through which users primarily access the web.

cable media (also called wireline media) Communications channels that use physical wires or cables to transmit data and information.

chat room A virtual meeting place in which groups of regulars come to talk among themselves electronically.

clients Computers, such as users' personal computers, that use any of the services provided by servers.

client/server computing Form of distributed processing in which some machines (servers) perform computing functions for end-user PCs (clients).

coaxial cable Insulated copper wire; used to carry high-speed data traffic and television signals.

collaboration Mutual efforts by two or more individuals who perform activities to accomplish certain tasks.

commercial (public) portal A website that offers fairly routine content for diverse audiences. It offers customization only at the user interface.

communications channel Pathway for communicating data from one location to another.

computer network A system that connects computers and other devices through communications media so that data and information can be transmitted among them.

corporate portal A website that provides a single point of access to critical business information located inside and outside of an organization.

crowdsourcing A process in which an organization outsources a task to an undefined, generally large group of people in the form of an open call.

digital signals A discrete pulse, either on or off, that conveys information in a binary form.

distance learning (DL) Learning situations in which teachers and students do not meet face to face.

distributed processing Network architecture that divides processing work between two or more computers, linked together in a network.

domain names The name assigned to an Internet site, consisting of multiple parts, separated by dots, which are translated from right to left.

domain name system (DNS) The system administered by the Internet Corporation for Assigned Names (ICANN) that assigns names to each site on the Internet.

e-learning Learning supported by the web; can be done inside traditional classrooms or in virtual classrooms.

enterprise network An organization's network composed of interconnected multiple LANs and WANs.

Ethernet A common local area network protocol.

extranet A network that connects parts of the intranets of different organizations.

fiber-optic cable A communications medium consisting of thousands of very thin filaments of glass fibers, surrounded by cladding, that transmit information through pulses of light generated by lasers.

file server (also called network server) A computer that contains various software and data files for a local area network and contains the network operating system.

hyperlink A connection from a hypertext file or document to another location or file, typically activated by clicking on a highlighted word or image on the screen, or by touching the screen.

hypertext Text displayed on a computer display with references, called hyperlinks, to other text that the reader can immediately access.

Hypertext Transport Protocol (HTTP) The communications standard used to transfer pages across the WWW portion of the Internet; defines how messages are formulated and transmitted.

industrywide portal A web-based gateway to information and knowledge for an entire industry.

Internet (the Net) A massive global WAN that connects approximately 1 million organizational computer networks in more than 200 countries on all continents.

Internet backbone The primary network connections and telecommunications lines that link the computers and organizational nodes of the Internet.

Internet Protocol (IP) A set of rules responsible for disassembling, delivering, and reassembling packets over the Internet.

Internet Protocol (IP) address An assigned address that uniquely identifies a computer on the Internet.

Internet service provider (ISP) A company that provides Internet connections for a fee.

Internet telephony (Voice-over-Internet Protocol, or VoIP) The use of the Internet as the transmission medium for telephone calls.

Internet2 A new, faster telecommunications network that deploys advanced network applications such as remote medical diagnosis, digital libraries, distance education, online simulation, and virtual laboratories.

intranet A private network that uses Internet software and TCP/IP protocols.

local area network (LAN) A network that connects communications devices in a limited geographic region, such as a building, so that every user device on the network can communicate with every other device.

metasearch engine A computer program that searches several engines at once and integrates the findings of the various search engines to answer queries posted by users.

modem Device that converts signals from analog to digital and vice versa.

network access points (NAPs) Computers that act as exchange points for Internet traffic and determine how traffic is routed.

network server See **file server**.

packet switching The transmission technology that divides blocks of text into packets.

peer-to-peer (P2P) processing A type of client/server distributed processing that allows two or more computers to pool their resources, making each computer both a client and a server.

portal A web-based personalized gateway to information and knowledge that provides information from disparate information systems and the Internet, using advanced search and indexing techniques.

protocol The set of rules and procedures governing transmission across a network.

router A communications processor that routes messages from a LAN to the Internet, across several connected LANs, or across a wide area network such as the Internet.

search engine A computer program that searches for specific information by keywords and reports the results.

servers Computers that provide access to various network services, such as printing, data, and communications.

telecommuting A work arrangement whereby employees work at home, at the customer's premises, in special workplaces, or while traveling, usually using a computer linked to their place of employment.

teleconferencing The use of electronic communication that allows two or more people at different locations to have a simultaneous conference.

Transmission Control Protocol/Internet Protocol (TCP/IP) A file transfer protocol that can send large files of information across sometimes unreliable networks with the assurance that the data will arrive uncorrupted.

twisted-pair wire A communications medium consisting of strands of copper wire twisted together in pairs.

unified communications Common hardware and software platform that simplifies and integrates all forms of communications—voice, e-mail, instant messaging, location, and videoconferencing—across an organization.

uniform resource locator (URL) The set of letters that identifies the address of a specific resource on the web.

videoconference A virtual meeting in which participants in one location can see and hear participants at other locations and can share data and graphics by electronic means.

virtual collaboration The use of digital technologies that enable organizations or individuals to collaboratively plan, design, develop, manage, and research products, services, and innovative information systems and electronic commerce applications.

virtual group (team) A workgroup whose members are in different locations and who meet electronically.

virtual universities Online universities in which students take classes on the Internet at home or at an offsite location.

Voice-over-Internet Protocol (VoIP) See **Internet telephony**.

website Collectively, all of the web pages of a particular company or individual.

wide area network (WAN) A network, generally provided by common carriers, that covers a wide geographical area.

wireless media See **broadcast media**.

wireline media See **cable media**.

workgroup Two or more individuals who act together to perform a task, on either a permanent or on a temporary basis.

workflow The movement of information as it flows through the sequence of steps that make up an organization's work procedures.

World Wide Web (the web, WWW, or W3) A system of universally accepted standards for storing, retrieving, formatting, and displaying information through a client/server architecture; it uses the transport functions of the Internet.

Problem-Solving Activities

1. Calculate how much bandwidth you consume when using the Internet every day. How many e-mails do you send daily and what is the size of each? (Your e-mail program may have e-mail file size information.) How many music and video clips do you download (or upload) daily and what is the size of each? If you view YouTube often, surf the web to find out the size of a typical YouTube file. Add up the number of e-mail, audio, and video files you transmit or receive on a typical day. When you have calculated your daily Internet usage, determine if you are a "normal" Internet user or a "power" Internet user. What impact does network neutrality have on you as a "normal" user? As a "power" user?
2. Access several P2P applications, such as SETI@home. Describe the purpose of each application, and indicate which ones you would like to join.

3. Access **http://ipv6.com** and **www.ipv6news.info** and learn about more the advantages of IPv6.

4. Access **www.icann.org** and learn more about this important organization.

5. Set up your own website using your name for the domain name (e.g., KellyRainer).

   a. Explain the process for registering a domain.

   b. Which top-level domain will you use and why?

6. Access **www.icann.org** and obtain the name of an agency or company that can register a domain for the TLD that you selected. What is the name of that agency or company?

7. Access the website for that agency or company (in question 6) to learn the process that you must use. How much will it initially cost to register your domain name? How much will it cost to maintain that name in the future?

8. You plan to take a two-week vacation to Australia this year. Using the Internet, find information that will help you plan the trip. Such information includes, *but is not limited to,* the following:

   a. Geographical location and weather conditions at the time of your trip

   b. Major tourist attractions and recreational facilities

   c. Travel arrangements (airlines, approximate fares)

   d. Car rental; local tours

   e. Alternatives for accommodation (within a moderate budget) and food

   f. Estimated cost of the vacation (travel, lodging, food, recreation, shopping, etc.)

   g. Country regulations regarding the entrance of your dog

   h. Shopping

   i. Passport information (either to obtain one or to renew one)

   j. Information on the country's language and culture

   k. What else do you think you should research before going to Australia?

9. Visit the websites of companies that manufacture telepresence products for the Internet. Prepare a report. Differentiate between telepresence products and videoconferencing products.

10. Access Google (or YouTube) videos and search for "Cisco Magic." This video shows Cisco's next-generation telepresence system. Compare and contrast it with current telepresence systems.

11. Access the website of your university. Does the website provide high-quality information (the right amount, clear, accurate, etc.)? Do you think a high school student who is thinking of attending your university would feel the same way as you?

12. Compare and contrast Google Sites (**www.google.com/sites**) and Microsoft Office Live (**www.liveoffice.com**). Which site would you use to create your own website? Explain your choice.

13. Access the website of the Recording Industry Association of America (**www.riaa.com**). Discuss what you find there regarding copyright infringement (i.e., downloading music files). How do you feel about the RIAA's efforts to stop music downloads? Debate this issue from your point of view and from the RIAA's point of view.

14. Research the companies involved in Internet telephony (Voice-over IP). Compare their offerings as to price, necessary technologies, ease of installation, and so on. Which company is the most attractive to you? Which company might be the most attractive for a large company?

15. Access various search engines other than Google. Search for the same terms on several of the alternative search engines and on Google. Compare the results on breadth (number of results found) and precision (results are what you were looking for).

16. Second Life (**www.secondlife.com**) is a three-dimensional, online world built and owned by its residents. Residents of Second Life are avatars who have been created by real people. Access Second Life, learn about it, and create your own avatar to explore this world. Learn about the thousands of people who are making "real-world" money from operations in Second Life.

17. Access Microsoft's Bing translator (http://**www.microsofttranslator.com**) or Google (**www.google.com/language_tools**) translation pages. Type in a paragraph in English and select, for example, English-to-French. When you see the translated paragraph in French, copy it into the text box, and select French-to-English. Is the paragraph that you first entered the same as the one you are looking at now? Why or why not? Support your answer.

Closing Case

MIS The Network Neutrality Battles Continue

The Problem

The number of users uploading and downloading huge files such as videos continues to rapidly increase. By the end of 2016, Internet traffic will have reached approximately 90 exabytes per month. The vast majority of that traffic consists of video uploads, downloads, and streaming.

The Internet bandwidth issue is as much about economics as it is about technology. Currently, consumers can send 1-kilobyte e-mails or watch the latest 30-gigabyte movie on their large-screen televisions for the same monthly broadband charge. Unlike the system used for power and water, bills where higher usage results in higher fees, monthly broadband fees are not tied to consumer usage.

A study from Juniper Networks (**www.juniper.net**) highlights this "revenue-per-bit" problem. The report predicts that Internet revenue for carriers such as AT&T (**www.att.com**) and Comcast (**www.comcast.com**) will grow by 5 percent per year through 2020. At the same time, Internet traffic will increase by 27 percent annually, meaning that carriers will have to increase their bandwidth investment by

20 percent per year just to keep up with demand. Under this model, the carriers' total necessary investment will eventually exceed revenue growth.

Few industry analysts expect carriers to stop investing in new capacity, but analysts agree that financial problems are coming. As Internet traffic increases, analysts expect revenue per megabit to decrease. These figures translate into a lower return on investment (ROI). Although carriers can find ways to increase their capacity, it will be difficult for them to gain any revenue benefits from doing so.

The heart of the problem is that, even if the technology is equal to the task of transmitting huge amounts of data, no one is sure how to pay for these technologies. One proposed solution is to eliminate network neutrality.

A Possible Solution

Network neutrality is an operating model under which Internet service providers (ISPs) must allow customers equal access to content and applications, regardless of the source or nature of the content. That is, Internet backbone carriers must treat all web traffic equally, not charging different rates by user, content, site, platform, or application.

Telecommunications and cable companies (the ISPs) want to replace network neutrality with an arrangement in which they can charge differentiated prices based on the amount of bandwidth consumed by the content that is being delivered over the Internet. The ISPs believe that differentiated pricing is the most equitable method by which they can finance the necessary investments in their network infrastructures.

The ISPs further contend that network neutrality hinders U.S. international competitiveness by decreasing innovation and discouraging capital investments in new network technologies. Without such investments and innovations, the ISPs state that they will be unable to handle the increasing demand for wired and wireless Internet data transmission.

From the opposite perspective, proponents of network neutrality are petitioning Congress to regulate the industry. They argue that the risk of censorship increases when network providers can selectively block or slow access to certain content, such as access to competing low-cost services like Skype and Vonage. They also assert that a neutral Internet encourages innovation. Finally, they contend that the neutral Internet has helped create many new businesses.

Most analysts expect that users who consume the most data eventually will have to pay more, most likely in the form of tiered pricing plans. Americans, however, have never had to contend with limits on the amount of data they upload and download, so there may be pushback from users.

On December 21, 2010, the Federal Communications Commission (FCC; **www.fcc.gov**) approved network neutrality rules that prohibited wireline-based broadband providers—but not mobile broadband providers—from engaging in "unreasonable discrimination" against web traffic. These rules are known as the Open Internet Order.

The Results

In 2012, Verizon initiated a legal action against the FCC, claiming that the agency had overstepped its authority and that its network neutrality rules were unconstitutional. Verizon may have had a point. The FCC could regulate the physical infrastructure over which packets travel on the network. It was less clear, however, whether the agency could also regulate the actual service or content that those packets deliver.

In January 2014, Verizon won a partial victory in its appeal of the FCC's Open Internet Order. The U.S. Court of Appeals for the Washington D.C. circuit rejected Verizon's claim that the FCC lacks jurisdiction over broadband providers. However, the court also ruled that the FCC cannot regulate broadband service providers the same way that it regulates telephone companies. This ruling suggested that network neutrality could not be enforced without further legislative intervention.

On February 23, 2014, Netflix agreed to a deal with Comcast to ensure that its movies and TV shows stream more quickly. This agreement demonstrated a shift in the balance of power in favor of ISPs and the likelihood of rising prices for consumers.

On May 15, 2014, the FCC decided to consider two options regarding the network neutrality issue: (1) permit fast and slow broadband lanes, which would compromise network neutrality; or (2) reclassify broadband as a telecommunications service, which would preserve network neutrality.

In 2015, the FCC chose the second options. Two main points of the 2015 network neutrality rules are as follows:

- The FCC changed the classification of broadband from an "information service" to a "telecommunications service." This rule allowed the FCC to begin regulating ISPs under the stricter laws that govern common carriers—service providers that transport goods or people, such as airlines, trucking companies, and telephone companies.
- The FCC rules prohibit the blocking of content, the slowing of transmissions (throttling), and the creation of "fast lanes" (that is, no paid prioritization). Paid prioritization refers to the management of a broadband provider's network to directly or indirectly favor one type of data traffic over another type through preferential traffic management. The rules apply to both fixed and mobile broadband Internet access service.

It is uncertain how FCC regulators will address the practice of "zero rating," in which wireless providers allow customers to use certain applications without having the data from those applications count against data usage caps. Some say this arrangement violates network neutrality.

In June 2016, a federal court ruled that broadband Internet service can be defined as a utility, clearing the way for more rigorous policing of broadband providers and greater protection for Internet users. The decision affirmed the government's view that broadband is as essential as the telephone and should be available to all Americans, rather than a luxury that does not need close government supervision. The court's decision upheld the FCC on the declaration of broadband as a utility.

As of November 2016, the court's decision limits the ability of broadband providers such as Comcast and Verizon to deliver certain content over the Internet at slower speeds. For example, ISPs could slow the transmission streams of Netflix or YouTube. Such business decisions by broadband providers would have created fast and slow lanes on the Internet, subjecting businesses and consumers to extra charges and limited access to online content.

The court's ruling also created a path for new limits on broadband providers beyond network neutrality. In April 2016, for example, the FCC proposed privacy rules for broadband providers, limiting their ability to collect and share data about their subscribers.

The legal battle over network neutrality continues. The cable and telecommunications industries intend to challenge any unfavorable decision, probably taking the case to the U.S. Supreme Court.

Federal Communication Commission chairman Tom Wheeler resigned on January 20, 2017. His resignation will likely give the Republican party a majority of the commission, and network neutrality could be undone.

Sources: Compiled from K. Finley, "Tom Wheeler Resigns from the FCC—So Long, Net Neutrality," *Wired*, December 15, 2016; M. Orcutt, "Three Big Questions Hanging over Net Neutrality," *MIT Technology Review*, August 19, 2016; C. Kang, "Court Backs Rules Treating Internet as Utility, Not Luxury," *New York Times*, June 14, 2016; T. Simonite, "India's Blow Against Facebook Sets Up a Grand Experiment in Net Neutrality," *MIT Technology Review*, February 8, 2016; J. Kastrenakes, "The FCC's Net Neutrality Rules Are Now in Effect," *The Verge*, June 12, 2015; R. Ruiz, "F.C.C. Sets Net Neutrality Rules," *New York Times*, March 12, 2015; J. Sommer, "What the Net Neutrality Rules Say," *New York Times*, March 12, 2015; J. Kastrenakes, "These Are the FCC's Rules for Protecting Net Neutrality," *The Verge*, March 12, 2015; R. Ruiz and S. Lohr, "F.C.C. Approves Net Neutrality Rules, Classifying Broadband Internet Service as a Utility," *New York Times*, February 26, 2015; "Searching for Fairness on the Internet," *New York Times*, May 15, 2014; D. Talbot, "Is Netflix Slowing Down? Good Luck Finding out Why," *MIT Technology Review*, February 21, 2014; B. Butler, "Verizon Denies Throttling Amazon's Cloud, Netflix Services," *Network World*, February 5, 2014; J. Feldman, "Net Neutrality: Regulation Makes Evil Empire Giggle," *Information Week*, January 17, 2014; J. Brodkin, "Time Warner, Net Neutrality Foes Cry Foul over Netflix Super HD Demands," *Ars Technica*, January 17, 2013; M. Reardon, "Verizon to FCC: Free Speech Trumps Net Neutrality Rules," *CNET News*, July 3, 2012; W. Plank, "Confessions of an iPhone Data Hog," the *Wall Street Journal*, January 27, 2012; L. Segall, "Verizon Challenges FCC Net Neutrality Rules," *CNN Money*, January 21, 2011; www.fcc.gov, accessed November 19, 2016.

Questions

1. Are the ISPs correct in claiming that network neutrality will limit the development of new technologies? Support your answer.
2. Are the content providers (e.g., Netflix) correct in claiming that eliminating network neutrality will encourage censorship by the ISPs? Support your answer.
3. Are the content providers correct in claiming that eliminating network neutrality will result in consumers paying higher prices for content they watch over the Internet? Support your answer.