CHAPTER 7

Telecommunications, the Internet, and Wireless Technology

LEARNING OBJECTIVES

After reading this chapter, you will be able to answer the following questions:

1. What are the principal components of telecommunications networks and key networking technologies?
2. What are the main telecommunications transmission media and types of networks?
3. How do the Internet and Internet technology work, and how do they support communication and e-business?
4. What are the principal technologies and standards for wireless networking, communication, and Internet access?
5. Why are radio frequency identification (RFID) and wireless sensor networks valuable for business?

OPENING CASE

Have You Ever been in a Virgin Megastore?

The first and only Virgin Megastore in Canada opened in Vancouver on Robson Street in 1996 in a building that was previously a public library. The store was located on three levels and totalled 3716 square metres. This store was taken over by HMV in 2005. Although at the time Virgin closed its Vancouver Megastore, it planned to open one of its stores in Toronto, the company chose to exit the Canadian market altogether before doing so.

Inside a Virgin Megastore, you will find racks and racks of CDs, DVDs, books, video games, and clothing, with videos playing on overhead screens. You can use Virgin Vault digital kiosks to preview music, videos, and games. You might also see a DJ sitting in a booth overlooking the sales floor and spinning the latest hits or tracks from undiscovered artists. Virgin Megastores are very media- and technology-intensive.

These stores are a carefully orchestrated response to an intensely competitive environment because the company must compete with stores such as HMV as well as big box discount chains such as Walmart and online music download services. The business must be able to react instantly to sales trends and operate efficiently to keep prices down. A new CD or DVD release might achieve half of its total sales within the first couple of weeks after its release. Too much or too little of a CD in stores at a specific time can translate into large losses. Although Virgin Megastores' inventory data warehouse based on Microsoft SQL Server database software provides up-to-the-minute information on sales and current stock levels, acting on a rapidly changing picture of supply and demand requires human communication.

In the United States, Virgin Megastores USA has 1400 employees in 11 retail locations. Its Los Angeles–based home office shares information with the retail stores via voice mail, e-mail, and audio weekly conference calls, which are used to discuss upcoming promotions and events, product inventory issues, and current market trends. People shied away from conference calling because of its costs, choosing a less expensive but also less immediate way of communicating, such as sending out a mass e-mail message. However, recipients of that message might not respond right away.

To speed up interaction, Virgin Megastores chose unified communications technology that integrated its voice mail, e-mail, conference calling, and instant messaging into a single solution that would be a natural and seamless way of working. In the fall of 2007, it deployed Microsoft's Office Communication Server, Office Communicator, and RoundTable

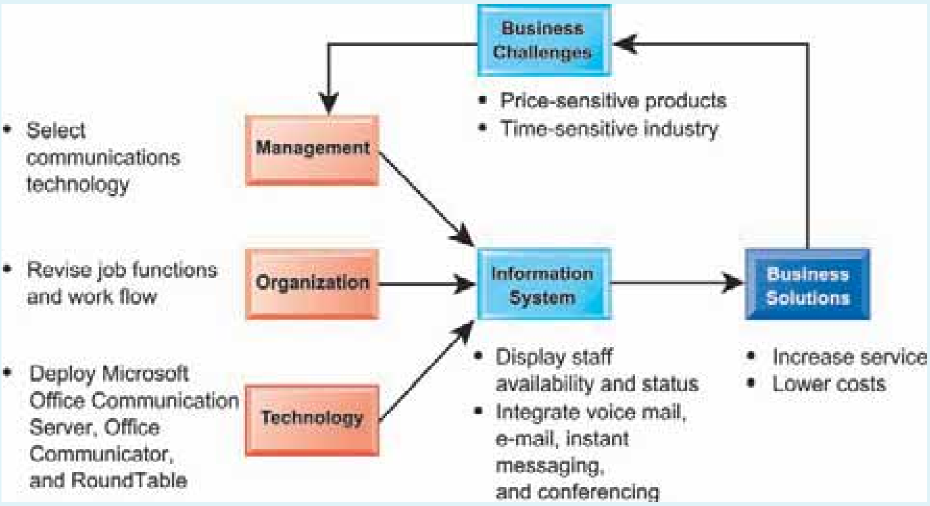
conferencing and collaboration tools. The technology has presence-awareness capabilities that display other people's availability and status (such as whether the person is already using the phone, in a Web conference, or working remotely) within the Microsoft productivity software they use in the course of their work. Users can see the people they work with in one window of Office Communicator and switch from one type of messaging to another as naturally and easily as picking up a telephone.

Calls integrating audio and video are helping employees resolve issues more quickly. The company is saving more than $60 000 annually in conferencing costs and now has in-house video and Web conferencing as well as audio conferencing.

Sources: Marina Strauss, "Virgin's Withdrawal Music to HMV's Ears," *The Globe and Mail*, June 29, 2005; "HMV Group to Open Canada's Largest Dedicated Music, DVD Store," **www.hmvgroup.com/media/view.jsp?id=1007** (accessed April 24, 2009); Lauren McKay, "All Talk," *Customer Relationship Management Magazine*, June 2008; John Edwards, "How to Get the Most from Unified Communications," *CIO*, February 8, 2008; and "Virgin Megastores USA Turns Up the Volume with Unified Communications," **www.microsoft.com** (accessed June 19, 2008).

Virgin Megastores' experience illustrates some of the powerful new capabilities—and opportunities—provided by contemporary networking technology. The company used unified communications technology to provide managers and employees with integrated voice, e-mail, and conferencing capabilities, with the ability to switch seamlessly from one type of messaging to another. Using unified communications accelerated information sharing and decision making, enabling the company to manage its inventory more precisely.

The chapter-opening diagram calls attention to important points raised by this case and this chapter. The retail music industry is exceptionally competitive and time-sensitive. To stay in the game, Virgin Megastores must be able to respond very rapidly to sales trends. The company's outdated networking and voice technology made it difficult to do this. Management decided that new technology could provide a solution and selected a new unified communications technology platform. Switching to unified communications technology saved time and facilitated information sharing between managers and employees and between retail outlets and corporate headquarters. With more up-to-date information, the company is able to respond more rapidly to sales trends and adjust inventory accordingly. These improvements save time and reduce inventory costs. Virgin Megastores had to make some changes in employee job functions and work flow to take advantage of the new technology.



7.1 Telecommunications and Networking in Today's Business World

If you run or work in a business, you cannot do without networks. You need to communicate rapidly with your customers, suppliers, and employees. Until about 1990, you would have used the postal system or telephone system with voice or fax for business communication. Today, however, you and your employees use computers and e-mail, the Internet, cell phones, and mobile computers connected to wireless networks for this purpose. Networking and the Internet are now nearly synonymous with doing business.

Networking and Communication Trends

Firms in the past used two fundamentally different types of networks: telephone networks and computer networks. Telephone networks historically handled voice communication, and computer networks handled data traffic. Telephone networks were built by telephone companies throughout the 20th century using voice transmission technologies (hardware and software), and these companies almost always operated as regulated monopolies throughout the world. Computer networks were originally built by computer companies seeking to transmit data between computers in different locations.

Thanks to continuing telecommunications deregulation and information technology innovation, telephone and computer networks are slowly converging into a single digital network using shared Internet-based standards and equipment. Telecommunications providers, such as Primus and Bell Canada (discussed in Chapter 5), today offer data transmission, Internet access, wireless telephone service, and television programming as well as voice service. Cable companies, such as Shaw and Rogers, now offer voice service and Internet access. Computer networks have expanded to include Internet telephone and limited video services. Increasingly, all of these voice, video, and data communications are based on Internet technology.

Both voice and data communication networks have also become more powerful (faster), more portable (smaller and mobile), and less expensive. For instance, the typical Internet connection speed in 2000 was 56 kilobits per second, but today more than 81 percent of Canadian households have high-speed **broadband** connections provided by telephone and cable TV companies running at 1 million bits per second. The cost for this service has fallen exponentially, from 25 cents per kilobit in 2000 to less than 1 cent today.

Broadband

Increasingly, voice and data communication as well as Internet access are taking place over broadband wireless platforms, such as cell phones, handheld digital devices, and PCs in wireless networks. In fact, mobile wireless broadband Internet access (2.5G and 3G cellular, which we describe in Section 7.4) was the fastest-growing form of Internet access in 2008, growing at a 96 percent compound annual growth rate. Fixed wireless broadband (Wi-Fi) is growing at a 28 percent compound annual growth rate, the second-fastest-growing form of Internet access. Now that cellular phones can use Wi-Fi as well as cellular networks, use of Wi-Fi networks is growing at a faster-than-ever pace.

What Is a Computer Network?

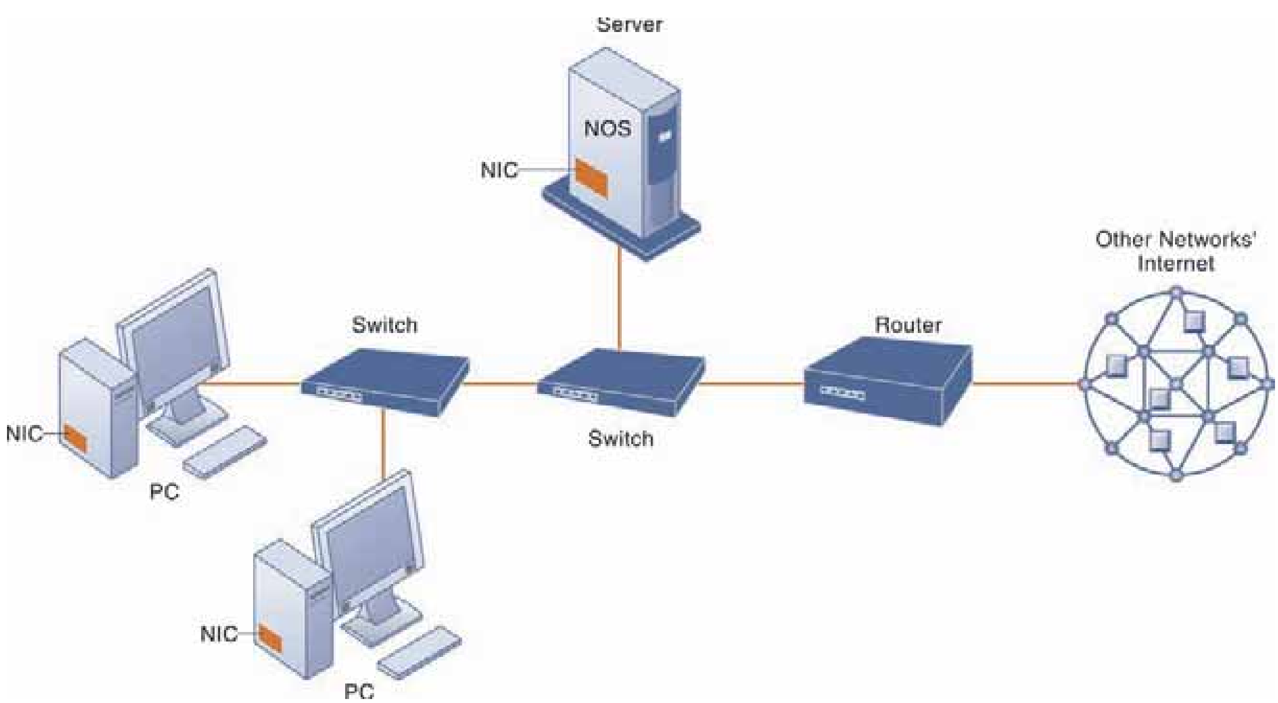
If you had to connect the computers for two or more employees together in the same office, you would need a computer network. Exactly what is a network? In its simplest form, a network consists of two or more connected computers. Figure 7-1 illustrates the major hardware, software, and transmission components used in a simple network: a client computer and a dedicated server computer, network interfaces, a connection medium, network operating system software, and either a hub or a switch.

Each computer on the network contains a network interface device called a **network interface card (NIC).** Most personal computers today have this card built into the motherboard. The connection medium for linking network components can be a telephone wire, coaxial cable, or radio signal in the case of cell phone and wireless localarea networks (Wi-Fi networks).

Network interface card (NIC)
Network operating system (NOS)

The **network operating system (NOS)** routes and manages communications on the network and coordinates network resources. It can reside on every computer in the network, or it can reside primarily on a dedicated server computer for all the applications on the network. A server computer is a computer on a network that performs important network functions for client computers, such as serving up Web pages, storing data, and storing the network operating system (and hence controlling the network). Server soft-

FIGURE 7-1 Components of a simple computer network.



Illustrated here is a very simple computer network, consisting of computers, a network operating system residing on a dedicated server computer, cable (wiring) connecting the devices, network interface cards (NIC), switches, and a router.

ware, such as Microsoft Windows Server, Linux, and Novell NetWare, are the most widely used network operating systems.

Most networks also contain a switch or a hub acting as a connection point between the computers. **Hubs** are very simple devices that connect network components, sending a packet of data to all other connected devices. A **switch** has more intelligence than a hub and can filter and forward data to a specified destination on the network.

What if you want to communicate with another network, such as the Internet? You would need a router. A **router** is a special communications processor used to route packets of data through different networks, ensuring that the data sent gets to the correct address.

Networks in Large Companies The network we have just described might be suitable for a small business. But what about large companies with many different locations and thousands of employees? As a firm grows and collects hundreds of small local area networks (LANs), these networks can be tied together into a corporate-wide networking infrastructure. The network infrastructure for a large corporation consists of a large number of these small localarea networks linked to other localarea networks and to firm-wide corporate networks. A number of powerful servers support a corporate Web site, a corporate intranet, and perhaps an extranet. Some of these servers link to other large computers supporting back-end systems.

Figure 7-2 provides an illustration of these more complex, larger-scale corporate-wide networks. Here you can see that the corporate network infrastructure supports a mobile sales force using cell phones; mobile employees linking to the company Web site, or internal company networks using mobile wireless local area networks (Wi-Fi networks); and a videoconferencing system to support managers across the world. In addition to these computer networks, the firm's infrastructure usually includes a separate telephone network that handles most voice data. Many firms are dispensing with their traditional telephone networks and using Internet telephones that run on their existing data networks (described later).

As you can see from Figure 7-2, a large corporate network infrastructure uses a wide variety of technologies—everything from ordinary telephone service and corporate data networks to Internet service, wireless Internet, and wireless cell phones. One of the major problems facing corporations today is how to integrate all the different communication networks and channels into a coherent system that enables information to flow from one part of the corporation to another, from one system to another. As more and more communication networks become digital and based on Internet technologies, it will become easier to integrate them.

Key Digital Networking Technologies

Contemporary digital networks and the Internet are based on three key technologies: client/server computing, the use of packet switching, and the development of widely used communications standards (the most important of which is Transmission Control Protocol/Internet Protocol, or TCP/IP) for linking disparate networks and computers.

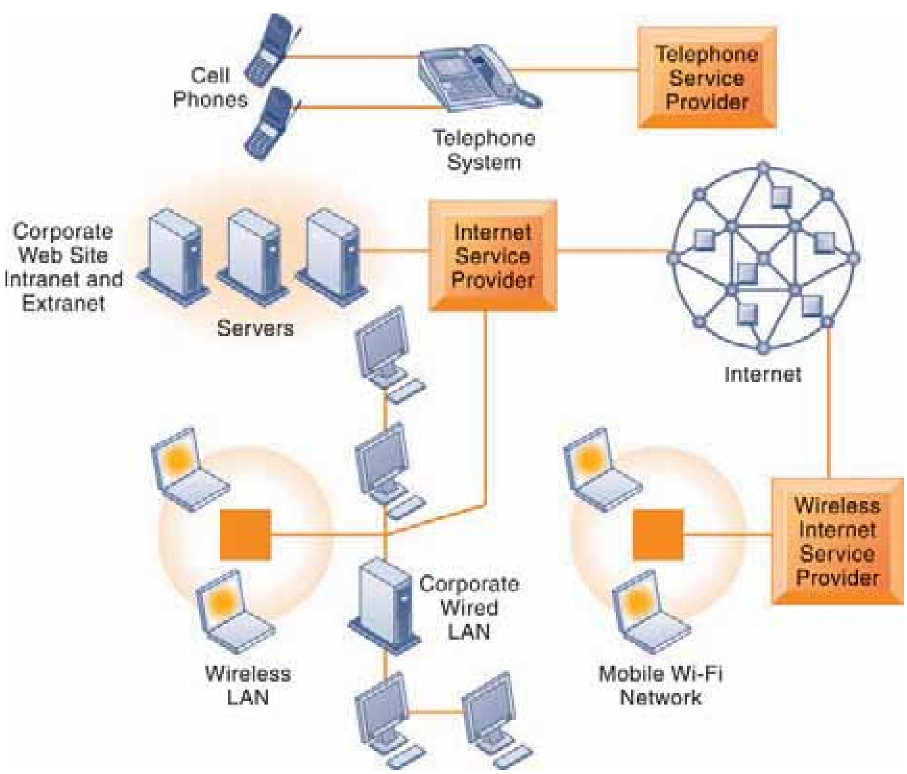
Client/Server Computing We introduced client/server computing in Chapter 5. Client/server computing is a distributed computing model in which some of the processing power is located within small, inexpensive client computers and resides literally on desktops, laptops, or in handheld devices. These powerful clients are linked to one another through a network that is controlled by a network server computer. The server sets the rules of communication for the network and provides every client with an address so others can find it on the network.

Client/server computing has largely replaced centralized mainframe computing in which nearly all of the processing takes place on a central large mainframe computer. Client/server computing has extended computing to departments, workgroups, factory floors, and other parts of the business that could not be served by a centralized architecture. The Internet is the largest implementation of client/server computing.

Packet Switching **Packet switching** is a method of slicing digital messages into parcels called *packets*, sending the packets along different communication paths as they become

Hubs
Switch
Router
Packet switching

FIGURE 7-2 Corporate network infrastructure.

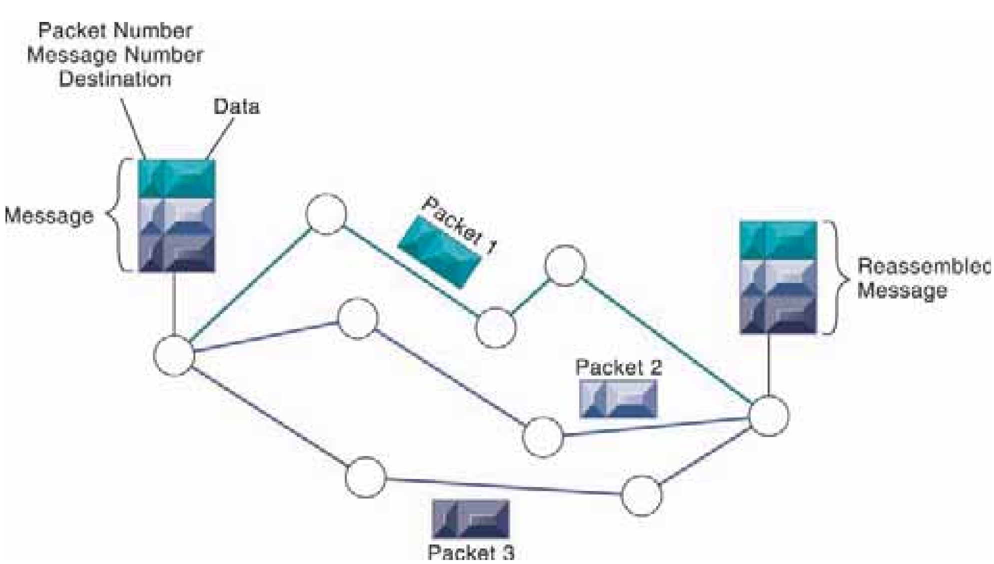


Today's corporate network infrastructure is a collection of many different networks, from the public switched telephone network, to the Internet, to corporate local area networks linking workgroups, departments, or office floors.

available, and then reassembling the packets once they arrive at their destinations (see Figure 7-3). Prior to the development of packet switching, computer networks used leased, dedicated telephone circuits to communicate with other computers in remote locations. In circuit-switched networks, such as the telephone system, a complete point-to-point circuit is assembled, and then communication can proceed. These dedicated circuit-switching techniques were expensive and wasted available communications capacity—the circuit was maintained whether or not any data were being sent.

Packet switching makes much more efficient use of the communications capacity of a network. In packet-switched networks, messages are first broken down into small, fixed bundles of data; these packets include information for directing each one to the right address and for

FIGURE 7-3 Packed-switched networks and packet communications.



Data are grouped into small packets, which are transmitted independently over various communications channels and reassembled at their final destination.

checking transmission errors along with the data. The packets are transmitted over various communications channels using routers, each packet travelling independently. Packets of data originating at one source are routed through many different paths and networks before being reassembled into the original message when they reach their destinations.

TCP/IP and Connectivity In a typical telecommunications network, diverse hardware and software components need to work together to transmit information. Different components in a network communicate with each other only by adhering to a common set of rules called protocols. A **protocol** is a set of rules and procedures governing transmission of information between two points in a network.

In the past, many diverse proprietary and incompatible protocols often forced business firms to purchase computing and communications equipment from a single vendor. But today corporate networks are increasingly using a single, common, worldwide standard called **Transmission Control Protocol/Internet Protocol (TCP/IP).** TCP/IP was developed during the early 1970s to support U.S. Department of Defense Advanced Research Projects Agency (DARPA) efforts to help scientists transmit data among different types of computers over long distances.

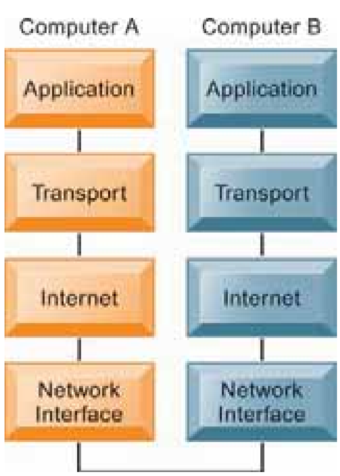
TCP/IP uses a suite of protocols, the main ones being TCP and IP. *TCP* refers to the Transmission Control Protocol (TCP), which handles the movement of data between computers. TCP establishes a connection between the computers, sequences the transfer of packets, and acknowledges the packets sent. *IP* refers to the Internet Protocol (IP), which is responsible for the delivery of packets and includes the disassembling and reassembling of packets during transmission. Figure 7-4 illustrates the four-layered reference model for TCP/IP. Starting from the sending computer, the four layers of the reference model are

1. **Application layer.** The application layer enables client application programs to access the other layers and defines the protocols that applications use to exchange data. One of these application protocols is the Hypertext Transfer Protocol (HTTP), which is used to transfer Web page files.
2. **Transport layer.** The transport layer is responsible for providing the application layer with communication and packet services. This layer includes TCP and other protocols.
3. **Internet layer.** The Internet layer is responsible for addressing, routing, and packaging data packets called IP datagrams. The Internet Protocol is one of the protocols used in this layer.
4. **Network interface layer.** At the bottom of the reference model, the network interface layer is responsible for placing packets on and receiving them from the network medium, which could be any networking technology.

Two computers using TCP/IP are able to communicate even if they are based on different hardware and software platforms. Data sent from one computer to the other passes downward through all four layers, starting with the sending computer's application layer and

Protocol
Transmission Control Protocol/ Internet Protocol (TCP/IP)

FIGURE 7-4 The Transmission Control Protocol/Internet Protocol (TCP/IP) reference model.



This figure illustrates the four layers of the TCP/IP reference model for communications.

passing through the network interface layer. After the data reach the recipient host computer, they travel up the layers at the receiving computer and are reassembled into a format the receiving computer can use. If the receiving computer finds a damaged packet, it asks the sending computer to retransmit it. This process is repeated when the receiving computer responds.

7.2 Communications Networks and Transmission Media

Let us look more closely at alternative networking technologies available to businesses.

Signals: Digital versus Analog

There are two ways to communicate a message in a network: either an analog signal or a digital signal. An *analog signal* is represented by a continuous waveform that passes through a communications medium; analog signals are used for voice communication. The most common analog devices are the typical wired telephone handset, the speaker on your computer, or your iPod earphone, all of which create analog wave forms that your ear can hear.

A *digital signal* is a discrete, binary waveform, rather than a continuous waveform. Digital signals communicate information as strings of two discrete states: one bit and zero bits, which are represented as on–off electrical pulses.

Computers use digital signals, so if you want to use the analog telephone system to send digital data, you will need a device called a **modem** to translate digital signals into analog form (see Figure 7-5). *Modem* stands for modulator-demodulator. You actually need two modems, one to translate (modulate) from digital to analog, and at the receiving end, one to translate (demodulate) from analog back to digital.

Types of Networks

There are many different kinds of networks and ways of classifying them. One way of looking at networks is in terms of their geographic scope (see Table 7-1).

Local Area Networks If you work in a business that uses networking, you are probably connecting to other employees and groups via a local area network. A **local area network (LAN)** is designed to connect personal computers and other digital devices within a half-mile or 500-metre radius. LANs typically connect a few computers in a small office, all the computers in one building, or all the computers in several buildings in close proximity. LANs can link to long-distance wide area networks (WANs, described later in this section) and other networks around the world using the Internet.

Review Figure 7-1, which could serve as a model for a small LAN that might be used in an office. One computer is a dedicated network file server, providing users with access to shared computing resources in the network, including software programs and data files. The server determines who gets access to what and in which sequence. The router connects the LAN to other networks, which could be the Internet or another corporate network, so that the LAN can exchange information with networks external to it. The most common LAN operating systems are Windows, Linux, and Novell. Each of these network operating systems supports TCP/IP as its default networking protocol.

Modem
Local area network (LAN)

FIGURE 7-5 Functions of the modem.

A modem is a device that translates digital signals from a computer into analog form so that they can be transmitted over analog telephone lines. The modem also translates analog signals back into digital form for the receiving computer.

TABLE 7-1 Types of networks.

Type	Area
Local area network (LAN)	Up to 500 metres (half a mile); an office or floor of a building
Campus area network (CAN)	Up to 1000 metres (a mile); a college campus or corporate facility
Metropolitan area network (MAN)	A city or metropolitan area
Wide area network (WAN)	A transborder or global area

Ethernet is the dominant LAN standard at the physical network level, specifying the physical medium to carry signals between computers, access control rules, and a standardized set of bits used to carry data over the system. Originally, Ethernet supported a data transfer rate of 10 megabits per second (Mbps). Newer versions, such as Fast Ethernet and Gigabit Ethernet, support data transfer rates of 100 Mbps and 1 gigabits per second (Gbps), respectively, and are used in network backbones.

The LAN illustrated in Figure 7-1 uses a client/server architecture where the network operating system resides primarily on a single file server, and the server provides much of the control and resources for the network. Alternatively, LANs may use a **peer-to-peer** architecture. A peer-to-peer network treats all processors equally and is used primarily in small networks with 10 or fewer users. The various computers on the network can exchange data by direct access and can share peripheral devices without going through a separate server.

In LANs using the Windows Server family of operating systems, the peer-to-peer architecture is called the *workgroup network model* in which a small group of computers can share resources, such as files, folders, and printers, over the network without a dedicated server. The Windows *domain network model*, in contrast, uses a dedicated server to manage the computers in the network.

Larger LANs have many clients and multiple servers, with separate servers for specific services, such as storing and managing files and databases (file servers or database servers), managing printers (print servers), storing and managing e-mail (mail servers), or storing and managing Web pages (Web servers).

Sometimes LANs are described in terms of the way their components are connected together, or their **topology.** There are three major LAN topologies: star, bus, and ring (see Figure 7-6).

In a **star topology**, all devices on the network connect to a single hub. Figure 7-6 illustrates a simple star topology in which all network traffic flows through the hub. In an *extended star network*, multiple layers or hubs are organized into a hierarchy.

In a **bus topology,** one station transmits signals, which travel in both directions along a single transmission segment. All of the signals are broadcast in both directions to the entire network. All machines on the network receive the same signals, and software installed on the client's enables each client to listen for messages addressed specifically to it. The bus topology is the most common Ethernet topology.

A **ring topology** connects network components in a closed loop. Messages pass from computer to computer in only one direction around the loop, and only one station at a time may transmit. The ring topology is primarily found in older LANs using Token Ring networking software.

Metropolitan and Wide Area Networks **Wide area networks (WANs)** span broad geographical distances—entire regions, states, continents, or the entire globe. The most universal and powerful WAN is the Internet. Computers connect to a WAN through public networks, such as the telephone system or private cable systems, or through leased lines or satellites. A **metropolitan area network (MAN)** is a network that spans a metropolitan area, usually a city and its major suburbs. Its geographic scope falls between a WAN and a LAN.

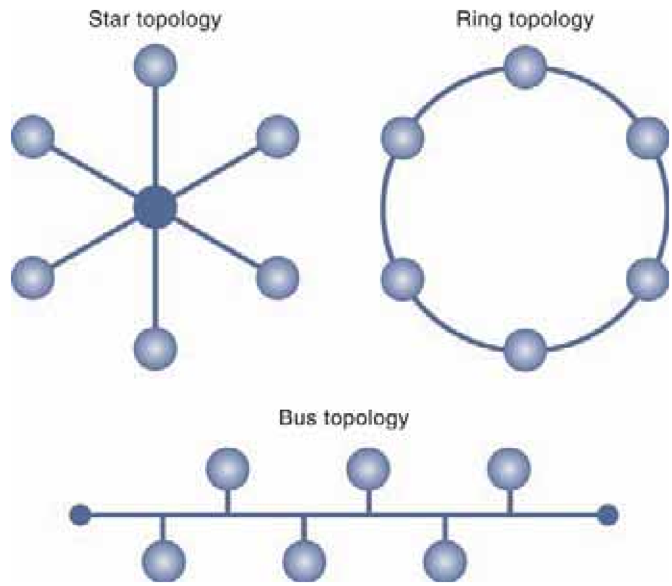
Physical Transmission Media

Networks use different kinds of physical transmission media, including twisted wire, coaxial cable, fibre optics, and media for wireless transmission. Each has advantages and limitations.

Peer-to-peer
Topology
Star topology
Bus topology
Ring topology
Wide area networks (WANs)
Metropolitan area network (MAN)

The three basic network topologies are the star, bus, and ring.

FIGURE 7-6 Network topologies.



A wide range of speeds is possible for any given medium depending on the software and hardware configuration.

Twisted Wire **Twisted wire** consists of strands of copper wire twisted in pairs and is an older type of transmission medium. Many of the telephone systems in buildings had twisted wires installed for analog communication, but they can be used for digital communication as well. Although an older physical transmission medium, the twisted wires used in today's LANs, such as CAT5, can obtain speeds up to 1 Gbps. Twisted-pair cabling is limited to a maximum recommended run of 100 metres (328 feet).

Coaxial Cable **Coaxial cable,** similar to that used for cable television, consists of thickly insulated copper wire, which can transmit a larger volume of data than twisted wire. Cable was used in early LANs and is still used today for longer (more than 100 metres) runs in large buildings. Coaxial has speeds up to 1 Gbps.

Fibre Optics and Optical Networks **Fibre optic cable** consists of bound strands of clear glass fibre, each the thickness of a human hair. Data are transformed into pulses of light, which are sent through the fibre optic cable by a laser device at rates varying from 500 kilobits to several trillion bits per second in experimental settings. Fibre optic cable is considerably faster, lighter, and more durable than wire media and is well suited to systems requiring transfers of large volumes of data. However, fibre optic cable is more expensive than other physical transmission media and harder to install.

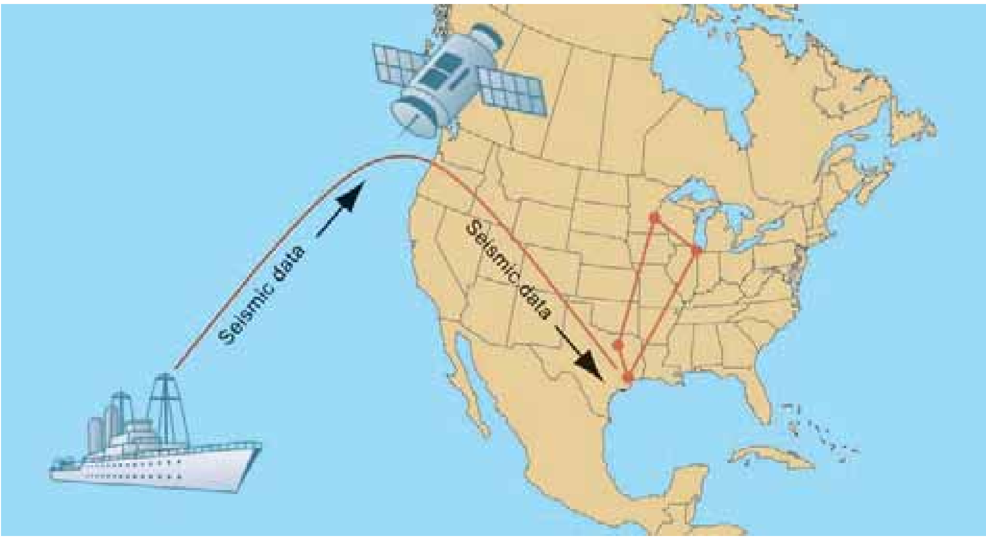
Until recently, fibre optic cable had been used primarily for the high-speed network backbone, which handles the major traffic. Now telecommunications companies are starting to bring fibre lines into homes for new types of services, such as ultra-high-speed Internet access (5 to 50 Mbps) and on-demand video.

Wireless Transmission Media Wireless transmission is based on radio signals of various frequencies. **Microwave** systems, both terrestrial and celestial, transmit high-frequency radio signals through the atmosphere and are widely used for high-volume, long-distance, point-to-point communication. Microwave signals follow a straight line and do not bend with the curvature of the earth. Therefore, long-distance terrestrial transmission systems require that transmission stations be positioned about 60 kilometres apart. Long-distance transmission is also possible by using communication satellites as relay stations for microwave signals transmitted from terrestrial stations.

Twisted wire
Coaxial cable
Fibre optic cable
Microwave

Communication satellites are typically used for transmission in large, geographically dispersed organizations that would be difficult to network using cabling media or terrestrial

FIGURE 7-7 BP's satellite transmission system.



Communication satellites help BP transfer seismic data between oil exploration ships and research centres in the United States.

microwave. For instance, the global energy company BP p.l.c. uses satellites for real-time data transfer of oil field exploration data gathered from searches of the ocean floor. Using geosynchronous satellites, exploration ships transfer these data to central computing centres in the United States for use by researchers in Houston, Tulsa, and suburban Chicago. Figure 7-7 illustrates how this system works.

Cellular systems use radio waves to communicate with radio antennas (towers) placed within adjacent geographic areas called *cells*. Communications transmitted from a **cell phone** to a local cell pass from antenna to antenna—cell to cell—until they reach their final destination.

Wireless networks are supplanting traditional wired networks for many applications and creating new applications, services, and business models. In Section 7.4 we provide a detailed description of the applications and technology standards driving the "wireless revolution."

Transmission Speed The total amount of digital information that can be transmitted through any telecommunications medium is measured in bits per second (bps). One signal change, or cycle, is required to transmit one or several bits; therefore, the transmission capacity of each type of telecommunications medium is a function of its frequency. The number of cycles per second that can be sent through that medium is measured in **hertz**—one hertz is equal to one cycle of the medium.

The range of frequencies that can be accommodated on a particular telecommunications channel is called its **bandwidth.** The bandwidth is the difference between the highest and lowest frequencies that can be accommodated on a single channel. The greater the range of frequencies, the greater the bandwidth and the greater the channel's transmission capacity. Table 7-2 compares the transmission speeds of the major types of media.

Cell phone
Hertz
Bandwidth

TABLE 7-2 Typical speeds and costs of telecommunications transmission media.

Medium	Speed
Twisted wire	Up to 1 Gbps
Microwave	Up to 600+ Mbps
Satellite	Up to 600+ Mbps
Coaxial cable	Up to 1 Gbps
Fibre optic cable	Up to 6+ Tbps

Mbps = megabits per second
Gbps = gigabits per second
Tbps = terabits per second

7.3 The Internet, Its Technologies, and How They Work

The Global Internet

We all use the Internet, and many of us cannot do without it. It has become an indispensable personal and business tool. But what exactly is the Internet? How does it work, and what does Internet technology have to offer for business? Let us look at the most important Internet features.

What Is the Internet?

The Internet has become the world's most extensive, public communication system that now rivals the global telephone system in reach and range. It is also the world's largest implementation of client/server computing and internetworking, linking millions of individual networks all over the world. This gigantic network of networks began in the early 1970s as a U.S. Department of Defense network to link scientists and university professors around the world.

Most homes and small businesses connect to the Internet by subscribing to an Internet service provider. An **Internet service provider (ISP)** is a commercial organization with a permanent connection to the Internet that sells temporary connections to retail subscribers. Rogers, Shaw, MTS, SaskTel, and Primus are ISPs. Individuals also connect to the Internet through their business firms, universities, or research centres that have designated Internet domains.

There are a variety of services for ISP Internet connections. Connecting via a traditional telephone line and modem, at a speed of 56.6 kilobits per second (Kbps) used to be the most common form of connection worldwide, but it is quickly being replaced by broadband connections. Digital subscriber line (DSL), cable, and satellite Internet connections, and T lines provide these broadband services.

Digital subscriber line (DSL) technologies operate over existing telephone lines to carry voice, data, and video at transmission rates ranging from 385 Kbps all the way up to 9 Mbps. **Cable Internet connections** provided by cable television vendors use digital cable coaxial lines to deliver high-speed Internet access to homes and businesses. They can provide high-speed access to the Internet of up to 10 Mbps. In areas where DSL and cable services are unavailable, it is possible to access the Internet via satellite, although some satellite Internet connections have slower upload speeds than these other broadband services.

T1 and T3 are international telephone standards for digital communication. They are leased, dedicated lines suitable for businesses or government agencies requiring high-speed guaranteed service levels. **T1 lines** offer guaranteed delivery at 1.54 Mbps, and T3 lines offer delivery at 45 Mbps. T3 lines cost approximately three times the monthly charge of T1 lines. An organization can also lease a fractional T1 line.

Internet Addressing and Architecture

The Internet is based on the TCP/IP networking protocol suite described earlier in this chapter. Every computer on the Internet is assigned a unique **Internet Protocol (IP) address,** which currently is a 32-bit number represented by four strings of numbers ranging from 0 to 255 separated by periods. For instance, the IP address of www.microsoft.com is 207.46.250.119.

When a user sends a message to another user on the Internet, the message is first decomposed into packets using the TCP protocol. Each packet contains its destination address. The packets are then sent from the client to the network server and from there on to as many other servers as necessary to arrive at a specific computer with a known address. At the destination address, the packets are reassembled into the original message.

Internet service provider (ISP)
Digital subscriber line (DSL)
Cable Internet connections
T1 lines
Internet Protocol (IP) address

The Domain Name System Because it would be incredibly difficult for Internet users to remember strings of 12 numbers, a **domain name system (DNS)** converts IP addresses to domain names. The **domain name** is the English-like name that corresponds to the unique 32-bit numeric IP address for each computer connected to the Internet. DNS servers maintain a database containing IP addresses mapped to their corresponding domain names. To access a computer on the Internet, users need only specify its domain name.

DNS has a hierarchical structure (see Figure 7-8). At the top of the DNS hierarchy is the root domain. The child domain of the root is called a *top-level domain*, and the child domain of a top-level domain is called is a *second-level domain*. Top-level domains are two- and three-character names you are familiar with from surfing the Web, for example, .com, .edu, .gov, and the various country codes such as .ca for Canada or .it for Italy. Second-level domains have two parts, designating a top-level name and a second-level name—such as aircanada.ca, queensu.ca, or amazon.ca. A host name at the bottom of the hierarchy designates a specific computer on either the Internet or a private network, such as angel.umanitoba.ca.

The most common domain extensions currently available and officially approved are shown in the following list. Countries also have domain names such as.uk,.au, and.fr (United Kingdom, Australia, and France, respectively). In the future, this list will expand to include many more types of organizations and industries.

.com	Commercial organizations/businesses
.edu	Educational institutions
.gov	U.S. government agencies
.mil	U.S. military
.net	Network computers
.org	Nonprofit organizations and foundations
.biz	Business firms
.info	Information providers
.name	Individual named persons
.pro	Professional organization, such as law firms
.coop	For cooperative organizations, such as rural electric cooperatives
.mus	Museums

Internet Architecture and Governance Internet data traffic is carried over transcontinental high-speed backbone networks that generally operate today in the range of 45 Mbps to 2.5 Gbps (see Figure 7-9). These trunk lines are typically owned by long-distance telephone companies (called *network service providers*) or by national governments. Local connection lines are owned by regional telephone and cable television companies that connect retail users in homes and businesses to the Internet. The regional networks lease access to ISPs, private companies, and government institutions.

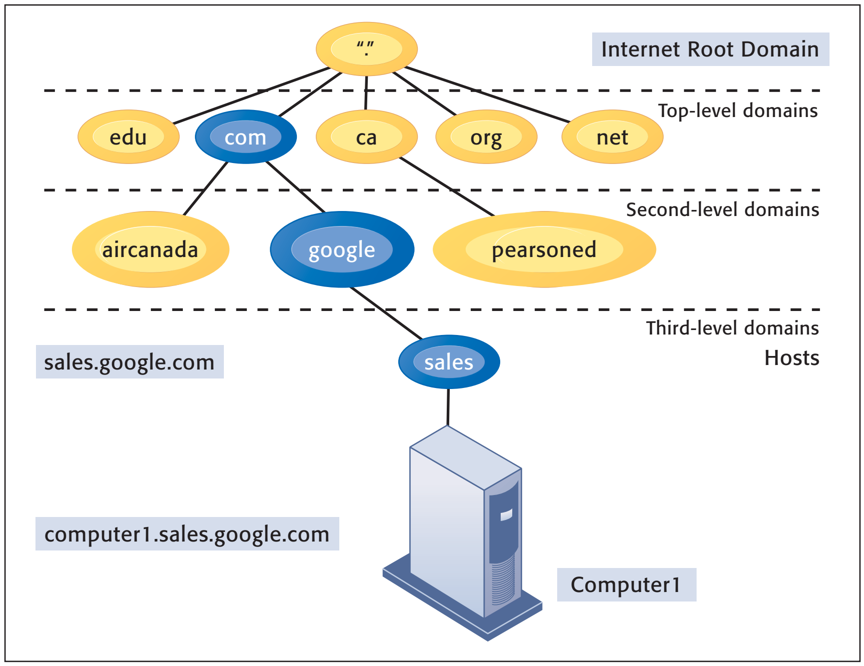
Each organization pays for its own networks and its own local Internet connection services, a part of which is paid to the long-distance trunk line owners. Individual Internet users pay ISPs for using their service, and they generally pay a flat subscription fee, no matter how much or how little they use the Internet. A debate is now raging on whether this arrangement should continue or whether heavy Internet users who download large video and music files should pay more for the bandwidth they consume. The Window on Organizations explores this topic as it examines the pros and cons of network neutrality.

No one "owns" the Internet, and it has no formal management. However, worldwide Internet policies are established by a number of professional organizations and government bodies, including the Internet Architecture Board (IAB), which helps define the overall structure of the Internet; the Internet Corporation for Assigned Names and Numbers (ICANN), which assigns IP addresses; and the World Wide Web Consortium (W3C), which sets Hypertext Markup Language (HTML) and other programming standards for the Web.

Domain name system (DNS)
Domain name

FIGURE 7-8 The domain name system.

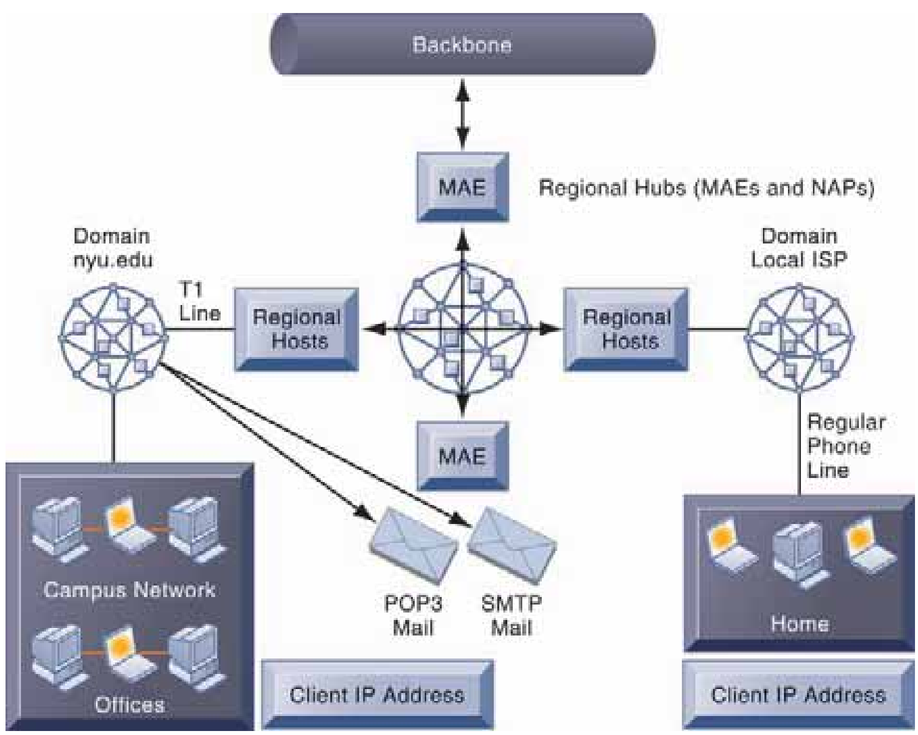
The domain name system is a hierarchical system with a root domain, top-level domains, second-level domains, and host computers at the third level.



These organizations influence government agencies, network owners, ISPs, and software developers with the goal of keeping the Internet operating as efficiently as possible. The Internet must also conform to the laws of the sovereign nation-states in which it operates, as well as the technical infrastructures that exist within the nation-states. Although in the early years of the Internet and the Web there was very little legislative or executive interference, this situation is changing as the Internet plays a growing role in the distribution of information and knowledge, including content that some find objectionable.

FIGURE 7-9 Internet network architecture.

The Internet backbone connects to regional networks, which in turn provide access to Internet service providers, large firms, and government institutions. Network access points (NAPs) and metropolitan area exchanges (MAEs) are hubs where the backbone intersects regional and local networks and where backbone owners connect with one another.



Organizations

WINDOW ON ORGANIZATIONS

Should Network Neutrality Continue?

What kind of Internet user are you? Do you primarily use the Net to do a little e-mail and look up phone numbers? Or are you online all day, watching YouTube videos, downloading music files, or playing massively multiplayer online games? If you are the latter, you are consuming a great deal of bandwidth, and hundreds of millions of people like you might start to slow down the Internet. YouTube consumed as much bandwidth in 2007 as the entire Internet did in 2000. That's one of the arguments being made today for charging Internet users based on the amount of transmission capacity they use.

According to one November 2007 report, a research firm projected that user demand for the Internet could outpace network capacity by 2011. If this happens, the Internet might not come to a screeching halt, but users would be faced with sluggish download speeds and slow performance of YouTube, Facebook, and other data-heavy services. Other researchers believe that, as digital traffic on the Internet grows, even at a rate of 50 percent per year, the technology for handling all this traffic is advancing at an equally rapid pace. The increased use of massive data downloading has led to an exaflood, "a surge of data traffic mostly created by video and other forms of new rich media flowing over the Internet," according to Burt Swanson, who coined the term. The prefix *exa* refers to 10 to the 18th power, according to Swanson.

In addition to these technical issues, the debate about metering Internet use centres around the concept of network neutrality. Network neutrality is the idea that Internet service providers must allow customers equal access to content and applications, regardless of the source or nature of the content. Currently, the Internet is indeed neutral: all Internet traffic is treated equally on a first-come, first-served basis by Internet backbone owners. The Internet is neutral because it was built on phone lines, which are subject to common carriage laws. These laws require phone companies to treat all calls and customers equally. They cannot offer extra benefits to customers willing to pay higher premiums for faster or clearer calls, a model known as tiered service.

Now telecommunications and cable companies want to be able to charge differentiated prices based on the amount of bandwidth consumed by content being delivered over the Internet. Today all major ISPs in Canada, as well as several in the United Kingdom, New Zealand, and other countries have moved to usage-based pricing. Other ISPs are also tinkering with alternative pricing models. In June 2008, Time Warner Cable started testing metered pricing for its Internet access service in the city of Beaumont, Texas. Under the pilot program, Time Warner charged customers an additional $1 per month for each gigabyte of content they downloaded or sent over the bandwidth limit of their monthly plan. The company reported that 5 percent of its customers had been using half the capacity on its local lines without paying any more than low-usage customers, and that metered pricing was "the fairest way" to finance necessary investments in its network infrastructure.

In addition to metered or usage-based pricing, an ISP can slow the flow of data of peer-to-peer traffic during peak demand hours. This is called traffic shaping, and it is targeted at users who have exceeded their ISP's definition of their fair allotment of bandwidth. These users are known as bandwidth hogs. Bell Canada uses this network management policy.

This is not how Internet service has worked traditionally and contradicts the goals of network neutrality. Advocates of net neutrality want the industry to be regulated, requiring network providers to refrain from these types of practices. However, any legislation or even regulation regarding net neutrality is considered unlikely to be passed quickly because of significant resistance by Internet service providers.

Internet service providers point to the upsurge in piracy of copyrighted materials over the Internet. Comcast, the second-largest Internet service provider in the United States, reported that illegal file sharing of copyrighted material was consuming 50 percent of its network capacity. At one point, Comcast slowed down transmission of BitTorrent files, used extensively for piracy and illegal sharing of copyrighted materials, including video. Comcast drew fierce criticism for its handling of BitTorrent packets, and later switched to a "platform-agnostic" approach. It currently slows down the connection of any customer who uses too much bandwidth during congested periods without singling out the specific services the customer is using. In controlling piracy and prioritizing bandwidth usage on the Internet, Comcast claims to be providing better service for its customers who are using the Web legally.

Net neutrality advocates argue that the risk of censorship increases when network operators can selectively block or slow access to certain content. There are already many examples of Internet providers restricting access to sensitive materials (such as anti-Bush comments from an online Pearl Jam concert, a text-messaging program from pro-choice group NARAL, or access to competitors like Vonage). In Canada, Telus restricted access to labour union blogs in 2005. Pakistan's government blocked access to anti-Muslim sites and YouTube as a whole in response to content government officials deemed defamatory to Islam.

Proponents of net neutrality also argue that a neutral Internet encourages everyone to innovate without permission from the phone and cable companies or other authorities, and this level playing field has spawned countless new businesses. Allowing unrestricted information flow becomes essential to free markets and democracy as commerce and society increasingly move online.

Network owners believe regulation like the bills proposed by net neutrality advocates will impede competitiveness by stifling innovation and hurt customers who will benefit from discriminatory network practices. North American Internet service lags behind other many other nations in overall speed, cost, and quality of service, adding credibility to the providers' arguments.

Network neutrality advocates counter that carriers already have too much power due to lack of options for service. Without sufficient competition, the carriers have more freedom to set prices and policies, and customers cannot seek recourse via other options. Carriers can discriminate in favour of their own content. Even broadband users in large metropolitan areas lack many options for service. With enough options for Internet access, net neutrality would not be such a pressing issue. Dissatisfied consumers could simply switch to providers who enforce net neutrality and allow unlimited Internet use.

The issue is a long way from resolution. The Canadian Radio-Television and Telecommunications Commission (CRTC) recently conducted a review of the Internet traffic management practices of ISPs. As this chapter is being written, public hearings on Internet traffic management conducted by the CRTC are under way. Even notable Internet personalities disagree, such as the co-inventors of the Internet Protocol, Vinton Cerf and Bob Kahn. Cerf favours net neutrality, saying that variable access to content would detract from the Internet's continued ability to thrive ("allowing broadband carriers to control what people see and do online would fundamentally undermine the principles that have made the Internet such a success"). Kahn is more cautious, saying that net neutrality removes the incentive for network providers to innovate, provide new capabilities, and upgrade to new technology. Who is right; who is wrong? The debate continues.

To Think About

1. What is network neutrality? Why has the Internet operated under net neutrality up to this point in time?
2. Who is in favour of network neutrality? Who's opposed? Why? Where do you stand on this debate?
3. What would be the impact on individual users, businesses, and government if Internet providers switched to a tiered service model?
4. Are you in favour of legislation enforcing network neutrality? Why or why not?

MIS in Action

1. Visit the Web site of the Open Internet Coalition, and select five member organizations. Then visit the Web site of each of these organizations, or surf the Web to find out more information about each. Write a short essay explaining why each organization is in favour of network neutrality.
2. Calculate how much bandwidth you consume when using the Internet every day. How many e-mails do you send daily, and what is the size of each? (Your e-mail program may have e-mail file size information.) How many music and video clips do you download daily, and what is the size of each? If you view YouTube often, surf the Web to find out the size of a typical YouTube file. Add up the number of e-mail, audio, and video files you transmit or receive on a typical day.

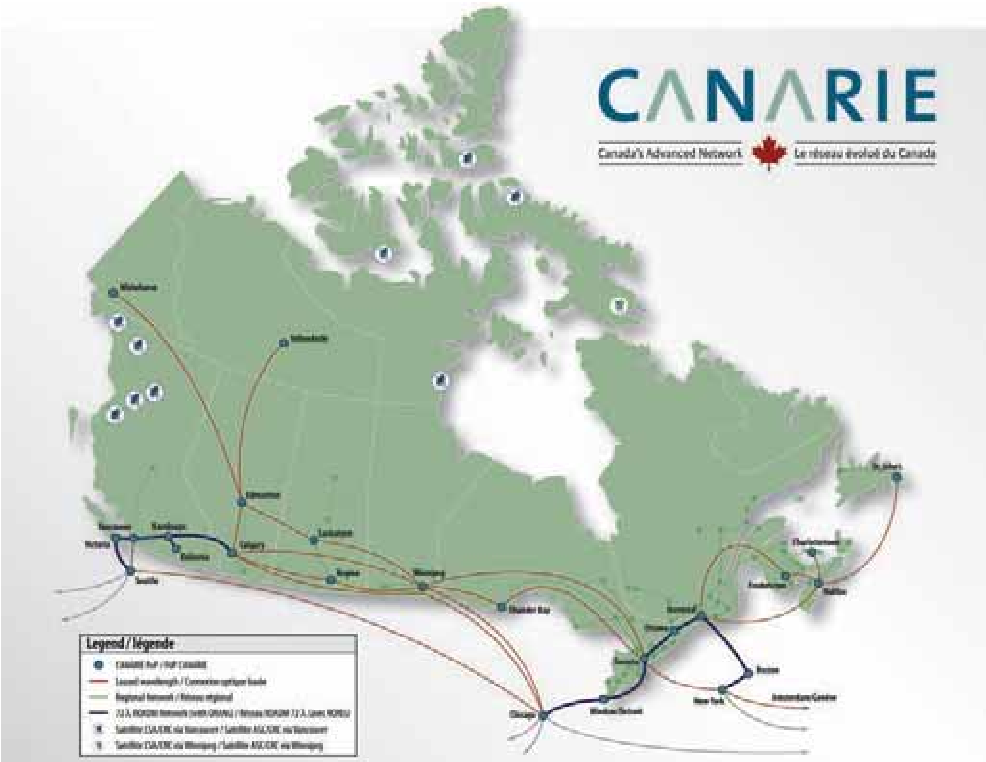
Sources: Josh Stern, "Investigating the Exaflood," *Convergence Magazine*, 2008, **http://magazines.humber.ca/convergence2008/exaflood.html** (accessed April 26, 2009); Kenneth Corbin, "Time Warner Cable Broadband Pricing Fight Rages," **www.internetnews.com/infra/print.php/3815591;** Andy Dornan, "Is Your Network Neutral?" *InformationWeek*, May 18, 2008; Rob Preston, "Meter Is Starting to Tick on Internet Access Pricing," *InformationWeek*, June 9, 2008; Damian Kulash, Jr., "Beware of the New New Thing," *The New York Times*, April 5, 2008; Steve Lohr, "Video Road Hogs Stir Fear of Internet Traffic Jam," *The New York Times*, March 13, 2008; Peter Burrows, "The FCC, Comcast, and Net Neutrality," *BusinessWeek*, February 26, 2008; S. Derek Turner, "Give Net Neutrality a Chance," *BusinessWeek*, July 12, 2008; K.C. Jones, "Piracy Becomes Focus of Net Neutrality Debate," *InformationWeek*, May 6, 2008; Jane Spencer, "How a System Error in Pakistan Shut YouTube," *The* Wall Street Journal, February 26, 2008.

The Future Internet: IPv6 and Internet2 The Internet was not originally designed to handle the transmission of massive quantities of data and billions of users. Because many corporations and governments have been given large blocks of millions of IP addresses to accommodate current and future needs, and because of sheer Internet population growth, the world will run out of available IP addresses using the existing addressing convention by 2012 or 2013. Under development is a new version of the IP addressing schema called *Internet Protocol version 6* (*IPv6*), which contains 128-bit addresses (2 to the power of 128), or more than a quadrillion possible unique addresses.

Internet2
CA*net

Internet2 and Next-Generation Internet (NGI) are consortia representing 200 universities, private businesses, and government agencies in the United States that are working on a new, robust, high-bandwidth version of the Internet. They have established several new high-performance backbone networks with bandwidths ranging from 2.5 Gbps to 9.6 Gbps. Internet2 research groups are developing and implementing new technologies for more effective routing practices; different levels of service, depending on the type and importance of the data being transmitted; and advanced applications for distributed computation, virtual laboratories, digital libraries, distributed learning, and tele-immersion. CANARIE is the Canadian equivalent of Internet2. CANARIE has deployed the various versions of **CA*net,** the national backbone for Canada with one "drop" per province. CA*net is the foundation

FIGURE 7-10 CA*net4 infrastructure.



The CA*net4 infrastructure describes how this advanced Internet infrastructure works, not only across Canada but also with links to the United States.

Source: Reprinted with the permission of CANARIE Inc.

for "innovation infrastructure" by interconnecting regional networks, universities, and schools to promote an "innovation culture" through advanced applications, such as tele-learning, grids, and so forth. Today, CA*net has evolved to CA*net4, which is based on optical networking technologies to promote the fastest speeds available over the Internet, primarily for research and education purposes. Figure 7-10 illustrates how this advanced network works. These networks do not replace the public Internet, but they do provide test beds for leading-edge technology that may eventually migrate to the public Internet.

Internet Services and Communication Tools

The Internet is based on client/server technology. Individuals using the Internet control what they do through client applications on their computers, such as Web browser software. The data, including e-mail messages and Web pages, are stored on servers. A client uses the Internet to request information from a particular Web server on a distant computer, and the server sends the requested information back to the client over the Internet. Chapters 5 and 6 describe how Web servers work with application servers and database servers to access information from an organization's internal information systems applications and their associated databases. Client platforms today include not only PCs and other computers but also cell phones, small handheld digital devices, and other information appliances.

Internet Services A client computer connecting to the Internet has access to a variety of services. These services include e-mail, electronic discussion groups, chatting and instant messaging, **Telnet, File Transfer Protocol (FTP),** and the World Wide Web. Table 7-3 provides a brief description of these services.

Each Internet service is implemented by one or more software programs. All of the services may run on a single server computer, or different services may be allocated to different machines. Figure 7-11 illustrates one way that these services might be arranged in a multitiered client/server architecture.

E-mail enables messages to be exchanged from computer to computer. Although some organizations operate their own internal electronic mail systems, most e-mail today is sent

Telnet
File Transfer Protocol (FTP)
E-mail

TABLE 7-3 Major Internet services.

CAPABILITY	FUNCTIONS SUPPORTED
E-mail	Person-to-person messaging; document sharing
Chatting and instant messaging	Interactive conversations
Newsgroups	Discussion groups on electronic bulletin boards
Telnet	Logging on to one computer system and doing work as though the user was working on a distant computer
File Transfer Protocol (FTP)	Transferring files from computer to computer
World Wide Web	Retrieving, formatting, and displaying information (including text, audio, graphics, and video) using hypertext links)

through the Internet. The cost of e-mail is far lower than equivalent voice, postal, or overnight delivery costs. Most e-mail messages arrive anywhere in the world in a matter of seconds.

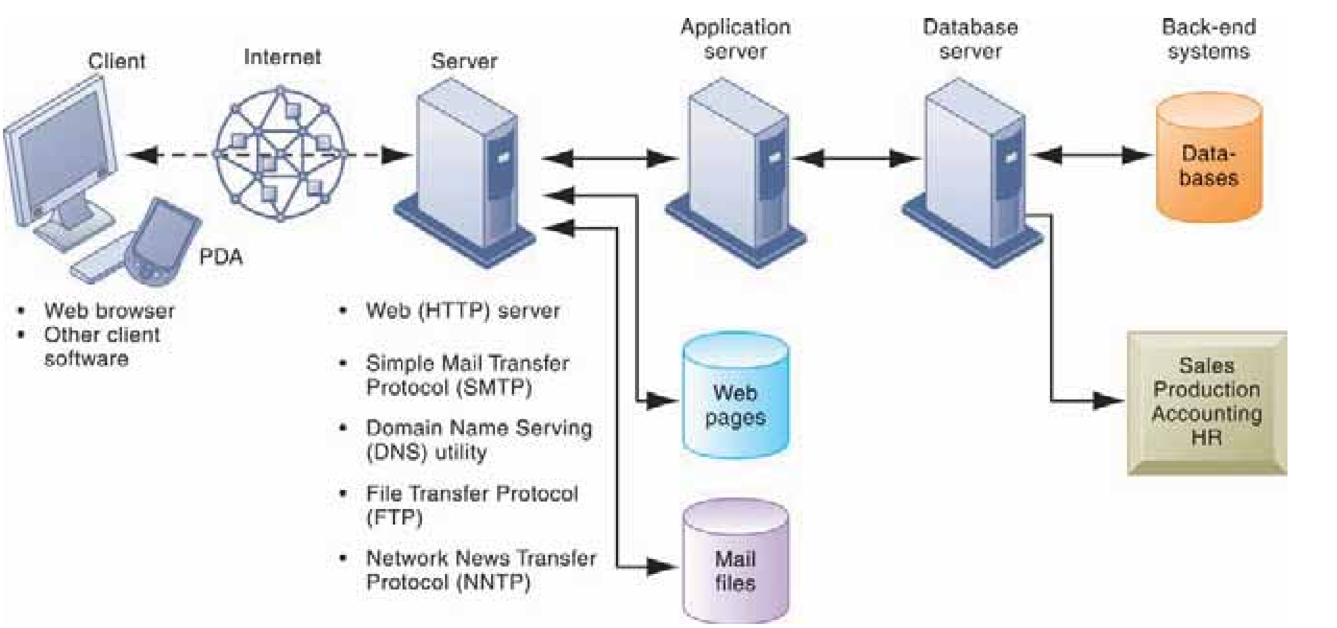
Nearly 90 percent of North American workplaces have employees communicating interactively using **chat** or instant messaging tools. Chatting enables two or more people who are simultaneously connected to the Internet to hold live, interactive conversations. Chat systems now support voice and video chat as well as written conversations. Many online retail businesses offer chat services on their Web sites to attract visitors, to encourage repeat purchases, and to improve customer service.

Instant messaging is a type of chat service that enables participants to create their own private chat channels. The instant messaging system alerts the user whenever someone on his or her private list is online so that the user can initiate a chat session with other individuals. Companies concerned with security use proprietary instant messaging systems such as Lotus Sametime.

Newsgroups are worldwide discussion groups posted on Internet electronic bulletin boards on which people share information and ideas on a defined topic, such as radiology or rock bands. Anyone can post messages on these bulletin boards for others to read. Many thousands of groups exist that discuss almost every conceivable topic.

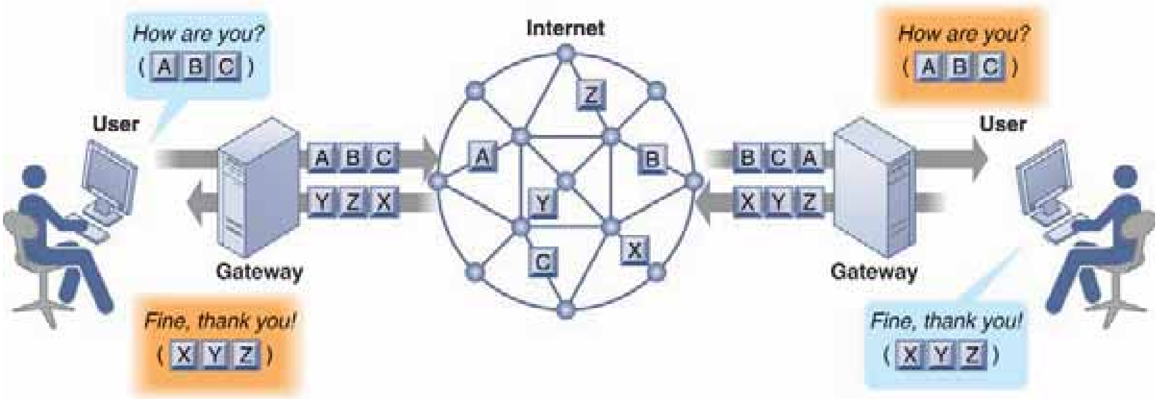
Chat
Instant messaging

FIGURE 7-11 Client/server computing on the Internet.



Client computers running Web browser and other software can access an array of services on servers over the Internet. These services may all run on a single server or on multiple specialized servers.

FIGURE 7-12 How Voice over IP works.



A VoIP phone call digitizes and breaks up a voice message into data packets that may travel along different routes before being reassembled at the final destination. A processor nearest the call's destination, called a gateway, arranges the packets in the proper order and directs them to the telephone number of the receiver or the IP address of the receiving computer.

Employee use of e-mail, instant messaging, and the Internet is supposed to increase worker productivity, but the accompanying Window on Management shows that this may not always be the case. Many company managers now believe they need to monitor and even regulate their employees' online activity. But is this ethical? Although there are some strong business reasons why companies may need to monitor their employees' e-mail and Web activities, what does this mean for employee privacy?

Voice over IP The Internet has also become a popular platform for voice transmission and corporate networking. **Voice over IP (VoIP)** technology delivers voice information in digital form using packet switching, avoiding the tolls charged by local and long-distance telephone networks (see Figure 7-12). Calls that would ordinarily be transmitted over public telephone networks travel over a corporate network based on the Internet Protocol, or the public Internet. Voice calls can be made and received with a desktop computer equipped with a microphone and speakers or with a VoIP-enabled telephone.

Telecommunications service providers (such as Rogers) and cable firms (such as Shaw) provide VoIP services. Skype, acquired by eBay, offers free VoIP worldwide using a peer-to-peer network, and Google has its own free VoIP service.

Although there are upfront investments required for an IP phone system, VoIP can reduce communication and network management costs by 20 to 30 percent. For example, VoIP saves Virgin Entertainment Group $700,000 per year in long-distance bills. In addition to lowering long-distance costs and eliminating monthly fees for private lines, an IP network provides a single voice-data infrastructure for both telecommunications and computing services. Companies no longer have to maintain separate networks or provide support services and personnel for each different type of network.

Voice over IP (VoIP)

Management

WINDOW ON MANAGEMENT

Monitoring Employees on Networks: Unethical or Good Business?

As Internet use has exploded worldwide, so have the use of e-mail and the Web for personal business at the workplace. Several management problems have emerged: First, checking e-mail, responding to instant messages, or sneaking in a brief YouTube or MySpace video create a series of nonstop interruptions that divert employee attention from the job tasks they are supposed to be performing. According to Basex, a business research company, these distractions take up as much as 28 percent of the average worker's day and result in more than $650 billion in lost productivity each year.

Second, these interruptions are not necessarily work-related. A number of studies have concluded that at least

25 percent of employee online time is spent on non-work-related Web surfing, and perhaps as many as 90 percent of employees receive or send personal e-mail at work.

Many companies have begun monitoring their employees' use of e-mail, blogs, and the Internet, sometimes without their knowledge. Although companies have the legal right to monitor employee Internet and e-mail activity while they are at work, is such monitoring unethical, or is it simply good business?

Managers worry about the loss of time and employee productivity when employees are focusing on personal rather than company business. Too much time on personal business, on the Internet or not, can mean lost revenue or overbilled clients because some employees may be charging time they spend trading their personal stocks online or pursuing other personal business to clients.

If personal traffic on company networks is too high, it can also clog the company's network so that legitimate business work cannot be performed. BBBank eG of Germany found that a key business driver was to have an overview of the way its employees used the Internet and for what purposes. According to BBBank's Nelson Gonzales, the bank used monitoring software that has helped to reduce costs and produces all the necessary reporting for accountability purposes. The bank can now properly manage its Internet expenditure, resulting in improved cost controls. "This includes statistical detail reporting by organization, department, and clients. As a consequence, of the reporting information gathered, the bank has deterred seven cases of inappropriate Internet usage and reduced its bandwidth costs by 15 percent," Gonzales says.

When employees use e-mail or the Web at employer facilities or with employer equipment, anything they do, including anything illegal, carries the company's name. Therefore, the employer can be traced and held liable. Management in many firms fear that racist, sexually explicit, hate, or other potentially offensive material accessed or traded by their employees could result in adverse publicity and even lawsuits for the firm. Even if the company is found not to be liable, responding to lawsuits could cost the company tens of thousands of dollars.

Companies also fear leakage of confidential information and trade secrets through e-mail or blogs. Ajax Boiler, based in Santa Ana, California, learned that one of its senior managers was able to access the network of a former employer and read the e-mail of that company's human resources manager. The Ajax employee was trying to gather information for a lawsuit against the former employer.

Companies that allow employees to use personal e-mail accounts at work face legal and regulatory trouble if they do not retain those messages. E-mail today is an important source of evidence for lawsuits, and companies are now required to retain all of their e-mail messages for longer periods than in the past. Courts do not discriminate about whether e-mails involved in lawsuits were sent via personal or business e-mail accounts, and not producing those e-mails could result in a significant fine.

Canadian companies have the legal right to monitor what employees are doing with company equipment during business hours. The question is whether electronic surveillance is an appropriate tool for maintaining an efficient and positive workplace. Some companies try to ban all personal activities on corporate networks—zero tolerance. Others block employee access to specific Web sites or limit personal time on the Web using software that enables IT departments to track the Web sites employees visit, the amount of time employees spend at these sites, and the files they download. Ajax uses software from SpectorSoft Corporation that records all the Web sites employees visit, time spent at each site, and all e-mails sent. BBBank eG uses WebSpy to categorize and filter Web content and block unwanted video.

Some firms have fired employees who have stepped out of bounds. One-third of the companies surveyed in an AMA study had fired workers for misusing the Internet on the job. Among managers who fired employees for Internet misuse, 64 percent did so because the employees' e-mail contained inappropriate or offensive language, and more than 25 percent fired workers for excessive personal use of e-mail.

No solution is problem-free, but many consultants believe companies should write corporate policies on employee e-mail and Internet use. The policies should include explicit ground rules that state, by position or level, under what circumstances employees can use company facilities for e-mail, blogging, or Web surfing. The policies should also inform employees whether these activities are monitored and explain why.

The rules should be tailored to specific business needs and organizational cultures. For example, although some companies may exclude all employees from visiting sites that have explicit sexual material, law firm or hospital employees may require access to these sites. Investment firms will need to allow many of their employees access to other investment sites. A company dependent on widespread information sharing, innovation, and independence could very well find that monitoring creates more problems than it solves.

To Think About

1. Should managers monitor employee e-mail and Internet usage? Why or why not?
2. Describe an effective e-mail and Web use policy for a company.

MIS in Action

Explore the Web site of a company offering online employee monitoring software such as WebSpy, SpectorSoft, or SpyTech NetVizor, and answer the following questions.

1. What employee activities does this software track? What can an employer learn about an employee by using this software?
2. How can businesses benefit from using this software?
3. How would you feel if your employer used this software where you work to monitor what you are doing on the job? Explain your response.

Sources: Nancy Gohring, "Over 50 Percent of Companies Fire Workers for E-mail, Net Abuse," *InfoWorld*, February 28, 2008; "BBBank eG," **www.webspy.com/resources/testimonials.aspx** (accessed April 26, 2009); Bobby White, "The New Workplace Rules: No Video-Watching," *The Wall Street Journal*, March 4, 2008; Maggie Jackson, "May We Have Your Attention, Please?" *BusinessWeek*, June 23, 2008; Katherine Wegert, "Workers Can Breach Security Knowingly or Not," Dow Jones News Service, June 24, 2007; Andrew Blackman, "Foul Sents," *The Wall Street Journal*, March 26, 2007.

Another advantage of VoIP is its flexibility. Unlike the traditional telephone network, phones can be added or moved to different offices without rewiring or reconfiguring the network. With VoIP, a conference call is arranged by a simple click-and-drag operation on the computer screen to select the names of the conferees. Voice mail and e-mail can be combined into a single directory.

Unified Communications In the past, each of the firm's networks for wired and wireless data, voice communications, and videoconferencing operated independently of each other and had to be managed separately by the information systems department. Now, however, firms are able to merge disparate communications modes into a single universally accessible service using **unified communications** technology. As the chapter-opening case on Virgin Megastores points out, unified communications integrates disparate channels for voice communications, data communications, instant messaging, e-mail, and electronic conferencing into a single experience where users can seamlessly switch back and forth between different communication modes. Presence technology shows whether a person is available to receive a call. Companies will need to examine how work flows and business processes will be altered by this technology in order to gauge its value.

Virtual Private Networks What if you had a marketing group charged with developing new products and services for your firm with members spread across Canada? You would want to be able to e-mail each other and communicate with the home office without any chance that outsiders could intercept the communications. In the past, one answer to this problem was to work with large private networking firms that offered secure, private, dedicated networks to customers. But this was an expensive solution. A much less expensive solution is to create a virtual private network within the public Internet.

A **virtual private network (VPN)** is a secure, encrypted, private network that has been configured within a public network to take advantage of the economies of scale and management facilities of large networks, such as the Internet (see Figure 7-13). A VPN provides your firm with secure, encrypted communications at a much lower cost than the same capabilities offered by traditional non-Internet providers that use their private networks to secure communications. VPNs also provide a network infrastructure for combining voice and data networks.

Several competing protocols are used to protect data transmitted over the public Internet, including *Point-to-Point Tunnelling Protocol (PPTP)*. In a process called tunnelling, packets of data are encrypted and wrapped inside IP packets. By adding this wrapper around a network message to hide its content, business firms create a private connection that travels through the public Internet.

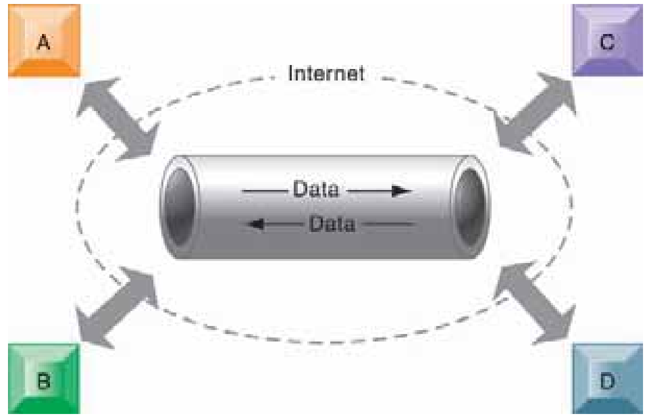
The World Wide Web

You have probably used the World Wide Web to download music, to find information for a term paper, or to obtain news and weather reports. The Web is the most popular Internet service. It is a system with universally accepted standards for storing, retrieving, formatting, and displaying information using a client/server architecture. Web pages are formatted using hypertext with embedded links that connect documents to one another and that also link pages to other objects, such as sound, video, or animation files. When you click a graphic and a video clip plays, you have clicked a hyperlink. A typical **Web site** is a collection of Web pages linked to a home page.

Hypertext Web pages are based on a standard Hypertext Markup Language (HTML), which formats documents and incorporates dynamic links to other documents and pictures stored in the same or remote computers (see Chapter 5). Web pages are accessible through the Internet because Web browser software operating your computer can request Web pages stored on an Internet host server using the **Hypertext Transfer Protocol (HTTP).** HTTP is the communications standard used to transfer pages on the Web. For example, when you type a Web address in your browser, such as www.pearsoned.ca, your browser sends an HTTP request to the pearsoned.ca server requesting the home page of pearsoned.ca.

Unified communications
Virtual private network (VPN)
Web site
Hypertext Transfer Protocol (HTTP)

FIGURE 7-13 A virtual private network using the Internet.



This VPN is a private network of computers linked using a secure "tunnel" connection over the Internet. It protects data transmitted over the public Internet by encoding the data and "wrapping" them within the Internet Protocol (IP). By adding a wrapper around a network message to hide its content, organizations can create a private connection that travels through the public Internet.

HTTP is the first set of letters at the start of every Web address, followed by the domain name, which specifies the organization's server computer that is storing the document. Most companies have a domain name that is the same as or closely related to their official corporate name. The directory path and document name are two more pieces of information within the Web address that help the browser track down the requested page. Together, the address is called a **uniform resource locator (URL).** When typed into a browser, a URL tells the browser software exactly where to look for the information. For example, in the URL www.megacorp.com/content/features/082602.html, *http* names the protocol used to display Web pages, *www.megacorp.com* is the domain name, *content/features* is the directory path that identifies where on the domain Web server the page is stored, and *082602.html* is the document name and the name of the format it is in (it is an HTML page).

Web Servers A Web server is software for locating and managing stored Web pages. It locates the Web pages requested by a user on the computer where they are stored and delivers the Web pages to the user's computer. Server applications usually run on dedicated computers although they can all reside on a single computer in small organizations.

The most common Web server in use today is Apache HTTP Server, which holds 66 percent of the market. Apache is an open source product that is free of charge and can be downloaded from the Web. Microsoft's product Internet Information Services is the second most commonly used Web server, with a 19 percent market share (Netcraft, 2009).

Searching for Information on the Web No one knows for sure how many Web pages there really are. The surface Web is the part of the Web that search engines visit and about which information is recorded. For instance, Google visited about 50 billion pages in 2007 although publicly it acknowledges indexing more than 25 billion. But there is a "deep Web" that contains an estimated 800 billion additional pages, many of them proprietary (such as the pages of *The Wall Street Journal* Online, which cannot be visited without an access code) or that are stored in protected corporate databases.

Obviously, with so many Web pages, finding specific Web pages that can help you or your business, nearly instantly, is an important problem. The question is, how can you find the one or two pages you really want and need out of billions of indexed Web pages? **Search engines** attempt to solve the problem of finding useful information on the Web nearly instantly, and, arguably, they are the "killer app" of the Internet era. Today's search engines can sift through HTML files, files of Microsoft Office applications, and PDF files, with capabilities that are in various stages of development for searching audio, video, and image files. There are hundreds of different search engines in the world, but the vast majority of search results are supplied by three top providers: Google, Yahoo!, and Microsoft.

Web search engines started out in the early 1990s as relatively simple software programs that roamed the nascent Web, visiting pages and gathering information about the content of each page. The first search engines were simple keyword indexes of all the pages they visited, leaving the user with lists of pages that may not have been truly relevant to the search.

Uniform resource locator (URL)
Search engines

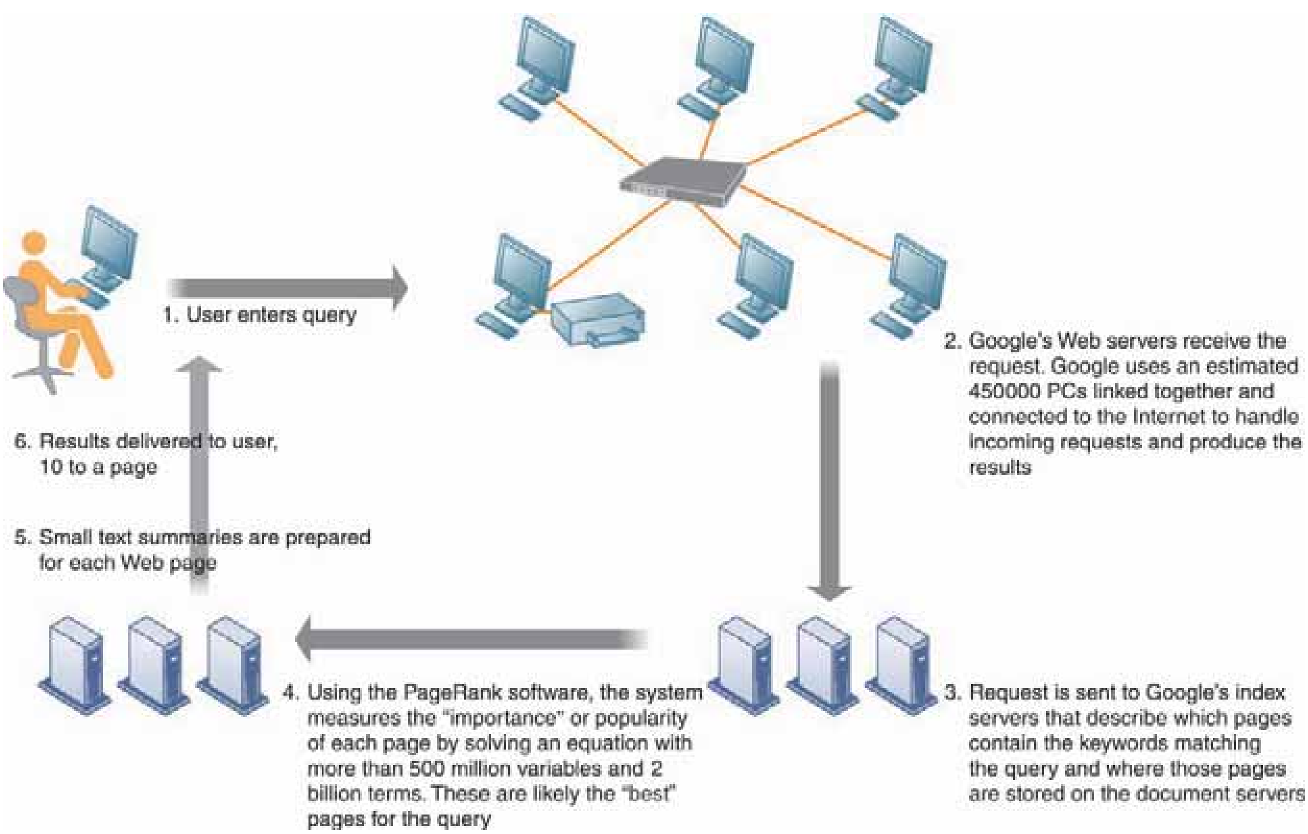
In 1994, Stanford University computer science students David Filo and Jerry Yang created a hand-selected list of their favourite Web pages and called it "Yet Another Hierarchical Officious Oracle," or Yahoo!. Yahoo! was not initially a search engine but rather an edited selection of Web sites organized by categories the editors found useful, but it has since developed its own search engine capabilities.

In 1998, Larry Page and Sergey Brin, two other Stanford computer science students, released their first version of Google. This search engine was different: It not only indexed each Web page's words, but it also ranked search results based on the relevance of each page. Page patented the idea of a page ranking system (PageRank System), which essentially measures the popularity of a Web page by calculating the number of sites that link to that page. Brin contributed a unique Web crawler program that indexed not only keywords on a page but also combinations of words (such as authors and the titles of their articles). These two ideas became the foundation for the Google search engine. Figure 7-14 illustrates how Google works.

Web sites for locating information, such as Yahoo!, Google, and MSN, have become so popular and easy to use that they also serve as major portals for the Internet (see Chapter 13). Their search engines have become major shopping tools by offering what is now called **search engine marketing.** When users enter a search term at Google, MSN, Yahoo!, or any of the other sites serviced by these search engines, they receive two types of listings: sponsored links, for which advertisers have paid to be listed (usually at the top of the search results page), and unsponsored "organic" search results. In addition, advertisers can purchase tiny text boxes on the side of the Google and MSN search results page. The paid, sponsored advertisements are the fastest-growing form of Internet advertising and are powerful new marketing tools that precisely match consumer interests with advertising messages at the right moment (see the chapter-ending case study). Search engine marketing monetizes the value of the search process.

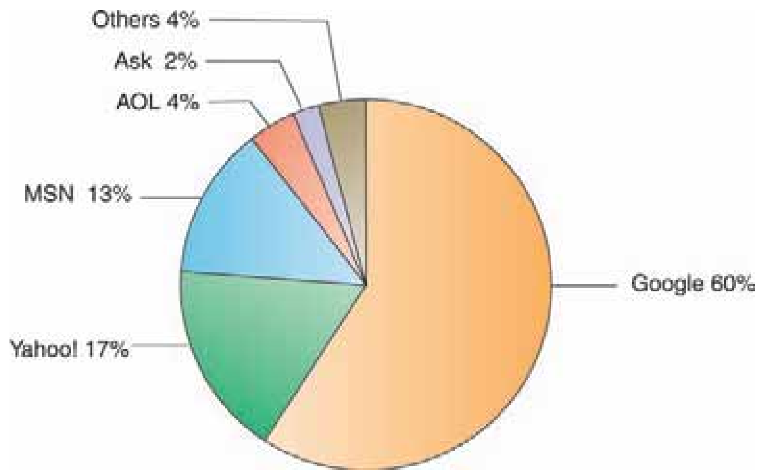
Search engine marketing

FIGURE 7-14 How Google works.



The Google search engine is continuously crawling the Web, indexing the content of each page, calculating its popularity, and storing the pages so that it can respond quickly to user requests to see a page. The entire process takes about one-half second.

FIGURE 7-15 Top Web search engines.



Google is the most popular search engine on the Web, handling 60 percent of all Web searches.

Source: Based on data from Nielsen Online and MegaView Search, 2008.

In 2008, 71 million people each day in the United States alone used a search engine, producing over 10 billion searches a month. There are hundreds of search engines, but the top three (Google, Yahoo!, and MSN) account for 90 percent of all searches (see Figure 7-15).

Although search engines were originally built to search text documents, the explosion in online video and images has created a demand for search engines that can quickly find specific videos. The words "dance," "love," "music," and "girl" are all exceedingly popular in titles of YouTube videos, and searching on these keywords produces a flood of responses even though the actual contents of the video may have nothing to do with the search term. Searching videos is challenging because computers are not very good or quick at recognizing digital images. Some search engines have started indexing movies scripts so it will be possible to search on dialogue to find a movie. One of the most popular video search engines is **Blinkx.com,** which stores 18 million hours of video and employs a large group of human classifiers who check the contents of uploaded videos against their titles.

Chapter 15 describes the capabilities of software agents with built-in intelligence that can gather or filter information and perform other tasks to assist users. **Shopping bots** use intelligent agent software for searching the Internet for shopping information. Shopping bots such as MySimon or Froogle can help people interested in making a purchase filter and retrieve information about products of interest, evaluate competing products according to criteria the users have established, and negotiate with vendors for price and delivery terms. Many of these shopping agents search the Web for pricing and availability of products specified by the user and return a list of sites that sell the item along with pricing information and a purchase link.

Web 2.0 If you have shared photos over the Internet at Flickr or another photo site, blogged, looked up a word on Wikipedia, or contributed information yourself, you have used services that are part of **Web 2.0.** Today's Web sites do not just contain static content—they also enable people to collaborate, share information, and create new services online. Web 2.0 refers to these second-generation interactive Internet-based services.

The technologies and services that distinguish Web 2.0 include cloud computing, software mashups and widgets, blogs, RSS, and wikis. Mashups and widgets, which we introduced in Chapter 5, are software services that enable users and system developers to mix and match content or software components to create something entirely new. For example, Yahoo's photo storage and sharing site Flickr combines photos with other information about the images provided by users and tools to make the photos and information usable within other programming environments.

These software applications run on the Web itself instead of the desktop and bring the vision of Web-based computing closer to realization. With Web 2.0, the Web is not just a collection of destination sites, but a source of data and services that can be combined to create applications users need. Web 2.0 tools and services have fuelled the creation of

Shopping bots
Web 2.0

social networks and other online communities where people can interact with one another in the manner of their choosing.

These social aspects of Web 2.0 technology are changing the social interactions and culture of the Internet community. While the Web originally permitted individuals to interact with a particular, relatively static Web site, Web 2.0 technologies permit Web users to interact proactively not only with Web sites but also with other individuals who use those Web sites. This is certainly true of sites such as Second Life, MySpace, Facebook, Twitter, and Flickr. As these social and cultural changes impact the use of the Web, they also change the economics of commerce. More and more micro-payments are being generated, and tracking taxes and contractual obligations of these micro-payment-based sales is becoming more and more difficult.

A **blog,** the popular term for a Web log, is an informal yet structured Web site where subscribing individuals can publish stories, opinions, and links to other Web sites of interest. Blogs have become popular personal publishing tools, but they also have business uses (see Chapters 13 and 15). For example, Royal Bank of Canada uses a blog to update those interested in its "Next Great Innovator Challenge," open to more than 20 Canadian colleges and universities.

If you are an avid blog reader, you might use RSS to keep up with your favourite blogs without constantly checking them for updates. **RSS,** which stands for Rich Site Summary or Really Simple Syndication, syndicates Web site content so that it can be used in another setting. RSS technology pulls specified content from Web sites and feeds it automatically to users' computers or handheld devices, where it can be stored for later viewing.

To receive an RSS information feed, you need to install aggregator or news reader software that can be downloaded from the Web. (Microsoft Internet Explorer 7 includes RSS reading capabilities.) Alternatively, you can establish an account with an aggregator Web site. You tell the aggregator to collect all updates from a given Web page, or list of pages, or gather information on a given subject by conducting Web searches at regular intervals. Once subscribed, you automatically receive new content as it is posted to the specified Web site. A number of businesses use RSS internally to distribute updated corporate information. BMO Bank of Montreal uses RSS to deliver news feeds for those interested in corporate information and investor relations as well as other topics offered through its RSS site.

Blogs allow visitors to add comments to the original content, but they do not allow visitors to change the original posted material. **Wikis,** in contrast, are collaborative Web sites where visitors can add, delete, or modify content on the site, including the work of previous authors. Wiki comes from the Hawaiian word for "quick." Probably the best-known wiki site is Wikipedia, the massive online opensource encyclopedia to which anyone can contribute. But wikis are also used for business. For example, as an experiment, CBC used a wiki to let viewers collaborate on a script for the CBC radio show, *Spark*.

Web 3.0: The Future Web Every day, about 75 million Americans enter 330 million queries to search engines. How many of these 330 million queries produce a meaningful result (a useful answer in the first three listings)? Arguably, fewer than half. Google, Yahoo!, Microsoft, and Amazon are all trying to increase the odds of people finding meaningful answers to search engine queries. But with more than 50 billion Web pages indexed, the means available for finding the information you really want are quite primitive, based on the words used on the pages, and the relative popularity of the page among people who use those same search terms. In other words, it is hit or miss.

To a large extent, the future of the Web involves developing techniques to make searching the 50 billion Web pages more productive and meaningful for ordinary people. Web 1.0 solved the problem of obtaining access to information. Web 2.0 solved the problem of sharing that information with others and building new Web experiences. **Web 3.0** is the promise of a future Web where all this digital information, all these contacts, can be woven together into a single meaningful experience.

Sometimes this is referred to as the **Semantic Web.** "Semantic" refers to meaning. Most of the Web's content today is designed for humans to read and for computers to display, not for computer programs to analyze and manipulate. Search engines can discover when a particular term or keyword appears in a Web document, but they do not really understand

Blog
RSS
Wikis
Web 3.0
Semantic Web

its meaning or how it relates to other information on the Web. You can check this out on Google by entering two searches. First, enter "Paris Hilton." Next, enter "Hilton in Paris." Because Google does not understand ordinary English, it has no idea that you are interested in the Hilton Hotel in Paris in the second search. Because it cannot understand the meaning of pages it has indexed, Google's search engine returns the most popular pages for those queries where "Hilton" and "Paris" appear on the pages.

First described in a 2001 *Scientific American* article, the Semantic Web is a collaborative effort led by the World Wide Web Consortium to add a layer of meaning atop the existing Web to reduce the amount of human involvement in searching for and processing Web information (Berners-Lee et al., 2001).

Views on the future of the Web vary, but they generally focus on ways to make the Web more "intelligent," with machine-facilitated understanding of information promoting a more intuitive and effective user experience. For instance, suppose you want to set up a party with your tennis buddies at a local restaurant Friday night after work. One problem is that you had earlier scheduled to go to a movie with another friend. In a Semantic Web 3.0 environment, you would be able to coordinate this change in plans with the schedules of your tennis buddies and the schedule of your movie friend, and make a reservation at the restaurant all with a single set of commands issued as text or voice to your handheld smartphone. Right now, this capability is beyond our grasp.

Work proceeds slowly on making the Web a more intelligent experience, in large part because it is difficult to make machines, including software programs, that are truly intelligent like humans. But there are other views of the future Web. Some see a 3D Web where you can walk through pages in a 3D environment. Others point to the idea of a pervasive Web that controls everything from the lights in your living room, to your car's rear view mirror, not to mention managing your calendar and appointments.

Other complementary trends leading toward a future Web 3.0 include more widespread use of cloud computing and SaaS business models, ubiquitous connectivity among mobile platforms and Internet access devices, and the transformation of the Web from a network of separate siloed applications and content into a more seamless and interoperable whole. These more modest visions of the future Web 3.0 are more likely to be realized in the near term.

Intranets and Extranets

Organizations use Internet networking standards and Web technology to create private networks called *intranets*. We introduced intranets in Chapter 1, explaining that an intranet is an internal organizational network that provides access to data across the enterprise. It uses the existing company network infrastructure along with Internet connectivity standards and software developed for the World Wide Web. Intranets create networked applications that can run on many different kinds of computers throughout the organization, including mobile handheld computers and wireless remote access devices.

While the Web is available to anyone, an intranet is private and is protected from public visits by **firewalls**—security systems with specialized software to prevent outsiders from entering private networks. Intranet software technology is the same as that of the World Wide Web. A simple intranet can be created by linking a client computer with a Web browser to a computer with Web server software using a TCP/IP network and a firewall. We discuss firewalls further in Chapter 8.

Extranets A firm creates an extranet to allow authorized vendors and customers to have limited access to its internal intranet. For example, authorized buyers could link to a portion of a company's intranet from the public Internet to obtain information about the costs and features of the company's products. The company uses firewalls to ensure that access to its internal data is limited and remains secure; firewalls also authenticate users, making sure that only authorized users access the site.

Both intranets and extranets reduce operational costs by providing the connectivity to coordinate disparate business processes within the firm and to link electronically to customers and suppliers. Extranets often are employed for collaborating with other companies for supply chain management, product design and development, and training efforts.

Firewalls

7.4 The Wireless Revolution

If you have a cell phone, do you use it for taking and sending photos, sending text messages, or downloading music clips? Do you take your laptop to class or to the library to link up to the Internet? If so, you are part of the wireless revolution. Cell phones, laptops, and small handheld devices have evolved into portable computing platforms that let you perform some of the computing tasks you used to do at your desk.

Wireless communication helps businesses more easily stay in touch with customers, suppliers, and employees and provides more flexible arrangements for organizing work. Wireless technology has also created new products, services, and sales channels, which we discuss in Chapter 13.

If you require mobile communication and computing power or remote access to corporate systems, you can work with an array of wireless devices: cell phones, personal digital assistants, and smartphones. PCs are also starting to be used in wireless transmission.

Personal digital assistants (PDAs) are small, handheld computers featuring applications such as electronic schedulers, address books, memo pads, and expense trackers. Models with digital cell phone capabilities such as e-mail messaging, wireless access to the Internet, voice communication, and digital cameras are called **smartphones.**

Cellular Systems

Cell phones and smartphones have become all-purpose devices for digital data transmission. In addition to voice communication, mobile phones are now used for transmitting text and e-mail messages, instant messaging, digital photos, and short video clips; for playing music and games; for surfing the Web; and even for transmitting and receiving corporate data. For example, CN equipped its 350 intermodal drivers with BlackBerrys that were loaded with a custom dispatch application that CN had developed. CN has cut down on phone calls from its drivers by 50 percent, and it is easier for CN to track its drivers' progress.

Within a few years, a new generation of mobile processors and faster mobile networks will enable these devices to function as digital computing platforms performing many of the tasks of today's PCs. Smartphones will have the storage and processing power of a PC and be able to run all of your key applications and access all of your digital content.

Cellular Network Standards and Generations Digital cellular service uses several competing standards. In Europe and much of the rest of the world outside North America, the standard is Global System for Mobile Communications (GSM). GSM's strength is its international roaming capability. There are GSM cell phone systems in North America, including Rogers; both Bell Canada and Telus plan to introduce GSM in 2010.

The major standard in North America is Code Division Multiple Access (CDMA), which is the system used by most Canadian cellular service providers. CDMA transmits over several frequencies, occupies the entire spectrum, and randomly assigns users to a range of frequencies over time. In general, CDMA is cheaper to implement, is more efficient in its use of spectrum, and provides higher quality of voice and data than GSM.

Earlier generations of cellular systems were designed primarily for voice and limited data transmission in the form of short text messages. Wireless carriers are now rolling out more powerful cellular networks called **third-generation** or **3G networks,** with transmission speeds ranging from 144 Kbps for mobile users in, for example, a car, to more than 2 Mbps for stationary users. This is sufficient transmission capacity for video, graphics, and other rich media, in addition to voice, making 3G networks suitable for wireless broadband Internet access. Many of the cellular handsets available today are 3G-enabled, including the newest version of Apple's iPhone.

3G networks are widely used in Japan, South Korea, Taiwan, Hong Kong, Singapore, and parts of northern Europe, but these services are not yet available in many North American locations. To compensate, Canadian cellular carriers have upgraded their networks to support higher-speed transmission. These interim **2.5G networks** provide data

Personal digital assistants (PDAs)
Smartphones
Third-generation (3G) networks
2.5G networks

transmission rates ranging from 60 to 354 Kbps, enabling cell phones to be used for Web access, music downloads, and other broadband services. PCs equipped with a special card can use these broadband cellular services for ubiquitous wireless Internet access.

The next complete evolution in wireless communication, termed 4G, will be entirely packet-switched and capable of providing between 1 Mbps and 1 Gbps speeds, with premium quality and high security. Voice, data, and high-quality streaming video will be available to users anywhere, anytime. International telecommunications regulatory and standardization bodies are working for commercial deployment of 4G networks between 2012 and 2015.

Wireless Computer Networks and Internet Access

If you have a laptop computer, you might be able to use it to access the Internet as you move from room to room in your residence hall or table to table in your university library. An array of technologies provide high-speed wireless access to the Internet for PCs and other wireless handheld devices as well as for cell phones. These new high-speed services have extended Internet access to numerous locations that could not be covered by traditional wired Internet services.

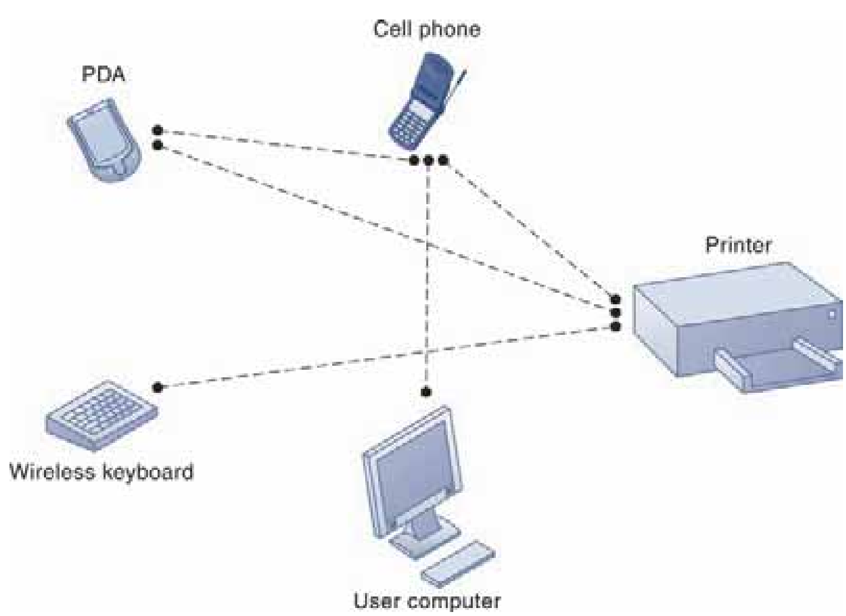
Bluetooth **Bluetooth** is the popular name for the 802.15 wireless networking standard, which is useful for creating small **personal area networks (PANs).** It links up to eight devices within a 10-metre area using low-power, radio-based communication and can transmit up to 722 Kbps in the 2.4-GHz band.

Wireless phones, pagers, computers, printers, and computing devices using Bluetooth communicate with each other and even operate each other without direct user intervention (see Figure 7-16). For example, a person could direct a notebook computer to send a document file wirelessly to a printer. Bluetooth connects wireless keyboards and mice to PCs or cell phones to earpieces without wires. Bluetooth has low power requirements, making it appropriate for battery-powered handheld computers, cell phones, or PDAs.

Although Bluetooth lends itself to personal networking, it has uses in large corporations. For example, FedEx drivers use Bluetooth to transmit the delivery data captured by their handheld PowerPad computers to cellular transmitters, which forward the data to corporate computers. Drivers no longer need to spend time docking their handheld units physically in the transmitters, and Bluetooth has saved FedEx $20 million per year.

Bluetooth
Personal-l area networks (PANs)

FIGURE 7-16 A Bluetooth network (PAN).



Bluetooth enables a variety of devices, including cell phones, PDAs, wireless keyboards and mice, PCs, and printers, to interact wirelessly with each other within a small 10 metre area. In addition to the links shown, Bluetooth can be used to network similar devices to send data from one PC to another.

Wi-Fi The 802.11 set of standards for wireless LANs is also known as **Wi-Fi.** There are three standards in this family: 802.11a, 802.11b, and 802.11g. 802.11n is an emerging standard for increasing the speed and capacity of wireless networking.

The 802.11a standard can transmit up to 54 Mbps in the unlicensed 5-GHz frequency range and has an effective distance of 10 to 30 metres. The 802.11b standard can transmit up to 11 Mbps in the unlicensed 2.4-GHz band and has an effective distance of 30 to 50 metres, although this range can be extended outdoors by using tower-mounted antennas. The 802.11g standard can transmit up to 54 Mbps in the 2.4-GHz range. 802.11n will transmit at more than 100 Mbps.

802.11b was the first wireless standard to be widely adopted for wireless LANs and wireless Internet access. 802.11g is increasingly used for this purpose, and dual-band systems capable of handling 802.11b and 802.11g are available.

In most Wi-Fi communications, wireless devices communicate with a wired LAN using access points. An access point is a box consisting of a radio receiver/transmitter and antennas that link to a wired network, router, or hub.

Figure 7-17 illustrates an 802.11 wireless LAN operating in infrastructure mode that connects a small number of mobile devices to a larger wired LAN. Most wireless devices are client machines. The servers that the mobile client stations need to use are on the wired LAN. The access point controls the wireless stations and acts as a bridge between the main wired LAN and the wireless LAN. (A bridge connects two LANs based on different technologies.) The access point also controls the wireless stations.

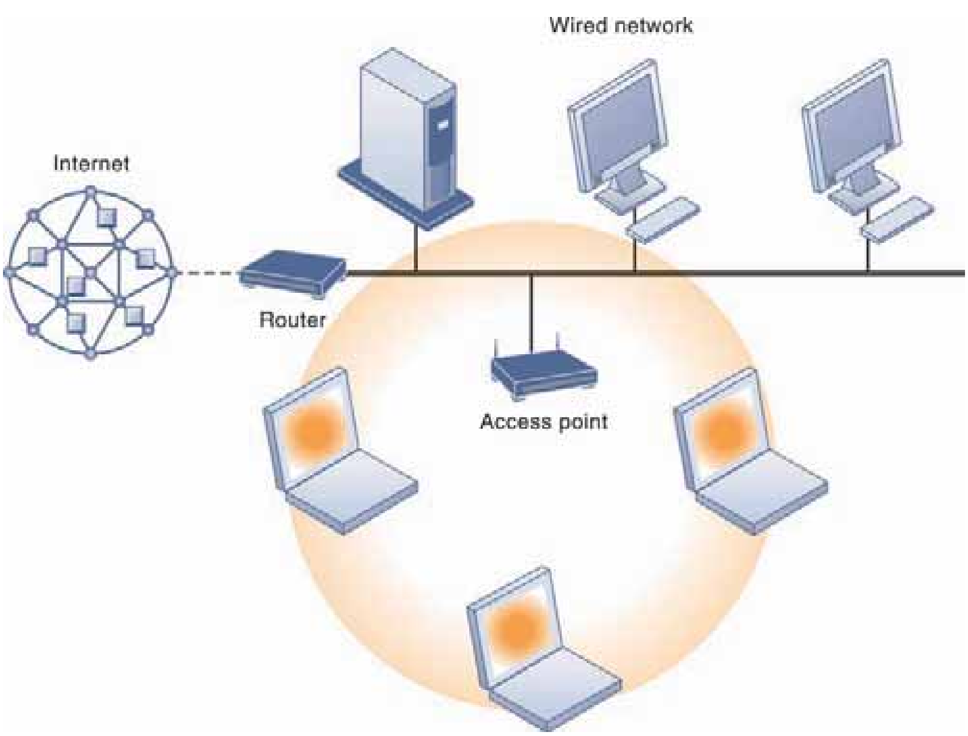
Laptop PCs now come equipped with chips to receive Wi-Fi signals. Older models may need an add-in wireless network interface card.

Wi-Fi and Wireless Internet Access The 802.11 standard also provides wireless access to the Internet using a broadband connection. In this instance, an access point plugs into an Internet connection, which could come from a cable TV line or DSL telephone service. Computers within range of the access point use it to link wirelessly to the Internet.

Businesses of all sizes are using Wi-Fi networks to provide low-cost wireless LANs and Internet access. Wi-Fi hotspots are springing up in hotels, airport lounges, libraries, cafes, and college campuses to provide mobile access to the Internet. Most colleges and universities now use Wi-Fi for research, course work, and entertainment.

Wi-Fi

FIGURE 7-17 An 802.11 wireless LAN.



Mobile laptop computers equipped with network interface cards link to the wired LAN by communicating with the access point. The access point uses radio waves to transmit network signals from the wired network to the client adapters, which convert them into data that the mobile device can understand. The client adapter then transmits the data from the mobile device back to the access point, which forwards the data to the wired network.

Hotspots typically consist of one or more access points positioned on a ceiling, wall, or other strategic spot in a public place to provide maximum wireless coverage for a specific area. Users in range of a hotspot are able to access the Internet from laptops, handhelds, or cell phones that are Wi-Fi enabled, such as Apple's iPhone. Some hotspots are free or do not require any additional software to use; others may require activation and the establishment of a user account by providing a credit card number over the Web.

Wi-Fi technology poses several challenges, however. Right now, users cannot freely roam from hotspot to hotspot if these hotspots use different Wi-Fi network services. Unless the service is free, users need to log on to separate accounts for each service, each with its own fees.

One major drawback of Wi-Fi is its weak security features, which make these wireless networks vulnerable to intruders. We provide more detail about Wi-Fi security issues in Chapter 8.

Another drawback of Wi-Fi networks is susceptibility to interference from nearby systems operating in the same spectrum, such as wireless phones, microwave ovens, or other wireless LANs. Wireless networks based on the 802.11n specification will solve this problem by using multiple wireless antennas in tandem to transmit and receive data and technology to coordinate multiple simultaneous radio signals. This technology is called *MIMO (multiple input multiple output).*

WiMax A surprisingly large number of areas in Canada and throughout the world do not have access to Wi-Fi or fixed broadband connectivity. The range of Wi-Fi systems is no more than 91 metres from the base station, making it difficult for rural groups that do not have cable or DSL service to find wireless access to the Internet.

The IEEE, formerly known as the Institute of Electrical and Electronics Engineers, is a professional standards developing body and developed a new family of standards known as WiMax to deal with these problems. **WiMax,** which stands for Worldwide Interoperability for Microwave Access, is the popular term for IEEE Standard 802.16, known as the "Air Interface for Fixed Broadband Wireless Access Systems." WiMax has a wireless access range of up to 50 kilometres, compared to 91 metres for Wi-Fi and 10 metres for Bluetooth, and a data transfer rate of up to 75 Mbps. The 802.16 specification has robust security and quality-of-service features to support voice and video.

WiMax antennas are powerful enough to beam high-speed Internet connections to rooftop antennas of homes and businesses miles away. Hydro One, headquartered in Ontario, is about to begin using WiMax so that its smart metres in rural areas can communicate with its base systems.

7.5 Radio Frequency Identification and Wireless Sensor Networks

RFID and Wireless Sensor Networks

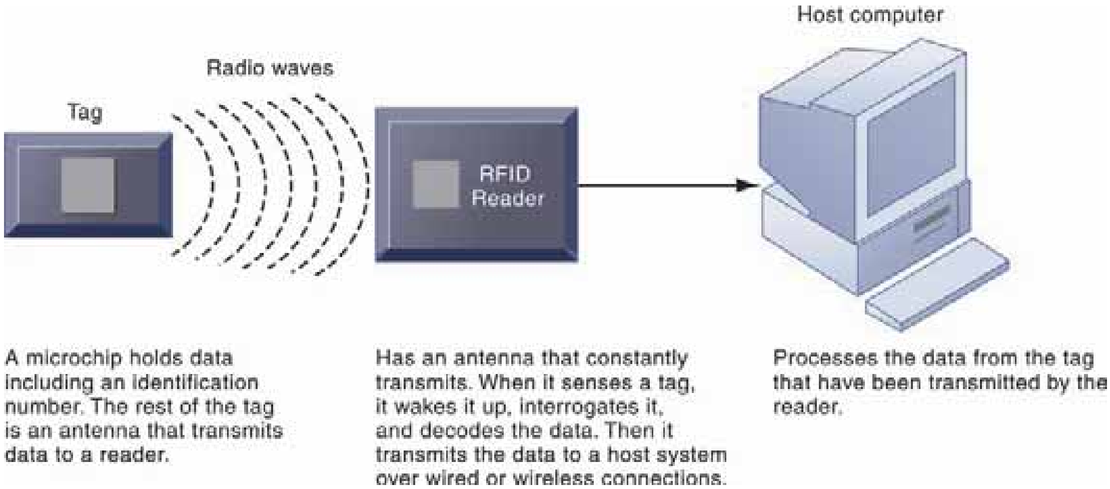
Mobile technologies are creating new efficiencies and ways of working throughout the enterprise. In addition to the wireless systems we have just described, radio frequency identification systems and wireless sensor networks are having a major impact.

Radio Frequency Identification (RFID) **Radio frequency identification (RFID)** systems provide a powerful technology for tracking the movement of goods throughout the supply chain. RFID systems use tiny tags with embedded microchips containing data about an item and its location to transmit radio signals over a short distance to special RFID readers. The RFID readers then pass the data over a network to a computer for processing. Unlike bar codes, RFID tags do not need line-of-sight contact to be read.

The RFID tag is electronically programmed with information that can uniquely identify an item plus other information about the item, such as its location, where and when it was made, or its status during production. Embedded in the tag is a microchip for storing the data. The rest of the tag is an antenna that transmits data to the reader.

Hotspots
WiMax
Radio frequency identification (RFID)

FIGURE 7-18 How RFID works.



RFID uses low-powered radio transmitters to read data stored in a tag at distances ranging from a couple of centimetres to 30 metres. The reader captures the data from the tag and sends them over a network to a host computer for processing.

The reader unit consists of an antenna and radio transmitter with a decoding capability attached to a stationary or handheld device. The reader emits radio waves in ranges anywhere from 1 inch to 100 feet, depending on its power output, the radio frequency employed, and surrounding environmental conditions. When an RFID tag comes within the range of the reader, the tag is activated and starts sending data. The reader captures these data, decodes them, and sends them back over a wired or wireless network to a host computer for further processing (see Figure 7-18). Both RFID tags and antennas come in a variety of shapes and sizes.

Active RFID tags are powered by an internal battery and typically enable data to be rewritten and modified. Active tags can transmit for several dozen metres but cost $5 and upward per tag. Automated toll-collection systems such as New York's E-ZPass use active RFID tags.

Passive RFID tags do not have their own power source and obtain their operating power from the radio frequency energy transmitted by the RFID reader. They are smaller, lighter, and less expensive than active tags, but have a range of only a metre or two.

In inventory control and supply chain management, RFID systems capture and manage more detailed information about items in warehouses or in production than bar-coding systems. If a large number of items are shipped together, RFID systems track each pallet, lot, or even unit item in the shipment. This technology may help companies such as Walmart Canada improve receiving and storage operations by improving their ability to "see" exactly what stock is stored in warehouses or on retail store shelves.

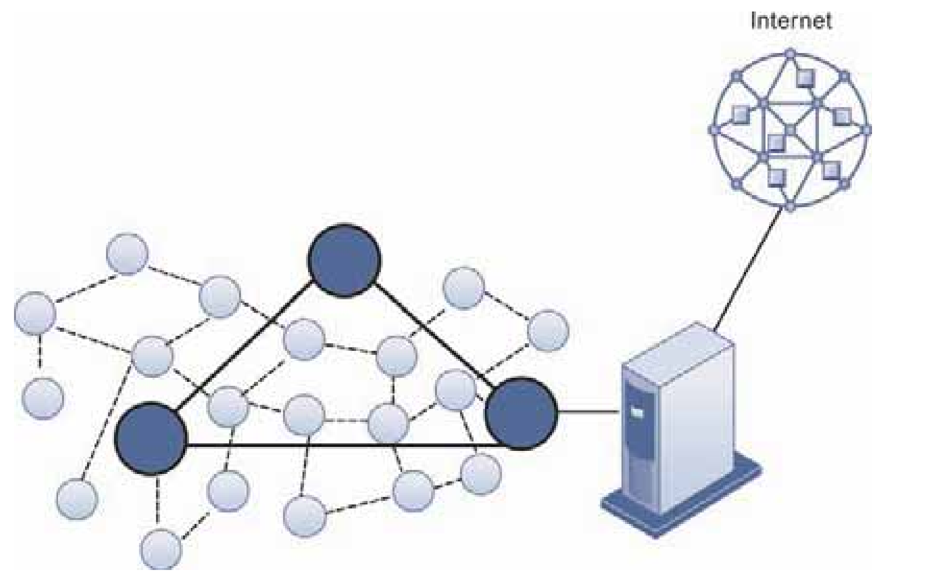
Walmart Canada has installed RFID readers at store receiving docks to record the arrival of pallets and cases of goods shipped with RFID tags. The RFID reader reads the tags a second time just as the cases are brought onto the sales floor from backroom storage areas. Software combines sales data from Walmart's point-of-sale systems and the RFID data regarding the number of cases brought out to the sales floor. The program determines which items will soon be depleted and automatically generates a list of items to pick in the warehouse to replenish store shelves before they run out. This information helps Walmart reduce out-of-stock items, increase sales, and further shrink its costs.

The cost of RFID tags used to be too high for widespread use, but now it is approaching 20 cents per passive tag in Canada. As the price decreases, RFID is starting to become cost-effective for some applications.

In addition to installing RFID readers and tagging systems, companies may need to upgrade their hardware and software to process the massive amounts of data produced by RFID systems—transactions that could add up to tens or hundreds of terabytes.

FIGURE 7-19 A wireless sensor network.

The small circles represent lower-level nodes, and the larger circles represent high-end nodes. Lower-level nodes forward data to each other or to higher-level nodes, which transmit data more rapidly and speed up network performance.



Special software is required to filter, aggregate, and prevent RFID data from overloading business networks and system applications. Applications will need to be redesigned to accept massive volumes of frequently generated RFID data and to share those data with other applications. Major enterprise software vendors, including SAP and Oracle-PeopleSoft, now offer RFID-ready versions of their supply chain management applications.

Wireless Sensor Networks If your company wanted state-of-the-art technology to monitor building security or detect hazardous substances in the air, it might deploy a wireless sensor network. **Wireless sensor networks (WSNs)** are networks of interconnected wireless devices that are embedded into the physical environment to provide measurements of many points over large spaces. These devices have built-in processing, storage, and radio frequency sensors and antennas. They are linked into an interconnected network that routes the data they capture to a computer for analysis.

These networks range from hundreds to thousands of nodes. Because wireless sensor devices are placed in the field for years at a time without any maintenance or human intervention, they must have very low power requirements and batteries capable of lasting for years.

Figure 7-19 illustrates one type of wireless sensor network, with data from individual nodes flowing across the network to a server with greater processing power. The server acts as a gateway to a network based on Internet technology.

Wireless sensor networks are valuable in areas such as monitoring environmental changes; monitoring traffic or military activity; protecting property; efficiently operating and managing machinery and vehicles; establishing security perimeters; monitoring supply chain management; or detecting chemical, biological, or radiological material.

Wireless sensor networks (WSNs)

SUMMARY

1. ***What are the principal components of telecommunications networks and key networking technologies?***
   A simple network consists of two or more connected computers. Basic network components include computers, network interfaces, a connection medium, network operating system software, and either a hub or a switch. The networking infrastructure for a large company includes the traditional telephone system, mobile cellular communication, wireless local area networks, videoconferencing systems, a corporate Web site, intranets, extranets, and an array of local and wide area networks, including the Internet. Contemporary networks have been shaped by the rise of client/server computing, the use of packet switching, and the adoption of Transmission Control Protocol/Internet Protocol (TCP/IP) as a universal communications standard for linking disparate networks

and computers, including the Internet. Protocols provide a common set of rules that enable communication among diverse components in a telecommunications network.

2. ***What are the main telecommunications transmission media and types of networks?***
The principal physical transmission media are twisted copper telephone wire, coaxial copper cable, fibre optic cable, and wireless transmission. Twisted wire enables companies to use existing wiring for telephone systems for digital communication although it is relatively slow. Fibre optic and coaxial cable are used for high-volume transmission but are expensive to install. Microwave and communications satellites are used for wireless communication over long distances. Local area networks (LANs) connect PCs and other digital devices together within a 500-metre radius and are used today for many corporate computing tasks. Network components may be connected using a star, bus, or ring topology. Wide area networks (WANs) span broad geographical distances, ranging from several kilometres to continents, and are private networks that are independently managed. Metropolitan-area networks (MANs) span a single urban area. Digital subscriber line (DSL) technologies, cable Internet connections, and T1 lines are often used for high-capacity Internet connections. Cable Internet connections provide high-speed access to the Web or corporate intranets at speeds of up to 10 Mbps. A T1 line supports a data transmission rate of 1.544 Mbps.

3. ***How do the Internet and Internet technology work, and how do they support communication and e-business?***
The Internet is a worldwide network of networks that uses the client/server model of computing and the TCP/IP network reference model. Every computer on the Internet is assigned a unique numeric IP address. The domain name system (DNS) converts IP addresses to more user-friendly domain names. Worldwide Internet policies are established by organizations and government bodies, such as the Internet Architecture Board and the World Wide Web Consortium. Major Internet services include e-mail, newsgroups, chatting, instant messaging, Telnet, FTP, and the World Wide Web. Web pages are based on Hypertext Markup Language (HTML) and can display text, graphics, video, and audio. Web site directories, search engines, and RSS technology help users locate the information they need on the Web. RSS, blogs, and wikis are features of Web 2.0. Web technology and Internet networking standards provide the connectivity and interfaces for internal private intranets and private extranets that be accessed by many different kinds of computers inside and outside the organization. Firms are also starting to realize economies by using Internet VoIP technology for voice transmission and by using virtual private networks (VPNs) as low-cost alternatives to private WANs.

4. ***What are the principal technologies and standards for wireless networking, communication, and Internet access?***
Cellular networks are evolving toward high-speed, high-bandwidth, digital packet-switched transmission. Broadband 3G networks are capable of transmitting data at speeds ranging from 144 Kbps to more than 2 Mbps. However, 3G services are still not available in most Canadian locations, so cellular carriers have upgraded their networks to support higher-speed transmission. These interim 2.5G networks provide data transmission rates ranging from 60 to 354 Kbps, enabling cell phones to be used for Web access, music downloads, and other broadband services.
Major cellular standards include Code Division Multiple Access (CDMA), which is used primarily in North America, and Global System for Mobile Communications (GSM), which is the standard in Europe and most of the rest of the world.
Standards for wireless computer networks include Bluetooth (802.15) for small personalarea networks (PANs), Wi-Fi (802.11) for localarea networks (LANs), and WiMax (802.16) for metropolitanarea networks (MANs).

5. ***Why are radio frequency identification (RFID) and wireless sensor networks valuable for business?***
Radio frequency identification (RFID) systems provide a powerful technology for tracking the movement of goods by using tiny tags with embedded data about an item and its location. RFID readers read the radio signals transmitted by these tags and pass the data over a network to a computer for processing. Wireless sensor networks (WSNs) are networks of interconnected wireless sensing and transmitting devices that are embedded into the physical environment to provide measurements of many points over large spaces.

Key Terms

2.5G networks, 227
3G networks, 227
Bandwidth, 221
Blog, 225
Bluetooth, 228
Broadband, 203
Bus topology, 209
Cable Internet connections, 209
CA*net, 216

Review Questions

1. *What are the principal components of telecommunications networks and key networking technologies?*
   - *Describe the features of a simple network and the network infrastructure for a large company.*
   - *Name and describe the principal technologies and trends that have shaped contemporary telecommunications systems.*
2. *What are the main telecommunications transmission media and types of networks?*
   - *Name the different types of physical transmission media, and compare them in terms of speed and cost.*
   - *Define a LAN, and describe its components and the functions of each component.*
   - *Name and describe the principal network topologies.*
3. *How do the Internet and Internet technology work, and how do they support communication and e-business?*
   - *Define the Internet, describe how it works, and explain how it provides business value.*
   - *Explain how the domain name system (DNS) and IP addressing system work.*
   - *List and describe the principal Internet services.*
   - *Define and describe VoIP and virtual private networks, and explain how they provide value to businesses.*
   - *List and describe alternative ways of locating information on the Web.*
   - *Compare Web 2.0 and Web 3.0.*
   - *Define and explain the difference between intranets and extranets. Explain how they provide value to businesses.*
4. *What are the principal technologies and standards for wireless networking, communications, and Internet access?*
   - *Define Bluetooth, Wi-Fi, WiMax, and 3G networks.*
   - *Describe the capabilities of each of these networks and for which types of applications each is best suited.*
5. *Why are radio frequency identification (RFID) and wireless sensor networks (WSNs) valuable for business?*
   - *Define RFID, and explain how it works and how it provides value to businesses.*
   - *Define WSNs, explain how they work, and describe the kinds of applications that use them.*

Discussion Questions

1. *It has been said that within the next few years, smartphones will become the single most important digital device we own. Discuss the implications of this statement.*
2. *Should all major retailing and manufacturing companies switch to RFID? Why or why not?*

Collaboration and Teamwork: Evaluating Smartphones

Form a group with three or four of your classmates. Compare the capabilities of Apple's iPhone with a smartphone handset from another vendor with similar features. Your analysis should consider the purchase cost of each device, the wireless networks on which each device can operate, service plan and handset costs, and the services available for each device. You should also consider other capabilities of each device, including the ability to integrate with existing corporate or PC applications. Which device would you select? What criteria would you use to guide your selection? If possible, use Google Sites to post links to Web pages, team communication announcements, and work assignments; to brainstorm; and to work collaboratively on project documents. Try to use Google Docs to develop a presentation of your findings for the class.

Visit the MyMISLab Web site at **www.pearsoned.ca/mymislab.** This online homework and tutorial system puts you in control of your own learning with study and practice tools directly correlated to this chapter's content.

Learning Track Module

The following Learning Tracks provide content relevant to topics covered in this chapter:

1. Computing and Communications Services Provided by Commercial Communications Vendors
2. Broadband Network Services and Technologies
3. Cellular System Generations
4. Wireless Applications for Customer Relationship Management, Supply Chain Management, and Health Care
5. Web 2.0

HANDS-ON MIS Projects

The projects in this section give you hands-on experience evaluating and selecting communications technology, using spreadsheet software to improve selection of telecommunications services, and using Web search engines for business research.

Management Decision Problems

1. Your company supplies ceramic floor tiles to Rona, Home Depot, and other home improvement stores. You have been asked to start using radio frequency identification tags on each case of the tiles you ship to help your customers improve the management of your products and those of other suppliers in their warehouses. Use the Web to identify the cost of hardware, software, and networking components for an RFID system for your company. What factors should be considered? What are the key decisions that have to be made in determining whether your firm should adopt this technology?

2. Fictional BestMed Medical Supplies Corporation sells medical and surgical products and equipment from over 700 different manufacturers to hospitals, health clinics, and medical offices. The company employs 500 people at seven different locations across Canada, including account managers, customer service and support representatives, and warehouse staff. Employees communicate via traditional telephone voice services, e-mail, instant messaging, and cell phones. Management is inquiring about whether the company should adopt a system for unified communications. What factors should be considered? What are the key decisions that have to be made in determining whether to adopt this technology? Use the Web, if necessary, to find out more about unified communications and its costs.

Improving Decision Making: Using Spreadsheet Software to Evaluate Wireless Services

Software skills: Spreadsheet formulas, formatting
Business skills: Analyzing telecommunications services and costs

In this project, you will use the Web to research alternative wireless services and use spreadsheet software to calculate wireless service costs for a sales force.

You would like to equip your sales force of 35 based in Windsor, Ontario, with mobile phones that have capabilities for voice transmission, text messaging, and taking and sending photos. Use the Web to select a wireless service provider that provides nationwide service as well as good service in your home area. Examine the features of the mobile handsets offered by each of these vendors. Assume that each of the 35 salespeople will need to spend three hours per day during business hours (8 a.m. to 6 p.m.) on mobile voice communication, send 30 text messages per day, and five photos per week. Use your spreadsheet software to determine the wireless service and handset that will offer the best pricing per user over a two-year period. For the purposes of this exercise, you do not need to consider corporate discounts.

Achieving Operational Excellence: Using Web Search Engines for Business Research

Software skills: Web search tools
Business skills: Researching new technologies

This project will help develop your Internet skills in using Web search engines for business research.

You want to learn more about ethanol as an alternative fuel for motor vehicles. Use the following search engines to obtain that information: Yahoo!, Google, and MSN. If you wish, try other search engines as well. Compare the volume and quality of information you find with each search tool. Which tool is the easiest to use? Which produced the best results for your research? Why?

CASE STUDY

Google versus Microsoft: Clash of the Technology Titans

Google and Microsoft, two of the most prominent technology companies of the past several decades, are poised to square off for dominance of the workplace, the Internet, and the technological world. In fact, the battle is already well under way. Both companies have already achieved dominance in their areas of expertise. Google has dominated the Internet while Microsoft has dominated the desktop. But both are increasingly seeking to grow into the other's core businesses. The competition between the companies promises to be fierce.

The differences in the strategies and business models of the two companies illustrate why this conflict will shape our technological future. Google began as one search company among many. But the effectiveness of its PageRank search algorithm and online advertising services, along with its ability to attract the best and brightest minds in the industry, have helped Google become one of the most prominent companies in the world. The company's extensive infrastructure allows it to offer the fastest search speeds and a variety of Web-based products.

Microsoft grew to its giant stature on the strength of its Windows operating system and Office desktop productivity applications, which are used by 500 million people worldwide. Sometimes vilified for its anti-competitive practices, the company and its products are nevertheless staples for businesses and consumers looking to improve their productivity with computer-based tasks.

Today, the two companies have very different visions for the future, influenced by the continued development of the Internet and increased availability of broadband Internet connections. Google believes that the maturation of the Internet will allow more and more computing tasks to be performed via the Web, on computers sitting in data centres rather than on your desktop. This idea is known as cloud computing, and it is central to Google's business model going forward. Microsoft, on the other hand, has built its success around the model of desktop computing. Microsoft's goal is to embrace the Internet while persuading consumers to retain the desktop as the focal point for computing tasks.

Only a small handful of companies have the cash flow and human resources to manage and maintain a cloud, and Google and Microsoft are among them. With a vast array of Internet-based products and tools for online search, online advertising, digital mapping, digital photo management, digital radio broadcasting, and online video viewing, Google has pioneered cloud computing. It is obviously betting that Internet-based computing will supplant desktop computing as the way most people work with their computers. Users would use various connectivity devices to access applications from remote servers stored in data centres, as opposed to working locally from their computer.

One advantage to the cloud computing model is that users would not be tied to a particular machine to access information or do work. Another is that Google would be responsible for most of the maintenance of the data centres that house these applications. But the disadvantages of the model are the requirement of an Internet connection to use the applications and the security concerns surrounding Google's handling of your information. Google is banking on the increasing ubiquity of the Internet and availability of broadband and Wi-Fi connections to offset these drawbacks.

Microsoft already has several significant advantages to help remain relevant even if cloud computing is as good as Google advertises. The company has a well-established and popular set of applications that many consumers and businesses feel comfortable using. When Microsoft launches a new product, users of Office products and Windows can be sure that they will know how to use the product and that it will work with their system.

Google itself claims that it is not out to supplant Microsoft but rather wants to provide products and services that will be used in tandem with Microsoft applications. Dave Girouard, president of Google's Enterprise division, says that "people are just using both [Google products and Office] and they use what makes sense for a particular task."

But cloud computing nevertheless represents a threat to Microsoft's core business model, which revolves around the desktop as the centre for all computing tasks. If, rather than buying software from Microsoft, consumers can instead buy access to applications stored on remote servers for a much cheaper cost, the desktop suddenly no longer occupies that central position. In the past, Microsoft used the popularity of its Windows operating system (found on 95 percent of the world's personal computers) and Office to destroy competing products such as Netscape Navigator, Lotus 1-2-3, and WordPerfect. But Google's offerings are Web-based, and thus not reliant on Windows or Office. Google believes that the vast majority of computing tasks, around 90 percent, can be done in the cloud. Microsoft disputes this claim, calling it grossly overstated.

Microsoft clearly wants to bolster its Internet presence in the event that Google is correct. Microsoft's recent attempts to acquire Internet portal Yahoo! indicate this desire. No other company would give Microsoft more Internet search market share than Yahoo!. Google controls over 60 percent of the Internet search market, with Yahoo! a distant second at just over 20 percent, and Microsoft third at under 10 percent. While Microsoft-Yahoo! would still trail Google by a wide margin, the merger would at least increase the possibility of dethroning Google. However, Microsoft's initial buyout attempts were met with heavy resistance from Yahoo!.

With its attempted acquisition of Yahoo!, Microsoft wanted not only to bolster its Internet presence but also to end the threat of an advertising deal between Google and Yahoo!. In June 2008, those chances diminished further due to a partnership between Google and Yahoo! under which Yahoo! will outsource a portion of its advertising to Google. Google plans to deliver some of its ads alongside some of the less profitable areas of Yahoo!'s search, since Google's technology is far more sophisticated and generates more revenue per search than any competitor. Yahoo! recently introduced a comprehensive severance package that critics dismissed as a "poison pill" intended to make the company less appealing for acquisition to Microsoft. In response to this and other moves he considered to be incompetent, billionaire investor Carl Icahn has built up a large stake in the company and has agitated for change in Yahoo! leadership and reopening of negotiations with Microsoft, but the advertising agreement between Yahoo! and Google casts doubt over whether Microsoft can actually pull off a buyout.

With or without Yahoo!, the company's online presence will need a great deal of improvement. Microsoft's online services division's performance has worsened while Google's has improved. Microsoft lost $732 million in 2007 and was on track for an even worse year in 2008. Google earned $4.2 billion in profits over the same 2007 span.

Microsoft's goals are to "innovate and disrupt in search, win in display ads, and reinvent portal and social media experiences." Its pursuit of Yahoo! suggests skepticism even on Microsoft's own part that the company can do all of this on its own. Developing scale internally is far more difficult than simply buying it outright. In attempting to grow into this new area, Microsoft faces considerable challenges. The industry changes too quickly for one company to be dominant for very long, and Microsoft has had difficulty sustaining its growth rates since the Internet's inception. Even well-managed companies encounter difficulties when faced with disruptive new technologies, and Microsoft may be no exception.

Google faces difficulties of its own in its attempts to encroach on Microsoft's turf. The centrepiece of its efforts is the Google Apps suite. These are a series of Web-based applications that include Gmail, instant messaging, calendar, word processing, presentation, and spreadsheet applications (Google Docs), and tools for creating collaborative Web sites. These applications are simpler versions of Microsoft Office applications, and Google is offering basic versions of them for free, and "Premier"' editions for a fraction of the price. Subscribing to the Premier edition of Google Apps costs $50 per year per person, as opposed to approximately $500 per year per person for Microsoft Office.

Google believes that most Office users do not need the advanced features of Word, Excel, and other Office applications, and have a great deal to gain by switching to Google Apps. Small businesses, for example, might prefer cheaper, simpler versions of word processing, spreadsheet, and electronic presentation applications because they do not require the complex features of Microsoft Office. Microsoft disputes this, saying that Office is the result of many years and dollars of market research about what consumers want and that consumers are very satisfied with Microsoft's products. Many businesses agree, saying that they are reluctant to move away from Office because it is the "safe choice." These firms are often concerned that their data is not stored on-site and that they may be in violation of laws such as the Canadian *Sarbanes-Oxley Sarbanes and Oxley Act* (see Chapter 4) as a result, which requires that companies maintain and report their data to the government upon request. Microsoft is also offering more software features and Web-based services to bolster its online presence. These include SharePoint, a Web-based collaboration and document management platform, and Microsoft Office Live, providing Web-based services for e-mail, project management, and organizing information, and online extensions to Office.

The battle between Google and Microsoft is not just being waged in the area of office productivity tools. The two companies are trading blows in a multitude of other fields, including Web browsers, Web maps, online video, cell phone software, and online health record-keeping tools. **Salesforce.com** (see the Window on Organizations in Chapter 5) represents the site of another conflict between the two giants. Microsoft has attempted to move in on the software-as-a-service model popularized by **Salesforce.com**, offering a competing CRM product for a fraction of the cost. Google has gone the opposite route, partnering with Salesforce to integrate that company's CRM applications with Google Apps and creating a new sales channel to market Google Apps to businesses that have already adopted Salesforce CRM software.

Additionally, both companies are attempting to open themselves up as platforms to developers. Google has already launched its Google App Engine, which allows outside programmers to develop and launch their own applications for minimal cost. In a move that represented a drastic change from previous policy, Microsoft announced that it would reveal many key details of its software that were previously kept secret. Programmers will have an easier time building services that work with Microsoft programs. Microsoft's secrecy once helped the it control the marketplace by forcing other companies to use Windows rather than develop alternatives, but if Microsoft cannot do the same to Google Apps, it makes sense to try a different approach to attract developers.

Time will tell whether or not Microsoft is able to fend off Google's challenge to its dominance in the tech industry. Many other prominent companies have fallen victim to paradigm shifts, such as mainframes to personal computers, traditional print media to Internet distribution, and, if Google has its way, personal computers to cloud computing.

CASE STUDY QUESTIONS:

1. Define and compare the business strategies and business models of Google and Microsoft.
2. Has the Internet taken over the PC desktop as the centre of the action? Why or why not?
3. Why did Microsoft attempt to acquire Yahoo!? How did it affect its business model? Do you believe this was a good move?
4. What is the significance of Google Apps to Google's future success?
5. Would you use Google Apps instead of Microsoft Office applications for computing tasks? Why or why not?
6. Which company and business model do you believe will prevail in this epic struggle? Justify your answer.

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