

## 7

Telecommunications, the Internet,  
and Wireless Technology

## LEARNING OBJECTIVES

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

- 7-1** What are the principal components of telecommunications networks and key networking technologies?
- 7-2** What are the different types of networks?
- 7-3** How do the Internet and Internet technology work, and how do they support communication and e-business?
- 7-4** What are the principal technologies and standards for wireless networking, communication, and Internet access?
- 7-5** How will MIS help my career?

## CHAPTER CASES

Alibaba: Redefining Traditional Retailing  
Monitoring Employees on Networks:  
Unethical or Good Business?  
Talking Cars Make for Better Road Safety  
Google, Apple, and Facebook Battle for Your  
Internet Experience

## VIDEO CASES

Telepresence Moves out of the Boardroom  
and into the Field  
Virtual Collaboration with IBM Sametime

## MyLab MIS

Discussion Questions: 7-5, 7-6, 7-7; Hands-On MIS Projects: 7-8, 7-9, 7-10, 7-11;  
eText with Conceptual Animations

## Alibaba: Redefining Traditional Retailing

In 2020 Alibaba opened its 200th Hema (or Freshhippo) Supermarket, which it believes represents the “New Retail,” a seamless experience that combines digital and physical retail. Using apps, facial recognition payment, self-check-out, digitized inventories, and artificial intelligence, Alibaba's omnichannel supermarkets offer a look at the future of all retail worldwide. The supermarkets deviate from the conventional retailer in one major respect: they have succeeded in seamlessly merging the offline and online retail spaces.

Alibaba has re-imagined traditional brick-and-mortar retailing, with Internet and wireless technologies playing a facilitating role in this new kind of store. Alibaba Group's founder, Jack Ma, in a letter to shareholders, laid out the Group's strategic focus given that the retail industry is moving toward an omnichannel business model that focuses on the integration of online, offline, logistics, and data across a single value chain.

The Hema stores serve as the test bed for this strategy, not only in terms of how the customer interfaces with a retail store but also in the way in which the store learns and adapts to its customers. By requiring all customers to engage with the store through the Hema app, Alibaba has evolved the conventional store loyalty card further: it continuously acquires information from its customers, not only with regard to the purchases they make but also to other products of interest that they may have scanned. This information provides a wealth of data that the organization mines through big data analytics, determining preferences from what they scan or purchase and even from their path through the store.

Through a combination of web and wireless technologies, Alibaba curates its fresh goods, allowing customers to view such details as the item's production date, location, and nutritional details, in addition to complementary products and even recommended recipes, all by scanning a QR code. All interactions between the customer and the store take place through the supermarket's app.

Customers install the app and link it to either their AliPay or Taobao account, which serves as the payment medium for all transactions. Free Wi-Fi is provided in-store for customers to scan QR codes placed next to each product using their smartphone, and customers can not only make purchases but also submit ingredients to in-store chefs to prepare. To cap it all, they can request delivery of their goods within a 3-km radius of the store.

Three thousand items are available within the Hema stores, but a further 11,000 items are available to purchase through the app itself, further blurring



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the lines between offline and online retailing. The Hema app also leverages artificial intelligence to remember the purchasing behavior of customers and makes personalized shopping recommendations. Based on fully exploiting the capabilities afforded by Internet and wireless technologies, this next step in the evolution of retail is providing organizations with newer, deeper insights into their customers' preferences and behavior even as it enhances the customer's shopping experience.

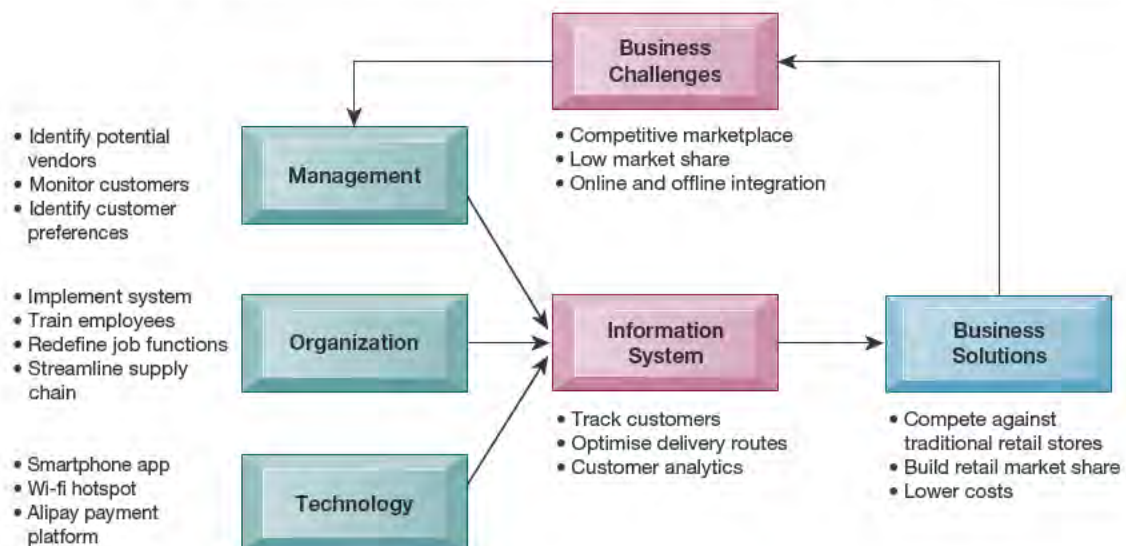
**Sources:** Dashveenjit Kaur, "What's Behind Alibaba's 'New Retail' Strategy?," *techwireasia.com*, October 22, 2020; Thaddeus Han, "5 Retail Insights from Alibaba's 'New Retail' Revolution," *medium.com*, February 6, 2020; Tricia McKinnon, "The Future of Retail: 9 Ways Alibaba Is Redefining Retail Stores," *www.indigo9digital.com*, October 3, 2019; David Lidsky, "These Chinese Supermarkets Make Amazon Go Stores Seem Basic," *TechCrunch*, February 19, 2019; Xinhua, "Alibaba's AI-powered Hema Stores to Drive Digitization of Retail Industry," *China Daily*, January 16, 2019; Donna Fuscaldo, "Alibaba Pushes Dual Strategy with New Stores," *www.investopedia.com*, July 17, 2017; Jack Ma, "Letter to Shareholders from Executive Chairman Jack Ma," *www.alibabagroup.com*, October 13, 2016.

*Case contributed by Imran Medi, Asia Pacific University of Technology and Innovation*

Alibaba's leveraging of the Internet to not only enter the traditional retail space but also to redefine it illustrates the capabilities and potential of wireless technologies. Alibaba increased profitability in a crowded market, in which even large and well-established retailers have limited market share and small levels of return per retail space. Hema's seamless integration of its physical and online stores proved to be very appealing to customers, while the central role of the Hema app in the interaction between the customer and the store is enabling the company to better manage its supply chain.

The chapter-opening diagram highlights the important issues raised by this chapter. Alibaba as well as other e-commerce-based organizations (such as Amazon) are venturing into the brick-and-mortar retail space, leveraging their expertise in web-based technologies to reshape traditional retail. However, the Chinese retail market is an especially competitive one.

As the primary payment alternative to cash transactions, Alibaba capitalized on its users' familiarity with the Alipay platform to build its entire retail shopping experience around a smartphone app. Wi-fi technology allows customers



to view information relating to a product that is far in excess of what is feasible through the traditional shelf-based store arrangement. Meanwhile, the app is enabling Alibaba to tailor its products to the exact preferences of its customers.

Here are some questions to think about: How does wireless technology allow the organization to better understand its customers? How will the use of web technology drive change across brick-and-mortar retailing?

## 7-1 What are the principal components of telecommunications networks and key networking technologies?

If you run or work in a business, you can't do it without networks. You need to communicate rapidly with your customers, suppliers, and employees. Until about 1990, businesses used the postal system or telephone system with voice or fax for communication. Today, however, you and your employees use computers, email, text messaging, the Internet, mobile 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 companies built telephone networks throughout the twentieth century by using voice transmission technologies (hardware and software), and these companies almost always operated as regulated monopolies throughout the world. Computer companies originally built computer networks to transmit data between computers in different locations.

Thanks to continuing telecommunications deregulation and information technology innovation, telephone and computer networks are converging into a single digital network using shared Internet-based standards and technology. Telecommunications providers today, such as BT, offer data transmission, Internet access, mobile phone service, and television programming as well as voice service. Cable companies, such as Liberty Global, Telefónica and Deutsche Telekom, among others, offer voice service and Internet access. Computer networks have expanded to include Internet telephone and video services.

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 the majority of U.S. households have high-speed **broadband** connections provided by telephone and cable TV companies running from 5 to over 900 megabits per second. The cost for this service has fallen exponentially, from 50 cents per kilobit in 2000 to a tiny fraction of a cent today.

Increasingly, voice and data communication, as well as Internet access, are taking place over broadband wireless platforms such as mobile phones, mobile handheld devices, and PCs in wireless networks. According to eMarketer, there almost 3.5 billion worldwide mobile Internet users, over 45% of the world's population (eMarketer, Inc., 2020).



## What Is a Computer Network?

If you had to connect the computers for two or more employees in the same office, you would need a computer 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 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 to link the computer to the network. 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 local area networks (Wi-Fi networks).

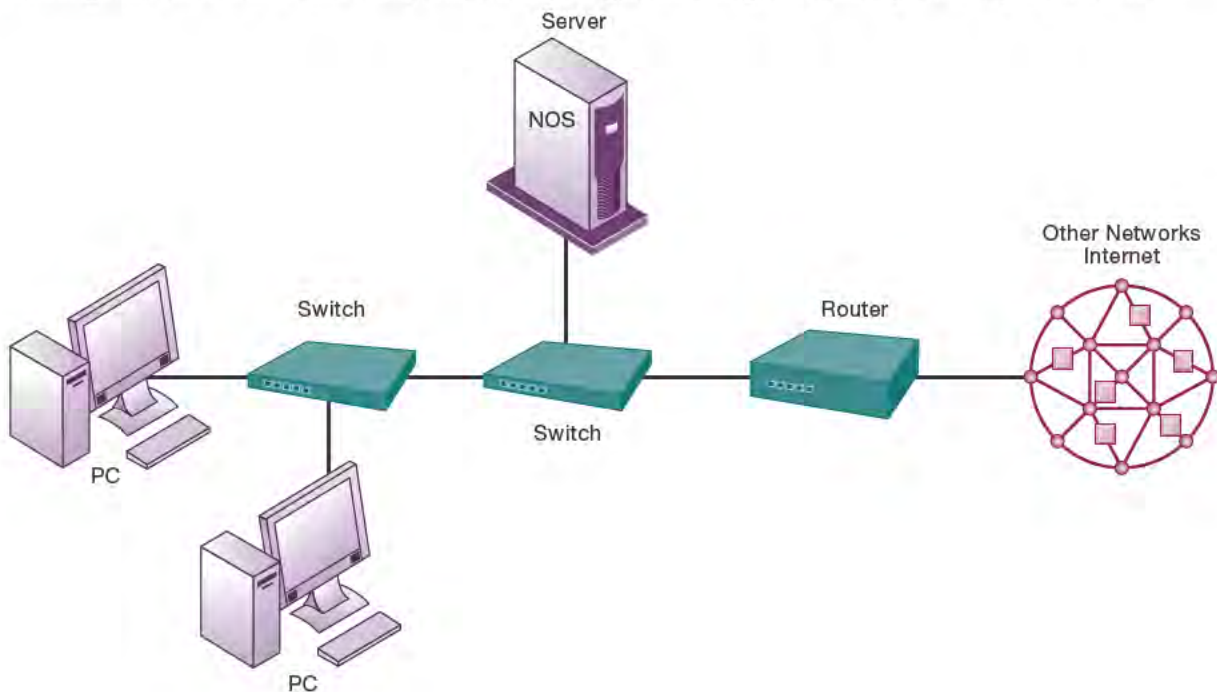
The **network operating system (NOS)** routes and manages communications on the network and coordinates network resources. It can reside on every computer in the network or primarily on a dedicated server computer for all the applications on the network. A server is a computer on a network that performs important network functions for client computers, such as displaying web pages, storing data, and storing the network operating system (hence controlling the network). Microsoft Windows Server and Linux 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 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 communications processor that routes packets of data through different networks, ensuring that the data sent get to the correct address.

**FIGURE 7.1** COMPONENTS OF A SIMPLE COMPUTER NETWORK

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



Network switches and routers have proprietary software built into their hardware for directing the movement of data on the network. This can create network bottlenecks and makes the process of configuring a network more complicated and time-consuming. **Software-defined networking (SDN)** is a networking approach in which many of these control functions are managed by one central program, which can run on inexpensive commodity servers that are separate from the network devices themselves. This is especially helpful in a cloud computing environment with many pieces of hardware because it allows a network administrator to manage traffic loads in a flexible and more efficient manner.

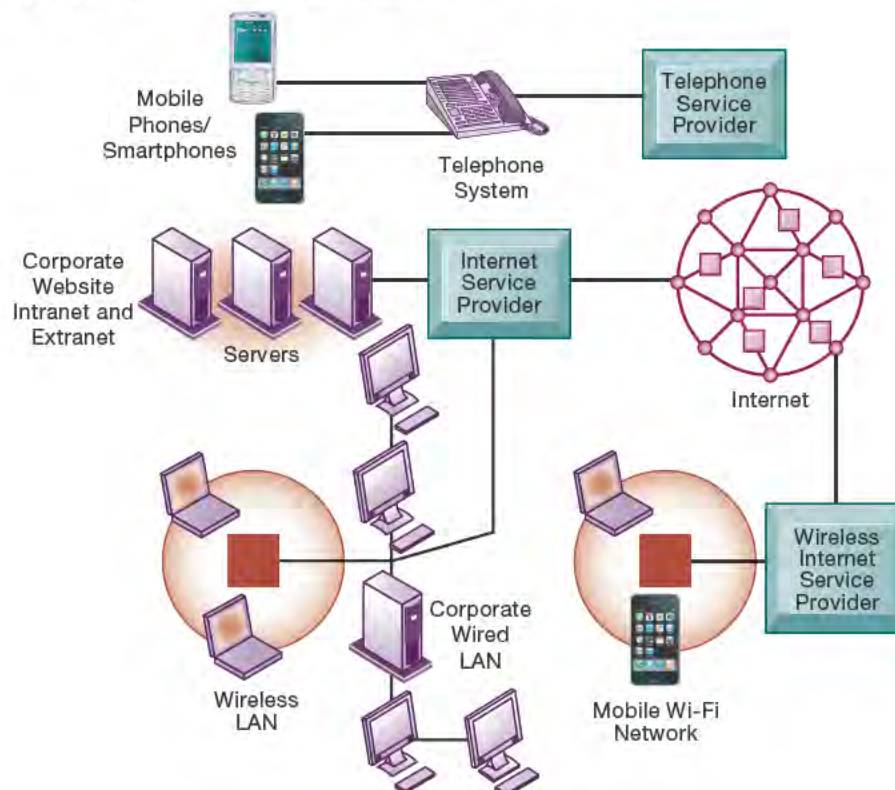
## Networks in Large Companies

The network we've just described might be suitable for a small business, but what about large companies with many locations and thousands of employees? As a firm grows, its small 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 local area networks linked to other local area networks and to firmwide corporate networks. A number of powerful servers support a corporate website, 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 the corporate network infrastructure supports a mobile sales force using mobile phones and smartphones, mobile employees

**FIGURE 7.2** CORPORATE NETWORK INFRASTRUCTURE

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



linking to the company website, and internal company networks using mobile wireless local area networks (Wi-Fi networks). In addition to these computer networks, the firm's infrastructure may include 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 this figure, 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 mobile 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 and from one system to another.

## 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

Client/server computing, introduced in Chapter 5, is a distributed computing model in which some of the processing power is located within small, inexpensive client computers and resides literally on desktops or 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 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. It also makes it possible for personal computing devices such as PCs, laptops, and mobile phones to be connected to networks such as the Internet. The Internet is the largest implementation of client/server computing.

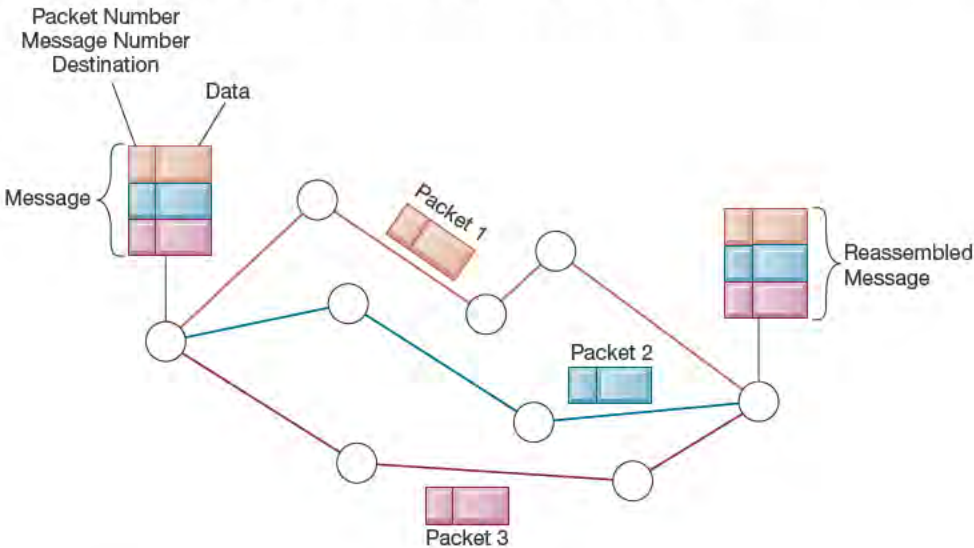
### Packet Switching

**Packet switching** is a method of slicing digital messages into parcels called packets, sending the packets along different communication paths as they become 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 regardless of whether any data were being sent.



### FIGURE 7.3 PACKET-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.



Packet switching is more efficient. Messages are first broken down into small fixed bundles of data called packets. The packets include information for directing the packet to the right address and for checking transmission errors along with the data. The packets are transmitted over various communications channels by using routers, each packet traveling independently. Packets of data originating at one source will be routed through many 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 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, diverse proprietary and incompatible protocols often forced business firms to purchase computing and communications equipment from a single vendor. However, 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, 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 THE TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL (TCP/IP) REFERENCE MODEL

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

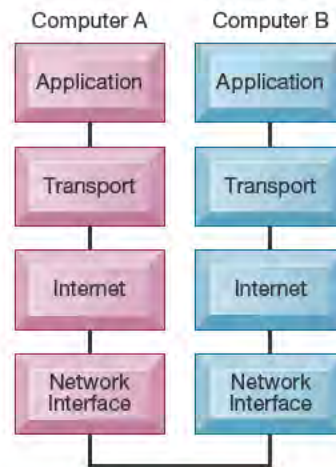


Figure 7.4 illustrates the four-layered Department of Defense reference model for TCP/IP, and the layers are described as follows:

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 can 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 passing through the Network Interface layer. After the data reach the recipient host computer, they travel up the layers 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 reversed when the receiving computer responds.

## 7-2 What are the different types of networks?

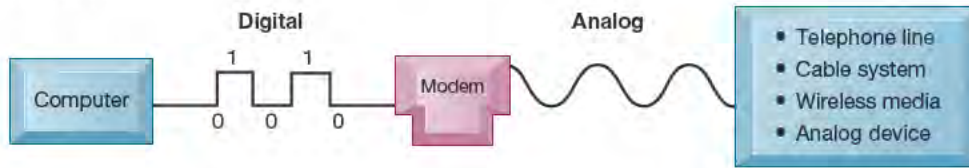
Let's look more closely at alternative networking technologies available to businesses.

### Signals: Digital Versus Analog

There are two ways to communicate a message in a network: an analog signal or a digital signal. An *analog signal* is represented by a continuous waveform that passes through a communications medium and has been used for audio communication. The most common analog devices are the telephone handset,

**FIGURE 7.5** FUNCTIONS OF THE MODEM

A modem is a device that translates digital signals into analog form (and vice versa) so that computers can transmit data over analog networks such as telephone and cable networks.



the speaker on your computer, or your iPhone earphone, all of which create analog waveforms 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: 1 bits and 0 bits, which are represented as on-off electrical pulses. Computers use digital signals and require a modem to convert these digital signals into analog signals that can be sent over (or received from) telephone lines, cable lines, or wireless media that use analog signals (see Figure 7.5). **Modem** stands for modulator-demodulator. Cable modems connect your computer to the Internet by using a cable network. DSL modems connect your computer to the Internet using a telephone company's landline network. Wireless modems perform the same function as traditional modems, connecting your computer to a wireless network that could be a cell phone network or a Wi-Fi network.

## Types of Networks

There are many 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-meter 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 also are used to 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 server, providing users with access to shared computing resources in the network, including software programs and data files.

**TABLE 7.1** TYPES OF NETWORKS

TYPE	AREA
Local area network (LAN)	Up to 500 meters (half a mile); an office or floor of a building
Campus area network (CAN)	Up to 1,000 meters (a mile); a college campus or corporate facility
Metropolitan area network (MAN)	A city or metropolitan area
Wide area network (WAN)	A regional, transcontinental, or global area

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 and Linux.

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 that carry data over the system. Originally, Ethernet supported a data transfer rate of 10 megabits per second (Mbps). Newer versions, such as Gigabit Ethernet, support a data transfer rate of 1 gigabit per second (Gbps).

The LAN illustrated in Figure 7.1 uses a client/server architecture in which the network operating system resides primarily on a single 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 ten 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.

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 email (mail servers), or storing and managing web pages (web servers).

**Metropolitan and Wide Area Networks**

**Wide area networks (WANs)** span broad geographical distances—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.

**Transmission Media and Transmission Speed**

Networks use different kinds of physical transmission media, including twisted pair wire, coaxial cable, fiber-optic cable, and media for wireless transmission. Each has advantages and limitations. A wide range of speeds is possible for any given medium, depending on the software and hardware configuration. Table 7.2 compares these media.

**TABLE 7.2    PHYSICAL TRANSMISSION MEDIA**

TRANSMISSION MEDIUM	DESCRIPTION	SPEED
Twisted pair wire	Strands of copper wire twisted in pairs for voice and data communications. Includes CAT5 and CAT6 cabling, with CAT6 capable of gigabit speeds.	CAT5: 10 Mbps-100 Mbps CAT6: Up to 10 Gbps
Coaxial cable	Thickly insulated copper wire, which is capable of high-speed data transmission and less subject to interference than twisted wire. Currently used for cable TV and for networks with longer runs (more than 100 meters).	Up to 1 Gbps
Fiber-optic cable	Strands of clear glass fiber, transmitting data as pulses of light generated by lasers. Useful for high-speed transmission of large quantities of data. More expensive than other physical transmission media; used for last-mile delivery to customers and the Internet backbone.	15 Mbps to 6+ Tbps
Wireless transmission media	Based on radio signals of various frequencies and includes both terrestrial and satellite microwave systems and cellular networks. Used for long-distance, wireless communication, and Internet access.	Up to 600+ Mbps



## Bandwidth: 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.

### 7-3 How do the Internet and Internet technology work, and how do they support communication and e-business?

The Internet 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's look at the most important Internet features.

## What Is the Internet?

The Internet is the world's most extensive public communication system. It's also the world's largest implementation of client/server computing and internetworking, linking millions of individual networks all over the world. This global network of networks began in the early 1970s as a U.S. Department of Defense project 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. Individuals also connect to the Internet through their business firms, universities, or research centers that have designated Internet domains.

There is 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 high-speed broadband connections have largely replaced it. Digital subscriber line, cable, 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 to over 100 Mbps, depending on usage patterns and distance. Fios (Verizon's fiber optic cable service) can deliver over 900 Mbps, although most home service delivers 100 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 between 20 and 100 Mbps, with high-speed cable Internet download speed approaching 1 Gbps. 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 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. The Internet does not provide similar guaranteed service levels but, simply, best effort.

## Internet Addressing and Architecture

The Internet is based on the TCP/IP networking protocol suite described earlier in this chapter. Every device connected to the Internet (or another TCP/IP network) is assigned a unique **Internet Protocol (IP) address** consisting of a string of numbers.

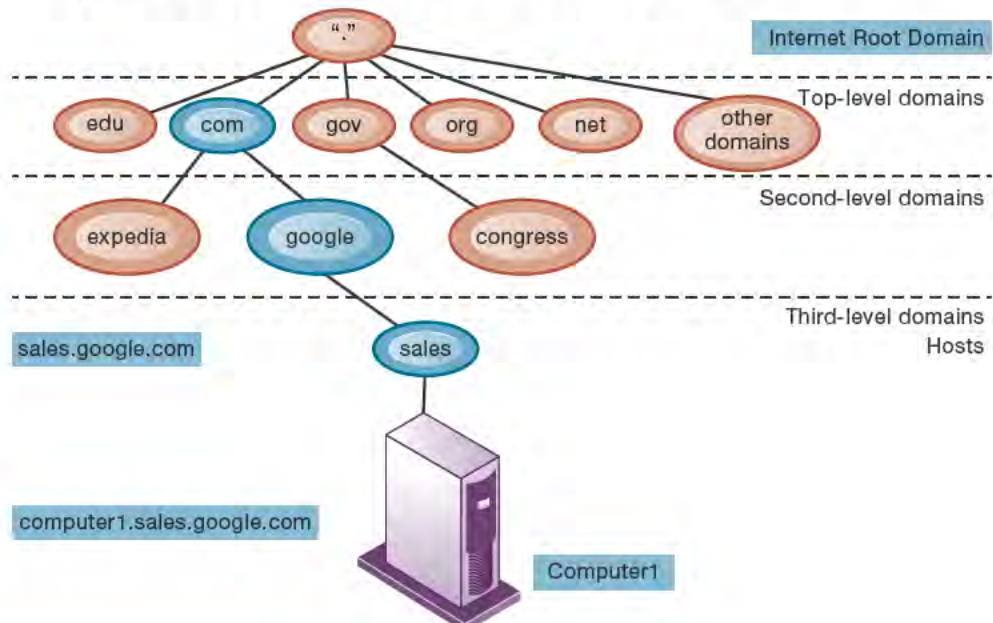
When a user sends a message to another user on the Internet or another TCP/IP network, the message is first decomposed into packets. Each packet contains its destination address. The packets are then sent from the client to the network server and from there on to as many other servers as necessary to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

### The Domain Name System

Because it would be incredibly difficult for Internet users to remember long strings of numbers, an IP address can be represented by a natural language convention called a **domain name**. The **Domain Name System (DNS)** converts domain names to IP addresses. 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, such as Expedia.com,

**FIGURE 7.6 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.



DNS has a hierarchical structure (see Figure 7.6). 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 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 buy.com, nyu.edu, or amazon.ca. A host name at the bottom of the hierarchy designates a specific computer on either the Internet or a private network.

The following list shows the most common domain extensions currently available and officially approved. Countries also have domain names such as .uk, .au, and .fr (United Kingdom, Australia, and France, respectively), and there is a new class of internationalized top-level domains that use non-English characters. In the future, this list will expand to include many more types of organizations and industries as follows:

- .com Commercial organizations/businesses
- .edu Educational institutions
- .gov U.S. government agencies
- .mil U.S. military
- .net Network computers
- .org Any type of organization
- .biz Business firms
- .info Information providers

## Internet Architecture and Governance

Internet data traffic is carried over transcontinental high-speed backbone networks that generally operate in the gigabit range (see Figure 7.7). 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 in the United States and in other countries that connect retail users in homes and businesses to the Internet. The regional networks lease access to ISPs, private companies, and government institutions.

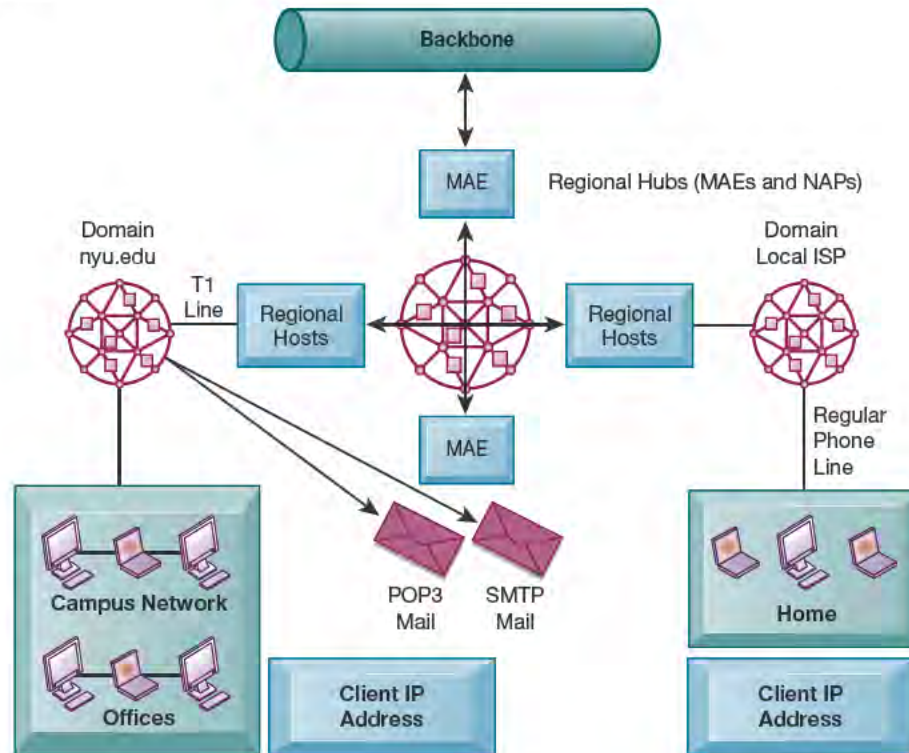
Each organization pays for its own networks and its own local Internet connection services, a part of which is paid to the long-distance trunk line owners. Individual Internet users pay ISPs for using their service, and they generally pay a flat subscription fee, no matter how much or how little they use the Internet. 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 manages the domain name system; and the World Wide Web Consortium (W3C), which sets Hypertext Markup Language and other programming standards for the web.

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 to 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



**FIGURE 7.7** 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.



is changing as the Internet plays a growing role in the distribution of information and knowledge, including content that some find objectionable.

### The Future Internet: IPv6 and Internet2

The Internet was not originally designed to handle billions of users and the transmission of massive quantities of data. Because of sheer Internet population growth, the world is about to run out of available IP addresses using the old addressing convention. The old system based on 32-bit addresses is being replaced by a new version of IP addressing called **IPv6** (Internet Protocol version 6), which contains 128-bit addresses ( $2$  to the power of  $128$ ), or more than a quadrillion possible unique addresses. IPv6 is compatible with most modems and routers sold today, and IPv6 will fall back to the old addressing system if IPv6 is not available on local networks. The transition to IPv6 will take several years as systems replace older equipment.

**Internet2** is an advanced networking consortium serving 317 U.S. universities, 60 government agencies, 43 regional and state education networks, 59 leading corporations, and 70 national research and education network partners from more than 100 countries. To connect these communities, Internet2 developed a high-capacity, 100 Gbps network that serves as a test bed for leading-edge technologies that may eventually migrate to the public Internet, including large-scale network performance measurement and management tools, secure identity and access management tools, and capabilities such as scheduling high-bandwidth, high-performance circuits.

## 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 email 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. Client platforms today include not only PCs and other computers but also smartphones and tablets.

### Internet Services

A client computer connecting to the Internet has access to a variety of services. These services include email, chatting and instant messaging, electronic discussion groups, **Telnet**, **File Transfer Protocol (FTP)**, and the web. Table 7.3 provides a brief description of these services.

Each Internet service is implemented by one or more software programs. All the services may run on a single server computer, or different services may be allocated to different machines. Figure 7.8 illustrates one way these services can be arranged in a multitiered client/server architecture.

**Email** enables messages to be exchanged from computer to computer, with capabilities for routing messages to multiple recipients, forwarding messages, and attaching text documents or multimedia files to messages. Most email today is sent through the Internet. The cost of email is far lower than equivalent voice, postal, or overnight delivery costs, and email messages can arrive anywhere in the world in a matter of seconds.

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 websites 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. Instant messaging systems for consumers include Yahoo! Messenger, Google Hangouts, AOL Instant Messenger, and Facebook Messenger. Companies concerned with security use proprietary communications and messaging systems such as IBM 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.

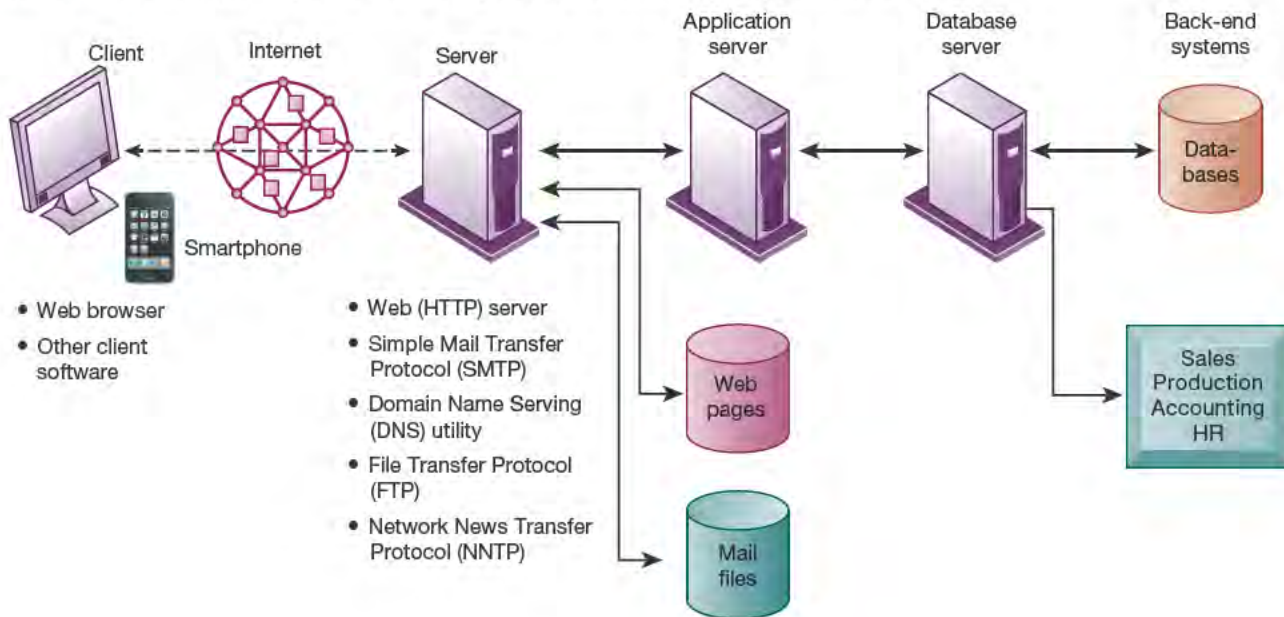
**TABLE 7.3** MAJOR INTERNET SERVICES

CAPABILITY	FUNCTIONS SUPPORTED
Email	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 on another
File Transfer Protocol (FTP)	Transferring files from computer to computer
World Wide Web	Retrieving, formatting, and displaying information (including text, audio, graphics, and video) by using hypertext links



**FIGURE 7.8** CLIENT/SERVER COMPUTING ON THE INTERNET

Client computers running web browsers 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.



Employee use of email, instant messaging, and the Internet is supposed to increase worker productivity, but the accompanying Interactive Session 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 companies may need to monitor their employees' email 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 7.9). Calls that would ordinarily be transmitted over public telephone networks travel over the corporate network based on the Internet protocol, or over the public Internet. Voice calls can be made and received with a computer equipped with a microphone and speakers or with a VoIP-enabled telephone.

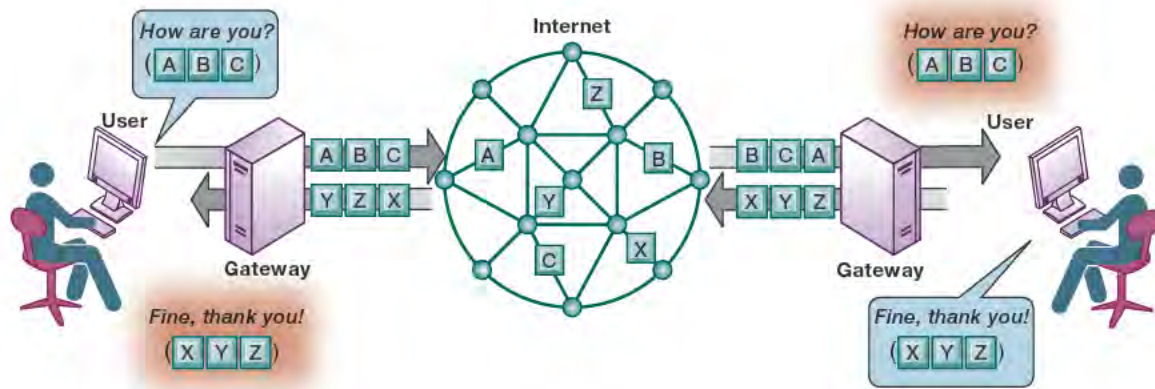
Firms such as Vonage provide VoIP service bundled with high-speed Internet and cable offerings. Skype offers free VoIP worldwide using a peer-to-peer network, and Google has its own free VoIP service.

Although up-front investments are 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 type of network.



**FIGURE 7.9 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.



## 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 can merge disparate communications modes into a single universally accessible service using unified communications technology. **Unified communications** integrates disparate channels for voice communications, data communications, instant messaging, email, and electronic conferencing into a single experience by which users can seamlessly switch back and forth between different communication modes. Presence technology shows whether a person is available to receive a call.

Turning Point, a not-for-profit health and social care provider serving hospitals, prisons, and primary care settings across England and Wales, has achieved agility and cost savings by using Cisco Unified Communications Manager (CallManager). CallManager provides an integrated enterprise-wide infrastructure for voice and video calling, instant messaging, and mobility. The organization is able to centralize call control and session management. For instance, employees can start a chat session and then escalate this interaction to a phone call.

## Virtual Private Networks

What if you had a marketing group charged with developing new products and services for your firm with members spread across the United States? You would want them to be able to email each other and communicate with the home office without any chance that outsiders could intercept the communications. Large private networking firms offer secure, private, dedicated networks to customers, but this is expensive. A lower-cost 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

## INTERACTIVE SESSION **MANAGEMENT**

### Monitoring Employees on Networks: Unethical or Good Business?

The Internet has become an extremely valuable business tool, but it's also a huge distraction for workers on the job. Employees are wasting valuable company time by surfing inappropriate websites (Facebook, shopping, sports, etc.), sending and receiving personal email, texting to friends, and downloading videos and music. According to a survey by International Data Corp (IDC), 30 to 40 percent of Internet access is spent on non-work-related browsing, and a staggering 60 percent of all online purchases are made during working hours. UK-based employment site MyJobGroup.co.uk surveyed 1,000 British workers and found that almost 6 percent of them spent over an hour a day using social media of some kind, including *Facebook*. This is roughly one-eighth of their workday. By extension, about 2 million of Britain's 34-million-person workforce likely were doing the same, costing the British economy about 14 billion pounds in lost productivity.

Many companies have begun monitoring employee use of email and the Internet, sometimes without their knowledge. Many tools are now available for this purpose from vendors such as Veriato OsMonitor, Work Examiner, Mobistealth, and Spytech. These products enable companies to record online searches, monitor file downloads and uploads, record keystrokes, keep tabs on emails, create transcripts of chats, or take certain screenshots of images displayed on computer screens. Instant messaging, text messaging, and social media monitoring are also increasing.

Microsoft Corporation collects and analyzes data on the frequency of chats, emails, and meetings between its staff and clients using its own Office 365 services to measure employee productivity, management effectiveness, and work-life balance. Tracking email, chats, and calendar appointments can show how employees spend an average of 20 hours of their work time each week. The company only allows managers to look at groups of five or more workers.

Microsoft sales team members have received personalized dashboards that show how they spend their time, but this information is shielded from managers. The dashboards offers recommendations on how to build out networks of contacts and spend more time with customers rather than in internal meetings.

Microsoft also sells workplace analytics software to other companies, such as Macy's Inc., which analyzed data on staff work-life balance by measuring how many hours employees spent sending emails and logged in online outside of business hours. Mortgage giant Freddie Mac used Microsoft's tools to gauge how much time workers spent in meetings and try to determine whether some of those gatherings were redundant.

Although U.S. companies have the legal right to monitor employee Internet and email 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 translates into lost revenue. Some employees may even be billing time they spend pursuing personal interests online to clients, thus overcharging them.

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. GMI Insurance Services, which serves the U.S. transportation industry, found that employees were downloading a great deal of music and streaming video and storing the files on company servers. GMI's server backup space was being eaten up.

When employees use email or the web (including social networks) 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, 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 run up huge legal bills. Companies also fear leakage of confidential information and trade secrets through email or social networks. U.S. 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 websites or social sites, closely monitor email messages, or limit personal time on the web.

Should all employees be monitored while working? Not necessarily. Not every workforce, workplace, or work culture and environment is a candidate for electronic surveillance. The decision depends on the company and the work environment an employer wants to create. A major concern of some employers is the potential damage to a work culture that fosters trust, employee commitment, and motivation. Electronic surveillance of employees could prove highly counterproductive in such an environment.

No solution is problem-free, but many consultants believe companies should write corporate policies on employee email, social media, and Internet use. Many workers are unaware that employers have the right to monitor and collect data about them. The policies

should include explicit ground rules that state, by position or level, under what circumstances employees can use company facilities for email, 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, 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.

*Sources:* "How Do Employers Monitor Internet Usage at Work?" wisegeek.com, accessed March 1, 2020; Sarah Krouse, "The New Ways Your Boss Is Spying on You," *Wall Street Journal*, July 19, 2019; www.privacyrights.org, accessed February 15, 2020; and Susan M. Heathfield, "Surfing the Web at Work," thebalancereers.com, November 25, 2019.

## CASE STUDY QUESTIONS

1. Should managers monitor employee email and Internet usage? Why or why not?
2. Describe an effective email and web use policy for a company.
3. Should managers inform employees that their web behavior is being monitored? Or should managers monitor secretly? Why or why not?

the economies of scale and management facilities of large networks, such as the Internet (see Figure 7.10). 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 Tunneling Protocol (PPTP). In a process called *tunneling*, 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 Web

The web is the most popular Internet service. It's a system with universally accepted standards for storing, retrieving, formatting, and displaying information by using a client/server architecture. Web pages are formatted using hypertext, 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 **website** is a collection of web pages linked to a home page.

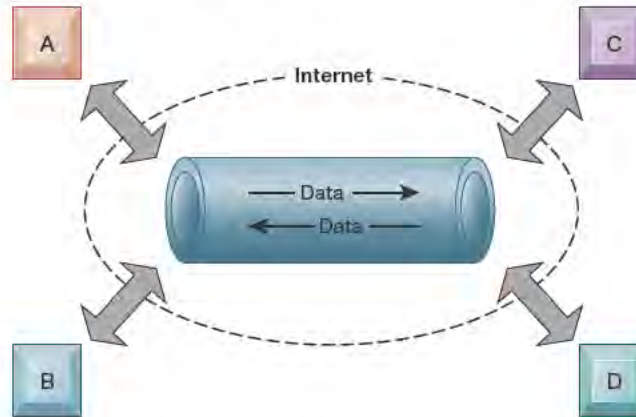
## Hypertext

Web pages are based on a standard Hypertext Markup Language (HTML), which formats documents and incorporates dynamic links to other documents and other objects stored in the same or remote computers (see Chapter 5). Web pages are



**FIGURE 7.10 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. By adding a wrapper around a network message to hide its content, organizations can create a private connection that travels through the public Internet.



accessible through the Internet because web browser software operating your computer can request web pages stored on an Internet host server by using the **Hypertext Transfer Protocol (HTTP)**. HTTP is the communications standard that transfers pages on the web. For example, when you type a web address in your browser, such as `http://www.sec.gov`, your browser sends an HTTP request to the `sec.gov` server requesting the home page of `sec.gov`.

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 web page. Most companies have a domain name that is the same as or closely related to their official corporate name. The directory path and web page 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 `http://www.megacorp.com/content/features/082610.html`, `http` names the protocol that displays 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 `082610.html` is the web page 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 a user requests 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 leading web servers in use today are Microsoft Internet Information Services (IIS) and Apache HTTP Server. Apache is an open source product that is free of charge and can be downloaded from the web.

## 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 indexed an estimated 5 billion pages in 2019, and this reflects a large portion of the publicly accessible web page population. But there is a deep web that contains an estimated 1 trillion additional pages, many of them proprietary (such as the pages of *Financial Times*, which cannot be visited without a subscription or access code), or that are stored in protected corporate databases. Facebook, with web pages of text, photos, and media for more than 2 billion members, is a closed web, and its pages are not completely searchable by Google or other search engines. A small portion of the deep web called the **dark web** has been intentionally hidden from search engines, uses masked IP addresses, and is accessible only with a special web browser in order to preserve anonymity. The dark web has become a haven for criminals because it allows the buying and selling of illicit goods, including credit card and Social Security numbers, with complete anonymity.

**Search Engines** Obviously, with so many web pages, finding specific ones 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; PDF files; and audio, video, and image files. There are hundreds of search engines in the world, but the vast majority of search results come from Google, Baidu, Yahoo, and Microsoft's Bing (see Figure 7.11). While we typically think of Amazon as an online store, it is also a powerful product search engine.

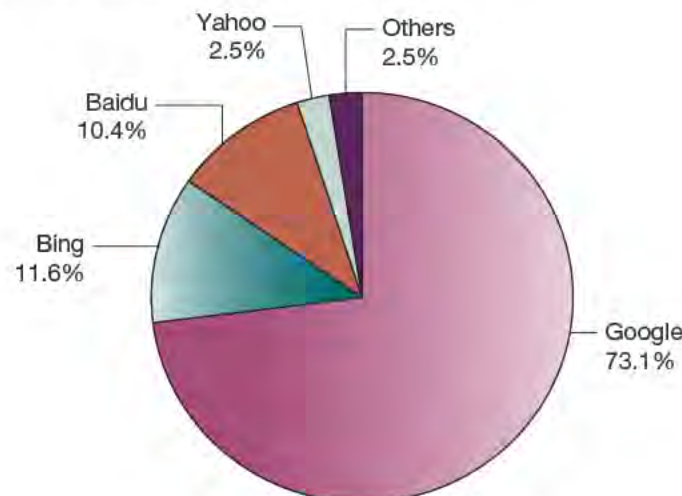
Web search engines started out in the early 1990s as relatively simple software programs that roamed the nascent web, visiting pages and gathering information about the content of each page. The first search engines were simple keyword indexes of all the pages they visited, leaving users with lists of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

In 1994, Stanford University computer science students David Filo and Jerry Yang created a hand-selected list of their favorite web pages and called it "Yet Another Hierarchical Official Oracle," or Yahoo. Yahoo was not initially a search engine but rather an edited selection of websites organized by categories the editors found useful. Currently, Yahoo relies on Microsoft's Bing for search results.

**FIGURE 7.11** TOP DESKTOP/LAPTOP WEB SEARCH ENGINES WORLDWIDE

Google is the world's most popular search engine.

Source: Based on data from Net Market Share, February 2020.





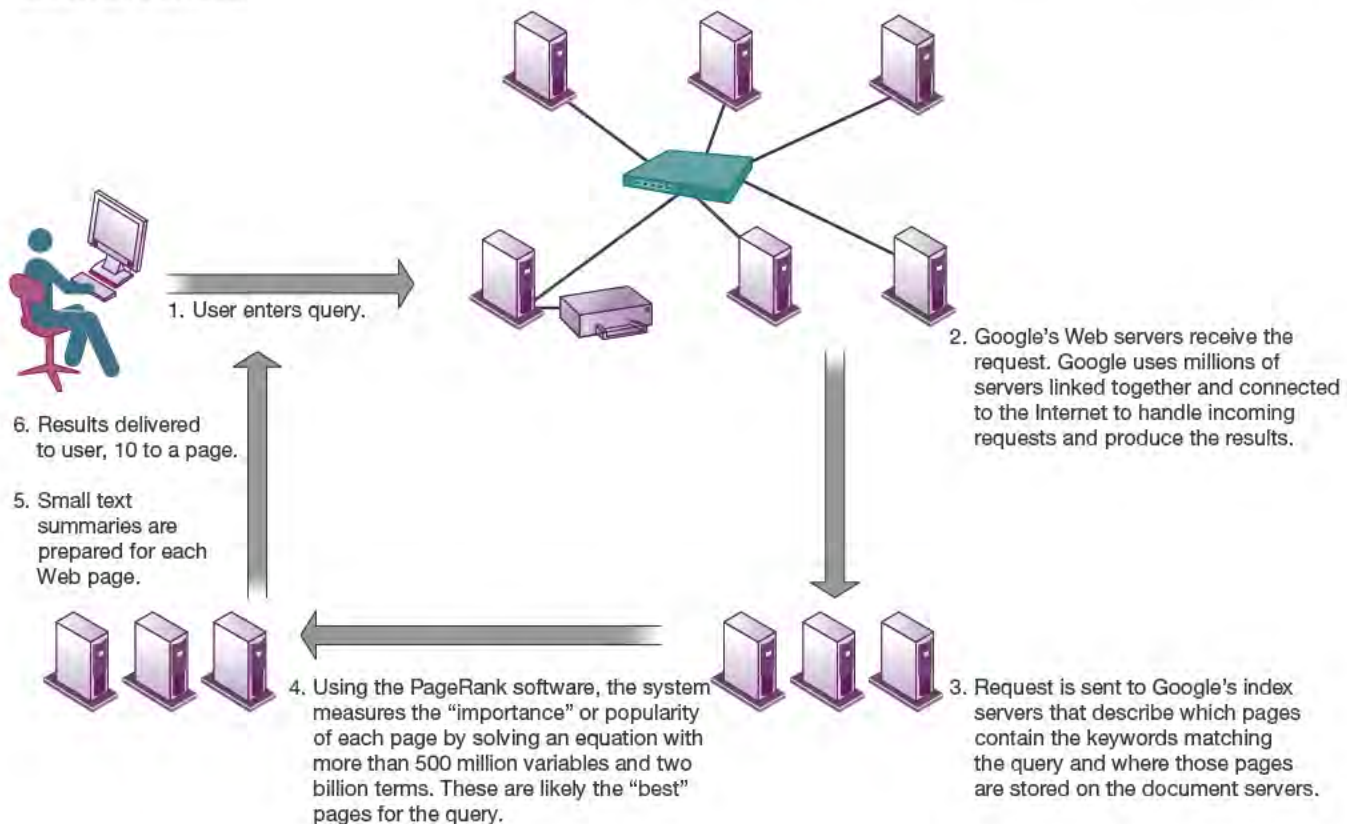
In 1998, Larry Page and Sergey Brin, two other Stanford computer science students, released their first version of Google. This search engine was different. Not only did it index each web page's words but it also ranked search results based on the relevance of each page. Page patented the idea of a page ranking system (called *PageRank System*), which essentially measures the popularity of a web page by calculating the number of sites that link to that page as well as the number of pages to which it links. The premise is that popular web pages are more relevant to users. 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 7.12 illustrates how Google works.

**Mobile Search** Mobile search from smartphones and tablets makes up more than 50 percent of all searches and will expand rapidly in the next few years. Google, Amazon, and Yahoo have developed new search interfaces to make searching and shopping from smartphones more convenient. Google revised its search algorithm to favor sites that look good on smartphone screens. Although smartphones are widely used to shop, actual purchases typically take place on laptops or desktops, followed by tablets.

**Semantic Search** Another way for search engines to become more discriminating and helpful is to make search engines capable of understanding what we are really looking for. Called **semantic search**, the goal is to build a search engine that can really understand human language and behavior. Google and other search engine firms are attempting to refine search engine algorithms to capture

**FIGURE 7.12** 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 half a second.





more of what the user intended and the meaning of a search. Rather than evaluate each word separately in a search, Google's Hummingbird search algorithm tries to evaluate an entire sentence, focusing on the meaning behind the words. For instance, if your search is a long sentence like "Google annual report selected financial data 2020," Hummingbird should be able to figure out that you really want Google's parent company Alphabet's annual Form 10-K report filed with the U.S. Securities and Exchange Commission in February 2020.

Google searches also take advantage of Knowledge Graph, an effort of the search algorithm to anticipate what you might want to know more about as you search on a topic. Results of the knowledge graph appear on the right of the screen on many search result pages and contain more information about the topic or person you are searching on. For example, if you search "Lake Lucerne," the search engine will return basic facts about Lucerne (altitude, average temperature, and local fish), a map, and hotel accommodations. Google has made **predictive search** part of most search results. This part of the search algorithm guesses what you are looking for and suggests search terms as you type your search words. Google has continued to refine its search algorithms using mathematical modeling and artificial intelligence machine learning (see Chapter 11) to make its responses to queries even more accurate and intelligent (Copeland, 2019)..

**Visual Search and the Visual Web** Although search engines were originally designed to search text documents, the explosion of photos and videos on the Internet created a demand for searching and classifying these visual objects. Facial recognition software can create a digital version of a human face. You can also search for people on Facebook by using their digital image to find and identify them. Facebook is now using artificial intelligence technology to make its facial recognition capabilities more accurate.

Searching photos, images, and video has become increasingly important as the web becomes more visual. The **visual web** refers to websites such as Pinterest, where pictures replace text documents, where users search pictures, and where pictures of products replace display ads for products. Pinterest is a social networking site that provides users (as well as brands) with an online board to which they can pin interesting pictures. Pinterest had 335 million active users worldwide in 2020. Instagram is another example of the visual web. Instagram is a photo and video sharing site that allows users to take pictures, enhance them, and share them with friends on other social sites such as Facebook and Twitter. In 2020, Instagram had 1 billion active users.

**Intelligent Agent Shopping Bots** Chapter 11 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 PriceGrabber, and travel search tools like Trivago, can help people interested in making a purchase or renting a vacation room filter and retrieve information according to criteria the users have established, and in some cases negotiate with vendors for price and delivery terms.

**Search Engine Marketing** Search engines have become major advertising platforms and shopping tools by offering what is now called **search engine marketing**. Searching for information is one of the web's most popular activities. Over 90 percent of web traffic comes through search engines, and search engine marketing accounts for over 40 percent of digital ad spending worldwide (eMarketer 2020d). With this huge audience, search engines are

the foundation for the most lucrative form of online marketing and advertising: search engine marketing. When users enter a search term on Google, Bing, 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 small text boxes on the side of search results pages. 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. Search engine marketing monetizes the value of the search process.

Because search engine marketing is so effective (it has the highest click-through rate and the highest return on ad investment), companies seek to optimize their websites for search engine recognition. The better optimized the page is, the higher a ranking it will achieve in search engine result listings. **Search engine optimization (SEO)** is the process of improving the quality and volume of web traffic to a website by employing a series of techniques that help a website achieve a higher ranking with the major search engines when certain keywords and phrases are put into the search field. One technique is to make sure that the keywords used in the website description match the keywords likely to be used as search terms by prospective customers. For example, your website is more likely to be among the first ranked by search engines if it uses the keyword *lighting* rather than *lamps* if most prospective customers are searching for *lighting*. It is also advantageous to link your website to as many other websites as possible because search engines evaluate such links to determine the popularity of a web page and how it is linked to other content on the web.

Search engines can be gamed by scammers who create thousands of phony website pages and link them to a single retailer's site in an attempt to fool Google's search engine. Firms can also pay so-called link farms to link to their site. Google changed its search algorithm to deal with this problem by examining the quality of links more carefully with the intent of down-ranking sites that have a suspicious pattern of sites linking to them.

In general, search engines have been very helpful to small businesses that cannot afford large marketing campaigns. Because shoppers are looking for a specific product or service when they use search engines, they are what marketers call hot prospects—people who are looking for information and often intending to buy. Moreover, search engines charge only for click-throughs to a site. Merchants do not have to pay for ads that don't work, only for ads that receive a click. Consumers benefit from search engine marketing because ads for merchants appear only when consumers are looking for a specific product. Thus, search engine marketing saves consumers cognitive energy and reduces search costs (including the cost of transportation needed to search for products physically). One study estimated the global value of search to both merchants and consumers to be more than \$800 billion, with about 65 percent of the benefit going to consumers in the form of lower search costs and lower prices (McKinsey & Company, 2011).

## Sharing Information on the Web

Today's websites don't just contain static content—they enable people to collaborate, share information, and create new services and content online. Today's web can support interactivity, real-time user control, social participation (sharing), and user-generated content. The technologies and services behind these

features include cloud computing, software mashups and apps, blogs, RSS, wikis, and social networks. We have already described cloud computing, mashups, and apps in Chapter 5 and introduced social networks in Chapter 2.

A **blog**, the popular term for a weblog, is a personal website that typically contains a series of chronological entries (newest to oldest) by its author and links to related web pages. The blog may include a *blogroll* (a collection of links to other blogs) and *trackbacks* (a list of entries in other blogs that refer to a post on the first blog). Most blogs allow readers to post comments on the blog entries as well. The act of creating a blog is often referred to as blogging. Blogs can be hosted by a third-party service such as Blogger.com or TypePad.com, and blogging features have been incorporated into social networks such as Facebook and collaboration platforms such as IBM Notes. WordPress is a leading open source blogging tool and content management system. **Microblogging**, used in Twitter or other platforms with serious space or size constraints, is a type of blogging that features very small elements of content such as short sentences, individual images, or video links.

Blog pages are usually based on templates provided by the blogging service or software. Therefore, millions of people without HTML skills of any kind can post their own web pages and share content with others. Although blogs have become popular personal publishing tools, they also have business uses (see Chapters 2 and 10).

If you're an avid blog reader, you might use RSS to keep up with your favorite blogs without constantly checking them for updates. **RSS**, which stands for Really Simple Syndication or Rich Site Summary, pulls specified content from websites and feeds it automatically to users' computers. RSS reader software gathers material from the websites or blogs that you tell it to scan and brings new information from those sites to you. RSS readers are available through websites such as Google and Yahoo, and they have been incorporated into the major web browsers and email programs.

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 websites on which visitors can add, delete, or modify content, including the work of previous authors. *Wiki* comes from the Hawaiian word for "quick."

Wiki software typically provides a template that defines layout and elements common to all pages, displays user-editable software program code, and then renders the content into an HTML-based page for display in a web browser. Some wiki software allows only basic text formatting, whereas other tools allow the use of tables, images, or even interactive elements, such as polls or games. Most wikis provide capabilities for monitoring the work of other users and correcting mistakes.

Because wikis make information sharing so easy, they have many business uses. The U.S. Department of Homeland Security's National Cyber Security Center (NCSC) deployed a wiki to facilitate information sharing with other federal agencies on threats, attacks, and responses and as a repository for technical and standards information. Pixar Wiki is a collaborative community wiki for publicizing the work of Pixar Animation Studios. The wiki format allows anyone to create or edit an article about a Pixar film.

**Social networking** sites enable users to build communities of friends and professional colleagues. Members typically create a profile—a web page for posting photos, videos, audio files, and text—and then share these profiles with others on the service identified as their friends or contacts. Social networking sites are highly interactive, offer real-time user control, rely on user-generated content, and are broadly based on social participation and sharing of content



and opinions. Leading social networking sites include Facebook, Twitter, and LinkedIn (for professional contacts).

Social networking has radically changed how people spend their time online; how people communicate and with whom; how business people stay in touch with customers, suppliers, and employees; how providers of goods and services learn about their customers; and how advertisers reach potential customers. The large social networking sites are also application development platforms where members can create and sell software applications to other members of the community. Facebook alone has millions of apps and websites integrated with it, including applications for gaming, video sharing, and communicating with friends and family. We talk more about business applications of social networking in Chapters 2 and 10, and you can find social networking discussions in many other chapters of this book.

## The Future Web

The future Internet is becoming visible. Its key features are more tools for individuals to make sense out of the trillions of pages on the Internet, or the millions of apps available for smartphones and a visual, even three-dimensional (3D) web where you can walk through pages in a 3D environment. (Review the discussion of semantic search and visual search earlier in this chapter.)

Even closer in time is a pervasive web that controls everything from a city's traffic lights and water usage, to the lights in your living room, to your car's rear view mirror, not to mention managing your calendar and appointments. This is referred to as the **Internet of Things (IoT)** and is based on billions of Internet-connected sensors throughout our physical world. Objects, animals, or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

General Electric, IBM, HP, Oracle, and hundreds of smaller startups, are building smart machines, factories, and cities through extensive use of remote sensors and fast cloud computing. By 2025 more than 75 billion IoT devices will be connected to the web (Maayan, 2020). Over time, more and more everyday physical objects will be connected to the Internet and will be able to identify themselves to other devices, creating networks that can sense and respond as data changes. The re-imagination of retailing by Alibaba in its Hema stores described in the chapter-opening case is an IoT application, as is the vehicle-to-everything technology discussed in the Interactive Session on Technology.

The App Internet is another element in the future web. The growth of apps within the mobile platform is astounding. More than 80 percent of mobile minutes in the United States are generated through apps, as opposed to browsers. Apps give users direct access to content and are much faster than loading a browser and searching for content.

Other complementary trends leading toward a future web include more widespread use of cloud computing and software as a service (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.

## INTERACTIVE SESSION TECHNOLOGY

### Talking Cars Make for Better Road Safety

Toward the end of 2015, Toyota, Japan's biggest manufacturer of small-sized vehicles, began to offer the Intelligent Transportation System (ITS) Connect safety package. ITS Connect overcomes the constraints of other similar systems that rely on line-of-sight limited sensors, such as poor function in extreme weather and blind spots, by enabling cars to talk to one another. The system allows a vehicle's on-board computer to perform vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) wireless communication continuously with other vehicles and with roadside infrastructure (lamp poles and traffic light poles).

ITS Connect allows effective communication within a radius of up to 300 meters at a frequency of 760 MHz, which was previously used in analog television broadcasting. Each V2V message contains basic data about the vehicle's position, speed, acceleration, type and size, and the timestamp, as well as free fields reserved for service expansion to be defined by individual applications such as the nearest intersection ahead. A vehicle with ITS Connect keeps broadcasting such messages and "listening to" these messages from other vehicles or infrastructure for analysis, and it responds accordingly long before a danger is visually perceived.

The ITS Connect system is designed to avoid collisions with other vehicles, pedestrians, and cyclists, by either changing the speed automatically (in case a vehicle ahead brakes abruptly) or by giving instant audio or visual safety information to the driver of any approaching vehicle from either side when passing through an intersection. By providing drivers with timely information and feedback, such as a reminder to give way to an approaching emergency vehicle or a countdown to a traffic signal change, the system can improve driving efficiency. The package also enables cooperative adaptive cruise control (CACC), which uses information obtained from V2V messages to automatically adjust the speed of an automobile to match that of the vehicle ahead.

Toyota and its allies began to promote Wi-Fi-based DSRC using the 5.9 GHz frequency band in the United States and European markets in 2017. Another standard of vehicular communication, cellular-vehicle-to-everything (C-V2X), appeared in 2018 and is trying to win different regional markets before DSRC becomes the mainstream. C-V2X consists of

not only V2V and V2I but also vehicle-to-pedestrians (V2P) direct communications and vehicle-to-network (V2N) operations. V2P allows communications between vehicles and the mobile phones of non-vehicle road users, such as pedestrians and cyclists. V2N refers to exchange of traffic information, like the incidence of traffic jams, between vehicles and cloud-based data centers.

Since the two standards are adopted by different countries and regions and neither is mainstream, automotive parts manufacturing companies such as Continental AG and Autotalk have decided to let their products "speak" both "languages" by being compatible with both standards, thus giving flexibility to vehicle manufacturers and end users.

Regardless of standard, vehicular communications are expected to improve road safety by reducing 80 percent of traffic accidents, particularly collisions. In addition, V2X can increase efficiency in coordination of traffic flow through platooning and green waves. Platooning refers to a system in which multiple trucks drive together as a convoy, each at a consistent distance from the other, with the lead truck using a CACC application. This allows drivers on long-distance trips to take turns resting, and if the convoy is aerodynamic-optimal, fuel consumption is reduced as well. A green wave refers to a situation in which a series of traffic lights at several intersections turn green in perfect timing to allow continuous traffic flow in the same direction. The data collected in vehicular communication can be used to analyze patterns in traffic flow and in urban planning. Proper use of platooning and green waves could optimize mobility, improve congestion, save fuel, and reduce pollution.

These advances in vehicular communications are also paving the way toward the realization of the driverless automobile. In fact, Release 16 of 5G C-V2X, using a new radio-based sidelink, allows multicast communication to support advanced functions such as autonomous driving. The development of automatic driving is expected to provide further opportunities not only for the car-makers, telecommunication service providers, and chipset manufacturers but also for other sectors, such as shipment, logistics, insurance, and mobile healthcare.

However, regardless of standard, worries abound regarding data security and privacy issues. Vehicular

communications involve the transmittal of sensitive data, such as vehicle ID, and this data can be leaked. Malicious interception and alteration of transmitted messages could allow specific vehicles to be tracked, or false reports of misconduct to be generated.

*Sources:* Autotalks, [auto-talks.com](http://auto-talks.com), accessed December 31, 2020; Continental AG, [continental.com](http://continental.com), accessed December 31, 2020; ITS Connect Promotion Consortium, [itsconnect-pc.org](http://itsconnect-pc.org), accessed December 31, 2020; Toyota Motor Corporation, [global.toyota](http://global.toyota), accessed December 31, 2020; Jason Ellis and Shailesh Patil, "How NR-based Sidelink Expands 5G C-V2X to Support New Advanced Use Cases," [qualcomm.com](http://qualcomm.com), March 31, 2020; K. Momota, "Connectivity Technologies Attracting Attention Due to Frequent Traffic Accidents," [Furuno.com](http://Furuno.com), May 31, 2019; Kristen Hall-Geisler, "In Japan, Priuses Can Talk to Other Priuses," [TechCrunch](http://TechCrunch), August 17, 2016.

## CASE STUDY QUESTIONS

1. What are the pros and cons of the V2X technology?
2. What can be done to speed up the adoption of V2X technology among vehicle owners?
3. What other applications can you think of for the ITS Connect?

*Case contributed by Joyce Chan, City University of Hong Kong*

## 7-4 What are the principal technologies and standards for wireless networking, communication, and Internet access?

Welcome to the wireless revolution! Cell phones, smartphones, tablets, and wireless-enabled personal computers have morphed into portable media and computing platforms that let you perform many of the computing tasks you used to do at your desk, and a whole lot more. We introduced smartphones in our discussions of the mobile digital platform in Chapters 1 and 5. **Smartphones** such as the iPhone, Android phones, and BlackBerry combine the functionality of a cell phone with that of a mobile laptop computer with Wi-Fi capability. This makes it possible to combine music, video, Internet access, and telephone service in one device. A large part of the Internet is becoming a mobile, access-anywhere, broadband service for the delivery of video, music, and web search.

### Cellular Systems

Worldwide, there are almost 4.9 billion mobile phone users, with over 3.1 billion using smartphones (eMarketer, 2020b, 2020). Mobile is now the leading digital platform, with total activity on smartphones and tablets accounting for two-thirds of digital media time spent (Anderson, 2019).

Digital cellular service uses several competing standards. In Europe and much of the rest of the world outside the United States, the standard is Global System for Mobile Communications (GSM). GSM's strength is its international roaming capability. There are GSM cell phone systems in the United States, including T-Mobile and AT&T.

A competing standard in the United States is Code Division Multiple Access (CDMA), which is the system Verizon and Sprint use. CDMA was developed by the military during World War II. It transmits over several frequencies, occupies the entire spectrum, and randomly assigns users to a range of frequencies over time, making it more efficient than GSM.



Earlier generations of cellular systems were designed primarily for voice and limited data transmission in the form of short text messages. Today wireless carriers offer 3G and 4G networks. **3G networks**, with transmission speeds ranging from 144 Kbps for mobile users in, say, a car, to more than 2 Mbps for stationary users, offer transmission speeds appropriate for email and web browsing, but are too slow for videos. **4G networks** have much higher speeds, up to 100 Mbps download and 50 Mbps upload, with more than enough capacity for watching high-definition video on your smartphone. Long Term Evolution (LTE) and mobile Worldwide Interoperability for Microwave Access (WiMax—see the following section) are the current 4G standards.

The next generation of wireless technology, called **5G**, is designed to support transmission of very large amounts of data in the gigabit range, with fewer transmission delays and the ability to connect many more devices (such as sensors and smart devices) at once than existing cellular systems. 5G technology will be needed for self-driving vehicles, smart cities, and extensive use of the Internet of Things (IoT). AT&T, Verizon, and other carriers are starting to launch 5G networks, in the United States which will also improve the speed and intensive data-handling of smartphones. Mobile Internet users will be able to download entire movies within seconds.

## Wireless Computer Networks and Internet Access

An array of technologies provides high-speed wireless access to the Internet for PCs and mobile devices. These new high-speed services have extended Internet access to numerous locations that could not be covered by traditional wired Internet services and have made ubiquitous computing, anywhere, anytime, a reality.

### 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-meter 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 7.13). 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 or cell phones.

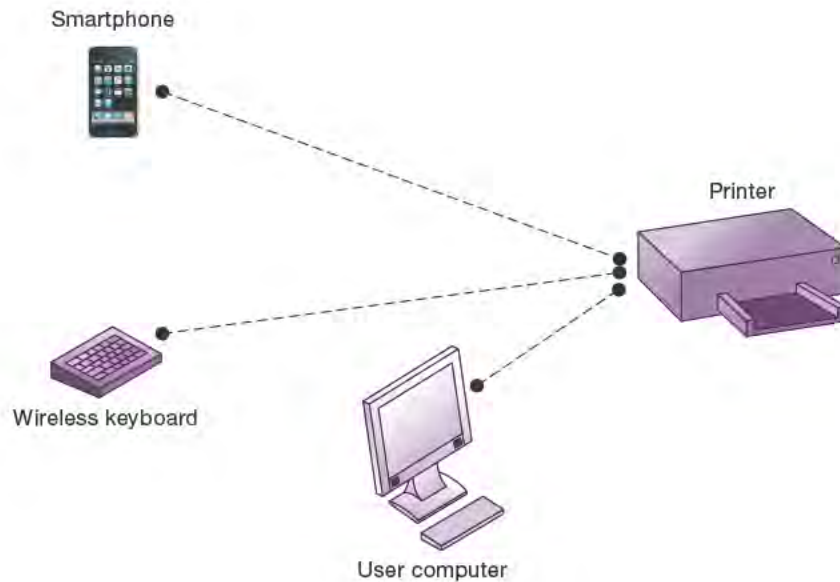
Although Bluetooth lends itself to personal networking, it has uses in large corporations. For example, FedEx drivers use Bluetooth to transmit the delivery data captured by their handheld computers to cellular transmitters, which forward the data to corporate computers. Drivers no longer need to spend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

### Wi-Fi and Wireless Internet Access

The 802.11 set of standards for wireless LANs and wireless Internet access is also known as **Wi-Fi**. The first of these standards to be widely adopted was 802.11b, which can transmit up to 11 Mbps in the unlicensed 2.4-GHz band and has an effective distance of 30 to 50 meters. The 802.11g standard can transmit up to 54 Mbps in the 2.4-GHz range. 802.11n is capable of transmitting over

**FIGURE 7.13 A BLUETOOTH NETWORK (PAN)**

Bluetooth enables a variety of devices, including cell phones, smartphones, wireless keyboards and mice, PCs, and printers, to interact wirelessly with each other within a small, 30-foot (10-meter) area. In addition to the links shown, Bluetooth can be used to network similar devices to send data from one PC to another, for example.



100 Mbps and 802.11ac can transmit up to 1 Gbps. Today's PCs and tablets have built-in support for Wi-Fi, as do the iPhone, iPad, and other smartphones.

In most Wi-Fi communication, 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 links to a wired network, router, or hub.

Figure 7.14 illustrates an 802.11 wireless LAN that connects a small number of mobile devices to a larger wired LAN and to the Internet. 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. The access point also controls the wireless stations.

The most popular use for Wi-Fi today is for high-speed wireless Internet service. In this instance, the access point plugs into an Internet connection, which could come from a cable service or DSL telephone service. Computers within range of the access point use it to link wirelessly to the Internet.

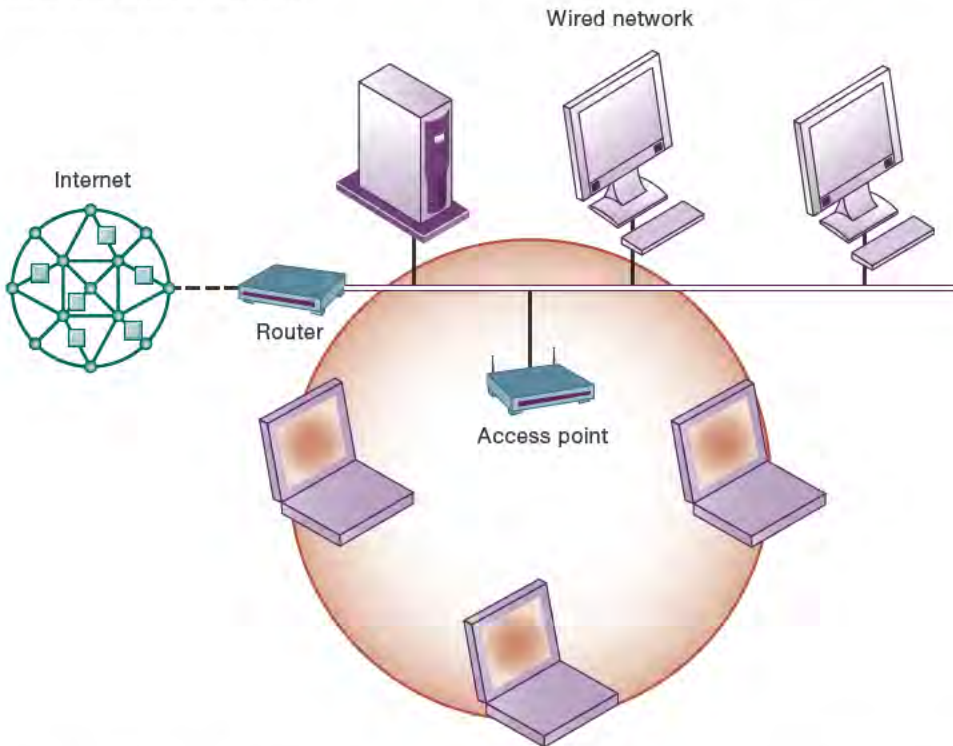
**Hotspots** are locations with one or more access points providing wireless Internet access and are often in public places. Some hotspots are free or do not require any additional software to use; others may require activation and the establishment of a user account by providing a credit card number over the web.

Businesses of all sizes are using Wi-Fi networks to provide low-cost wireless LANs and Internet access. Wi-Fi hotspots can be found in hotels, airport lounges, libraries, cafes, and college campuses to provide mobile access to the Internet. University of London is one of many campuses where students now use Wi-Fi for research, course work, and entertainment.

Wi-Fi technology poses several challenges, however. One is Wi-Fi's security features, which make these wireless networks vulnerable to intruders. We provide more detail about Wi-Fi security issues in Chapter 8.

**FIGURE 7.14** 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 to 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.



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. However, wireless networks based on the 802.11n standard solve this problem by using multiple wireless antennas in tandem to transmit and receive data and technology called MIMO (multiple input multiple output) to coordinate multiple simultaneous radio signals.

## WiMax

A surprisingly large number of areas in the United States 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 300 feet from the base station, making it difficult for rural groups that don't have cable or DSL service to find wireless access to the Internet.

The Institute of Electrical and Electronics Engineers (IEEE) developed a 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. It has a wireless access range of up to 31 miles and transmission speed of 30–40 Mbps (and up to 1 Gbps for fixed stations).

WiMax antennas are powerful enough to beam high-speed Internet connections to rooftop antennas of homes and businesses that are miles away. Cellular handsets and laptops with WiMax capabilities are appearing in the marketplace. Mobile WiMax is one of the 4G network technologies we discussed earlier in this chapter.



## 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) and Near Field Communication (NFC)

**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 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.

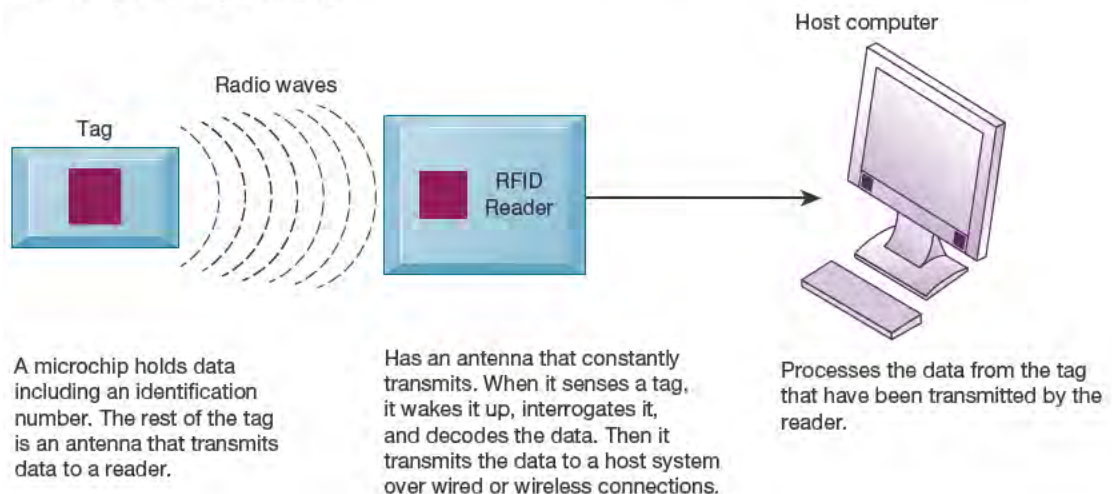
The RFID tag is electronically programmed with information that can uniquely identify an item plus other information about the item such as its location, where and when it was made, or its status during production. The reader emits radio waves in ranges anywhere from 1 inch to 100 feet. When an RFID 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 7.15). Both RFID tags and antennas come in a variety of shapes and sizes.

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 improve receiving and storage operations by improving their ability to see exactly what stock is stored in warehouses or on retail store shelves.

Walmart 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

**FIGURE 7.15** HOW RFID WORKS

RFID uses low-powered radio transmitters to read data stored in a tag at distances ranging from 1 inch to 100 feet. The reader captures the data from the tag and sends them over a network to a host computer for processing.



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 starts at around 7 cents per tag in the United States. As the price decreases, RFID is starting to become cost-effective for many 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.

Software is used to filter, aggregate, and prevent RFID data from overloading business networks and system applications. Applications often need to be redesigned to accept large volumes of frequently generated RFID data and to share those data with other applications. Major enterprise software vendors now offer RFID-ready versions of their supply chain management applications.

Tap-and-go services like Apple Pay or Google Wallet use an RFID-related technology called **near field communication (NFC)**. NFC is a short-range wireless connectivity standard that uses electromagnetic radio fields to enable two compatible devices to exchange data when brought within a few centimeters of each other. A smartphone or other NFC-compatible device sends out radio frequency signals that interact with an NFC tag found in compatible card readers or smart posters. The signals create a current that flows through the NFC tag, allowing the device and the tag to communicate with one another. In most cases the tag is passive and only sends out information while the other device (such as a smartphone) is active and can both send and receive information. (There are NFC systems where both components are active.)

NFC is used in wireless payment services, to retrieve information, and even to exchange videos or information with friends on the go. You could share a website link by passing your phone over a friend's phone, while waving the phone in front of a poster or display containing an NFC tag could show information about what you're viewing at a museum or exhibit.

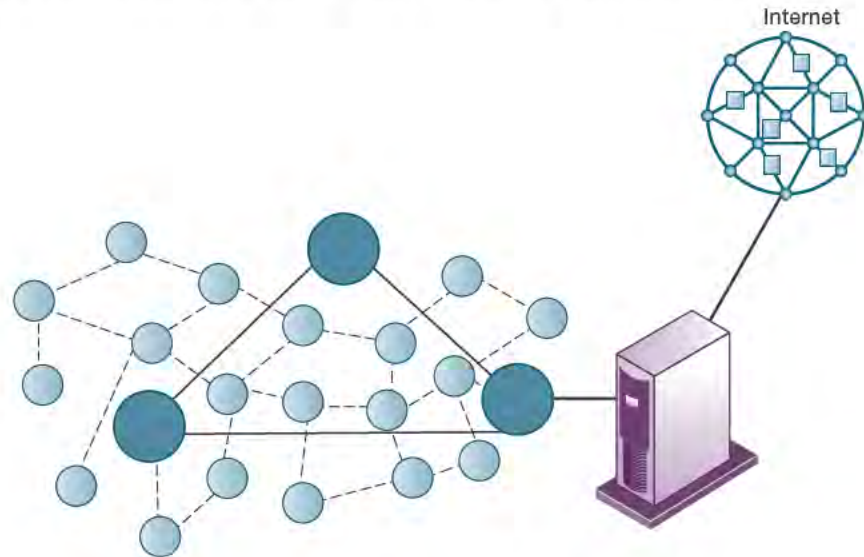
## Wireless Sensor Networks

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 in 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. Figure 7.16 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 for uses 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.

**FIGURE 7.16 A WIRELESS SENSOR NETWORK**

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



Output from RFID systems and wireless networks is fueling the Internet of Things (IoT), introduced earlier in this chapter, in which machines such as jet engines, power plant turbines, or agricultural sensors constantly gather data and send the data over the Internet for analysis. The re-imagination of retailing by Alibaba in its Hema stores, described in the chapter-opening case, is an example of an IoT application. You'll find more examples of the Internet of Things in Chapters 2 and 12.

**7-5 How will MIS help my career?**

Here is how Chapter 7 and this book can help you find a job as an automotive digital advisor.

**The Company**

Autoworld, a large and fast-growing Danish automobile dealership based in Copenhagen, is looking for an automotive digital advisor to run its digital marketing program. The company has more than 500 vehicles for sale, 170 employees, and three locations for selling and servicing new and used vehicles.

**Position Description**

The automotive digital assistant will be part of a team assisting the dealership group with online marketing, including search engine optimization (SEO) and search engine marketing (SEM), social media and reputation management, and website management. Job responsibilities include coordinating efforts for the dealership owner, dealership managers, and marketing manager in the following areas:



- Online advertising, SEO, and SEM.
- Social media management, including managing the dealership's overall social media and content calendar and developing new content.
- Online reputation management.
- Website management.
- Maintaining the dealership's blog.

## Job Requirements

- College graduate in marketing
- Knowledge of digital marketing and social media
- Microsoft Office skills
- Knowledge of automotive sales and content management systems desirable

## Interview Questions

1. Have you ever taken any digital marketing courses?
2. Have you any experience running a digital marketing campaign? Did you use SEO and SEM? How did you measure the effectiveness of your social media campaign and audience growth?
3. Do you have any experience with social media management software?
4. Do you have any experience with online reputation management or online inventory management?
5. Have you ever maintained a blog?
6. What is your level of proficiency with Microsoft Office software?

## Author Tips

1. Review the discussions of search, search engine marketing, and blogs in this chapter and also the discussions of e-commerce marketing and building an e-commerce presence in Chapter 10.
2. Use the web to learn more about SEO, SEM, social media management, and online reputation management and software tools used for this work. Look into how to generate metrics reports using standardized tools and how to put together analyses and recommendations based on the social media data.
3. Look at how major auto dealers in large metropolitan areas are using social media channels. Are they creating content on YouTube, Instagram, Facebook, and Twitter? Which channels are generating higher levels of audience engagement?
4. Inquire about exactly what you would have to do for website management and required software skills.
5. Inquire about the Microsoft Office skills you would need for this job. Bring examples of the work you have done with this software.

## REVIEW SUMMARY

### 7-1 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 website, 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.

### 7-2 What are the different types of networks?

The principal physical transmission media are twisted copper telephone wire, coaxial copper cable, fiber-optic cable, and wireless transmission.

Local area networks (LANs) connect PCs and other digital devices within a 500-meter radius and are used today for many corporate computing tasks. Wide area networks (WANs) span broad geographical distances, ranging from several miles to entire continents and are often 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.

### 7-3 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 (IAB) and the World Wide Web Consortium (W3C).

Major Internet services include email, newsgroups, chatting, instant messaging, Telnet, FTP, and the web. Web pages are based on Hypertext Markup Language (HTML) and can display text, graphics, video, and audio. Website directories, search engines, and RSS technology help users locate the information they need on the web. RSS, blogs, social networking, and wikis are current information-sharing capabilities of the web. The future web will feature more semantic search, visual search, prevalence of apps, and interconnectedness of many different devices (Internet of Things).

Firms are also starting to realize economies by using VoIP technology for voice transmission and virtual private networks (VPNs) as low-cost alternatives to private WANs.

### 7-4 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. 3G networks are capable of transmitting data at speeds ranging from 144 Kbps to more than 2 Mbps. 4G networks are capable of transmission speeds of 100 Mbps, and 5G networks capable of transmitting in the gigabit range among many devices are starting to be rolled out.

Major cellular standards include Code Division Multiple Access (CDMA), which is used primarily in the United States, and Global System for Mobile Communications (GSM), which is the standard in Europe and much of the rest of the world.

Standards for wireless computer networks include Bluetooth (802.15) for small personal area networks (PANs), Wi-Fi (802.11) for local area networks (LANs), and WiMax (802.16) for metropolitan area networks (MANs).

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 in the physical environment to provide measurements of many points over large spaces.

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### MyLab MIS

To complete the problems with MyLab MIS, go to the EOC Discussion Questions in MyLab MIS.

## Review Questions

### 7-1 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.

### 7-2 What are the different types of networks?

- Define an analog and a digital signal.
- Distinguish between a LAN, MAN, and WAN.



**7-3** 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.
- Describe how online search technologies are used for marketing.

**7-4** What are the principal technologies and standards for wireless networking, communication, and Internet access?

- Define Bluetooth, Wi-Fi, WiMax, and 3G, 4G, and 5G networks.
- Describe the capabilities of each and for which types of applications each is best suited.
- Define RFID, explain how it works, and describe how it provides value to businesses.
- Define near field communication (NFC) and explain how it works.
- Define WSNs, explain how they work, and describe the kinds of applications that use them.

## Discussion Questions

**7-5** 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.

MyLab MIS

**7-6** Should all major retailing and manufacturing companies switch to RFID? Why or why not?

MyLab MIS

**7-7** What are some of the issues to consider in determining whether the Internet would provide your business with a competitive advantage?

MyLab MIS

## 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. Visit MyLab MIS to access this chapter's Hands-On MIS Projects.

### Management Decision Problems

**7-8** LionClaw is a Singapore-based clothing brand with a sustainability profile. Management now wants each garment to be accompanied by a tag with a link to a website where the customer can read more about the work environment in the clothing factory, where the fabric is coming from, and so on. Use the web to search for an RFID, NFC, or QR code system for generating codes and printing tags. Work out the differences and choose from these systems to determine the best option for LionClaw.

**7-9** BestMed Medical Supplies Corporation sells medical and surgical products and equipment from more than 700 manufacturers to hospitals, health clinics, and medical offices. The company employs 500 people at seven locations throughout Europe, including account managers, customer service and support representatives, and warehouse staff. Employees communicate by traditional telephone voice services, email, 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 must 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

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Software skills: Spreadsheet formulas, formatting

Business skills: Analyzing telecommunications services and costs

**7-10** In this project, you'll 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 St. Louis, Missouri, with mobile phones that have capabilities for voice transmission, text messaging, Internet access, and taking and sending photos. Use the web to select two wireless providers that offer nationwide voice and data service as well as good service in your home area. Examine the features of the mobile handsets and wireless plans offered by each of these vendors. Assume that each of the 35 salespeople will need unlimited voice, text, and data service in the United States and the ability to take and send photos. 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

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Software skills: Web search tools

Business skills: Researching new technologies

**7-11** This project will help develop your Internet skills in using web search engines for business research.

Use Google and Bing to obtain information about ethanol as an alternative fuel for motor vehicles. If you wish, try some 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?

## Collaboration and Teamwork Project

### Evaluating Smartphones

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**7-12** Form a group with three or four of your classmates. Compare the capabilities of Apple's iPhone with a smartphone from another vendor with similar features. Your analysis should consider the purchase cost of each device, the wireless networks where each device can operate, plan and handset costs, and the services available for each device. You should also consider other capabilities of each device, including available software, security features, and the ability to integrate with existing corporate or PC applications. Which device would you select? On what criteria would you base your selection? If possible, use Google Docs and Google Drive or Google Sites to brainstorm, organize, and develop a presentation of your findings for the class.