CHAPTER 6

Telecommunications and Networking

CHAPTER OUTLINE	LEARNING OBJECTIVES
6.1 What Is a Computer Network?	**6.1** Compare and contrast the two 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: Education	**6.7** Explain the impact that educational network applications have had on business and everyday life.

Opening Case

Case 6.1 Myanmar Suddenly Goes Online

Myanmar—formerly known as Burma—is a largely Buddhist country of 51 million people located in southeast Asia. In 2014, less than 1 percent of the population had Internet access. By 2017, the country was rapidly getting online—but so was false news and anti-Muslim sentiment.

For nearly 50 years, Myanmar lived under military dictatorships that suppressed all forms of dissent and severely limited free speech. In response to these repressive policies, the international community, including Canada, the United States, and Europe, imposed strict sanctions that largely cut off the country from the rest of the world. That situation changed in 2011, when the military junta was officially dissolved, and a civilian government was established.

In Myanmar, as recently as 2011 a SIM card for a mobile phone could cost more than $3,000, and it was available only to people with government connections. A few Internet cafés existed, most of them in the capital, but they were far too expensive for the average person. The International Monetary Fund (**www.imf.org**) estimated that fewer than 0.2 percent of the population was online.

In the years immediately following the easing of military rule, Internet use rose slowly. Then in 2014, Myanmar allowed international telecommunications companies to operate in the country. The result

was that Internet use increased explosively. For instance, subscribers to the telecommunications firm Ericsson (**www.ericsson.com**) mushroomed from several thousand in 2011 to more than 35 million by 2018. The mobile service providers offer data plans that enable customers to access social media inexpensively with their smartphones.

The sudden availability of the Internet to the general public has led to drastic changes in the country. The Internet has revolutionized life for the people of Myanmar, from how they interact with one another to how they obtain their news, which they used to get almost exclusively from the regulated state media.

Here is how the average person connects to the Internet. They go to a shop that sells mobile phones and accessories. For about $3, a salesperson does two things for each customer: sets up an email address for the customer, and opens up a Facebook account in any name the customer wants. Salespeople note that customers do not care about email. Facebook is what they really want. If customers forget their login information for Facebook, they simply return for a new Facebook account. Nobody seems to know about Facebook's policy that users must use their real names.

Facebook's domination is so complete that people in Myanmar use "Internet" and "Facebook" interchangeably. By August 2018, over half of Myanmar's population had a Facebook account.

Although the majority of the population has Internet access, Myanmar has one of the world's lowest rates of information literacy. The term *information literacy*, or *digital literacy*, measures how well people using the Internet understand what they are doing and how to stay safe while they are online. Because the rates in Myanmar are so low, users in that country are among the most likely to fall for scams, hacks, and false news.

Mobilized by the sudden freedom of expression on online platforms such as Facebook, radical Buddhist anti-Muslim groups have quickly found supporters across the country. For instance, Ashin Wirathu is a monk who openly advocates hardline anti-Muslim positions. On his many Facebook pages, Wirathu has called for his fellow citizens to boycott Muslim businesses and for the government to expel Muslims from the country. It is difficult for him to keep the pages open, because Facebook keeps shutting them down. Despite Facebook's efforts, however, he manages to maintain a growing online following.

On August 24 and 25, 2018, Rohingya militants attacked military and police bases, prompting the government to launch a "clearance operation" that eventually forced some 1 million Rohingya into refugee camps in Bangladesh. Hate speech targeting the Rohingya exploded on Facebook at the time of the attack. Using Facebook in Myanmar to spread hate speech and misinformation has taken on great urgency as the United Nations calls the Rohingya refugee camps in Bangladesh a humanitarian crisis.

Civil rights groups in Myanmar are demanding that Facebook increase its moderations of Burmese-language content to curb hate speech. In April 2018, Facebook founder Mark Zuckerberg told United States senators that the social media website was hiring dozens more native Burmese speakers to review hate speech posted in Myanmar. In mid-August 2018, Reuters found more than 1,000 examples of posts, comments, images, and videos attacking the Rohingya or other Myanmar Muslims on Facebook. Almost all of these examples were in the main local language, Burmese. Significantly, some of the material discovered by Reuters had been on Facebook for as long as six years.

Facebook critics in Myanmar do not believe that the firm is doing enough. They note persistent problems, which include a slow response time to posts violating Facebook's standards and a small staff that cannot handle hate speech or understand Myanmar's cultural nuances. Furthermore, critics contend that Facebook would do even less if a small group of civil society groups did not alert the company to dangerous posts spreading on the platform.

In February 2018, Facebook did ban Wirathu. The platform has taken down pages of other organizations and monks, removing major sources of hate speech and misinformation. It is also exploring the possibility of using artificial intelligence to identify harmful content faster.

On August 27, 2018, Facebook removed 18 accounts, one Instagram account, and 52 pages that were followed by some 12 million people. Facebook also banned 20 individuals and organizations, including Myanmar's top military official. The move occurred the same day as a United Nations report accused the country's armed forces of committing war crimes against the country's Muslim Rohingya minority.

Myanmar experts predict that the number of people connected to the Internet will continue to increase (e.g., on Facebook). As a result, there are already concerns about the role that Facebook could have in the country's future elections. In the meantime, caustic posts against the Rohingya continue even as Myanmar makes preparations for the return of the refugees.

For many people in Myanmar, the Internet and Facebook brought free speech and a glimpse of Western values. However, no one told them what would happen if they actually exercised free speech. Essentially, how were people in Myanmar expected to judge what is real and what is fake?

Sources: Compiled from I. Marlow, "Facebook Bans Myanmar's Top Military Chief for Hate Speech," Bloomberg, August 27, 2018; S. Stecklow, "Why Facebook Is Losing the War on Hate Speech in Myanmar," Reuters, August 15, 2018; T. McLaughlin, "How Facebook's Rise Fueled Chaos and Confusion in Myanmar," *Wired*, July 6, 2018; A. Kuhn, "Activists in Myanmar Say Facebook Needs to Do More to Quell Hate Speech," NPR, June 14, 2018; L. Hogan and M. Safi, "Revealed: Facebook Hate Speech Exploded in Myanmar during Rohingya Crisis," *The Guardian*, April 2, 2018; F. Solomon, "Myanmar's Crisis, Bangladesh's Burden: Among the Rohingya Refugees Waiting for a Miracle," *Time*, November 23, 2017; C. Zara, "Jailed for a Facebook Poem: The Fight Against Myanmar's Draconian Defamation Laws," *Fast Company*, July 13, 2017; R. Samarajiva, "Proportion of Facebook Users in Myanmar," *LIRNEasia*, June 30, 2017; T. Sin, "Facebook Bans Racist Word 'Kalar' in Myanmar, Triggers Censorship," *Business Standard*, June 3, 2017; Y. Nitta and T. Hlahtway, "Myanmar Faces Onslaught of Social Media Fake News," *Nikkei Asian Review*, May 30, 2017; "Myanmar Says Fake News Being Spread to Destabilize Government, Vows Action," *Mizzima*, May 6, 2017; O. Schuelke, "Myanmar's Amazing Modernization," *The Diplomat*, March 22, 2017; R. Samarajiva, "Is Low Digital Literacy in Myanmar a Result of No Government Programs?" *LIRNEasia*, November 28, 2016; S. Frenkel, "This Is What Happens When Millions of People Suddenly Get the Internet," *BuzzFeed*, November 20, 2016; C. Trautwein, "Facebook Racks Up 10M Myanmar Users," *The Myanmar Times*, June 13, 2016; "Connect to Learn Takes Significant Step Toward Reaching 21,000 Students in Myanmar," Ericsson press release, January 13, 2016.

Questions

1. What is the "good news" of providing Internet access to so many citizens of Myanmar? Provide examples to support your answer.
2. What is the "bad news" of providing Internet access to so many citizens of Myanmar? Provide examples to support your answer.

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, health care), 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 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 you work in a business, then you cannot function without networks. You will need to communicate rapidly with your customers, business partners, suppliers, employees, and colleagues. 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, email, 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 key 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.

We simply cannot overemphasize the global importance of the Internet. It has truly been said that the Internet is the nervous system of our world. In fact, having fast (broadband) access to the Internet is a prerequisite for success for many people.

You begin this chapter by learning what a computer network is and by identifying the various types of networks. You then study network fundamentals. 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 less expensive. **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.* According to the Canadian Radio-television and Telecommunications Commission (CRTC) **broadband** is "an always-on, high-speed connection to the Internet through the facilities of an ISP. The term commonly refers to Internet access via cable and DSL but can include other technologies including wireless HSPDA and 1X that provide download throughput of greater than 1 Mbps."[1] This definition will change by 2021 to include transmission capacities of a communications medium (discussed later in this chapter) faster than 50 megabits per second (Mbps) for download—the transmission speed for material coming to you from an Internet server, such as a movie streamed from Netflix—and 10 Mbps for upload—the transmission speed for material that you upload to an Internet server such as a Facebook post or YouTube video. 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 metres—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 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 inexpensive communication if they are willing to accept slower speeds. A third possible combination of the three trade-offs is fast, inexpensive 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.

[1]CRTC, Information Resource Centre, Glossary: Broadband, **https://crtc.gc.ca/multites/mtwdk.exe?k=glossary-glossaire&l=60&w=1&n=1&s=5&t=2**, accessed January 31, 2020.

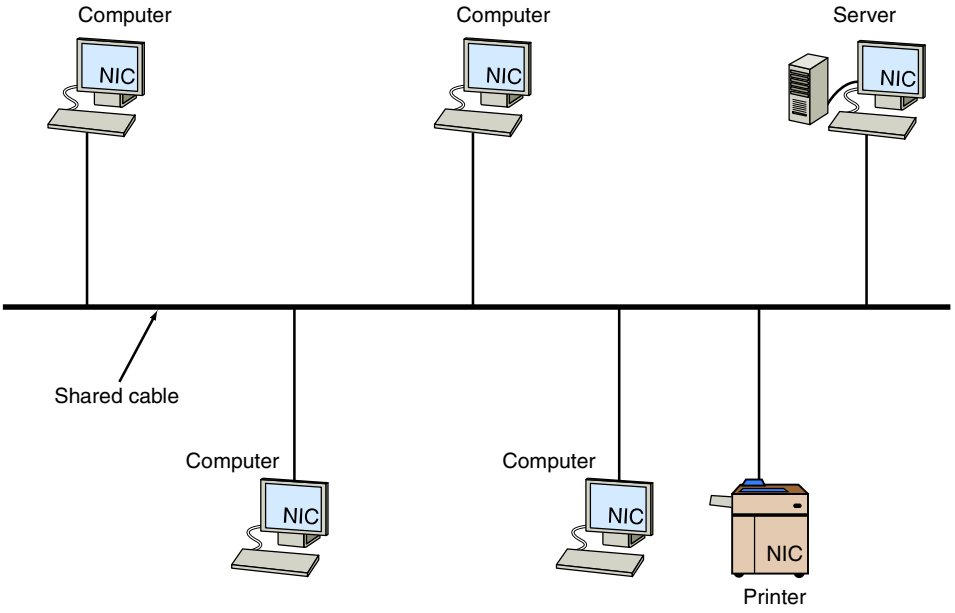


FIGURE 6.1 **Ethernet local area.**

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 Bell Canada (**www.bell.ca**) and Rogers Communications (**www.rogers.com**), AT&T (**www.att.com**) in 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., fibre-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.

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). Therefore, 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 that control how network traffic flows

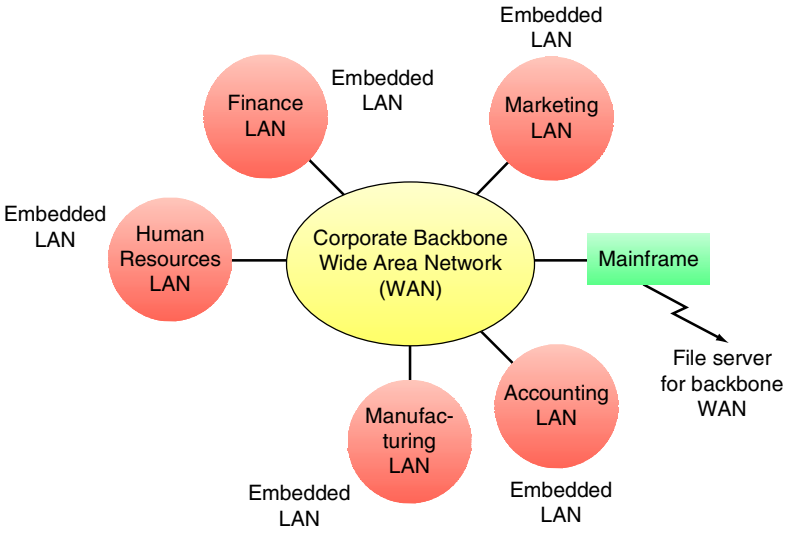


FIGURE 6.2 **Enterprise network.**

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 the 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. With this system, 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 the 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 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. *Analog signals* are continuous waves that transmit information by altering the amplitude and frequency of the waves. POTS requires *dial-up modems* to convert signals from analog to digital and vice versa. 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 to 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 neighbours 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 made up of two types of media: cable (twisted-pair wire, coaxial cable, or fibre-optic cable) and broadcast (microwave, satellite, radio, or infrared).

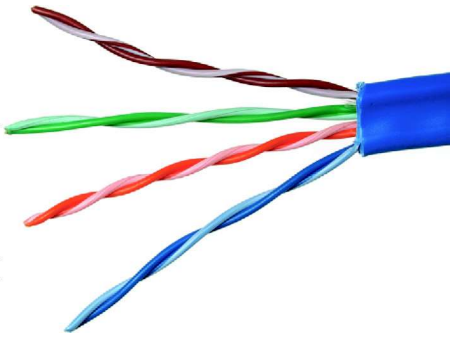
TABLE 6.1 Advantages and Disadvantages of Wireline Communications Channels

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

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 fibre-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.

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.

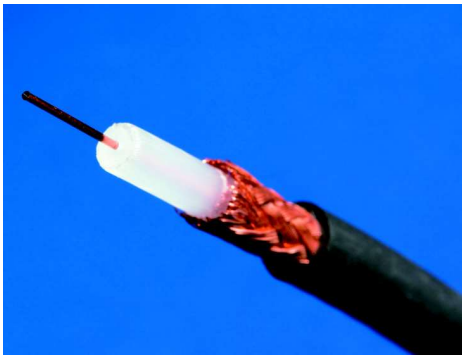


iStock.com/deepspacedave

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.



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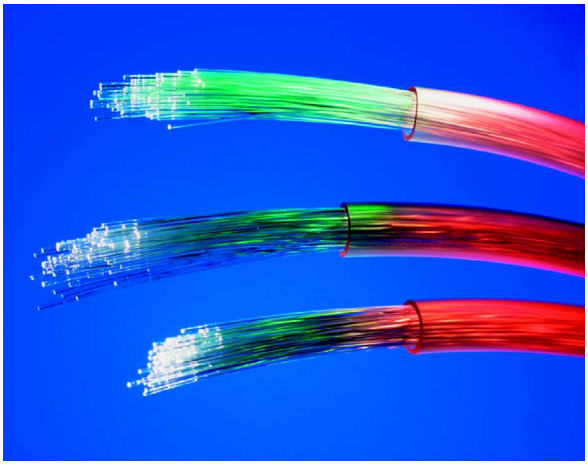
Cross-section view

How coaxial cable looks to us

iStock.com/piotr_malczyk

FIGURE 6.4 Two views of coaxial cable.



PHILLIP HAYSON/Science Source

Cross-section view

Chris Knapton/Science Source

How fibre-optic cable looks to us

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

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

Fibre-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 tapping. Fibre-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 9,000-kilometre undersea fibre-optic cable connecting Japan and the United States, became operational. FASTER transmits data at 60 terabits (trillions of bits) per second across the Pacific Ocean. Another example is MAREA, a fibre-optic cable connecting the United States and Spain and able to transmit 160 terabits per second. Google is also working on building its own subsea fibre-optic cable with a capacity of 250 terabits.

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 enables 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 the latest standard for high speed network communications based on Ethernet protocol.

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 primary 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

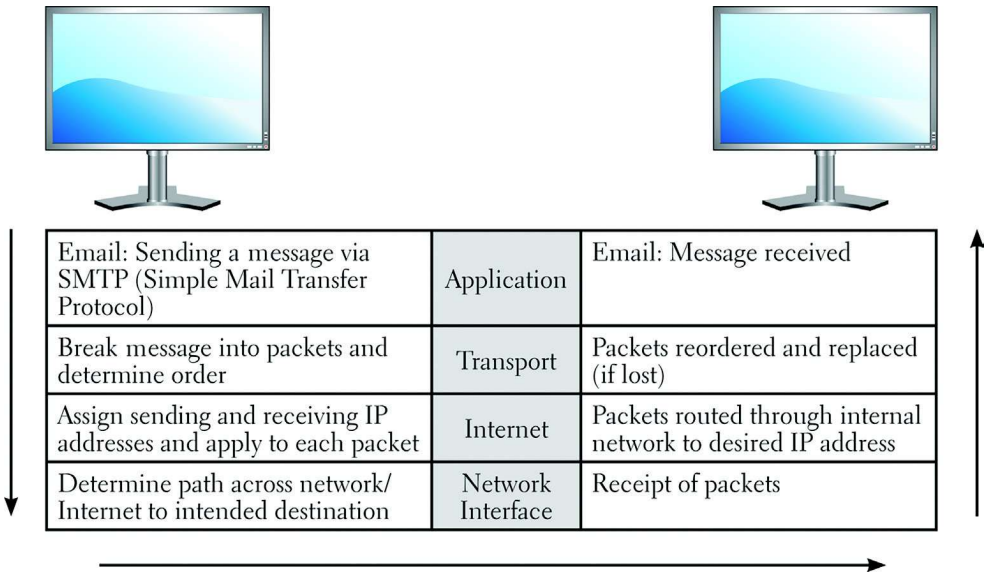


FIGURE 6.6 **The four layers of the TCP/IP reference model.**

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 resent.

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.

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 Toronto to Calgary over a packet-switching network. Note that the different coloured packets travel by different routes to reach their destination in Calgary, where they are reassembled into the complete message.

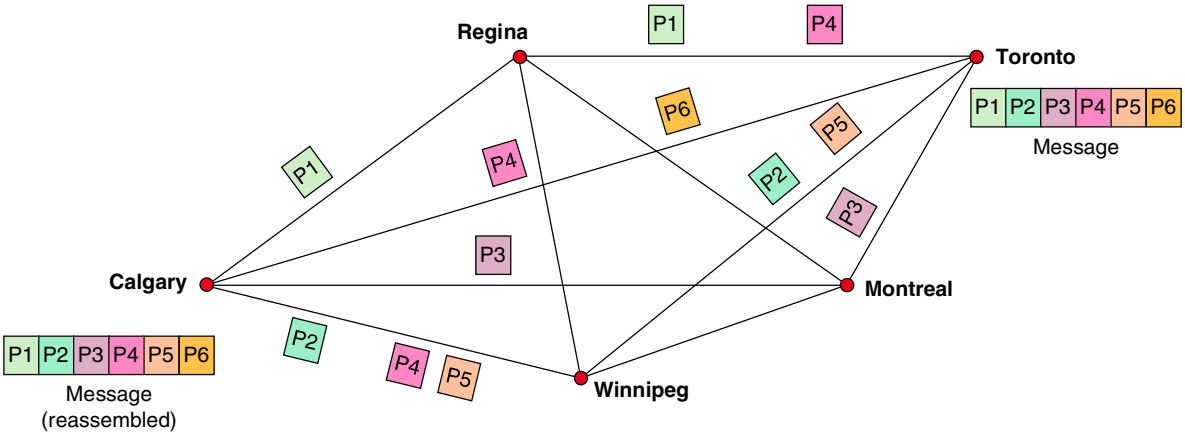


FIGURE 6.7 **Packet switching.**

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 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 (**https://products.office.com/en-ca/sharepoint/**). 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, with a free option, 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 fibre-optic network that is operated primarily by large telecommunications companies.

Many people mistakenly assume that Internet traffic (data transmissions) occurs wirelessly. However, only 1 percent of Internet traffic is carried by satellites. So, what does the Internet actually look like?

The Internet is quite tangible, consisting of 300 underwater cables that 1.2 million kilometres in length. These underwater cables range in thickness from a garden hose to about eight centimetres in diameter. The underwater cables come onshore at cable landing points. For example, MAREA connects Spain (Balboa) with the United States (Virginia) through 6,600 kilometres of underwater fibre-optic cable.

From these points, the cables are buried underground and make their way to large data centres. (We discuss data centres in Technology Guide 3.) In the United States, there are 542 underground cables connecting at 273 different points. Most of these underground cables are located along major roads and railways. In fact, one of the world's most concentrated hubs in terms of Internet connectivity is located in lower Manhattan in New York City. In Canada, a submarine fibre-cable connects Toronto with Buffalo, NY through Lake Ontario.

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 enters 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 Canadian ISPs include Bell Canada (**www.bell.ca**), Rogers Communications (**www.rogers.com**), TekSavvy (**www.teksavvy.com**), and TELUS (**www.telus.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** shows a schematic of the Internet in Canada. The red lines that link the main Canadian cities in the map represent the ultra-high-speed network and constitute

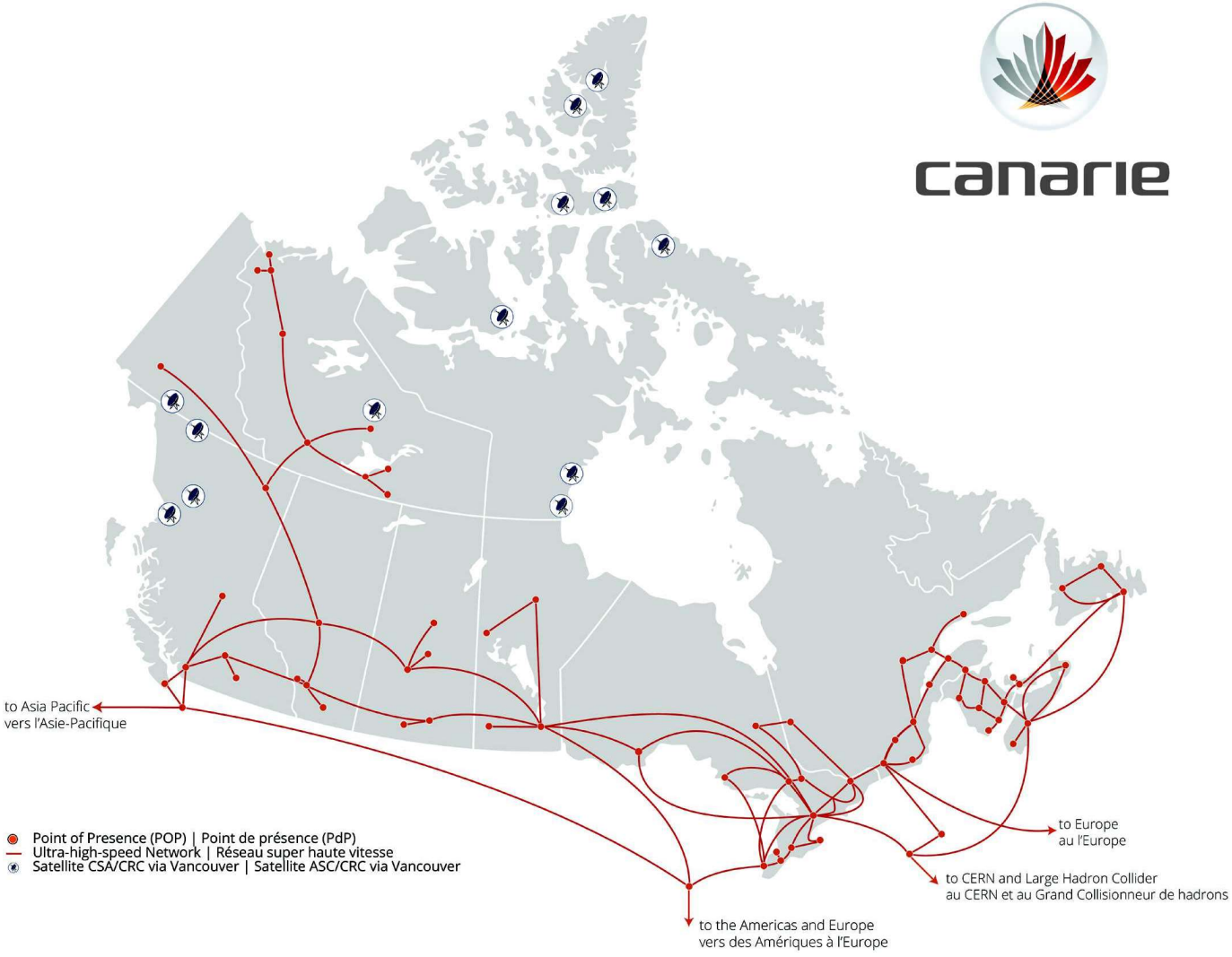


FIGURE 6.8 **Canada's Internet backbone.** https://weathermap.canarie.ca/cds/index.html

TABLE 6.2 Internet Connection Methods

Service	Description
Dial-up	Access via a conventional telephone line
DSL	Broadband access through telephone companies
Cable modem	Access over your cable TV coaxial cable
Satellite	Access over radio wave satellite network
Wireless	Access via Wi-Fi access point or cell phone network
Fibre-to-the-home (FTTH)	Broadband access via a fibre-optic cable

the Canadian Internet backbone; the same figure also shows little satellite dishes. These small satellites provide connectivity to the Internet backbone for remote locations in Canada where a fibre-optic link is still not available.

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 fibre-to-the-home (FTTH) is growing rapidly. FTTH involves connecting fibre-optic cable directly to individual homes. Table 6.2 summarizes the various means of connecting to the Internet. Satellite connections worth noting in more detail.

Connecting through Satellite See our discussion in Section 8.1 Wireless Transmission Media, discussion under Satellite.

Given the essential importance of the Internet, the question arises: Is broadband Internet a right or a privilege? IT's About Business 6.1 addresses this important question.

IT's About Business 6.1

Is Broadband Internet a Right or a Privilege?

The Problem

According to recent data, households in the three Canadian territories—Yukon, Northwest Territories, and Nunavut—lack access to broadband Internet, described as 50/10 Mpbs speeds with unlimited data available. According to the same report, 63 percent of households in rural Canada do not have access to the same broadband Internet. Also, the cost of that Internet varies drastically across the country. For example, a basic Internet package in the Northwest Territories can cost $110 a month, while the same package in British Columbia can cost $50. Although the digital divide was once only a problem of access, today, it is also a problem of connection quality and speed. Put simply, the digital divide is now the gap between areas with and without sufficient bandwidth to effectively use the Internet.

According to a report based on U.S. data, nearly 70 percent of the economic impact of broadband Internet access goes to urban economies rather than rural ones. The same study estimates that if broadband is as good in rural areas as it is in urban areas, online retail sales would be "at least US $1 billion higher."

The Internet is used for all kinds of important activities, including applying for jobs. Individuals and families who have barriers to access the Internet might be missing out on these activities. Although the Internet was previously a luxury, it has quickly become a necessity for Canadians. ACORN Canada, a charitable organization that advocates for low- to moderate-income families, in its recent report Barriers to Digital Equity in Canada, concludes that low-income families have no access to the Internet due to high costs. ACORN sees access to the Internet as more of a human right and would like to see the federal government make it a top priority. ACORN Canada also wants the federal government's Connecting Families program, which gives low-income families with children Internet access for $10 a month, to expand in order to further deal with the digital inequality across the country.

Rural communities often face logistics problems installing fibre-optic cable in sparsely populated areas. These problems are particularly acute in northern Canada and First Nations reserves in particular. In general, rural communities typically have intermittent Internet access, often through a patchwork of satellite, dial-up, and wireless service. Telecommunications and cable companies avoid such areas because it is too expensive to bring equipment and service over long distances to so few people. In fact, burying fibre-optic cables is very expensive.

Solutions

The solutions to the problem of the digital divide are many and diverse, involving technology companies and government intervention. Let's take a look at some examples.

Telecom providers Bell Canada will be receiving funding in order to either bring Moose Deer Point First Nation, Dillon, Snug Harbour, and Killbear Park new high-speed Internet access or improve the current Internet access and capacity. With this funding, more communities will have access to high-speed Internet, further bridging the digital divide. The initiative is also going to help make high-speed Internet more of a basic human right for Canadians rather than a luxury. The communities will be able to use the high-speed Internet for things like education, business, and connecting and communicating with friends and family.

Federal and provincial governments In British Colombia, investment of $50 million will be going toward bringing high-speed Internet access to 200 rural Indigenous communities. This investment will be bridging the digital divide for many in B.C.'s rural communities as well as its Indigenous communities. Although this process will be very technically challenging because of the geography of the land, it is worth the effort as high-speed Internet is a necessity or even a human right, as some might argue. The leaders of the rural and Indigenous communities will be working alongside the Internet providers to tackle this project and get access to high-speed Internet.

In July 2019, a partnership between the Government of Canada and Telesat formed to further decrease the digital divide. They would be doing this by granting those in rural Canada access to high-speed Internet at an affordable price through Telesat's LEO Satellite Constellation, which will consist of 298 satellites. The difference between these satellites and others is that they will be much closer to Earth, which will allow for shorter trips for Internet signals. Canadians will be offered high-speed, reliable Internet access for prices that they will be able to afford. This partnership will allow for more Canadians to access the Internet, as it is an essential part of one's daily life and not a luxury.

Alphabet Alphabet (Google's parent company) is testing the idea of using stratospheric drones and balloons (Project Loon) to provide Internet service in rural areas.

Facebook Facebook's open-source wireless access platform, called OpenCellular (**https://connectivity.fb.com/opencellular/**), will provide both hardware and software to set up small-scale cellular networks. Its goal is to allow people in the poorest parts of the world to go online using their phones. OpenCellular attempts to create a more affordable means of deploying wireless network access points in remote parts of the world.

Microsoft Microsoft plans to connect 2 million rural Americans to high-speed wireless broadband by 2022, and it is beginning with 12 pilot projects. The company is also offering free access to its intellectual property to help the rest of rural America get connected.

Microsoft is not planning to become an ISP itself. Instead, the company will partner with telecommunications companies to build wireless networks using the television "white spaces" spectrum. White spaces are the unused broadcasting frequencies in the wireless spectrum. Television networks leave gaps between channels for buffering purposes. This space can be used to deliver broadband Internet. This bandwidth enables wireless signals to travel over hills and through buildings and trees. Significantly, unlicensed spectrum is not restricted to any single entity. Rather, anyone can use it as long as they comply with certain rules designed to prevent interference with other devices and services.

Early Results

Being able to connect to the Internet is crucial for Canada's northern territories and rural residents. Broadband access enables them to buy goods and services that may not be available locally, to market their own goods and services to a much larger area, to connect remotely with health services that previously required several hours of driving, and even to telecommute. Educational and government institutions can use broadband access for academic and vocational training, helping to develop a competent workforce. It is widely acknowledged that helping children gain technological knowledge is crucial to their future. Medical providers must have broadband access to practise telemedicine in underserved areas, thereby improving health care in those areas.

The Canadian Radio-television and Telecommunications Commission (CRTC), the Canadian agency that regulates Internet access across the country, expected approximately 90 percent of Canadian homes and businesses to be able to access faster broadband speeds by 2021. Provinces and territories were working hard and making plans to meet this deadline.

Sources: Compiled from M. Dunne, "Small-Town Ingenuity Is Making Gigabit Broadband a Reality," *Wired*, August 26, 2018; G. Horwitz, "How the Digital Divide Dies: Broadband for All," *Forbes*, April 19, 2018; K. Rogers, "What It's Like to Live in America without Broadband Internet," *Motherboard*, April 16, 2018; C. Aguh, "How the 'Digital Divide' Is Holding the U.S. Economy Back," *VentureBeat*, February 10, 2018; R. Boucher, "Don't Forget Rural America in Open Internet Debate," *Forbes*, August 22, 2017; "The Digital Divide between Rural and Urban America's Access to Internet," CBS News, August 4, 2017; C. Malone, "The Worst Internet in America," Fivethirtyeight.com, July 27, 2017; J. Brodkin, "Microsoft Wants All of Rural America to Get High-Speed Broadband," *Ars Technica*, July 11, 2017; "Rural America Has a Serious Internet Problem," *The Week*, June 15, 2017; A. Dellinger, "Is Internet Access a Right? Americans Split on Belief If Internet Access Is a Right or Privilege," *International Business Times*, May 7, 2017; H. Kuttner, "The Economic Impact of Rural Broadband," Hudson Institute, April 20, 2016; A. Newcomb, "Which States Have the Speediest – and the Slowest – Internet?" NBC News, March 16, 2017; B. Whitacre, "Broadband Internet Helps Rural Areas Connect – Online and in Real Life," *Newsweek*, March 4, 2017; J. Koebler, "The City that Was Saved by the Internet," *Motherboard*, October 27, 2016; J. Condliffe, "Locally Owned Internet Is an Antidote for the Digital Divide," *MIT Technology Review*, August 8, 2016; C. Kang, "How to Give Rural America Broadband? Look to the Early 1900s," *New York Times*, August 7, 2016; J. Condliffe, "Facebook Plans to Beam Internet to Backwaters with Lasers," *MIT Technology Review*, July 20, 2016; J. Condliffe, "Facebook Has a Plan to Take Cellular Data to the Sticks," *MIT Technology Review*, July 7, 2016; T. Simonite, "America's Broadband Improves, Cementing a 'Persistent Digital Divide'," *MIT Technology Review*, January 29, 2016; R. Letzter, "Here's Why Internet Services Are So Abysmal in America," *Business Insider*, January 28, 2016; S. Stogsdill, "Ferra Aerospace Holds Groundbreaking in Grove," *Tulsa World*, December 16, 2015; Y. Hupka, "Findings on the Economic Benefits of Broadband Expansion to Rural and Remote Areas," Center for Urban and Regional Affairs, University of Minnesota, 2014, "The Digital Divide Leaves More Canadians Offline than You Think," CBC Radio, October 19, 2018; M. Draaisma, "High Cost of Internet Access Leaving Low-Income Families Behind, Report Finds," CBC News, August 13, 2019; "The Government of Canada and Telesat Partner to Bridge Canada's Digital Divide through Low Earth Orbit (LEO) Satellite Technology, Over $1 Billion in Revenue for Telesat expected," Globenewswire news release July 24, 2019; "P.E.I. NDP Leader Calls Rural High-Speed Internet Access 'Essential Public Service,'" *The Guardian*, April 6, 2019; R. Aiello, "Singh Making Pitch for More Affordable Cell, Internet Services," CTV News, June 10, 2019;

Innovation, Science and Economic Development Canada, "Rural Communities in Ontario Will Benefit from Faster Internet," Newswire.ca, August 16, 2019; J. Bala, "B.C. Invest $50M to Bring High-Speed Internet to Remote Areas," Global News, March 22, 2019.

Questions

1. Describe the problems that occur in areas that do not have broadband Internet access.
2. Now, consider what your educational experience at your college or university would be without broadband Internet access. Provide specific examples to support your answer.
3. Identify and discuss some of the benefits provided by broadband Internet access.
4. Discuss in groups whether Internet access should be considered a human right or not.

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.

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 need 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).

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, the Canadian Internet Registration Authority or CIRA manages the registration of .ca domain names. For example, consider the domain name **www.cbc.ca**, home of the Canadian Broadcasting Corporation website. The rightmost part (or zone) of an Internet name is its top-level domain (TLD). The letters "ca" indicate that this is a Canadian site. Just like in the example of .ca, domain names consist of multiple parts, separated by dots that are read from right to left. The following are popular TLDs:

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

A top-level domain (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.

On October 1, 2016, the U.S. National Telecommunications and Information Administration (NTIA), a part of the U.S. Commerce Department, turned over control of the Internet Domain Name System to the California-based non-profit, Internet Corporation for Assigned Names and Numbers. Since that time, ICANN has been working on behalf of an international "multistakeholder community" composed predominantly of technology companies.

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, research networks in different countries are working toward developing new technologies to support the growing needs of the Internet. In Canada, CANARIE Inc. (**www.canarie.ca**) is a not-for-profit organization supported by the government and the private sector with the goal of doing research and implementing advanced communication networks. CANARIE's most advanced network interconnects provincial research networks, universities, research centres, government research laboratories, and schools. CANARIE develops and deploys advanced network applications essential for national and international collaboration, such as remote medical diagnosis, digital libraries, distance education, online simulation, and virtual laboratories. Similarly, **Internet2** (**https://www.internet2.edu/**), the U.S. equivalent of CANARIE, 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.

Another possible future for the Internet, called the "splinternet," is less positive. IT's About Business 6.2 discusses the emergence and implications of the splinternet.

IT's About Business 6.2

The Splinternet

Written by John Perry Barlow and published in 1996, the Declaration of the Independence of Cyberspace is an early paper addressing the applicability (or lack thereof) of government on the Internet. The declaration stated that cyberspace transcends all borders. For most of its short history, the Internet has had very limited centralized planning or governance. In general, the Internet today enables users to exchange ideas and cultural artefacts instantaneously and with minimum supervision, regardless of national boundaries. Unfortunately, the modern, open Internet also provides a platform for nations to undertake information warfare, manipulate one another's citizens, and project their interests past national borders.

Nations balance the destabilizing effects of the Internet against its benefits for economic development, trade, productivity, and intellectual and cultural exchange by framing their national access policies accordingly. For instance, authoritarian governments routinely order an Internet shutdown when political opposition appears. Furthermore, there is virtually no access to the outside Internet in North Korea, although the government operates a few websites to guarantee complete ideological conformity.

Digital borders are being constructed all the time. Even liberal democracies must strike a balance between a managed Internet and an open Internet. In Britain and South Korea, for example, ISPs must limit access to pornography. Further, 30 countries have ordered ISPs to block The Pirate Bay (TPB). TPB is an online index of digital content of entertainment media and software that allows visitors to search, download, and contribute links and torrent files that facilitate peer-to-peer sharing among users of the BitTorrent protocol. TPB has caused controversy concerning the legal aspects of file sharing, copyright, and civil liberties.

China is the largest power to opt out of the open Internet entirely. China's Internet is enclosed by Golden Shield, a censorship and surveillance project operated by the Ministry of Public Security. The most famous component of Golden Shield is the Great Firewall of China, a combination of legislative and technological actions that restrict citizens' access to foreign services like Google, Facebook, and *The New York Times*.

By building a "national" Internet that favours Chinese services, China receives all of the benefits of today's networks without any of the drawbacks. Privately operated foreign Internet platforms that can promote dissent, opposition, or subversive ideas, such as many social media websites that are common in the rest of the world, are not permitted in China.

China's Internet policy may be a precursor to a federated, loosely connected set of national Internets called the *splinternet* (also known as *Internet balkanization*). In addition to national interests, the Internet could divide as a result of other factors, such as technology (e.g., broadband access), commerce, politics, and

special interests. Specifically, how users experience the Internet in one country is becoming increasingly different from how it is experienced in another country. In essence, the splinternet refers to a broad tendency to use laws and regulatory powers within territorial jurisdictions to impose limits on digital activities.

A seminal moment in the emergence of the splinternet occurred in 2013 when Edward Snowden, a contractor with the U.S. National Security Agency (NSA), leaked a number of classified documents. These documents suggested that the NSA, through its PRISM program, had been collecting information from global users of Google, Facebook, Apple, Microsoft, and Yahoo, including many national political leaders such as Angela Merkel of Germany and Dilma Rousseff of Brazil. In some of these countries, Snowden's disclosures accelerated a move toward developing national Internet control. For example, Brazil's Marco Civil da Internet law now requires global companies to comply with Brazilian laws concerning data protection.

The splinternet is growing as a result of content blocking by regions and nations as well as the need for companies to comply with diverse, often conflicting national policies, regulations, and court decisions. These policies are particularly evident with platform companies such as Google, Facebook, and Twitter. These companies have users in almost every country, and governments are increasingly insisting that they comply with local laws and cultural norms regarding access and content. Consider these important occurrences that could lead to the splinternet:

- The European Union's General Data Protection Regulation (GDPR) could force a trend toward the splinternet. For example, certain U.S. news organizations intentionally blocked or limited the EU versions of their sites at the GDPR's beginning on May 25, 2018. Imagine the problems if Japan, India, and other countries mandate similar laws. Further, California and other states are also considering their own regulations.

  Multiple, overlapping regulations could limit the international business that the Internet supports. It would also be a huge burden on small companies that may not have the resources to adhere to a multitude of complex compliance laws.
- Internet censorship is nothing new (e.g., China, Iran, Turkey), but Russia blocked entire cloud services to stop the Telegram messaging platform (**https://telegram.org**) after Telegram used multiple cloud providers in its attempt to circumvent Russia's initial shutdown. Some 19 million IP addresses were affected.

  TripAdvisor used a cloud provider, so it was one of the companies caught in this shutdown. Its website availability for users in Russia and Eastern Europe dropped to as low as 12.5 percent, meaning that about 90 percent of the time, no one could access the website. When the site was available, page load times approached 23 minutes! This problem could happen when censorship meets a world where many online services are concentrated in a small number of cloud providers.
- Network neutrality was repealed in the United States, meaning that since June 11, 2018, Internet service providers could offer tiered service packages. These offerings dictate the quality (i.e., speed) of online services based on a customer's ability to pay. Ending network neutrality could divide the Internet into high-quality and low-quality offerings.

Sources: Compiled from M. Daoudi, "Beware the SplinterNet – Why Three Recent Events Should Have Businesses Worried," *Forbes*, July 12, 2018; R. Foroohar, "'Splinternet' to Herald a Trade War for the Ages," *Financial Times*, March 5, 2018; "The 'Splinternet' May Be the Future of the Web," *Business Insider*, August 8, 2017; D. Alba, "The World May Be Headed for a Fragmented 'Splinternet,'" *Wired*, July 7, 2017; B. Moscowitz, "The Reasons Why a Free and Open Internet Could Spell the Web's Downfall," *Quartz Media*, April 4, 2017; "What Is the 'Splinternet'?" *The Economist*, November 22, 2016; "Lost in the Splinternet," *The Economist*, November 5, 2016; T. Parmar, "Will the Public Internet Survive?" *The Nation*, August 15-22, 2016; B. Sterling, "The China Splinternet Model Is Winning," *Wired*, July 2, 2016; E. Macaskill and G. Dance, "NSA Files Decoded," *The Guardian*, November 1, 2013; S. Meinrath, "The Future of the Internet: Balkanization and Borders," *Time*, October 11, 2013; C. Lynch, "Brazil's President Condemns NSA Spying," *The Washington Post*, September 24, 2013.

Questions

1. What are the advantages of the splinternet to a nation? Provide examples to support your answer.
2. What are the disadvantages of the splinternet to a nation? Provide examples to support your answer.
3. What are the advantages of the splinternet to you as an individual? Provide examples to support your answer.
4. What are the disadvantages of the splinternet to you as an individual? Provide examples to support your answer.

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 email, also run on the Internet.

The **World Wide Web** (**the Web** or **WWW**) 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 2019, Google Chrome was the leading browser, with 67 percent of users worldwide, followed by Firefox with 8.5 percent and Microsoft Edge with 6.3 percent.

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 that are currently available to users. Even if these applications formed an exhaustive list today, they would not do so tomorrow, when something new inevitably 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 they checked out of the library). Today, the information is available to multiple users at the same time.
- 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 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-2019, four search engines accounted for almost all searches in North America. 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 claims approximately 75 percent of the Chinese market.

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**).

Portals

Most organizations and their managers encounter information overload. Information is scattered across numerous documents, email messages, and databases at multiple locations and in multiple 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 Yahoo Canada (**https://ca.yahoo.com**) and The Loop (**www.theloop.ca/**).

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 6.9** displays the affinity portal for York University.

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 the Canadian Trucking Alliance (**http://cantruck.ca**), a portal for the trucking industry and the trucking community, including professional drivers, owner/operators, and trucking companies. The portal provides drivers with personalized

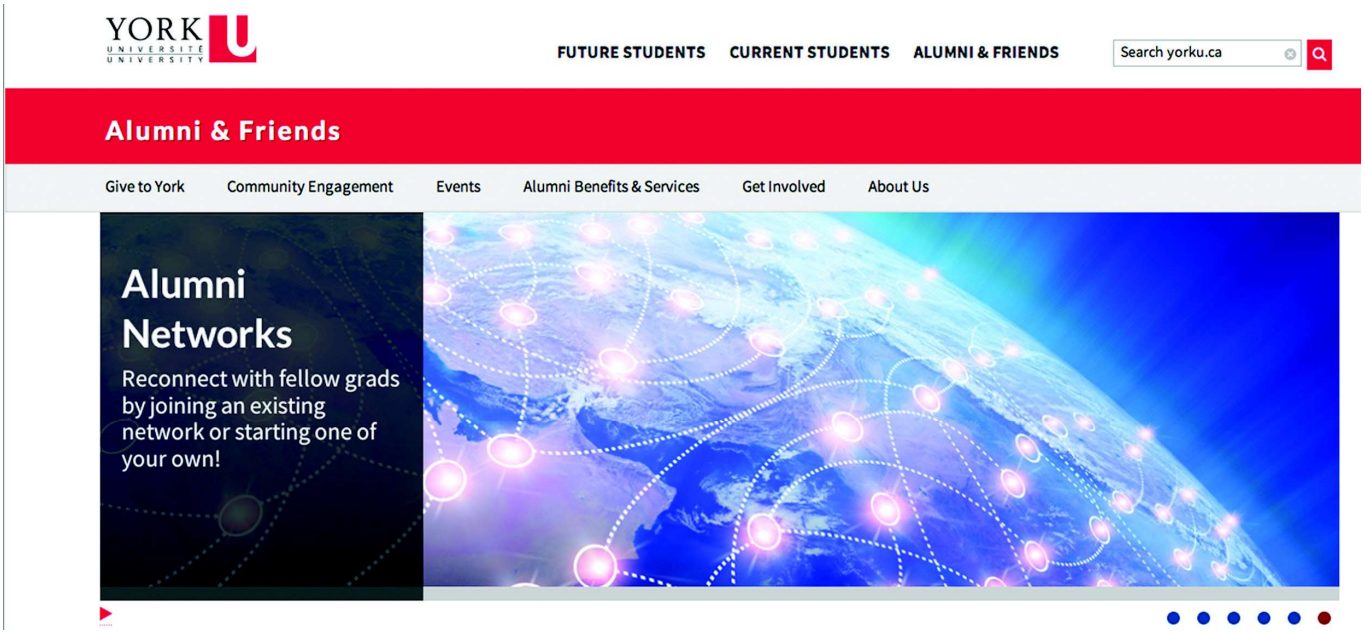


FIGURE 6.9 **York University alumni affinity portal (http://alumniandfriends.yorku.ca/). (Courtesy of York University)**

web-based email, access to applications to leading trucking companies in Canada, and discussions of issues of interest. The portal also provides a large database of trucking jobs and general information related to the trucking industry.

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 50 percent 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.

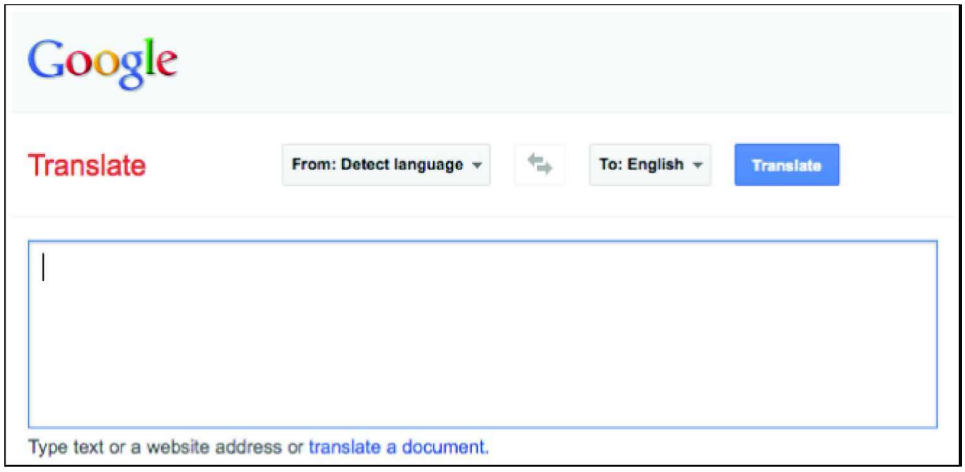
Not only is there a huge amount of information on the Internet, but it is also written in many languages. How, then, do you access this information? The answer is that you use an *automatic translation* of web pages. Such translation is available to and from all major languages, and its quality is improving 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 $0.20 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 total millions of dollars.

Some major translation products are Microsoft's Translator app (**www.microsofttranslator.com**), Google (**https://translate.google.com**) (see **Figure 6.10**), and Skype Translator (**https://www.skype.com/en/features/skype-translator/**), as well as products and services available at Trados (**www.translationzone.com**) and Systran S.A. (**www.systransoft.com**).

Google has announced its new translation service (Google Assistant), which is based on deep learning (see Technology Guide 4). In a competition that compared the new translation



Source: Google LLC

FIGURE 6.10 **Google Translate. (Google and the Google logo are registered trademarks of Google Inc., used with permission).**

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. Google Assistant is expected to act as a real-life translator in 27 different languages.

Microsoft has also 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. Microsoft Translator app also works offline.

Before You Go On . . .

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

6.5 Network Applications: Communication

The second major category of network applications is communication. There are many types of communication technologies, including email, call centres, 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.

Electronic Mail

Electronic mail (email) is the largest-volume application running over the Internet. Studies have found that almost all companies conduct business transactions through email, and the vast majority confirm that email is tied to their means of generating revenue. At the same time, however, the amount of email that managers receive has become overwhelming. The problem is that too much email can actually make a business less productive.

Web-Based Call Centres

Effective personalized customer contact is becoming an important aspect of web-based customer support. Such service is provided through *web-based call centres*, also known as *customer care centres.* 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 centre, using email, a telephone conversation, or a simultaneous voice and web session. Web-based call centres are sometimes located in foreign countries such as India. Such *offshoring* is an important issue for Canadian companies. (We discuss offshoring in Chapter 13.)

Significantly, some companies are moving their call centre operations back to their country of origin for several reasons. First, they believe they have less control of their operations when the centres 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 centre 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., Facebook online messenger **www.facebook.com/messenger/**). The second type is email 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, Skype allows you to make calls to landline phones and mobile phones. Skype can also provide 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, email, 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 their email 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 in 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.

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.

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, lack of socialization, and the potential for slower promotions. Researchers at Stanford University have reported 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.

Another problem is that telecommuting employees also often have difficulties managing both the demands from work and family. The major disadvantages to employers are difficulties in supervising work and potential data security problems. IT's About Business 6.3 provides some further insights about telecommuting in Canada.

IT's About Business 6.3

Telecommuting

In the spring of 2020, millions of workers around the world suddenly found themselves telecommuting when the coronavirus pandemic caused many offices to shut down. But even before the pandemic, telecommuting was a growing trend. Technology is one of the main drivers of the increase in telecommuting and has given many workers flexibility. Telecommuting is beneficial to employees as commute times are reduced and productivity levels are increased and it is beneficial to employers as profitability increases. Employees are also able to balance their work with their personal lives.

According to recent research at the University of Guelph, telecommuting saves time and money. When telecommuting, individuals can save their money in ways such as not having to buy as much fuel for their cars and not having to do as much maintenance. People who live in peri-urban areas, which is the meeting point of urban and rural areas, would save the most money as they have to travel longer distances, which takes more time. Research also showed that in suburban areas, more than half of the households have at least one person who telecommutes. Not only did they find that telecommuting is beneficial to the individual, but it also has social benefits, some of which include less traffic and less pollution. Lawyers and their employees prefer working for firms that allow telecommuting over firms that don't.

But telecommuting and distributed workforces have been the subject of criticism by some business leaders, who see several

downsides. For example, telecommuters argue that the lack of social interactions increases their feelings of isolation and loneliness, making telecommuting no longer appealing. In 2013 Yahoo CEO Marissa Mayer banned teleworking. One reason? It wasn't good for corporate culture. It's estimated that half of all jobs in Canada are suitable for telecommuting. But is telecommuting suitable for everyone?

Sources: P. Heltzel, "How to Combat Collaboration Burnout in the Workplace," ITprotoday, August 13, 2019; R. Half Legal, "Flexible Scheduling, Telecommuting Best Perks to Help Canadian Lawyers Improve Work-Life Balance, Survey Reveals," Newswire.ca, July 18, 2019; H. Hambly and J. Lee, "Telecommuting Does Save Time and Money, Research Shows," Globalnews.ca, November 24, 2018; D. Buckner, "The Working-at-Home Blues: Loneliness, Depression a Risk for Those Who Are Isolated," CBC News, April 24, 2019; J. Lee, "Telecommuting Becoming Standard in Canadian Workplaces: Survey," Benefitscanada.com, November 28, 2018.

Questions

1. Explain the role that software plays in enabling telecommuting.
2. What IT network-related issues would need to be considered when allowing employees to telecommute?
3. What challenges would telecommuting pose to an IT department?
4. Is telecommuting suitable for everyone and every type of organization? Does the threat of a pandemic mean many organizations have no choice but to operate by teleworking? Give examples where telecommuting would be difficult to implement and explain why.

Before You Go On . . .

1. Discuss the advantages and disadvantages of electronic mail.
2. Why are many companies bringing their call centres back to their country of origin?
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 too many software tools are 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 Office 365 Teams (**https://www.microsoft.com/en-ca/microsoft-365/microsoft-teams/group-chat-software**), Jive

(www.jivesoftware.com), Glip (https://glip.com), Slack (www.slack.com), Atlassian (www.atlassian.com), and Facebook's Workplace (www.facebook.com/workplace), as well as many others. In general, these products provide online collaboration capabilities, workgroup email, 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 email, social media, calendars, and file sharing with analytics in one software package designed to overhaul email 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 (https://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 email, 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 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 6.4 explores how Boeing uses its Collaboration Center to maximize collaboration with customers.

IT's About Business 6.4

The Boeing Collaboration Center

The Boeing Company (www.boeing.com) is a U.S.-based multinational corporation that designs, manufactures, and sells airplanes, rotorcraft, rockets, and satellites globally. The company is the second-largest defence contractor in the world, behind Lockheed-Martin (www.lockheedmartin.com).

Boeing designed its Collaboration Center in its Arlington, Virginia, regional headquarters to provide new ways of engaging with the company's global customers. The Center enables Boeing to present its capabilities in an immersive, visual environment that encourages close collaboration with its customers. Boeing's intent is to deliver a customer engagement experience unlike any that its customers have previously seen. In addition, the Center wants each customer to have a customized experience.

The Center consists of 700 square metres of multi-use spaces. Customers first see an 8-by-2 metre Entrance Feature. This large screen offers an audiovisual presentation of Boeing's diverse capabilities. The screen is composed of Christie MicroTiles. The tiles are modular, rear-projection cubes that can be placed to form a large video wall-style display. Customers are then greeted at the Welcome Wall. This 3-by-3 array of Samsung 55-inch multitouch displays communicates customized messaging and includes the objectives for the meeting, agenda details, and concierge features, which can include real-time flight arrival and departure information as well as a 100-year history of Boeing.

A pair of Collaboration Rooms feature Cisco videoconferencing systems and 90-inch Sharp displays that include touch interfaces that create comfortable, flexible spaces that are ideal for effective collaboration. These rooms can be configured in different ways. Alternatively, they can be combined into one large working environment.

Next to the Collaboration Rooms is the Launch Window, which offers sofa seating in front of a 90-inch interactive Sharp display screen. This screen can present three-dimensional content to showcase Boeing products and touch-enable simulations.

The Global Presence Wall features a 3-by-3 array of Samsung 55-inch multitouch displays with custom content about Boeing's global presence, featuring supplier information, economic impact, and corporate citizenship initiatives. Customers can drill down and see details by country and by global location.

The highlight of the Collaboration Center is the One Boeing Wall, a display consisting of 18 Samsung 55-inch monitors. The Wall has audio and video conferencing capabilities as well as a multitouch capability that enables multiple customers to explore and cross-reference Boeing products and services at the same time. After a collaboration, documentation annotated on the Wall can be saved and sent to customers for follow-up.

The same application supporting the One Boeing Wall also supports two multitouch interactive table displays that are located at opposite ends of the Collaboration Center. Each table contains two embedded 42-inch multitouch computers that feature object recognition. Boeing staffers and customers can place an object, such as carbon fibre or a product model, on these tables to obtain a deeper understanding of the object's capabilities.

In the Center's Horizon Theater, customers experience presentations, webcasts, and flight simulations. Customers can also engage in two-way video and audio conferences with remote participants such as Boeing executives or subject matter experts dispersed throughout the world. The Theater is an immersive environment with digital surround sound and three high-definition projection images on a 180-degree curved screen. In the Theater, the

visual and audio experience of a flight simulation is so realistic that Boeing installed steady bars for customers to balance themselves.

Interestingly, as impressive and state-of-the-art as the Collaboration Center is, Boeing does not think the Center will look the same in three years. The aerospace giant is already anticipating how augmented reality and virtual reality technologies will impact the firm's collaboration with its customers.

Sources: Compiled from L. Myler, "Why Customer Collaboration Is the Ticket to B2B Success," *Forbes*, July 19, 2017; D. Uptmor, "Why You Should Collaborate with Your Customers," *Clarizen*, March 2, 2017; "Customer Experience Collaboration," *ClearAction*, February 14, 2017; J. Zettel, "AVI-SPL: Building the Culture of Collaboration," *CIO Review*, 2017; J. Owens, "Top 5 AV Business and Tech Trends for 2017," *AVNetwork*, December 12, 2016; C. Zakrzewski, "Virtual Reality Takes on the Videoconference," *Wall Street Journal*, September 18, 2016; "High-Value Marketing: Connecting Customers through Technology, Analytics, and Collaboration," *Harvard Business Review*, September 6, 2016; M. Reynolds, "Customer Collaboration Is the Future of Business," *Huffington Post*, June 21, 2016; J. Durr, "B2B Organic Growth Requires Collaboration with Customers," *Gallup Business Journal*, May 18, 2016; R. Hase, "AVI-SPL Case Study: Boeing Collaboration Center," **www.linkedin.com**, March 31, 2016; **www.boeing.com**, accessed August 30, 2019.

Questions

1. Refer to Chapter 2. Is Boeing's Collaboration Center a strategic information system? Why or why not? Support your answer.
2. With the emergence of virtual reality technologies, do you think that Boeing will even need its Collaboration Center in the future? Why or why not? Support your answer.

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 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.

- IdeaBOOST (**www.ideaboost.ca**) is an innovative and creative business development lab sponsored by the Canadian Film Centre that uses crowdsourcing to help Canadian entertainment entrepreneurs grow ideas into products and concepts into businesses. The website serves as a platform where ideas are submitted, and based on the audience's response, the highest rated ideas are shortlisted. The chosen contestants spend four months working with industry-leading mentors to define their business model and to develop a market-ready prototype.
- 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.
- 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 the participants cannot communicate face to face, nor can they view 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 cancelling out any voices. These systems also require technical staff to operate and maintain. Examples of high-end systems are Cisco's TelePresence system (**www.cisco.com**) and Polycom's RealPresence Immersive system (**www.polycom.com**).

Jennifer Pottheiser/National Basketball Association/Getty Images

FIGURE 6.11 **Telepresence system.**

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 Network (**www.bluejeans.com**) offer telepresence systems that utilize cloud computing. The cloud delivery model enables Fuze and BlueJeans to provide systems that are less expensive, 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.

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: Education

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 (DL)** 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 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 centres 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. In addition, 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**) and Moodle (**www.moodle.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.

Many universities are offering MOOCs. For example, the University of Alberta (**www.ualberta.ca**) enrolls up to 50,000 students from anywhere in the world in three popular courses—mountain 101, dinosaurs, and video games—at half the cost of a classroom course. The University of Toronto (**www.utoronto.ca**) also offers a wide variety of MOOCs, ranging from introduction to psychology to programming fundamentals. The University of Manitoba (**http://umanitoba.ca**) was a MOOC pioneer back in 2008, when it offered a free online course on learning theory to some 2,300 students around the world.

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 quite challenging. 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 number. Nevertheless, despite these issues, 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 degree.

Some of the world's top providers of MOOCs are:

- Coursera
- edX
- XuetangX
- FutureLearn
- Udacity
- LinkedIn Learning (**Lynda.com**)

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 Athabasca University (**www.athabascau.ca**), the University of Manitoba (**www.umanitoba.ca**), Thompson Rivers University (**www.tru.ca**), and TÉLUQ (**www.teluq.uquebec.ca**), offer hundreds of courses and dozens of degrees to students, all 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?

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.

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.

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.

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.

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 health care, 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.

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 transmission technologies.

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.

Fibre-optic cables consist of thousands of very thin filaments of glass fibres that transmit information by way of pulses of light generated by lasers. Fibre-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. Fibre-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 fibre 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 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 email, call centres, 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.

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 that is faster than 25 Mbps.

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

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

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

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 both inside and outside 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.

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 or among two or more computers that are linked together in a network.

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

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

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

enterprise network An organization's network, which is 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.

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

file server (or network server) A computer that contains various software and data files for a local area network as well as 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; it 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 (or 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.

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 searching and indexing techniques.

protocol The set of rules and procedures that govern 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 travelling, 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 (UC) Common hardware and software platform that simplifies and integrates all forms of communications—voice, email, 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 or WWW) 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.

Discussion Questions

1. What are the implications of having fibre-optic cable to everyone's home?

2. What are the implications of BitTorrent for the music industry? For the motion picture industry?

3. Discuss the pros and cons of P2P networks.

4. Should the Internet be regulated? If so, by whom?

5. Discuss the pros and cons of delivering this book over the Internet.

6. Explain how the Internet works. Assume you are talking with someone who has no knowledge of information technology (in other words, keep it very simple).

7. How are the network applications of communication and collaboration related? Do communication tools also support collaboration? Give examples.

8. Search online for the article from *The Atlantic:* "Is Google Making Us Stupid?" *Is* Google making us stupid? Support your answer.

9. *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 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. ISPs further contend that net neutrality hinders international competitiveness by decreasing innovation and discouraging capital investments in new network technologies. Without such investments and innovations, ISPs will be unable to handle the exploding demand for Internet and wireless data transmission.

From the opposite perspective, proponents of network neutrality 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 such as Skype and Vonage. They also assert that a neutral Internet encourages innovation. Finally, they contend that the neutral Internet has helped to create many new businesses.

a. How do you feel about the net neutrality issue?

b. Do you believe heavier bandwidth users should pay for more bandwidth?

c. Do you believe wireless carriers should operate under different rules from wireline carriers?

d. Evaluate your own bandwidth usage. (For example: Do you upload and download large files such as movies?) If network neutrality were to be eliminated, what would the impact be for you?

10. Should businesses monitor network usage? Do you see a problem with employees using company-purchased bandwidth for personal use? Please explain your answer.

Problem-Solving Activities

1. Calculate how much bandwidth you consume when using the Internet every day. How many emails do you send daily and what is the size of each? (Your email program may have email 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 email, 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 **https://www.arin.net/resources/guide/ipv6/** and learn more about 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. From your own experience or from the vendor's information, list the major capabilities of Lotus Notes/Domino. Do the same for Microsoft Exchange. Compare and contrast the products. Explain how the products can be used to support knowledge workers and managers.

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

11. 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.

12. 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?

13. Compare and contrast Google Sites (**https://gsuite.google.ca/intl/en_ca/products/sites/**) and Microsoft Office 365 (**www.office.com**). Which site would you use to create your own website? Explain your choice.

14. Access the website of Music Canada (**www.musiccanada.com**). Discuss what you find there regarding digital rights and copyright infringement (that is, downloading music files through P2P networks, for example). What are Music Canada's efforts to stop music downloads? What have been some of the recent changes to music digital rights? Debate this issue from your point of view and from Music Canada's point of view.

15. 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?

16. 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).

17. 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.

18. Access Microsoft's Bing translator (**www.bing.com/translator**) or Google (**translate.google.com**) 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.

Chapter Closing Case

Case 6.2 The Network Neutrality Battles Continue

The Problem

In 2022, consumer Internet traffic is expected to reache over 333 exabytes per month. (An exabyte is 1 billion gigabytes.) 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 emails 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 U.S. Internet 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. Similar patterns are expeced for Canadian Internet carriers Bell (**www.bell.ca**) and Rogers (**www.rogers.com**). Under this model, the carriers' necessary investment will eventually exceed their revenue growth.

Few industry analysts expect carriers to stop investing in new capacity. Analysts agree, however, 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 obtain any revenue benefits from doing so.

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

Network neutrality, or *net 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 rather than charge different rates based on the user, content, site, platform, or application.

The Debate over Network Neutrality

Arguments against network neutrality 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 makes the United States less competitive internationally because it hinders innovation and discourages capital investments in new network technologies. Without these investments and innovations, the ISPs will be unable to handle the increasing demand for wired and wireless Internet data transmission.

Arguments for network neutrality From the opposite perspective, proponents of network neutrality—including more than 100 technology companies, such as Amazon, Google, Facebook Microsoft, Twitter, Netflix, Vimeo, and Yahoo—support net neutrality. These entities are petitioning the U.S. Congress to regulate the industry. They argue that allowing network providers to selectively block or slow access to certain content—for example, access to competing low-cost services such as Skype and Vonage—increases the risks of censorship. They further assert that a neutral Internet encourages, rather than discourages, innovation. Finally, they contend that the neutral Internet has helped create many new businesses.

In addition to these reasons, proponents identify other potential problems that abolishing network neutrality will create. First, broadband providers could privilege some content providers over others, for a price. Fast lanes or other types of network discrimination could impact independent websites and apps, many of which would have to pay more to compete with larger competitors to reach audiences. For example, ISPs could slow the transmission streams of Netflix or YouTube. Such business decisions by broadband providers would create fast and slow lanes on the Internet, subjecting businesses and consumers to extra charges while limiting their access to online content. The result would be paid prioritization arrangements in which companies pay to have their data prioritized.

Consider Netflix, Skype, and YouTube, all of which were founded during the mid-2000s when the initial net neutrality rules were in place. Had broadband providers been able to block video streaming and Internet-based phone calls at that time, then those companies may have had their growth blocked by established companies that were in a stronger financial position. Instead, net neutrality rules enabled them to evolve into the successful companies they are today. Abolishing net neutrality could mean that the next generation of Internet companies will not be able to compete with the established companies.

The end of net neutrality could also impact consumers. Amazon, Netflix, YouTube, and some other services currently dominate the online video market. Without net neutrality, however, broadband providers could try to make it more expensive to access popular streaming sites in an attempt to force customers to continue paying for expensive television packages. In fact, many ISPs are deploying streaming video products of their own: for example, in the U.S., AT&T with DirecTV Live, DirecTV NOW, FreeVIEW, and Fullscreen; Comcast with Xfinity; Verizon with Go90; and in Canada Bell Canada with Fibe TV and Rogers Communications with Ignite TV.

With net neutrality, ISPs cannot exempt certain kinds of content, such as streaming video, from counting toward a user's data cap. This practice is called zero-rating. *Zero-rating* occurs when ISPs do not charge their customers for data used by specific applications. Consider this example: AT&T allows customers to watch as much video as they want from its DirecTV Live streaming service without having it count toward their data caps. In contrast, competing services such as Dish's Sling would count against those caps unless the companies behind them pay AT&T to "sponsor" those data. Verizon has a similar system in place. T-Mobile exempts several streaming video and music apps and services from several partners as part of its "Music Freedom" and "Binge On" services, but it does not charge companies to participate in those programs.

AT&T customers can use 300 gigabytes before they incur additional fees. However, they can avoid those charges if they subscribe to DirecTV. Comcast customers in 28 states are limited to 1 terabyte

before they are charged extra fees, raising concerns that Comcast could use that limit to favour its own video services. Whereas larger companies such as YouTube and Netflix can probably afford to sponsor data for their customers, newer and smaller companies will be forced not only to spend additional money to be competitive but also to make deals with every major ISP. Companies that are unable to do so could be effectively locked out of the market.

Without network neutrality, there would be no regulations to stop ISPs from giving their content, or that of an exclusive partner, preferential treatment.

Net neutrality rules also include other consumer-friendly protections. For instance, they require ISPs to disclose information about the speed of their services, thus helping customers find out whether they are getting their money's worth. Rules also force broadband providers to allow customers to connect any device they want to their Internet connection. These rules prevent their provider from forcing them to use a specific type of WiFi router or dictating which Internet of Things devices they can or cannot use.

Early Results

Many in Canada are in favour of net neutrality. For example, in 2018 the Canadian Parliament voted unanimously in agreement of an open Internet in Canada. The Department of Canadian Heritage and Innovation, Science and Economic Development Canada, which handles the broadcasting rules and telecommunications infrastructure, is also a big supporter of net neutrality. Similarly, the Canadian Radio-television and Telecommunications Commission (CRTC), which regulates the Internet industry in Canada, has promoted net neutrality in many ways. For example, service providers are not permitted to suppress competitors by means of limiting traffic of their content.

However, in a study released in September 2018, researchers from Northeastern University and the University of Massachusetts, Amherst found that the largest U.S. telecommunications companies are slowing Internet traffic to and from popular apps such as YouTube and Netflix. The researchers used a smartphone app called Wehe to monitor which mobile services are being slowed, when and by whom. The app detected slowing by Verizon Communications more than 11,100 times and AT&T 8,398 times. The carriers said that they practised slowing in order to manage Internet traffic. And the bottom line? The network neutrality battles continue.

Sources: Compiled from O. Kharif, "YouTube, Netflix Videos Found to Be Slowed by Wireless Carriers," Bloomberg, September 4, 2018; J. Doubek, "California Lawmakers Pass Net Neutrality Bill," NPR, September 1, 2018; D. Shepardson, "Internet Groups Urge U.S. Court to Reinstate 'Net Neutrality' Rules," Reuters, August 27, 2018; K. Finley, "New California Bill Restores Strong Net Neutrality," *Wired*, July 5, 2018; L. Tung, "Comcast: We've Stopped Throttling Speeds for Heavy Internet Users, for Now," *ZDNet*, June 14, 2018; S. Crawford, "Net Neutrality Is Just a Gateway to the Real Issue: Internet Freedom," *Wired*, May 18, 2018; K. Finley, "Senate Votes to Save Net Neutrality, but Hurdles Remain," *Wired*, May 16, 2018; B. Chappell, "FCC Plans Net Neutrality Rollback for June 11; Senate Democrats Plan a Key Challenge," NPR, May 10, 2018; "Super-Local Broadband May Be the Best Way to Preserve Net Neutrality," *Futurism*, March 30, 2018; J. Brodkin, "California Weighs Toughest Net Neutrality Law in U.S. – with Ban on Paid Zero-Rating," *Ars Technica*, March 14, 2018; K. Finley, "Washington State Enacts Net Neutrality Law, in Clash with FCC," *Wired*, March 5, 2018; G. Sohn and Am Fazlullah, "Ajit Pai's Plan Will Take Broadband Away from Poor People," *Wired*, February 21, 2018; "Montana Governor Takes Preserving Net Neutrality into His Own Hands," *Futurism*, January 23, 2018; C. Kang, "What's Next after Repeal of Net Neutrality," *New York Times*, December 15, 2017; C. Kang, "F.C.C. Repeals Net Neutrality Rules," *New York Times*, December 14, 2017; "The Latest: States Warming Up Net-Neutrality Lawsuits," Associated Press, December 14, 2017; J. Kastrenakes, "FCC Will Block States from Passing Their Own Net Neutrality Laws," *The Verge*, November 22, 2017; J. Chokkattu, "No Matter Where You Stand, This Is What You Need to Know about Net Neutrality," *Digital Trends*, November 22, 2017; K. Finley, "FCC Plans to Gut Net Neutrality, Allow Internet 'Fast Lanes'," *Wired*, November 21, 2017; D. Shepardson, "Major Tech Firms, Internet Providers Clash over U.S. Net Neutrality Rules," Reuters, July 17, 2017; K. Finley, "Why Net Neutrality Matters Even in the Age of Oligopoly," *Wired*, June 22, 2017; K. Finley, "The End of Net Neutrality Could Shackle the Internet of Things," *Wired*, June 6, 2017; K. Finley, "Internet Providers Insist They Love Net Neutrality. Seriously?" *Wired*, May 18, 2017; M. Snider, "The FCC Votes to Overturn Net Neutrality," *USA Today*, May 18, 2017; M. Orcutt, "Net Neutrality Rules May Slow Innovation, but Uncertainty Will Be Worse," *MIT Technology Review*, May 2, 2017; M. Orcutt, "Why Snap Is Worried about Net Neutrality," *MIT Technology Review*, February 7, 2017; M. Orcutt, "What Happens If Net Neutrality Goes Away?" *MIT Technology Review*, January 30, 2017; K. Finley, "Tom Wheeler Resigns from the FCC—So Long, Net Neutrality," *Wired*, December 15, 2016; J. Brustein, "Time for Some Traffic Problems on Netflix?" *Bloomberg BusinessWeek*, November 21–27, 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; 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. 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; **www.fcc.gov**, accessed August 8, 2019; G. Ng, "CRTC Reaffirms Net Neutrality Commitment; Chairman Has "No Soft Spot for Carriers," **www.iphoneincanada.ca/**, January 17, 2019; M. Silva, "Canada's Parliament Votes to Protect Net Neutrality Nationwide," Digital Music News, June 4, 2018; E. Basa, "Canada Could Soon Block All Websites That Allow Illegal Streaming of Pirated Movies and TV Shows," Narcity, January 30, 2018; E. Jackson, "Quebec's Plan to Block Online Gambling Sites Unconstitutional, Court Rules," *Financial Post*, July 24, 2018; E. Jackson, "Parliament Enshrines Net Neutrality in Broadcast, Telecom Laws," *Financial Post*, May 24, 2018; A. Coop, "CRTC Exec Director Reconfirms Canada's Commitment to Net Neutrality," ITworld Canada, February 7, 2018; CRTC, **www.crtc.gc.ca**, accessed September 20, 2019.

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.
4. What impact might the repeal of network neutrality have on the cost of your Internet access? Support your answer.
5. Discuss IT's About Business 6.1 in light of the debate over network neutrality. That is, if network neutrality is eliminated, what could be the impact on providing broadband Internet for everyone?