

CHAPTER 7

Telecommunications, the Internet, and Wireless Technology

LEARNING OBJECTIVES

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

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

OPENING CASE: HAVE YOU EVER BEEN IN A VIRGIN MEGASTORE

Chapter 7 presents crucial concepts and terminology since telecommunications, networks, and the Internet are now introducing fundamental changes in businesses. The opening case, “Virgin Megastores Keeps Spinning with Unified Communications,” illustrates some of the new capabilities and opportunities provided by contemporary networking technology.

The business realized that in order to succeed it had to react instantly to sales trends and operate as efficiently as it could. It chose to use unified communications technology to integrate all of the ways managers and employees worked together. Rather than having separate systems for voice mail, e-mail, conference calling, and instant messaging, the new technology brought everything together into a more cohesive package that helps accelerate information sharing and allows everyone to make faster, better decisions.

The opening vignette provides an example of how businesses are adapting their business models to accommodate new technologies based on the Internet. It shows how companies must continually evolve as technology improves.

7.1

TELECOMMUNICATIONS AND NETWORKING IN TODAY'S BUSINESS WORLD

This chapter shows you how telecommunication networks are constructed and discusses the various elements involved in connecting all these computers. Knowing how it all works can give students insight into the changes that have taken place and an idea of what the future holds.

NETWORKING AND COMMUNICATION TRENDS

The world's largest and most widely used network is the Internet. The Internet is a global "network of networks" that uses universal standards to connect millions of different networks with more than 350 million host computers in over 200 countries around the world.

Enterprise networking and internetworking allow all the new connectivity to be made much more easily. The better the connectivity, the more productive employees will be since most of their work is now done through the electronic networks. Continuing telecommunication deregulation and information technology innovation, telephone and computer networks are slowly converging into a single digital network using shared Internet-based standards and equipment.

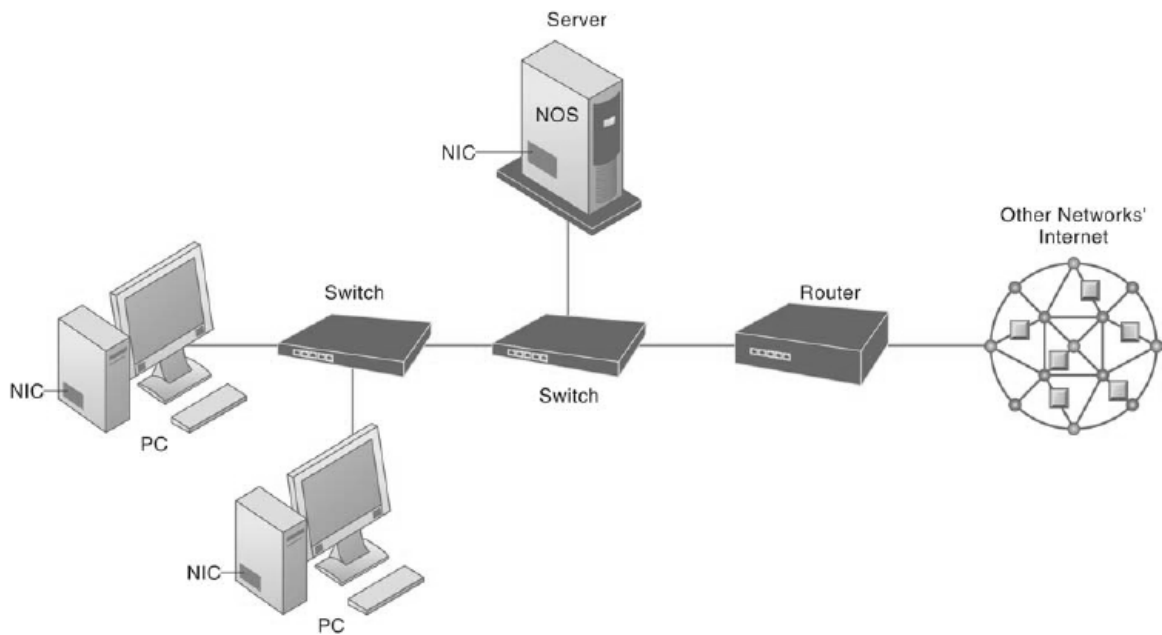
The term **broadband** refers to the amount of data that can be carried over the transmission line. The dial-up modems that are prevalent with home computers are called narrowband because they can't carry very large amounts of data. Data size is measured in kilobits. The faster broadband transmission lines are able to carry megabits and gigabits of data versus the kilobits available through slower dial-up modems. Broadband connections in private homes are becoming more popular than the dial-up modems because of the faster transmissions speeds.

The dilemma currently facing broadband providers and consumers is the age-old "chicken or the egg" conundrum. The broadband providers usually charge about \$50 a month for DSL or cable modem Internet access. They say that's their break-even point until more consumers sign up for the high-speed service. Content providers say there isn't that much demand for advanced content because most consumers don't have the Internet connections required for smooth delivery of the content. Consumers, on the other hand, say they don't want to pay that much for high-speed Internet access because of the lack of compelling content available.

WHAT IS A COMPUTER NETWORK?

In its simplest form, a network consists of two or more connected computers. What you should keep in mind is that you can continually add components to this kind of network and expand it exponentially. You can take a simple desktop computer and by way of a **network interface card (NIC)**, incorporate it into an existing network. To share network resources, such as printers, and to route communications on a LAN, you require special software called a **network operating system (NOS)**. Typically, the network operating system resides on a **dedicated server computer** for all the applications on the network. **Hubs** and **switches** help route traffic on the network to the right computing device. When two or more networks are connected to each other, you would need a **router** somewhere so that data transmissions are routed to the correct network device. Very large networks may require multiple routers so that transmissions can be processed faster.

FIGURE 7-1 COMPONENTS OF A SIMPLE COMPUTER NETWORK



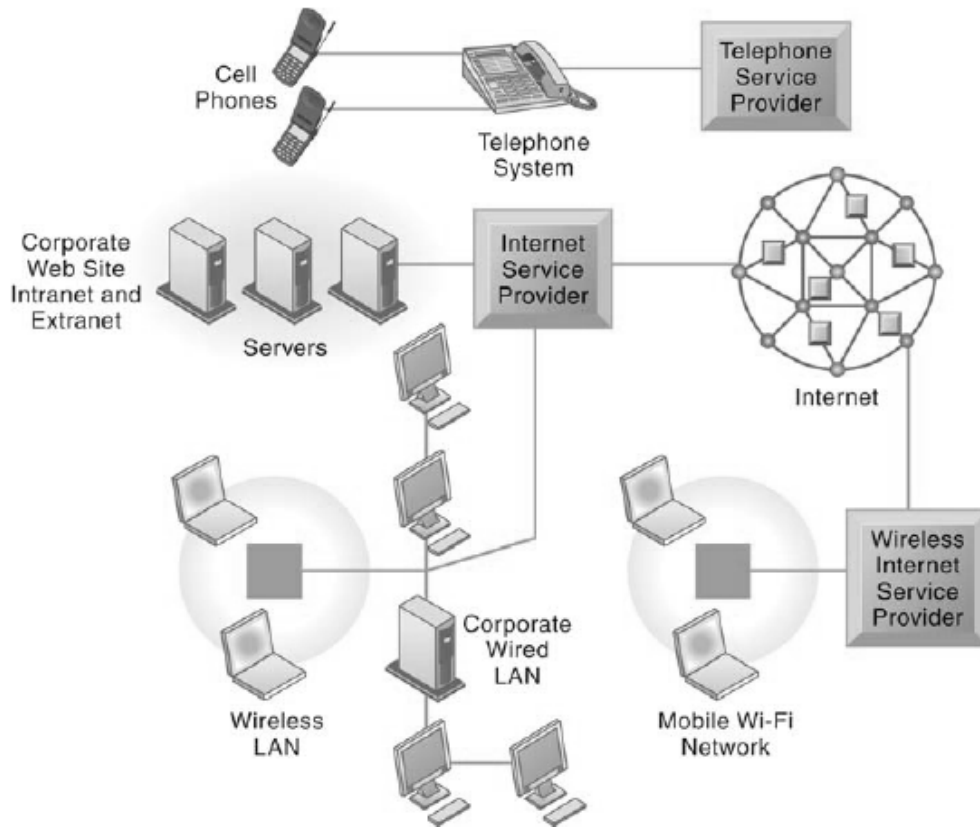
Networks in Large Companies

Most corporations, large or small, will use a combination of public and private transmission mediums, including networks built separately for voice communication and computer transactions. Little by little, the separate networks are coming together into one network that can transmit any type of data generated by any type of device.

It's likely that as a company grows, so will its networking capabilities and needs. Through enterprise networking a company can build a new network and connect it to existing, separate networks. We noted earlier how different types of computers can be connected through the use of software so that you don't have to replace your current computers. As an organization builds new networks, it must connect them to existing

networks, inside and outside the organization, through internetworking. It's cheaper and faster to use internetworking to expand capacity than to start from scratch and build a new network.

FIGURE 7-2 CORPORATE NETWORK INFRASTRUCTURE



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. Let's look at these three key technologies necessary for network computing.

Client/Server Computing

The client/server network facilitates computing on all kinds of networks including the Internet. Instead of one huge mainframe with individual nodes, smaller computers called servers connect to many clients. This type of network is ideal for companies that are continually expanding their networks or replacing hardware components.

Packet Switching

Packet switching is a method of breaking large blocks of text into smaller chunks of data and routing them in the most economical way through whichever communication channel is available.

When you access additional material for this textbook on the Web, it appears as though all the data came into your client computer together. But they didn't. The data were broken into small packets on their way out of the server computer and then sent to and reassembled on the client computer. It happens so quickly and so efficiently that you don't even notice. Packet switching also checks for transmission errors when data travels from one location to another.

TCP/IP and Connectivity

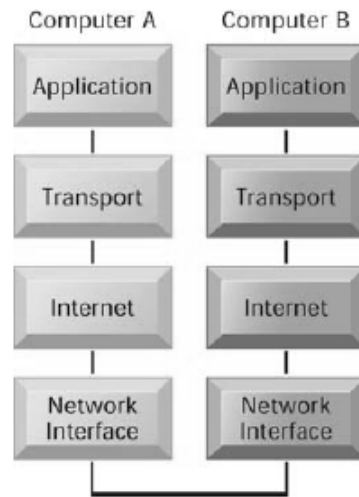
How does your Internet Service Provider manage to send your e-mail to the right place? We're talking millions and millions of people sending e-mail and using the World Wide Web every day. How do you keep from getting Mary's e-mail intended for Billy in Calgary? Notice that each computer user connected to a network has a separate, individual address. No two addresses are exactly the same. All of these addresses are stored on various computers placed around the networks. Software stored on routers uses these addresses to route the data to the right location. Routers use **protocols** to help route data around the many networks to get them to their correct destination

The most popular model for connecting networks is the **Transmission Control Protocol/Internet Protocol (TCP/IP)**. Even though this protocol was originally created for what we now call the Internet, it is easily transferred to networks of all sizes. It provides the easiest methodology for communicating between computers through standardized protocols that ignore the hardware and software platforms of the individual pieces of equipment.

Companies can create Web-based interfaces for different databases for data input/output and accessing information without actually combining the data physically in one huge computer. They do so by using TCP/IP models. With these protocols, they can reduce the disruption to the organization and decrease the overall costs of adding to their network. Figure 7-4 shows you how TCP/IP works.

The most important benefit of the TCP/IP model is that it allows two computers to communicate even if they are based on different hardware and software platforms.

FIGURE 7-4 THE TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL (TCP/IP) REFERENCE MODEL



7.2

COMMUNICATIONS NETWORKS AND TRANSMISSION MEDIA

The text discusses a number of alternative networking technologies available to businesses.

SIGNALS: DIGITAL VS. ANALOG

The two most basic ways for communicating a message is by using an analog or a digital signal. Most of us cannot imagine working today efficiently today using analog signals. Can you imagine Wal-Mart conducting their business by using communications media that had been designed for voice communication?

As we've said many times throughout this course, the computer understands only zeros and ones. Everything going into a computer system must be transformed into the *digital signals* of the computer. However, in the networking world much of the data are transmitted over telephone lines. These lines don't recognize zeros and ones. They only understand what are called *analog signals*. To change the signals back and forth between analog and digital transmission methods, you need a **modem**.

The purpose of a modem (modulator/demodulator) is to:

- Change digital signals from computers to analog signals that telephone lines can carry.
- Change analog signals back to digital signals that the computer can understand.

Clearly corporations would not be able to carry on business using analog signals as it is extremely slow and prone to communications errors. Instead they rely on digital signals that are faster and more reliable.

TYPES OF NETWORKS

Networks come in all shapes and sizes, as you'll see in this section. There are many different kinds of networks and ways of classifying them. Table 7-1 can be used as one way of looking at networks is in terms of their geographic scope.

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 transcontinental or global area

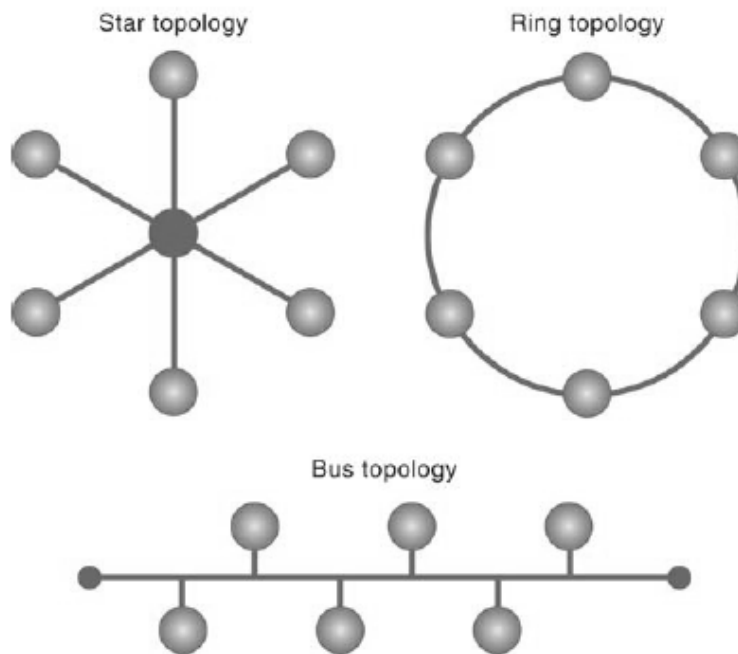
Local Area Networks

The **local area network (LAN)** is probably the most common network setup. You can have as few as two computers or as many as you can wire together in the local area. You could also set up a LAN for local area processing within your company and then connect it to a larger outside network that could be linked to distant locations. The real advantage to a LAN is that you can share expensive peripheral devices such as laser printers. LANs have taken on derivative names such as **CANs (campus area network)** depending on the physical location.

Many small businesses choose to forego a client/server network architecture in favour of a **peer-to-peer** network in which all the computers on the network are equal. Data on one computer can be accessed easily by any other computer. Setting up a small network with this configuration saves the cost of having a separate server computer.

The **topology** of a LAN can vary greatly:

- **Star network** — if the host computer goes down, the whole network goes down
- **Bus network** — all computers in the network are linked with cables and are treated equally
- **Ring network** — no central host computer; if one computer goes down the rest can still process data and transactions

FIGURE 7-6 NETWORK TOPOLOGIES

Generally, larger LANs will use a star topology with a central host computer, although you could use a bus or star topology as well. Applications software and data can be stored on the server computer and be available to a wider audience of users. This is an excellent setup for collaborative work teams.

Metropolitan and Wide Area Networks

A **wide area network (WAN)** is basically the same thing as a LAN, only for a broader geographic setting. This network is not limited by space and distance, and WANs use a combination of technologies to connect all the distant locations. Again, a WAN may take on a derivative name such as **MAN (metropolitan area network)** simply to describe its physical location.

PHYSICAL TRANSMISSION MEDIA

All the computing devices in a network must eventually be connected to one another. Networks use different kinds of physical transmission media, including twisted wire, coaxial cable, fibre optics, microwave and other radio frequencies for wireless transmission. Each has advantages and limitations. Let's take a look at a few of the ways you can do that.

Twisted Wire

Twisted wire is a very common transmission media that has been around for years. It is used in your telephone. It consists of strands of copper wire twisted in pairs and is an older type of transmission medium.

Coaxial Cable

If you've ever hooked up a stereo system or connected a VCR to a television, you've used **coaxial cable**. It consists of a single, thickly insulated copper wire, which can transmit a large volume relative to twisted pair.

Fibre Optics and Optical Networks

Fibre-optic cable is faster, lighter and more durable than traditional transmission media. Fibre-optic cable consists of strands of clear glass fibre, each the thickness of a human hair, which are bound into cables.

One of the major differences between using communications media such as twisted wire and coaxial cable over that of using fibre optics is in the area of security. Signals transmitted over twisted pair wire and coaxial cable can be intercepted easily because they use electrical and magnetic impulses to transmit data. Fibre-optic cable uses pulses of light. So far, no one has figured out a way to intercept light pulses in order to intercept data.

Fibre-optic cable has a very high transmission capacity and is able to transmit data at higher speeds than other methods. Thus, **optical networks** are becoming more popular as a way to transmit bigger multimedia files such as voice and video.

As more fibre-optic cable is laid across the country, and more transmissions are transferred to this new medium, it's become necessary to find ways to increase the capacity of the cable. Hence, the new technology called **dense wavelength division multiplexing (DWDM)**.

Finally, the system of computers and associated transmission media form what's known as a network **backbone**. Think of your own body. Without your backbone, you'd have a tough time standing, sitting and moving. That's similar to a network backbone. All the computers physical wires, wireless media, processors and software come together in a network backbone to give us a whole new way of communicating.

Wireless Transmission Media and Devices

Some experts call us a wired nation. If you consider all the methods we use to communicate, we should be referred to as a *wireless* nation. Our paging systems and cellular telephones use **microwave** and **satellite** technologies to transmit our voice and data communications from one place to another. We have personal communication services (PCS), mobile data networks, and personal digital assistants (PDAs) to help us compute on the go. Now when people say they are "going to the office," it could just as well be their car or truck!

Cellular telephones (cell phones) work by using radio waves to communicate with radio antennas (towers) placed within adjacent geographic areas called cells. Most of us cannot conceive of the notion of not having a “cell” with us as we go about our daily routines.

All the transmission channels discussed in this section combine to give you what seems to be a single clear channel from one physical location to another physical location. In fact, it is very likely that when you access the Internet and call up a Web site you are using a combination of twisted pair wire, fibre-optic cable, microwave stations, and satellites to get from your computer to the other computer.

Transmission Speed

When you transmit the latest information from a Web site to your personal computer, the speed at which it moves across all the transmission media is measured in bits per second (BPS). The speed at which the bits are transmitted in each cycle is referred to as **hertz**. If you transmit one million bits in each cycle, you would call that rate megahertz (one million bits per a single cycle). The **bandwidth** of a communication channel is measured by the difference between the highest and lowest frequencies that can be transmitted by that channel.

Table 7-2 shows the speeds of the transmission media that we've covered in this section so you can compare one to another.

TABLE 7-2 TYPICAL SPEEDS AND COSTS OF TELECOMMUNICATIONS TRANSMISSION MEDIA

Medium	Speed
Twisted wire (unshielded)	Up to 1000 Mbps or 1 Gbps
Microwave	Up to 600+ Mbps
Satellite	Up to 600+ Mbps
Coaxial cable	Up to 100 Gps
Fiber-optic cable	Up to 6+ Tbps

Mbps – megabits per second

Gbps – gigabits per second

Tbps – terabits per second

Bottom Line: Protocols are the rules used in networks to ensure that transmissions can pass between the various components. Communication channels consist of wired and wireless media. Processors and software are combined with the protocols and transmission media to form a network. Many small networks can be connected to form larger networks, which in turn can be connected to the Internet. There are many different types of network infrastructure configurations. Which one is best for your organization depends on your situation. Many new network services are being introduced to increase the speed of network access and will probably reach your world in the next few years.

7.3**THE INTERNET, ITS TECHNOLOGIES, AND HOW THEY WORK**

Try picking up a newspaper or magazine, listening to the radio or television, or simply talking to people, and you'll be hard-pressed not to hear something about the Internet and how it's changing businesses and the way people buy and sell items.

WHAT IS THE INTERNET?

The Internet was developed in 1969 for the U.S. military and eventually spread to universities and civilian researchers. Because of its open structure, interest in its use began to grow beyond these exclusive groups. In 1990, a scientist named Tim Berners-Lee created a software program to help him keep track of his personal information. He eventually extended the software to other uses and called it the World Wide Web. The program allowed for the use of hyperlinks that connect one document to another. The word Internet derives from the word **internetworking**, or the linking of separate networks, each of which retains its own identity, into an interconnected network.

In 1991, commercial use of the Internet was permitted for the first time and that's when it started to explode. In 1993, Netscape Communications Inc. was formed by Marc Andreessen and Jim Clark to market a new software application for the Web called a browser. This graphical user interface allowed users to maneuver around the Web using a point-and-click method instead of textual commands.

The Internet is best described by what it isn't. There is:

- No single computer
- No single control source
- No single entry point
- No single type of application

The Internet consists of computers spread all over the world, connected through wired and wireless transmission media that contain software codes that allow them to talk to each other. That's it. If you tried to find a single "front door" to the Internet, you'd be looking for a long, long time.

Small businesses and individuals connect to the Internet through **Internet service providers (ISP)** such as America Online, Yahoo!, and Microsoft Network (MSN). In many areas the ISP is a small local company connected to a larger network. With recent mergers in the entertainment and Internet industries, some users can now access the Internet through their cable TV companies.

INTERNET ADDRESSING AND ARCHITECTURE

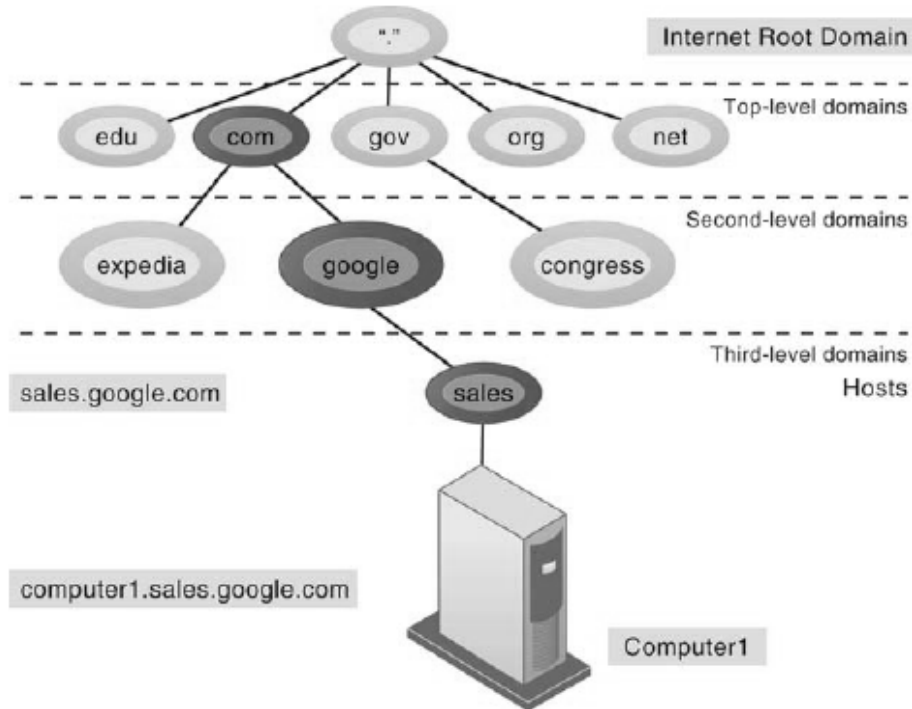
Every address used on the Internet whether it's an e-mail address or a Web site address is nothing more than a series of number called an **Internet Protocol (IP) address**.

Computers spread out through the Internet and various networks convert the series of numbers such as 195.128.15.11 to an easily read address such as <http://www.USAToday.com>.

The Domain Name System

The **Domain Name System (DNS)** was devised because it's much easier for people to read letters and words than to work with series of numbers. The DNS uses a hierarchical breakdown of addresses as Figure 7-8 shows.

FIGURE 7-8 THE DOMAIN NAME SYSTEM



The **domain names** used in e-mail addresses and Web site addresses are easily obtained through several services such as <http://www.networksolutions.com> and <http://www.register.com>. How do you get a domain name? Be the first to request a unique name and pay the required fee. That's all there is to it.

Internet Architecture and Governance

As the Internet and other networks continue to proliferate, it's becoming very difficult to work with the limited number of IP addresses available in the old system. Therefore new IP

addressing schemes are being developed along with an expanded Internet architecture. The text outlines some of the various organizations that help administer the Internet. Just remember, no one owns it.

WINDOW ON ORGANIZATIONS: SHOULD NETWORK NEUTRALITY CONTINUE?

TO THINK ABOUT QUESTIONS:

1. What is network neutrality? Why has the Internet operated under net neutrality up to this point in time?

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

2. Who's in favor of network neutrality? Who's opposed? Why?

Those in favour of network neutrality include organizations like MoveOn.org, the Christian Coalition, the American Library Association, every major consumer group, many bloggers and small businesses, and some large Internet companies like Google and Amazon. Some members of the U.S. Congress also support network neutrality. Vint Cerf, a co-inventor of the Internet Protocol also favours network neutrality saying that variable access to content would detract from the Internet's continued ability to thrive. This group argues that the risk of censorship increases when network operators can selectively block or slow access to certain content. Others are concerned about the effect of slower transmission rates on their business models if users can't download or access content in a speedy fashion.

Those who oppose network neutrality include telecommunications and cable companies who want to be able to charge differentiated prices based on the amount of bandwidth consumed by content being delivered over the Internet. Some companies report that 5 percent of their customers use about half the capacity on local lines without paying any more than low-usage customers. They state that metered pricing is "the fairest way" to finance necessary investments in its network infrastructure. Internet service providers point to the upsurge in piracy of copyrighted materials over the Internet as a reason to oppose network neutrality. Comcast reported that illegal file sharing of copyrighted material was consuming 50 percent of its network capacity. The company posits that if network transmission rates were slower for this type of content, users would be less likely to download or access it. Bob Kahn, another co-inventor of the Internet Protocol opposes

network neutrality saying that it removes the incentive for network providers to innovate, provide new capabilities, and upgrade to new technology.

3. What would be the impact on individual users, businesses, and government if Internet providers switched to a tiered service model?

Proponents of net neutrality argue that a neutral Internet encourages everyone to innovate without permission from the phone and cable companies or other authorities. A more level playing field spawns countless new businesses. Allowing unrestricted information flow becomes essential to free markets and democracy as commerce and society increasingly move online. Heavy users of network bandwidth would pay higher prices without necessarily experiencing better service. Even those who use less bandwidth could run into the same situation.

Network owners believe regulation like the bills proposed by net neutrality advocates will impede U.S. competitiveness by stifling innovation and hurt customers who will benefit from 'discriminatory' network practices. U.S. Internet service already lags behind other nations in overall speed, cost, and quality of service, adding credibility to the providers' arguments. Obviously, by increasing the cost of heavy users of network bandwidth, telecommunication and cable companies and Internet service providers stand to increase their profit margins.

4. Are you in favour of legislation enforcing network neutrality? Why or why not?

Student answers will vary. Some components and principles to consider in answering this question include:

- Price differentials: how much more would heavy bandwidth users pay than those who consume less bandwidth?
- Speed: how much faster would network transmissions be with a tiered service model?
- Stifle innovation: would a tiered service model stifle innovation by charging more for heavy bandwidth use or would it free up bandwidth thus allowing more innovation?
- Censorship: would telecommunication and cable companies and Internet service providers increase censorship of content transmitted over networks?
- Discrimination by carriers: would the end of network neutrality be the beginning of more discrimination?

MIS IN ACTION QUESTIONS

1. Visit the Web site of the Open Internet Coalition and select five member organizations. Then visit the Web site of each of these organizations or surf the Web to find out more information about each. Write a short essay explaining why each organization is in favour of network neutrality.

There are dozens of OIC member organizations ranging from search engines to Iceland Health Inc. It's apparent that companies like eBay, iwon.com, Match.com, Skype, and Shopping.com rely on unfettered and unrestrained network access for the success of their businesses.

2. Calculate how much bandwidth you consume when using the Internet every day. How many e-mails do you send daily and what is the size of each? (Your e-mail program may have e-mail file size information.) How many music and video clips do you download daily and what is the size of each? If you view YouTube often, surf the Web to find out the size of a typical YouTube file. Add up the number of e-mail, audio, and video files you transmit or receive on a typical day.

Obviously the answer to this question will vary among students. It can be an eye-opener for some to realize just how much bandwidth they use.

The Future Internet, IPv6 and Internet2

The Internet was not originally designed to handle the transmission of massive quantities of data and billions of users. Because many corporations and governments have been given large blocks of millions of IP addresses to accommodate current and future workforces, and because of sheer Internet population growth, the world is running out of available IP addresses using the existing addressing convention called IPv4. To prevent this, the Internet Engineering Task Force adopted a new Internet Protocol Version 6 (IPv6).

- IPv4 uses a 32 bit addressing scheme and contains only 4.6 billion addresses, not enough for each of the 6.5 billion people on earth.
- IPv6 uses a 128-bit addressing scheme that produces 3.4×10^{38} addresses.

The existing Internet has many shortcomings, chief among which are:

- Poor security
- No service level guarantees
- No differential service
- No differential pricing
- Bandwidth limitations

Technology hurdles remain a huge problem for businesses and individuals. We seem to be on a merry-go-round: New products require more bandwidth so we demand more bandwidth; the industry responds with increased bandwidth; new products are developed that use the increased bandwidth; then we demand still more bandwidth because the newer products require it. It's definitely a situation of "build it and they will come."

If the expectations of experts predicting increasing use of the Web are to be met, we need to improve and change the current configuration to meet the increasing numbers of people. The **Internet2** project may help. The Next Generation Internet (NGI) project has similar goals of advancing the use of the Internet in ways to enhance our lives.

INTERNET SERVICES AND COMMUNICATION TOOLS

With the recent introduction of new communication and **information appliances**, such as smart phones, PDAs, cell phones, and mobile data networks, organizations have found it necessary to upgrade their networks to incorporate these new technologies.

Internet Services

We keep complaining about information overload, yet we crave more. The Internet provides access to data about any topic you can imagine through e-mail, electronic discussion groups (*Usenet* newsgroups), chat functions and **instant messaging**, Telnet, and **file transfer protocol (FTP)**. Keep in mind that false information is as readily available as is true and correct information. Be careful about the source of information you access.

Many companies and individuals use FTP to share documents among geographic locations. It's a little faster and easier than e-mail but you do need a special software program to use it. Some Web sites offer FTP as a way to move files from a server computer to client computers and incorporate the necessary software into the download process.

You can also use Web sites offered by software companies to download “patches” or additional features via FTP. A patch is actually software code that fix bugs in programs. Two excellent examples of this convenient process are the automatic downloads offered by Microsoft for Windows XP and McAfee Virus software. The software will be automatically downloaded and installed on your computer whenever you are connected to the Internet. You can also set the process to a manual operation but you will have to remember to seek out the download patches and install them yourself.

The Internet allows small businesses to act large and for large businesses to act small. Small businesses have a much wider customer base than otherwise possible. Instead of selling products just in their immediate physical location, they can sell to customers around the world. Large businesses can cater more to individual preference through the Internet as we'll see in later chapters. They are no longer forced to build products based on a one-size-fits-all mentality.

Voice over IP (VoIP)

The Internet has become a platform for voice communication and corporate networking. Companies no longer have to maintain separate networks for voice and data transmission and cost savings for business and home users can be significant.

Virtual Private Networks

Companies all over the world are building **virtual private networks (VPN)** to help reduce costs and make it easier for customers, suppliers, and employees to communicate. And why not? The Internet technology offers a much cheaper alternative to the high cost

of building and maintaining their own technology or using other technologies that aren't built on the open standards of the Internet. VPNs also offer companies an extra layer of security protection through the tunneling process because of the “wrapping” effect not offered generic transmissions.

WINDOW ON MANAGEMENT: MONITORING EMPLOYEES ON NETWORKS: UNETHICAL OR GOOD BUSINESS?

Employee use of e-mail, 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 their employees' online activity. But is this ethical? Although there are some strong business reasons why companies may need to monitor their employees' e-mail and Web activities, what does this mean for employee privacy?

TO THINK ABOUT QUESTIONS

1. Should managers monitor employee e-mail and Internet usage? Why or why not?

Monitoring employee e-mail and Internet usage is a hotly debated subject. Some will argue that it amounts to an invasion of privacy, whereas others will state that managers have a right to expect that employees will do the job which they have been hired. Using corporate resources such as e-mail and the Internet on company time amounts to what is termed “service theft”. When employees use company time and computer equipment to participate in e-mailing or Web surfing activities that are not part of their duties, they are wasting valuable corporate resources.

2. Describe an effective e-mail and Web use policy for a company.

Like all policies an effective e-mail and Web use policy must be carefully designed and clearly communicated to all persons who use these corporate resources. There are a number of different policies in existence. Some companies allow absolutely no personal activities to be done on corporate networks whereas others allow some degree of activity, and this activity can be easily monitored. A good policy will detail exactly what type of activity is acceptable and what is not allowed. The policy should clearly articulate sanctions that will be followed for any and all offenses in relation to the policy.

As an instructor you might wish to show students an example of the University of South Australia's policy at

<http://www.unisa.edu.au/policies/policies/corporate/C22.asp>

MIS IN ACTION QUESTIONS

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

1. What employee activities does this software track? What can an employer learn about an employee by using this software?

From SpectorSoft Web site: The Spector Pro keylogger will instantly inform you whenever they type, or even simply view, any “alert words” or phrases that you specify. Spector Pro continuously looks for alert words in everything they type, every web site they visit, all chats/Instant Messages and in each e-mail sent or received. Every time a keyword is detected, Spector Pro will immediately e-mail you a detailed report of when, where and how the keyword was used.

2. How can businesses benefit from using this software?

A testimonial from the SpectorSoft Web site: “With Spector Pro, we were immediately able to discover which employees were non-productive. Not only has Spector Pro helped us weed out lazy workers, it also helped to uncover fraud in some of our departments. In addition, this program has also allowed us to realize and resolve training issues we've experienced with our internal software. Spector Pro is very stealthy, has no noticeable effect on system performance and provides excellent return on investment.”

3. How would you feel if your employer used this software where you work to monitor what you are doing on the job? Explain your answer.

Answers will vary based on student experiences and beliefs.

THE WORLD WIDE WEB

The **World Wide Web** is a vast repository of data and information connected through hyperlinks. When you think about the fact that it didn't even exist 15 years ago, it's amazing to realize how much it has permeated everything we do in our personal and business lives.

Hypertext

We discussed protocols before: The rules by which data are transmitted over networks. The **Hypertext Transfer Protocol (HTTP)** is what allows the Web to operate. When you see a **uniform resource locator (URL)** address on a Web site, it will generally start with `http://www`. Most software browser programs now automatically insert the `http` for you so you can simply enter the URL address of the Web site you want to access beginning with the `www`. A URL that begins with `https:` indicates a site using secure socket layers that offers more secure transmission protocols than the plain `http`.

Hypertext Markup Language (HTML) is the common language used to create Web documents. It is very easy to use and is now included in most common software applications, such as Word, WordPerfect, and Excel. As the technology improves to include audio, video, animated graphics, and movies on Web sites, derivative languages such as Dynamic HTML, Java, and ActiveX are becoming more common.

Web Servers

All the Web sites created are stored on Web servers scattered throughout the Internet. Rather than a small business owning and maintaining their own Web server computers, they can pay a Web hosting service to maintain the site. It's often cheaper and easier and the small business doesn't have to worry about downtime, scalability issues or security.

There is a difference between a Web *site* and a Web *page*. A **Web site** has the short domain address, such as www.prenhall.com. It is the central repository for many, many Web pages that will be included at the end of the address after the domain name and a slash. For example, www.prenhall.com/index.html is a Web page within the Web site for Prentice Hall. A Web page is a single document stored within the Web site and probably linked to other pages on the site. Generally the **home page** is the first page you'll see when you initially access a Web site. It's usually identified through the file name `index.htm` or `default.html`.

Webmasters, people who create and maintain Web sites, are in hot demand because of the limited knowledge and experience most companies have with Web sites. Software application programs such as Microsoft FrontPage or Macromedia Dreamweaver can help you set up and manage a Web site. You can also use these programs to create single pages and store them on a Web host server computer. Many Internet service providers such as America Online and Web sites such as Geocities also give you the ability to create and store your own Web page on their servers.

Searching for Information on the Web

The text gives you the basic information for using search engines and directories. You need to understand and remember that the various search engines use different methods of helping you find information on the Web. You shouldn't restrict yourself to just one or two search engines, but should try many different ones. You may be surprised at the different results you'll get using the same keyword search.

Some **search engines** use special software programs to monitor the Web for new or updated sites or pages. When they reach a new site or page they analyze the contents and determine the correct category in which it will be listed. They then add it to their database so that it will appear on the search result list when someone enters the appropriate subject. You can also search for FTP sites, Usenet, newswires, business news, stock quotes, and weather using these search engine capabilities.

If you develop a site or page, you can add your URL to the search engine so it will know your site is available. Many search engines don't require you to do this since their

software programs will eventually find your site, but you can speed up the process by registering with the search engines.

Some innovative entrepreneurs have established businesses that will register your site with all the search engines – over 400 of them – for a price. You can do it yourself with your time as your cost. Although many search engines allow you to register your site for free, others—called **search-engine marketing**—are now charging fees to list Web sites. Since January 2002, Yahoo! charges commercial sites a \$299 non-refundable fee to be considered for addition to the search directory. There is no guarantee Yahoo! will accept the commercial site for inclusion though.

When you are searching for information, try using a search site that submits your inquiry to 25 different search engines and returns a list of the results. The most popular search engine is <http://dogpile.com/>. Dogpile.com is called a meta-search engine. If you type in a topic such as “horse breeding” on the Dogpile.com Web site, it will submit the topic to popular search directories and engines such as Yahoo!, Excite, Lycos, Infoseek, and HotBot all at once. You tell the search service how you want the contents listed and in what priority. It's much easier and faster than visiting each search engine site yourself.

You also should be aware of the individual and business directories on the Web. You could call them the “Yellow Pages of the World.” They act just like the Yellow Pages of your telephone book. In fact, most of the information listed in them is gathered from the telephone directories. They are easy to use and cheaper than calling your phone company information service; they are free!

Many search engine home pages such as altavista.com have **shopping bots** available at a single click. Other shopping bot sites, such as <http://www.pricingcentral.com/> gather information from many sources and combine it for ease in comparing prices and availability. Keep in mind that some of the prices available through these kind of sites may not be the absolute lowest you could find on your own. Some companies pay a service fee to the shopping bot sites to have their products listed regardless of whether they are the lowest price. Buyer, beware.

Web 2.0

Web 2.0 (or Web 2) is the popular term for advanced Internet technology and applications including mashups, blogs, wikis, **RSS** and social bookmarking. The two major components of Web 2.0 are the technological advances enabled by Ajax and other new applications such as RSS and Eclipse and the user empowerment that they support.

One of the most significant differences between Web 2.0 and the traditional World Wide Web (retroactively referred to as Web 1.0) is greater collaboration among Internet users and other users, content providers, and enterprises.

Mashups — is a Web page or application that integrates complementary elements from two or more sources. Mash-ups are often created by using a development approach called Ajax.

Blogs — short for Weblog, have burst onto the scene in the last year thanks to the presidential election in 2004. While you may have become familiar with this feature through the controversies created by them, blogs are far more than political tools. Businesses use them to communicate with customers and suppliers to announce new products or services and to garner feedback about company services. An excellent example of effective business uses of blogs is the one by Microsoft employee Sara Williams at <http://blogs.msdn.com/saraw/> who uses her blog to communicate with software developers outside the company. She discusses policies and procedures with customers and users of the company's products and services. More valuable than that, she receives feedback from those outside the company and can use the information to help improve how the company meets its customer demands.

Real Simple Syndication (RSS) — is a useful feature that has been coupled with blogs. The process allows you to place a small program on your computing device that alerts you to new information posted to Web sites you've marked. When a blogger posts a new entry to your favourite site, you receive an alert and can immediately click on the RSS feed to review the posting. RSS can also be used on a variety of news-related Web sites to help you keep current on breaking headlines.

Wiki — is a server program that allows users to collaborate in forming the content of a Web site. With a wiki, any user can edit the site content, including other users' contributions, using a regular Web browser. Basically, a wiki Web site operates on a principle of collaborative trust.

Web 3.0: The Future Web

This is sometimes referred to as the **semantic web** where the content of the web is organized by meaning, and access is more productive.

INTRANETS AND EXTRANETS

Intranets and *extranets* use the same operating methods as the Internet. Intranets are restricted to the internal members of an organization and extranets are limited to certain users outside of an organization who are given special access to the Web site. Access to intranets and extranets is controlled through the use of usernames, passwords and **firewalls**, which are security software programs that keep unauthorized users out of the network.

The beauty of intranets and extranets is that they don't require any special software or hardware other than what you would use for the Internet. The easy-to-use software programs to create Web sites and pages give more people in an organization the ability to use these 'Nets for very creative purposes. Using these 'Nets can drastically reduce the costs of disseminating information to employees, customers, and suppliers.

Extranets

Suppose you are the human resources manager of a mid-size company and you are establishing a new employee retirement plan. Of course you need to get the information out to the employees as soon as possible so they can sign up for the plan. Many of them will have questions and will want some help computing the benefits of their enrollment. You can quickly and easily set up a Web page that explains how to enroll and gives them an enrollment form right on the Web. You can have a Frequently Asked Questions (FAQ) page employees can use to read what other people are asking and also post their questions. You can answer their questions on the FAQ page, which gives other employees the opportunity to see the information. An especially useful tool would be to include an online calculator to compute contributions and the rate of return on investments. Think of the time you and the other human resource office members will save if employees can do all that on their own and don't have to visit your office.

Extranets are becoming very popular as a way for companies to get information to customers and suppliers quickly and efficiently. It's much less costly to put the information on the extranet and it's faster to update the information than to have to print and send out paper updates. Some companies are using extranets to replace EDI systems. Smaller companies that couldn't afford the cost of EDI are using extranets as a way to allow product ordering and shipment tracking.

To be sure, there are costs associated with using 'Net technologies. But can you imagine setting up your own private network, which would have to be installed in all the other organizations you do business with? You simply couldn't do it. But you can establish your own network that is connected to the Internet, which in turn is connected to the other networks.

Bottom Line: The Internet is a vast worldwide compilation of networked computers. IP addresses and the Domain Name System help ensure transmissions are routed to the correct recipient. Many applications such as e-mail, FTP, newsgroups, instant messaging, and chatting are available. The Internet2 and NGI projects will improve on the current Internet configurations and make it easier and faster to exchange information and data.

7.4

THE WIRELESS REVOLUTION

The Internet is also creating new opportunities and headaches for businesses everywhere. Companies have so many choices in building a new infrastructure that they can easily make mistakes that will cost them thousands or millions of dollars in lost profits and lost customers. In this chapter we'll look at the way wireless networking in particular is changing the landscape of business and personal uses of the Internet and networks.

Because of the popularity of the Internet and networks in general, anytime, anywhere computing is growing in demand. Businesses are no longer content to keep their

employees tethered to the traditional desk in the traditional office working the traditional 40-hour work week. New wireless technologies are breaking the chains.

Just as we've seen a convergence in wired digital devices such as computers, televisions, and telephones, we're seeing a widespread convergence in wireless technology and the services it offers. If content can be digitized it can be transmitted over wireless networks. That includes voice, documents, photographs, music, movies, television shows, you name it. Why should we wait to show pictures of our vacation until we get home when we can instantly transmit them over the Internet via a photo-equipped cell phone? Why can't we take a thousand songs loaded on a wireless device with us wherever we go?

Earlier in the chapter we discussed various transmission media such as coaxial cable and fibre optics. Wireless transmissions rely on microwaves and satellites to send data across high frequency radio ranges that later connect to wired media.

On the ground, wireless communications use a variety of gadgets such as cell phones, **personal digital assistants (PDAs)** such as the Palm, e-mail handhelds devices such as the BlackBerry, and smart phones.

One of the hottest emerging communication appliances is the **smart phone** equipped with Web browser software. These hybrid devices combine the functionality of a PDA with that of a digital cell phone. Some merchants are teaming with Web portals to use global positioning systems to pinpoint your location. Once the merchants know you're in the local area, they offer you discounts on meals, clothing, and movies if you respond within the hour. As you're walking down the sidewalk, you can use your smart phone to locate restaurants, check movie schedules, review sports scores, take and send photographs, and use maps to find your way.

CELLULAR SYSTEMS

Mobile phones enable many millions of people to communicate and access the Internet in Africa and other countries where conventional telephone or Internet service are expensive or unavailable.

Cellular Network Standards and Generations

Interestingly enough, Canada and the United States are not among the most “wired wireless” countries in the world; that honor goes to South Korea, Japan, and many European countries. Unfortunately each world region has adopted separate standards for wireless networks and very often the standards don't allow for cross transmissions. Two major standards used in the world are:

- **Global System for Mobile Communication (GSM):** bandwidth is based on time division multiple access and is used in Europe, China, and Asia, and some regions of the United States.

- **Code Division Multiple Access (CDMA):** transmits over several radio frequencies and randomly assigns users to a range of frequencies over time. It is used mostly in the North America.

Just as we've experienced generations of computers and computer languages, we allocate generational labels to wireless phone systems. The newer cell phones allow short text messages known as **short message services (SMS)** to be sent from digital-based cell phones. Users of this service don't have to actually talk to the person on the other end but communicate in a shorthand type of language.

A short review of their characteristics may help you distinguish among them:

- First generation (1G): first appeared in the 1980s and were analog based. Mostly supported only voice transmissions.
- Second generation (2G): appeared in the 1990s and supported better voice quality and short message services.
- Interim generation (2.5G): appeared in the late 1990s and early 2000s and provides increased data transmissions based on the 2G technology. It's an interim fix until 3G technology is more fully refined.
- Third generation (3G): appeared in the early 2000s and are based on packet-switch technology that allows large amounts of data transmission. Supports voice, video, and graphics.
- Fourth generation (4G) is being worked on for commercial deployment in 2012

Bottom Line: Wireless networks allow businesses to mobilize their employees to wherever necessary with full access to data and services. Wireless communication devices use microwave towers and satellites to instantaneously transmit any form of digitized data. Wireless standards for Web access is still being defined but will allow access to applications of all kinds.

WIRELESS COMPUTER NETWORKS AND INTERNET ACCESS

In order for wireless networks to work in tandem with each other it is necessary to create standards such as we have with the Internet and other network technologies.

Bluetooth

The **Bluetooth** wireless technology standard comes installed on some computers, which helps create small **personal area networks (PANs)**. It's more appropriate to use Bluetooth technology in battery-powered devices that are within close proximity to each other. Bluetooth technology is mostly used to connect keyboards, printers, computers and handheld devices all within very close range.

Even though the Bluetooth technology got off to a slow start in the early 2000s, it is now being used for all kinds of applications, even automobiles. Vehicles are coming equipped with Bluetooth technology and allow the use of hands-free cell phones, stereos, global positioning systems, and security devices.

Wi-Fi

We mentioned earlier that today's computing environment should be referred to as "wireless." The recent proliferation of wireless technology is technically known as the 802.11 networking standard. It's more commonly, and easily, called **Wi-Fi** for wireless fidelity. Wi-Fi can be installed on your existing computers and connect them through a router hub. If you have several computers at home or in the office, a Wi-Fi network can help save money by negating the need for additional phone lines for Internet access or to use a single peripheral device such as a printer among several different computers. Each computer requires a **wireless NIC** (network interface card) containing a built-in radio and antenna. These cards are relatively inexpensive and you can avoid duplicating more expensive equipment by using a wireless network.

A Wi-Fi system can operate in two different modes:

- Infrastructure mode — 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.
- Ad-hoc mode — also known as peer-to-peer mode, wireless devices communicate with each other directly and do not use an access point.

Wi-Fi and Wireless Internet Access

Access points to a wireless network are also called **hot spots** and are proliferating in many public places such as libraries, Internet cafes, hotels and airports. You should be aware of the dangers in using these hot spots because of the lack of strong security typical of wireless networks and interference problems as more users try to access the network.

One of the biggest challenges facing the Wi-Fi industry is creating enough hotspots all around the country to provide blanket coverage without interruption. Currently there are still not enough continuous connections and many times users are dropped without warning. It's similar to the situation cell phones users have experienced with dropped calls and service interruptions.

Security is also a major concern because the Wi-Fi networks are intentionally built for openness and easy access. We address Wi-Fi network security more extensively in Chapter 8.

WiMax

Unfortunately there are still large regions of North America that must continue to rely on old telephone systems for Internet access. That prevents users from taking advantage of new high-speed access and many of the feature-rich applications available on the Internet. And because of limitations in frequency ranges associated with Wi-Fi, Bluetooth

and other technologies, many users are left out of the Internet evolution. Therefore a new technology called **WiMax** is being developed to help fill the gaps all across the country. WiMax increases the range of transmissions up to approximately 31 miles and increases the transmission speeds significantly over that available on regular telephone lines and dial-up modems.

Bottom Line: Wireless technologies create small networks that connect just about any kind of computing device. They are easier to configure and connect than wired technologies and allow users more flexibility and access. Wireless access points, or hotspots, are springing up in airports, hotels, coffee shops, and rest stops all across the country and world.

7.5 RADIO FREQUENCY IDENTIFICATION AND WIRELESS SENSOR NETWORKS

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

Radio Frequency Identification (RFID)

Radio Frequency Identification (RFID) systems are an excellent example of how wireless technology is totally remaking supply chain management systems. RFID tags are small microchips that contain information about the product. The tags transmit data via radio frequencies to computing devices that track the product. The tags can be either active or passive. Let's compare the characteristics of each:

- Active RFID tags: battery powered; data can be rewritten; have a longer read range, shorter operational life
- Passive RFID tags: no power source, smaller, lighter, and less expensive; unlimited operational lifetime; shorter read range

RFID tags offer more inventory management control over products than the current bar code technology for several reasons:

- More data can be written to RFID tags
- More real-time data can be provided by RFID tags
- RFID tags can trigger other processes within the computer system
- RFID tags do not require line-of-sight readers

Even though RFID tags are more expensive than bar-code technologies, the cost will drop as they become more prevalent and the system switch-over is completed.

Wireless Sensor Networks

The possibilities for wireless technology are endless. You can use wireless devices throughout your home and connect computer and entertainment devices into one computing system that will access the Internet and download music, photographs, videos, movies, and television programs.

As computers are combined with home entertainment devices such as televisions, stereos, game consoles, and telephones, it won't be long before **wireless sensor networks (WSNs)** are as ubiquitous as refrigerators and dishwashers. Businesses will use wireless sensor networks to connect handheld devices with data storage devices and allow workers to roam through warehouses and office buildings. In the long run, WSNs will be cheaper for businesses and homes since no structural changes will need to be made to the building's walls, ceilings, or floors. If you want to add equipment, you'll simply add another node to the network. You won't have to cut holes, run wires, or alter the physical structure at all.

Bottom Line: Wireless applications for customer relationship management are changing the complexity between businesses and customers. RFID technology is giving companies new opportunities and challenges for supply chain management. The health care industry is undergoing radical changes due to wireless technologies. Even the traditional home front is undergoing change because of wireless networks applications.

SUMMARY

1. What are the principal components of telecommunications networks and key networking technologies?

A simple network consists of two or more connected computers. Basic network components include computers, network interfaces, a connection medium, network operating system software, and either a hub or a switch. The networking infrastructure for a large company relies on both public and private infrastructures to support the movement of information across diverse technological platforms. It includes the traditional telephone system, mobile cellular communication, wireless local-area networks, videoconferencing systems, a corporate Web site, intranets, extranets, and an array of local and wide-area networks, including the Internet. This collection of networks evolved from two fundamentally different types of networks: telephone networks and computer networks.

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. Client/server networks have distributed much of the organization's computing power to the desktop and factory floor. Packet switching makes more efficient use of network communications capacity by breaking messages into small packets that are sent independently along different paths in a network and then reassembled at their

destinations. Protocols provide a common set of rules that enable communication among diverse components in a telecommunications network. TCP/IP is a suite of protocols that has become the dominant model of achieving connectivity among different networks and computers. It is the connectivity model used in the Internet.

2. What are the main telecommunications transmission media and types of networks?

The principal physical transmission media are twisted copper telephone wire, coaxial copper cable, fibre-optic cable, and wireless transmission. The choice of transmission medium depends on the distance and volume of communication required by the organization and its financial resources. Twisted wire enables companies to use existing wiring for telephone systems for digital communication. Fibre-optic and coaxial cable are used for high-volume transmission but are expensive to install. Microwave and satellite are used for wireless communication over long distances. The transmission capacity of a medium, known as the bandwidth, is determined by the range of frequencies it can accommodate.

There are different types of networks and network services available to organizations. Network selection and design should be based on the organization's information requirements and the distance required for transmission. Local-area networks (LANs) connect PCs and other digital devices together within a 500-meter radius and are used today for many corporate computing tasks. Network components may be connected together using a star, bus, or ring topology. Wide-area networks (WANs) span broad geographical distances, ranging from several miles to continents and are private networks that are independently managed. Metropolitan-area networks (MANs) span a single urban area, whereas campus-area networks (CANs) span a campus of buildings or a military base.

A number of network services are available requiring high-bandwidth transmission. Frame relay is a shared network service with transmission speeds ranging from 56 Kbps to more than 40 Mbps; it relies on digital circuits that require less error checking than packet switching. Asynchronous Transfer Mode (ATM) provides transmission speeds of 1.5 Mbps to more than 9 Gbps, parceling data into fixed 53-byte cells. ATM can pass data between computers from different vendors and is popular for transmitting data, video, and audio over the same network. Integrated Services Digital Network (ISDN) is an international standard for dial-up network access that uses existing local telephone lines to integrate voice, data, image, and video services. Basic rate ISDN can transmit data at a rate of 128 Kbps.

Digital subscriber line (DSL) technologies, cable Internet connections, and T1 lines are often used for high-capacity Internet connections. Like ISDN, DSL technologies also operate over existing copper telephone lines to carry voice, data, and video, but they have higher transmission capacities than ISDN. Asymmetric Digital Subscriber Line (ADSL) supports a transmission rate of 1.5 to 9 Mbps when receiving data and up to 640 Kbps when sending data. Symmetric Digital Subscriber Line (SDSL) supports the same transmission rate for sending and receiving data of up to 3 Mbps.

Cable Internet connections provide high-speed access to the Web or corporate intranets at speeds of up to 10 Mbps. T lines are high-speed data lines leased from communications providers. A T1 line supports a data transmission rate of 1.544 Mbps.

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

The Internet is a worldwide network of networks that uses the client/server model of computing and the TCP/IP network reference model. Every computer on the Internet is assigned a unique numeric IP address. The Domain Name System (DNS) converts IP addresses to domain names so that users only need to specify a domain name to access a computer on the Internet instead of typing the numeric IP address. No one owns the Internet and it has no formal management organization. However, worldwide Internet policies are established by organizations and government bodies, such as the Internet Architecture Board and the World Wide Web Consortium. The Internet must also conform to the laws of the sovereign nation-states in which it operates, as well as the technical infrastructure that exist within the nation-state.

Major Internet services include e-mail, Usenet, Usenet, chatting, instant messaging, Telnet, FTP, and the World Wide Web. Web pages are based on Hypertext Markup Language (HTML) and can display text, graphics, video, and audio. Web site directories, search engines, and Rich Site Summary (RSS) technology help users locate the information they need on the Web. Web site directories, search engines, and RSS technology help users locate the information they need on the Web. RSS blogs, and wikis are features of Web 2.0. Web technology and Internet networking standards provide the connectivity and interfaces for internal private intranets and private extranets that can be accessed by many different kinds of computers inside and outside the organization.

Internet-based groupware and electronic conferencing software provide tools to support communication and collaboration when people work together in groups or work teams, often in different locations. Firms are also starting to realize economies by using Internet telephone, which enables Internet technology to be used for telephone voice transmission. Internet technology can also reduce communication costs by enabling companies to create virtual private networks (VPNs) as low-cost alternatives to private WANs.

4. What are the principal technologies and standards for wireless networking, communication and Internet access.

Cellular networks have evolved from slow-speed (1G) analog networks to high-speed, high-bandwidth, digital packet-switched, third-generation (3G) networks with speeds ranging from 144 Kbps to more than 2 Mbps for data transmission. Second-generation (2G) cellular networks are digital circuit-switched networks used primarily for voice transmission, but they can also transmit data at rates ranging from 9.6 to 14.4 Kbps. 2.5G networks are packet switched, use many existing infrastructure elements, and have data transmission rates ranging from 50 to 144 Kbps.

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

Alternative standards governing the way wireless mobile devices access the Internet and the World Wide Web include Wireless Application Protocol (WAP) and I-mode.

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). Bluetooth can link 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, keyboards, computers, printers, and PDAs using Bluetooth can communicate with each other and even operate each other without direct user intervention.

The most popular of the 802.11 standards is currently **802.11b**, which can transmit up to 11 Mbps in the unlicensed 2.4 GHz band. 802.11g can transmit up to 54 Mbps in the same frequency range. The 802.11b standard has been the most widely used standard for creating wireless LANs and providing broadband wireless Internet access. However, 802.11b is vulnerable to penetration by outsiders and interference from other wireless devices in the same frequency spectrum.

WiMax has a wireless access range of up to 31 miles and a data transfer rate of up to 75 Mbps, making it suitable for providing broadband Internet access in areas lacking DSL and cable lines. The 802.16 specification also has robust security and quality-of-service features to support voice and video.

Major cellular carriers are also upgrading their networks to provide wireless broadband access to the Internet at an average speed of 300 to 500 Kbps. Verizon's service, called BroadBand Access, uses a technology called EV-DO to provide Internet access over a cellular network.

- 3.
- 4.
5. **Why are radio frequency identification (RFID) and wireless sensor networks (WSNs) valuable for business?**

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

KEY TERMS

The following alphabetical list identifies the key terms discussed in this chapter.

2.5G networks — Wireless digital cellular networks that provide higher-speed data transmission rates ranging from 50 to 144 kilobits per second (Kbps) using the existing cellular network infrastructure.

3G networks — cellular networks based on packet-switched technology with speeds ranging from 144 kilobits per second (Kbps) for mobile users to over 2 megabits per second (Mbps) for stationary users enabling users to transmit video, graphics, and other rich media, in addition to voice.

802.11b — wireless local area network (LAN) standard that can transmit up to 11 megabit per second (Mbps) in the unlicensed 2.4-GHZ band and that has an effective distance of 30 to 50 meters.

Access point — box in a wireless local area network (LAN) consisting of a radio, receiver/transmitter and antennas that link to a wired network, router, or hub.

Asynchronous Transfer Mode (ATM) — a networking technology that parcels information into 8-byte cells, enabling data to be transmitted between computers from different vendors at any speed.

Backbone — part of a network handling the major traffic and providing the primary path for traffic flowing to or from other networks.

Bandwidth — the capacity of a communications channel as measured by the difference between the highest and lowest frequencies that can be transmitted by that channel.

Blog — popular term for Weblog, designating an informal yet structured Web site where individuals can publish stories, opinions, and links to other Web sites of interest.

Bluetooth — standard for wireless personal area networks that can transmit up to 722 kilobits per second (Kbps) within a 10-meter area.

Broadband — high-speed transmission technology. Also designates a single communications medium that can transmit multiple channels of data simultaneously.

Bus networks — network topology linking a number of computers by a single circuit with all messages broadcast to the entire network.

Cable Internet connections — Internet connections that use digital cable coaxial lines to deliver high-speed Internet access to homes and businesses.

Campus area network (CAN) — an interconnected set of local area networks in a limited geographical area such as a college or corporate campus.

Cellular telephones (cell phones) — a device that transmits voice or data, using radio waves to communicate with radio antennas placed within adjacent geographic areas called cells.

Chat — live, interactive conversations over a public network.

Coaxial cable — a transmission medium consisting of thickly insulated copper wire; can transmit large volumes of data quickly.

Code Division Multiple Access (CDMA) — major cellular transmission standard in the United States that transmits over several frequencies, occupies the entire spectrum, and randomly assigns users to a range of frequencies over time.

Dedicated server computer — a computer on a network that performs important network functions for client computers, such as serving up Web pages, storing data, and storing the network operating system.

Dense wavelength division multiplexing (DWDM) — technology for boosting transmission capacity of optical fibre by using many different wavelengths to carry separate streams of data over the same fibre strand at the same time.

Digital subscriber line (DSL) — a group of technologies providing high-capacity transmission over existing copper telephone lines.

Domain name — English-like name that corresponds to the unique 32-bit numeric Internet Protocol (IP) address for each computer connected to the Internet.

Domain Name System (DNS) — a hierarchical system of servers maintaining a database enabling the conversion of domain names to their numeric IP addresses.

E-mail handhelds — handheld device for wireless data transmission that includes a small display screen and a keypad for typing short e-mail messages.

Electronic mail (e-mail) — the computer-to-computer exchange of messages.

EV-DO — technology used in Verizon's cellular network service for providing anytime, anywhere broadband wireless Internet access for PCs and other devices at average speeds of 300 to 500 kilobits per second (Kbps). Stands for Evolution Data Optimized.

Fibre-optic cable — a fast, light, and durable transmission medium consisting of thin strands of clear glass fibre found into cables. Data are transmitted as light pulses.

File Transfer Protocol (FTP) — specification for retrieving and transferring files from a remote computer.

Firewalls — hardware and software placed between an organization's internal network and an external network to prevent outsiders from invading private networks.

Frame relay — a shared network service technology that packages data into bundles for transmission but does not use error-correction routines. Cheaper and faster than packet switching.

Global System for Mobile Communication (GSM) — major cellular transmission standard outside the United States with strong international roaming capability that operates primarily in the 900 megahertz (MHz) and 1.8 gigahertz (GHz) frequency bands using Time Division Multiple Access (TDMA) in which each user is allocated a portion of time on the frequency.

Groupware — software that provides functions and services that support the collaborative activities of work groups.

Hertz — measure of frequency of electrical impulses per second, with 1 Hertz equivalent to 1 cycle per second.

Homepage — a World Wide Web text and graphical screen display that welcomes the user and explains the organization that has established the page.

Hotspots — a specific geographic location in which an access point provides public Wi-Fi network service.

Hubs — very simple devices that connect network components, sending a packet of data to all other connected devices.

Hypertext Transfer Protocol (HTTP) — the communications standard used to transfer pages on the Internet. Defines how messages are formatted and transmitted.

I-mode — standard developed by Japan's NNT DoCoMo mobile phone network for enabling cell phones to receive Web-based content and services.

Information appliance — device that has been customized to perform well a few specialized computing tasks with minimal user effort.

Instant messaging — chat service that enables participants to create their own private chat channels so that a person can be alerted whenever someone on his or her private list is online to initiate a chat session with that particular individual.

Integrated Services Digital Network (ISDN) — international standard for transmitting voice, video, image, and data to support a wide range of services over the public telephone lines.

Internet Protocol (IP) address — four-part numeric address indicating a unique computer location on the Internet.

Internet service provider (ISP) — a commercial organization with a permanent connection to the Internet that sells temporary connections to subscribers.

Internet telephony — technologies that use Internet Protocol packet-switched connections for voice service.

Internet2 — research network with new protocols and transmission speeds that provides an infrastructure for supporting high-bandwidth Internet applications.

Internetworking — the linking of separate networks, each of which retains its own identity, into an interconnected network.

Local-area network (LAN) — a telecommunications network that requires its own dedicated channels and that encompasses a limited distance, usually one building or several buildings in close proximity.

Metropolitan-area network (MAN) — network that spans a metropolitan area, usually a city and its major suburbs. Its geographic scope falls between a wide area network (WAN) and a local area network (LAN).

Microbrowser — Web browser software with a small file size that can work with low-memory constraints, tiny screens or handheld wireless devices, and low bandwidth of wireless networks.

Microwave — a high-volume, long-distance, point-to-point transmission in which high-frequency radio signals are transmitted through the atmosphere from one terrestrial transmission station to another.

Modem — a device for translating a computer's digital signals into analog form for transmission over ordinary telephone lines, or for translating analog signals back into digital form for reception by a computer.

Multiplexing — capability of a single communications channel to carry data transmissions from multiple sources simultaneously.

Network interface card (NIC) — expansion card inserted into a computer to enable it to connect to a network.

Network operating system (NOS) — special software that routes and manages communications on the network and coordinates network resources.

Optical networks — high-speed networking technologies for transmitting data in the form of light pulses.

Packet switching — technology that breaks messages into small bundles of data and routes them in the most economical way through any available communications channel.

Peer-to-peer — network architecture that gives equal power to all computers on the network; used primarily in small networks.

Personal-area networks (PANs) — computer network used for communication among digital devices (including telephones and personal digital assistants, or PDAs) that are close to one person.

Personal digital assistants (PDAs) — small, pen-based, handheld computers with built-in wireless telecommunications capable of entirely digital communications transmission.

Protocol — a set of rules and procedures that govern transmission between the components in a network.

Radio frequency identification (RFID) — technology using tiny tags with embedded microchips containing data about an item and its location to transmit short-distance radio signals to special RFID readers that then pass the data on to a computer for processing.

Ring networks — a network topology in which all computers are linked by a closed loop in a manner that passes data in one direction from one computer to another.

Router — specialized communications processor that forwards packets of data from one network to another network.

RSS — technology using aggregator software to pull content from Web sites and feed it automatically to subscribers' computers.

Satellites — the transmission of data using orbiting satellites that serve as relay stations for transmitting microwave signals over very long distances.

Search engines — a tool for locating specific sites or information on the Internet.

Search engine marketing — use of search engines to deliver sponsored links, for which advertisers have paid, in search engine results.

Shopping bots — software with varying levels of built-in intelligence to help electronic commerce shoppers locate and evaluate products or services they might wish to purchase.

Short message service (SMS) — text message service used by digital cell phone systems to send and receive short alphanumeric messages less than 160 characters in length.

Smart phones — wireless phone with voice, text, and Internet capabilities.

Star network — a network topology in which all computers and other devices are connected to a central host computer. All communications between network devices must pass through the host computer.

Switch — device to connect network components that has more intelligence than a hub and can filter and forward data to a specified destination.

T lines — high-speed lines leased from communications providers, such as T-1 lines (with a transmission capacity of 1.544 megabits per second).

Telnet — Network tool that allows someone to log on to one computer system while doing work on another.

Topology — the way in which the components of a network are connected.

Transmission Control Protocol / Internet Protocol (TCP/IP) — dominant model for achieving connectivity among different networks. Provides a universally agreed-on method for breaking up digital messages into packets, routing them to the proper addresses, and then reassembling them into coherent messages.

Twisted wire — a transmission medium consisting of pairs of twisted copper wires; used to transmit analog phone conversations but can be used for data transmission.

Uniform resource locator (URL) — the address of a specific resource on the Internet.

Usenet — forums in which people share information and ideas on a defined topic through large electronic bulletin boards where anyone can post messages on the topic for others to see and to which others can respond.

Virtual private network (VPN) — a secure connection between two points across the Internet used to transmit corporate data. Provides a low-cost alternative to a private network.

Voice over IP (VoIP) — facilities for managing the delivery of voice information using the Internet Protocol (IP).

Web — a system with universally accepted standards for storing, retrieving, formatting, and displaying information in a networked environment.

Web site — all of the World Wide Web pages maintained by an organization or an individual.

Webmaster — the person in charge of an organization's Web site.

Wide-area networks (WANs) — telecommunications network that spans a large geographical distance. Many consist of a variety of cable, satellite, and microwave technologies.

Wi-Fi — standards for Wireless Fidelity and refers to the Institute of Electrical and Electronics Engineers (IEEE) 802.11 family of wireless networking standards.

Wiki — are collaborative Web sites where visitors can add, delete, or modify content on the site, including the work of previous authors.

WiMax — popular term for Institute of Electrical and Electronics Engineers (IEEE) Standard 802.16 for wireless networking over a range of up to 31 miles with a data transfer rate of up to 75 megabits per second (Mbps). Stands for Worldwide Interoperability for Microwave Access.

Wireless Application Protocol (WAP) — system of protocols and technologies that enables cell phones and other wireless devices with tiny displays, low-bandwidth connections, and minimal memory to access Web-based information and services.

Wireless NICs — an add-in card (network interface card) that has a built-in radio and antenna to enable wireless transmission.

Wireless sensor networks (WSNs) — networks of interconnected wireless devices with built-in processing, storage, and radio-frequency sensors and antennas that are embedded into the physical environment to provide measurement of many points over large spaces.

REVIEW QUESTIONS

1. What are the principal components of telecommunications networks and key networking technologies?

Describe the features of a simple network and the network infrastructure for a large company.

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 relies on both public and private infrastructures to support the movement of information across diverse technological platforms. It includes the traditional telephone system, mobile cellular communication, wireless local-area networks, videoconferencing systems, a corporate Web site, intranets, extranets, and an array of local and wide-area networks, including the Internet. This collection of networks evolved from two fundamentally different types of networks: telephone networks and computer networks.

Name and describe the principal technologies and trends that have shaped contemporary telecommunications systems.

Client/Server computing, the use of packet switching, and the development of widely used communications standards such as TCP/IP are the three technologies that have shaped contemporary telecommunications systems.

Client/Server computing has extended to networking departments, workgroups, factory floors, and other parts of the business that could not be served by a centralized architecture. The Internet is based on client/server computing. Packet Switching technology allows nearly full use of almost all available lines and capacity. This was not possible with the traditional dedicated circuit-switching techniques that were used in the past. Having a set of protocols for connecting diverse hardware and software components has provided a universally agreed upon method for data transmission. TCP/IP is a suite of protocols that has become the dominant.

2. What are the main telecommunications transmission media and types of networks?

Name the different types of physical transmission media and compare them in terms of speed and cost.

Table 7-2 summarizes typical speeds and costs for telecommunications transmission media. Typical speeds and costs for several of the transmission media are provided below.

Medium	Speed	Cost
Twisted wire	up to 100 Mbps	Low
Microwave	up to 600+ Mbps	
Satellite	up to 600+ Mbps	
Coaxial cable	up to 1 Gbps	High
Fibre-optic cable	up to 6+ Tbps	

Define a LAN, and describe its components and the functions of each component?

A LAN is a telecommunications network that 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 require their own dedicated channels.

Components of a typical LAN consists of: computers (dedicated server and clients), a network operating system (NOS) residing on a dedicated server computer, cable (wiring) connecting the devices, network interface cards (NIC), switches or a hub, and a router.

- NIC each computer on the network contains a network interface device.

- 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).
- NOS routes and manages communications on the network and coordinates network resources.
- Dedicated server provides users with access to shared computing resources in the network. The server determines who gets access to data and in what sequence.
- Client computers are connected to one another.
- Switches or hub act as a connection point between the computers. Hubs are very simple devices that connect network components and send data packets to other connected devices. A switch has more intelligence than a hub and can filter and forward data to a specified destination.
- Router a special communications processor used to route data packets through different networks, ensuring messages are sent to the correct address.

Name and describe the principal network topologies.

The principal network topologies include:

- Star topology: all devices on the network connect to a single hub and all network traffic flows through the hub.
- Bus topology: one station transmits signals, which travel in both directions along a single transmission segment. All of the signals are broadcast in both directions to the entire network, with special software to identify which components receive each message.
- Ring topology: connects network components in a closed loop. Messages pass from computer to computer in only one direction around the loop and only one station at a time may transmit.

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.

The Internet is a vast network of computers that connects millions of people all over the world. The Internet 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. No one owns the Internet, and it has no formal management organization. However, worldwide Internet policies are established by organizations and government bodies, such as the Internet Architecture Board and the World Wide Web Consortium. The Internet must also conform to the laws of the sovereign nation-states in which it operates, as well as the technical infrastructure that exist within the nation-state.

The Internet enables employees to gain remote access to the company's internal systems through its Web site. They are able to better service customers and suppliers, improve operational efficiency, increase productivity, lower operational costs, have a broader market base, and reach more individual customers on a global scale by establishing a Web presence. The cost of e-mail and other Internet services tend to be far lower than equivalent voice, postal, or overnight delivery costs, making the Internet a very inexpensive communication medium. It is also a very fast method of communication, with messages arriving anywhere in the world in a matter of seconds or minutes.

Explain how the domain name and IP addressing system work.

A domain name is the English-like name that corresponds to the unique 32-bit numeric IP address for each computer connected to the Internet. The Domain Name System (DNS) converts IP addresses to domain names so that users only need to specify a domain name to access a computer on the Internet instead of typing the numeric IP address. DNS servers maintain a database containing IP addresses mapped to their corresponding domain names.

The Internet is based on the TCP/IP networking protocol suite. Every computer on the Internet is assigned a unique Internet Protocol (IP) address, which currently is a 32-bit number represented by four strings of numbers ranging from 0 to 255 separated by periods.

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

List and describe the principal Internet services.

Table 7.3 lists and describes the major Internet services.

- E-mail person-to-person messaging; document sharing.
- Newsgroups discussion groups on electronic bulletin boards.
- Chatting and instant messaging interactive conversations.
- 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) using hypertext links.

Define and describe VoIP and virtual private networks and explain how they provide value to businesses.

- Voice over Internet Protocol (VoIP) enables Internet technology to be used for telephone voice transmission over the Internet or private networks. VoIP offers the advantage of avoiding tolls charged by local and long-distance telephone networks. VoIP provides businesses an opportunity to reduce costs because they no longer have to maintain separate networks or provide support services and personnel for each different type of network. It gives organizations flexibility because phones can be added or moved to different offices without rewiring or reconfiguring networks.
- Virtual private networks are secure, encrypted, private networks that have been configured within a public network to take advantage of the economies of scale and management facilities of large networks, such as the Internet. VPNs are low-cost alternatives to private WANs. VPNs give businesses a more efficient network infrastructure for combining voice and data networks.

List and describe alternative ways of locating information on the Web.

- Search engines a facility on the Web that helps you find sites with the information and/or services you want. Examples: Google, Yahoo!, and MSN.
- Intelligent agent shopping bots use intelligent agent software for searching the Internet for shopping information. Examples: MySimon and Froogle
- Web 2.0 provides second-generation interactive Internet-based services that enable people to collaborate, share information, and create new services online. Web 2.0 software applications run on the Web itself instead of the desktop and bring the vision of Web-based computing closer to realization.
- Blogs are informal yet structured Web sites where subscribing individuals can publish stories, opinions, and links to other Web sites of interest.
- Rich Site Summary or Really Simple Syndication (RSS) is a simple way for people to have content they want pulled from Web sites and fed automatically to their computers, where it can be stored for later viewing. It's commonly used with blogs.
- Wikis are collaborative Web sites where visitors can add, delete, or modify content on the site, including the work of previous authors.
- Web 3.0 (Semantic Web) reduces the amount of human involvement in searching for and processing Web information. It's still in its infancy but promises to establish specific meanings for data on the Web, categories for classifying the data, and relationships between classification categories.

Compare Web 2.0 and Web 3.0.

Web 2.0 refers to second-generation interactive Internet-based services that enable people to collaborate, share information, and create new services online. Web 2.0 is distinguished by technologies and services like cloud computing, software mashups and widgets, blogs, RSS, and wikis. These software applications run on the Web itself instead of the desktop and bring the vision of Web-based computing closer to realization. Web 2.0 tools and services have fueled the creation of social networks

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

Web 3.0 focuses on developing techniques to make searching Web pages more productive and meaningful for ordinary people. Web 3.0 is the promise of a future Web where all digital information and all contacts can be woven together into a single meaningful experience. Sometimes referred to as the semantic Web, Web 3.0 intends to add a layer of meaning atop the existing Web to reduce the amount of human involvement in searching for and processing Web information. It also focuses on ways to make the Web more “intelligent,” with machine-facilitated understanding of information promoting a more intuitive and effective user experience. Web 3.0 will use cloud computing, software-as-a-service, ubiquitous connectivity among mobile platforms and Internet access devices, and transformation of the Web into a more seamless and interoperable whole.

Define and explain the difference between intranets and extranets. Explain how they provide value to businesses.

Web technology and Internet networking standards provide the connectivity and interfaces for internal private intranets and private extranets that can be accessed by many different kinds of computers inside and outside the organization.

- Intranet is an internal (private) organizational network that provides access to data across the enterprise and is protected from public users by firewalls. It uses the existing company network infrastructure along with Internet connectivity standards and software developed for the World Wide Web. Intranets create networked applications that can run on many different kinds of computers throughout the organization, including mobile handheld computers and wireless remote access devices.
- Extranet is an intranet that is restricted to an organization and authorized outside users like customers and suppliers. A company uses firewalls to ensure that access to its internal data is limited and remains secure.

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

4. What are the principal technologies and standards for wireless networking, communications, and Internet access?

Define Bluetooth, WiFi, WiMax, and 3G networks.

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). Bluetooth can link 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, keyboards, computers, printers, and PDAs using Bluetooth can communicate with each other and even operate each other without direct user intervention.

Wi-Fi is useful for creating wireless LANs and for providing wireless Internet access. Its access range is limited to anywhere between 300 feet and three miles. Hotspots are public access points individuals use to obtain high speed Internet access.

WiMax has a wireless access range of up to 31 miles and a data transfer rate of up to 75 Mbps, making it suitable for providing broadband Internet access in areas lacking DSL and cable lines. The 802.16 specification also has robust security and quality-of-service features to support voice and video.

3G is a short term for third-generation wireless technology, especially mobile communications. Cellular networks have evolved from slow-speed (1G) analog networks to high-speed, high-bandwidth, digital packet-switched, third-generation (3G) networks with speeds ranging from 144 Kbps to more than 2 Mbps for data transmission.

Describe the capabilities of each and for which types of applications each is best suited.

- a. **Bluetooth:** access very limited; useful for creating small personal-area networks.
- b. **Wi-Fi:** access is limited to 10 to 30 meters; useful for creating small local area networks
- c. **WiMax:** access is limited to a range up to 31 miles: useful for creating wide area networks
- d. **3G networks:** access is available on major cellular telephone carriers that have configured their networks for 3G services.

5. Why are RFID and wireless sensor networks (WSNs) valuable for business?

Define RFID, explain how it works and how it provides value to businesses.

Mobile wireless technology facilitates supply chain management by capturing data on the movement of goods as these events take place and by providing detailed, immediate information as goods move among supply chain partners. Radio frequency identification (RFID) systems provide a microchip that contains data about an item and its location. The tags transmit radio signals over a short distance to special RFID readers. The RFID readers then pass the data over a network to a computer for processing.

RFID gives businesses an opportunity to further automate their supply chain networks. The technology allows more data on an RFID chip than typical barcodes. RFID systems track each pallet, lot, or unit item in a shipment. The technology helps companies improve receiving and storage operations by improving their ability to “see” exactly what stock is stored in warehouses or on retail store shelves.

Define WSNs, explain how they work and describe the kinds of applications that use them.

Wireless sensor networks (WSNs) are networks of interconnected wireless devices with some processing and radio-transmitting capability that are embedded into the physical environment to provide measurements of many points over large spaces.

Wireless sensor networks are valuable for monitoring environmental changes, traffic patterns, security incidents, or supply chain events. Wireless sensor networks can be placed in the field for years without any maintenance or human intervention. That reduces costs to businesses using them.

DISCUSSION QUESTIONS

- 1. It has been said that within the next few years, smartphones will become the single most important digital device we own. Discuss the implications of this statement.**

Cell phones and smartphones are morphing into portable computing platforms that allow users to perform some computing tasks that previously could only be accomplished on a desktop computer. Smartphones enable digital capabilities like e-mail, messaging, wireless access to the Internet, voice communication, and digital cameras. They also allow users to view short video clips, play music and games, surf the Web and transmit and receive corporate data. New generations of mobile processors and faster mobile networks enable these devices to function as digital computing platforms allowing users to perform many of the tasks of today's PCs on smartphones. Storage and processing power continue to increase thereby rivaling those of the typical PC. That allows users to run key applications and access digital content through smartphone technologies.

Managers and employees will be able to break the tether to the desk and desktop computer because of smartphones. Users can more easily stay in touch with customers, suppliers, employees, and business partners and provide more flexible arrangements for organizing work.

On the downside, smartphones can potentially increase the amount of time workers spend “on the job” by making communication and computing possible anytime, anywhere. That may increase the amount of techno-stress employees and managers experience by not allowing them any free time or claim to their own personal space.

2. Should all major retailing and manufacturing companies switch to RFID? Why or why not?

RFID systems are complex and, in the past, expensive to implement. Now the cost of RFID tags is approaching 10 cents per passive tag. As the price decreases, RFID is starting to become cost-effective for some applications. Businesses that will most likely benefit from RFID technology are those that frequently track the movement of goods through supply chains. 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.

Major retailing and manufacturing companies will no doubt switch to RFID technology as costs continue to fall and applications increase. Whether or not all major retailing and manufacturing companies should switch to RFID is a matter of choice. They will no doubt go this way in the near future. By doing so, they will increase their operational efficiencies thereby increasing profits or gaining a competitive advantage by lowering overall costs to consumers. Ask your students to review the information in the following Web site: <http://www.epic.org/privacy/rfid/> and develop some ideas from there.

COLLABORATION AND TEAMWORK: EVALUATING SMARTPHONES

Form a group with three or four of your classmates. Compare the capabilities of Apple's iPhone with a smartphone handset from another vendor with similar features. Your analysis should consider the purchase cost of each device, the wireless networks where each device can operate, service plan and handset costs, and the services available for each device. You should also consider other capabilities of each device, including the ability to integrate with existing corporate or PC applications. Which device would you select? What criteria would you use to guide your selection? Use Google Sites to post the results on the team's Web site.

In their analysis, students should set up a table for each of the two devices that they selected and demonstrate how they made their comparison. What features did they consider the most valuable. They may use a weighted factor scale and assign weights to each capability to determine which product best fits their needs.

Ensure students explore not just the phones themselves, but also the support networks. That may be a bigger satisfaction factor than the phone.

Direct your students to conduct their search on the Internet for the Web sites listed below.

<http://www.verizon.com/>
<http://www.apple.com/>
<http://www.nokia.com/>
<http://www.samsung.com/>
<http://www.motorola.com/>

LEARNING TRACK MODULE

1. *Computing and Communications Services Provided by Commercial Telecommunications Vendors*
2. *Broadband Network Services and Technologies*
3. *Cellular System Generations*
4. *Wireless Applications for Customer Relationship Management (CRM), Supply Chain Management (SCM), and Healthcare*

Students will find Learning Track Modules on these topics at the MyMISLab for this chapter.

HANDS-ON MIS: PROJECTS

Management Decision Problems

1. Floor Tile Company: asked by major retailing customers to begin using RFID to improve management of products. Use the Web to identify the cost of hardware, software, and networking components for an RFID system for your company. What factors should be considered? What are the key decisions that have to be made in determining whether your firm should adopt this technology?

(The following information was copied from www.zebra.com, Nov 2008)

What is the estimated incremental cost for adopting RFID?

If one is discussing incremental costs over and above what was invested in your bar code infrastructure, then you can say that you will be making an investment in tags, printer/encoders, readers, middleware, and professional services to integrate these components into your bar code legacy environment. If you are not working with bar codes already, obviously you will need to make an investment in back-office, manufacturing, or WMS systems to use RFID data.

What is a ballpark figure for implementing RFID in a warehouse and distribution process?

According to Forrester Research, a typical supplier that attempts to comply with a mandate can expect to spend as much as \$9 million on RFID—depending on the size of its distribution network and Wal-Mart volume. According to this research, the largest expenditures are tag costs and additional warehouse labour. Again, it is stressed that this figure is derived from studying one company seeking compliance with the Wal-Mart mandate. However, this study provides a good perspective on the areas from which costs will derive.

How do smart label costs compare to conventional thermal/thermal-transfer printed labels?

A smart label runs in the vicinity of about 50 cents per label versus about one cent for a

conventional label. This is mainly due to the addition of the tag. This cost is also variable based on the total volume printed and the economies of scale associated with large quantities.

What companies are currently developing RFID software? Is it all customized or are there off-the-shelf solutions?

Numerous start-up and established software providers—including those who provide ERP software—have developed applications to deal with RFID reader and printer/encoder management, plus “tag data capture event” management. As with most business applications software, packages are typically customized to meet customers’ requirements rather than being ready to go “off the shelf.”

How will RFID integrate with EDI software?

EDI messages contain data about business transactions. While the format of an EDI message may change to accommodate “new data” (such as an EPC by comparison with a GTIN), fundamentally EDI message processors are unaware of the source of the data contained in messages. So there should be no reason that RFID cannot integrate with EDI software, provided the data structures are fundamentally the same. However, one area of difference is that many EDI systems typically deliver data in periodic batch mode; in contrast, the strength of RFID is its ability to deliver real-time data, so systems are up-to-the-minute.

Key decisions that a company needs to make when considering adopting RFID include:

- hardware and software costs
- implementation costs
- return on investments
- how technology fits into overall business strategy

2. BestMed Medical Supplies Corporation: sells products and equipment from over 700 different manufacturers to hospitals, health clinics, and medical offices. The company employs 500 people at seven different locations. Management is considering adopting a unified communications system. What factors should be considered? What are the key decisions that have to be made in determining whether to adopt this technology? Use the Web, if necessary, to find out more about unified communications and its costs.

Since the costs of purchasing and implementing a unified communication system will vary based on the chosen system, so too will student answers.

(The following information was copied from www.networkworld.com, Nov 2008)

From a broad perspective, Verizon Business suggests that organizations need to evaluate and measure how UC&C will benefit their organizations, determine whether the enterprise has adequate in-house technical resources, personnel and network capacity; and define how to integrate UC&C into business processes to align the deployment with critical business initiatives.

At a more detailed level, Verizon Business suggested that in preparation for UC&C, enterprises should:

- Invest in advanced IP networks since “UC&C starts with a capabilities-rich IP infrastructure. . . [and] flexible and expansive IP networks serve as the foundation of a successful UC&C deployment.”
- * Inventory technology and personnel resources to better understand the technological scope of UC&C deployments and “help identify potential network, equipment and application gaps.” Verizon Business also recommends a skills-assessment of technical staff “to identify possible new hires and individuals requiring additional training.”
- Align technology with business objectives to “make purchasing decisions with a focus on meeting specific business goals.” Any deployment should be designed to maximize the impact of UC&C on business processes. The enterprise should also establish benchmarks for success to better understand its ultimate objectives.
- Create a comprehensive roadmap that is “far reaching and covers areas such as technology and finances, as well as detailed deployment and implementation plans.”
- Tackle security at the onset, with a design that integrates “seamlessly with a business' current network and leverage existing technology investments.”
- Determine capabilities for ongoing management and decide “whether in-house staff has the skills and time required to effectively manage and troubleshoot performance issues.” As needed, enterprise should “select a managed services provider with the people, tools and processes to help provide consistent performance of UC&C applications.”
- Develop support systems and processes so that the corporate IT staff is prepared to address end-user performance issues and questions.
- Train and educate end users “to help users adopt and embrace these new tools so they can work more efficiently and productively.”
- Measure and modify, with built-in milestones planned that “go beyond reliability and availability measurements to assess the impact of UC&C from a financial, customer service, business process and end-user satisfaction perspective.”

IMPROVING DECISION MAKING: USING SPREADSHEET SOFTWARE TO EVALUATE WIRELESS SERVICES

Software skills: Spreadsheet formulas, formatting

Business skills: Analyzing telecommunications services and costs

You would like to equip your sales force of 35 based in Windsor, Ontario, with mobile phones that have capabilities for voice transmission, text messaging, and taking and sending photos. Use the Web to select a wireless service provider that provides nationwide service as well as good service in your home area. Examine the features of the mobile handsets offered by each of these vendors. Assume that each of the 35 salespeople will need to spend three hours per day during business hours (8 A.M. to 6 P.M.) on mobile voice communications, send 30 text messages per day, and five photos per week.

Use your spreadsheet software to determine the wireless service and handset that will offer both the best pricing per user over a two-year period. For the purposes of this exercise, you do not need to consider corporate discounts.

Answers will vary, since plan rates and costs of mobile phones are constantly changing. The answer can be found in the sample file named Ch_Evaluate_Wireless_Services.xls in the Chapter 7 folder.

ACHIEVING OPERATIONAL EXCELLENCE: USING WEB SEARCH ENGINES FOR BUSINESS RESEARCH

Software skills: Web search tools

Business skills: Researching new technologies

You have heard that fuel cells are new and might be an inexpensive way to provide electricity for your house, but you do not know anything about fuel cells. You decide that you want to research the topic to learn what fuel cells are and how they can be used for generating electricity for your house. Use the following four search engines to obtain that information: Yahoo!, Google, and MSN. 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 do the results differ if all search engines search the same Web?

As an example, the search string, “fuel cells” AND “electricity” was used for each of the search engines. The following results were obtained.

Yahoo!	2,250,000
Google	1,190,000
MSN	559,931

The Yahoo! site seemed very cluttered. Alta Vista and Google returned almost identical results for the first few pages. Their hits seemed like the most useful. Ask.com displayed a Related Searches box with the phrase, “Fuel Cells for Home”, but when that search was performed, disappointingly, the term “Home” represented home pages, not using fuel cells for the home.

CASE STUDY: GOOGLE VERSUS MICROSOFT: CLASH OF THE TECHNOLOGY TITANS

1. Define and compare the business strategies and business models of Google and Microsoft.

Google: Its business model has always focused on the Internet and the Web. It began as one of many search engines. It quickly ran away from the pack with its copyrighted

PageRank search algorithm which returns superior search results for Web users. It also has developed extensive online advertising services for businesses of all sizes. It's ability to attract the best and brightest minds in the industry helps make it one of the most successful Web-based businesses ever. Google provides value to the user by using an inexpensive, flexible infrastructure to speed up Web searches and provide its users with a vast array of Web-based services and software tools.

Microsoft: Its business model originally focused on the desktop computer running the Windows operating system and Office desktop productivity applications. The company and its products are staples for businesses and consumers looking to improve their productivity with computer-based tasks. While it is trying to expand its presence on the Internet, it still must try to keep customers bound to the desktop computer.

2. Has the Internet taken over the PC desktop as the center of the action? Why or why not?

The technology and computing world seems to be approaching the point where the Internet has taken over the PC desktop as the center of action thanks to Google and software-as-a-service companies. The Internet continues to develop and the availability of broadband Internet connections provide more bandwidth for users. Google's introduction of the concept of cloud computing allows more and more computing tasks to be performed via the Web, on computers sitting in data centers. Google is banking that Internet-based computing will supplant desktop computing as the way most people work with their computers. Using cloud computing, users are not tied to a particular machine to access information or do work. Google remains responsible for data center maintenance thereby relieving companies, small and large, from the chore. Google is also relying on the increasing ubiquity of the Internet and availability of broadband and Wi-Fi connections to offset security concerns and the potential lack of Internet connections to applications.

On the other hand, Microsoft has a well-established and popular set of applications that many consumers and businesses feel comfortable using. The installed base of Microsoft products provides it shelter, at least temporarily, from the onslaught of Internet-based products and services. Users are familiar and comfortable with Microsoft products and companies aren't about to throw all of their software out the window. The migration to the Internet away from PC desktops will be a gradual process.

3. Why did Microsoft attempt to acquire Yahoo!? How did it affect its business model? Do you believe this was a good move?

Microsoft realized it needed to bolster its Internet presence. Purchasing Yahoo! would give the company more Internet search market share – 20 percent more on top of its own 10 percent. The merger would increase the possibility of dethroning Google. With or without Yahoo!, Microsoft needs to improve its Internet presence a great

deal. It's online services division's performance has worsened while Google's has improve.

Microsoft wants to “innovate and disrupt in search, win in display ads, and reinvent portal and social media experiences.” Its pursuit of Yahoo! suggests skepticism even on Microsoft's own part that the company can do all of this on its own. It is far easier to simply buy a company that already does all these things rather than try to develop the services and products in-house.

Even though Microsoft's initial attempts to purchase Yahoo! were unsuccessful, it probably did the right thing. Even if it eventually succeeds and purchases the company, it will be very difficult to integrate Yahoo!'s culture and organization into Microsoft's. That will deal a setback to both companies.

4. What is the significance of Google Apps to Google's future success?

The Google Apps suite include a series of Web-based applications that include Gmail, instant messaging, calendar, word processing, presentation, and spreadsheet applications. It also includes tools for creating collaborative Web sites. The applications are smaller, more simpler versions of Microsoft's Office applications and exclude many advanced features that Google insists most users don't need. Basic versions are free while 'Premier' editions sell for about \$50 per year per person. Microsoft Office costs about \$500 per year per person. That appeals to small businesses who prefer cheaper, simpler versions of the application. Google has partnered with Salesforce.com to integrate their CRM applications with Google Apps. That created a new sales channel market Google Apps to businesses that have already adopted Salesforce CRM software and its business model of software-as-a-service.

Both Google and Microsoft have opened their software platforms to developers in an attempt to increase the number of applications available for each company.

5. Would you use Google Apps instead of Microsoft Office applications for computing tasks? Why or why not?

Answers will vary but some components that students should include in their answers are:

- **Price:** Google Apps are free for the slimmed down version or \$50 per year per use. Microsoft Office is a flat rate of \$500 per year per user.
- **Access:** Google Apps are available from any computer. Microsoft Office limits its availability to a particular desktop.
- **Security:** Google Apps may have security risks based on Internet vulnerabilities. Microsoft Office has little or no security risks as long as data remains on a secured desktop.
- **Compliance with federal laws:** Because Google Apps are maintained on central servers owned and maintained by Google, companies may find themselves out of compliance with laws like Sarbanes-Oxley which requires

that companies maintain and report their data to the government upon request. No such situation exists with Microsoft Office applications.

- Existing platforms: Many companies have built their computing platforms around Microsoft operating systems and Office applications. They are reluctant to give that up and move to a new platform like Google Apps.

6. Which company and business model do you believe will prevail in this epic struggle? Justify your answer.

Students should consider these principles in their answers:

- Developing scale internally is far more difficult than simply buying it outright. In attempting to grow into new areas, Microsoft faces considerable challenges. The industry changes too quickly for one company to be dominant for very long. Microsoft has had difficulty sustaining its growth rates since the Internet's inception. Even well-managed companies encounter difficulties when faced with disruptive new technologies and Microsoft may be no exception.
- The size, complexity, and bureaucracy of organizations affect the ability of any company to continue to innovate, grow, and expand its reach. (see Chapter 3) As both Google and Microsoft continue to grow, their ability to "turn on a dime" in the face of other competitors may be in serious jeopardy.
- Google currently has the major share of the Web-based advertising market, however Microsoft and other market entrants will be a major threat to them. The Microsoft corporation have very "deep pockets" and will stop at nothing to overturn and destroy Google's competitive advantage. Legal and regulatory compliance will be a major issue as this market grows and more concerns are expressed from the external environments.
- History, however, is not on Google's side. Every major company that's been a force in technology in one era has lost its lead in the next era. For example, IBM was king in the 1940s and 1950s. DEC was king in the mini-computer era during the 1970s. Microsoft was king in the 1980s and 1990s during the reign of desktop computers. Google reigns in the 2000s with its Web-based services. Will it remain on top as technology continues to evolve?