CHAPTER 3

E-commerce Infrastructure: The Internet, Web, and Mobile Platform

LEARNING OBJECTIVES

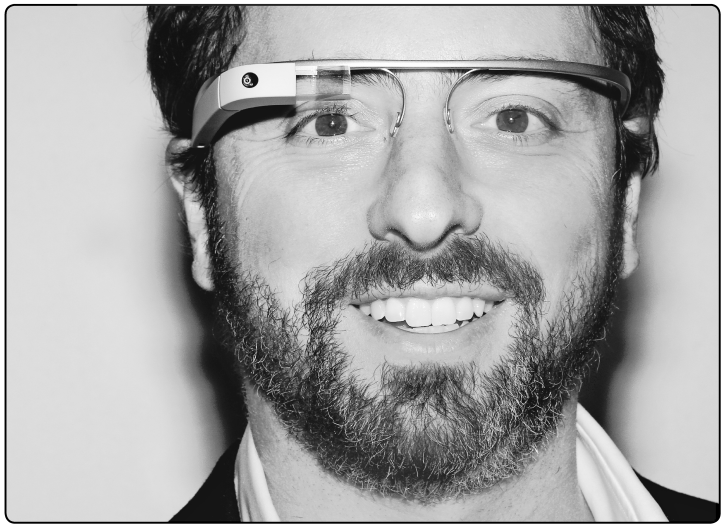
After reading this chapter, you will be able to:

- Discuss the origins of the Internet.
- Identify the key technology concepts behind the Internet.
- Describe the role of Internet protocols and utility programs.
- Discuss the impact of the mobile platform and cloud computing.
- Explain the current structure of the Internet.
- Describe the potential capabilities of the Internet of the future.
- Understand how the Web works.
- Describe how Internet and Web features and services support e-commerce.
- Understand the impact of m-commerce applications.

Google Glass:

Augment My Reality

Today, the primary means of accessing the Internet is through smartphones. Traditional desktop and laptop PCs will remain important e-commerce and Internet tools, but the action has shifted to the mobile platform. Rather than being just another channel to the Internet, mobile devices are becoming THE channel. This means the primary platform for e-commerce products and services will also change to the mobile platform. The number of mobile Internet users is expected to grow to more than 75% of all Internet users in the United States, about 200 million people, by 2016.



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The mobile platform provides the foundation for a number of unique new services. One of the most exciting examples is augmented reality. Augmented reality refers to content (text, video, and sound) that is superimposed over live images in order to enrich the user's experience. The technology brings together location and context, helping the user understand his or her environment better. A recent study by Semico Research predicted that by the end of 2016, revenue produced by the augmented reality industry will total more than $600 billion. There is a wealth of possibilities for augmented reality, and Google is leading the way.

In 2012, Google began releasing information about its prototype augmented reality glasses, and co-founder Sergey Brin was seen wearing a trial version in public. The small, wrap-around glasses have a clear display mounted above the eye, and they stream information directly to the lenses. The wearer can use voice commands to access features of the glasses, which also have a camera that can snap pictures or record video. Most importantly, the glasses have an augmented reality display, which will allow users to overlay graphics and other images on top of their vision that adjust based on the line of sight of the wearer.

Promotional videos released by Google suggest the device will perform a wide array of functions for the user, including calling up maps, accessing reviews on the fly, displaying schedule reminders at appropriate times, and integrating fully with other Google services, like Google+. Google's involvement in augmented reality is a major step in the maturation of the technology, and Apple has filed for patents that suggest it is planning its own augmented reality foray, which may be the final push needed to put augmented reality squarely into the mainstream. Still, skeptics worry that the technology is more flash than

substance, and that it might not deliver on the optimistic earnings projections cited today. Other critics worry that the technology will be too distracting. Google engineers counter that augmented reality displays will help users to connect more seamlessly with the real world, rather than obscuring it.

It's not hard to figure out where the e-commerce might reside in these tools. How would you like your business to show up on the Google glasses of users visiting or searching for points of interest in your neighborhood? Yellow Pages is testing the use of augmented reality to overlay advertisements, paid for by businesses, to street views where its app is used. Another variation is a real estate app tested by RightMove that allows users to point their phone up and down a street and find out what is for sale or for rent, and how much it costs. It also provides contact information for each of the properties.

How much would you pay to have an online travel guide with you all the time for that next trip abroad? Yelp, TripAdvisor, and Lonely Planet are just a few of the travel companies that have introduced some aspects of augmented reality to their apps. Wikitude is an online augmented reality mobile platform that uses the same kind of wiki tools that power Wikipedia, the online encyclopedia. The application is available for the iPhone, Android, and Symbian mobile operating systems. The Wikitude browser displays information about whatever the user's phone camera is pointed at. Using the smartphone's GPS, accelerometer, and compass, the browser knows where it is located, and what direction it is pointing. The browser then accesses the Wikitude database to provide text information on the object being looked at by the user, including identifying the object or scene, history, and related points of interest.

Many companies are using augmented reality as part of their mobile applications to allow users to see how a prospective purchase would look before buying. For example, Blinds.com's Window Shopper app allows consumers to take a photo of a window in their house using their mobile phone, and then overlay different styles of blinds on the photo to see how the end result would look before they finalize their purchase. Because the top reason that people provide for not buying blinds online is not being able to see what they would look like, augmented reality is helping Blinds.com drive more online sales than ever before.

Yet another current use of augmented reality is to allow users to simulate "trying on" the product. For instance, eBay's Fashion iPhone app lets users virtually try on sunglasses using the phone's front-facing camera to take a picture of themselves and then virtually "fit" the sunglasses to their face. Watchmaker Neuvo offers a similar app that lets users virtually try on watches, while a Converse app lets you do the same with Converse shoes. Software from Zugara allows you to try on clothing from online shops.

Gaming is another area where augmented reality is expected to make a big splash. Qualcomm, a leading digital wireless telecommunication development firm, has released an augmented reality game software development kit for both Android and iOS devices. Many believe that augmented reality will ultimately become essential to consumers' mobile experiences, just as mobile devices themselves have become essential. The challenge is to get past the tendency to view augmented reality as a science fiction come to life and instead look at it as a tool that businesses and consumers can use to connect and communicate.

SOURCES: "How Augmented Reality Will Change the Way We Live," by Mez Breeze, thenextweb.com, August 25, 2012; "Augmented Reality is a New Reality for a Forward Thinking Retailer," by Allison Enright, Internetretailer.com, August 24, 2012; "Augmented Reality is Finally Getting Real," by Rachel Metz, *Technology Review*, August 2, 2012; "Is the Floor Beneath Your Feet Real?" by Bill Siwicki, Internetretailer.com, July 31, 2012; "You Will Want Google Goggles," by Farhad Manjoo, *Technology Review*, July 2012; "Google Begins Testing Its Augmented-Reality Glasses," by Nick Bilton, *New York Times*, April 4, 2012; "Apple Patent Hints at Augmented Reality Camera App," by Josh Lowensohn, News.cnet.com; August 18, 2011; "Augmented Reality Kills the QR Code Star," by Kit Eaton, Fastcompany.com, August 4, 2011; "Qualcomm's Awesome Augmented Reality SDK Now Available for iOS," Techcrunch.com, July 27, 2011; "Real Life or Just Fantasy," by Nick Clayton, *Wall Street Journal*, June 29, 2011; "Augmented Reality Comes Closer to Reality," by John Markoff, *New York Times*, April 7, 2011; "Augmented Reality's Industry Prospects May Get Very Real, Very Fast," by Danny King, Dailyfinance.com, March 11, 2011; "Even Better Than the Real Thing," by Paul Skelton, *Wall Street Journal,* February 15, 2011; "Wikitude Goes Wimbledon 2010," press release, Wikitude.com, June 20, 2010.

This chapter examines the Internet, Web, and mobile platform of today and tomorrow, how it evolved, how it works, and how its present and future infrastructure enables new business opportunities.

The opening case illustrates how important it is for business people to understand how the Internet and related technologies work, and to be aware of what's new. Operating a successful e-commerce business and implementing key e-commerce business strategies such as personalization, customization, market segmentation, and price discrimination requires that business people understand Internet technology and keep track of Web and mobile platform developments.

The Internet and its underlying technology is not a static phenomenon in history, but instead continues to change over time. Computers have merged with cell phone services; broadband access in the home and broadband wireless access to the Internet via smartphones, tablet computers, and laptops is expanding rapidly; self-publishing on the Web via blogging, social networking, and podcasting now engages millions of Internet users; and software technologies such as Web services, cloud computing, and smartphone apps are revolutionizing the way businesses are using the Internet. Looking forward a few years, the business strategies of the future will require a firm understanding of these technologies to deliver products and services to consumers.

3.1 THE INTERNET: TECHNOLOGY BACKGROUND

What is the Internet? Where did it come from, and how did it support the growth of the Web? What are the Internet's most important operating principles? How much do you really need to know about the technology of the Internet?

Let's take the last question first. The answer is: it depends on your career interests. If you are on a marketing career path, or general managerial business path, then you need to know the basics about Internet technology, which you'll learn in this and the following chapter. If you are on a technical career path and hope to become a Web designer, or pursue a technical career in Web infrastructure for businesses, you'll need to start with these basics and then build from there. You'll also need to know about the business side of e-commerce, which you will learn about throughout this book.

As noted in Chapter 1, the **Internet** is an interconnected network of thousands of networks and millions of computers (sometimes called *host computers* or just *hosts*) linking businesses, educational institutions, government agencies, and individuals. The Internet provides approximately 2.3 billion people around the world (including about 239 million people in the United States) with services such as e-mail, apps, newsgroups, shopping, research, instant messaging, music, videos, and news (Internetworldstats.com, 2012). No single organization controls the Internet or how it functions, nor is it owned by anybody, yet it has provided the infrastructure for a transformation in commerce, scientific research, and culture. The word Internet is derived from the word *internetwork*, or the connecting together of two or more

Internet
an interconnected network of thousands of networks and millions of computers linking businesses, educational institutions, government agencies, and individuals

the Web
one of the Internet's most popular services, providing access to more than 100 billion Web pages

computer networks. The **Web** is one of the Internet's most popular services, providing access to billions, perhaps trillions, of Web pages, which are documents created in a programming language called HTML that can contain text, graphics, audio, video, and other objects, as well as "hyperlinks" that permit users to jump easily from one page to another. Web pages are navigated using browser software.

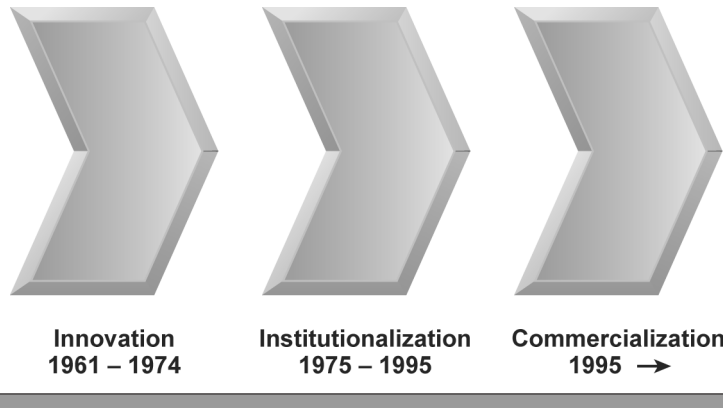
THE EVOLUTION OF THE INTERNET: 1961—THE PRESENT

Today's Internet has evolved over the last 60 or so years. In this sense, the Internet is not "new;" it did not happen yesterday. Although journalists talk glibly about "Internet" time—suggesting a fast-paced, nearly instant, worldwide global change mechanism—in fact, it has taken about 60 years of hard work to arrive at today's Internet.

The history of the Internet can be segmented into three phases (see **Figure 3.1**). In the first phase, the *Innovation Phase,* from 1961 to 1974, the fundamental building blocks of the Internet were conceptualized and then realized in actual hardware and software. The basic building blocks are: packet-switching hardware, a communications protocol called TCP/IP, and client/server computing (all described more fully later in this section). The original purpose of the Internet, when it was conceived in the 1960s, was to link large mainframe computers on different college campuses. This kind of one-to-one communication between campuses was previously only possible through the telephone system or private networks owned by the large computer manufacturers.

In the second phase, the *Institutionalization Phase*, from 1975 to 1995, large institutions such as the Department of Defense (DoD) and the National Science Foundation (NSF) provided funding and legitimization for the fledging invention called the Internet. Once the concepts behind the Internet had been proven in several

FIGURE 3.1 STAGES IN THE DEVELOPMENT OF THE INTERNET



The Internet has developed in three stages over a 50-year period from 1961 to the present. In the Innovation stage, basic ideas and technologies were developed; in the Institutionalization stage, these ideas were brought to life; in the Commercialization stage, once the ideas and technologies had been proven, private companies brought the Internet to millions of people worldwide.

government-supported demonstration projects, the DoD contributed $1 million to further develop them into a robust military communications system that could withstand nuclear war. This effort created what was then called ARPANET (Advanced Research Projects Agency Network). In 1986, the NSF assumed responsibility for the development of a civilian Internet (then called NSFNET) and began a 10-year-long $200 million expansion program.

In the third phase, the *Commercialization Phase*, from 1995 to the present, government agencies encouraged private corporations to take over and expand both the Internet backbone and local service to ordinary citizens—families and individuals across America and the world who were not students on campuses. By 2000, the Internet's use had expanded well beyond military installations and research universities.

THE INTERNET: KEY TECHNOLOGY CONCEPTS

In 1995, the Federal Networking Council (FNC) passed a resolution formally defining the term *Internet* as a network that uses the IP addressing scheme, supports the Transmission Control Protocol (TCP), and makes services available to users much like a telephone system makes voice and data services available to the public.

Behind this formal definition are three extremely important concepts that are the basis for understanding the Internet: packet switching, the TCP/IP communications protocol, and client/server computing. Although the Internet has evolved and changed dramatically in the last 30 years, these three concepts are at the core of the way the Internet functions today and are the foundation for Internet II.

Packet Switching

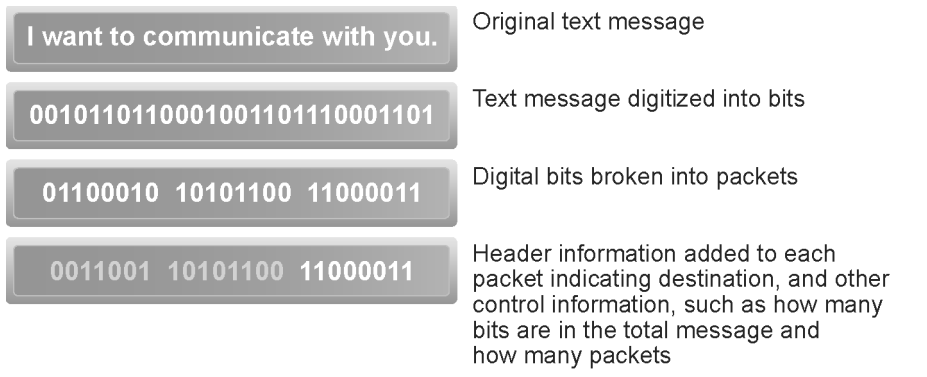
Packet switching is a method of slicing digital messages into discrete units called **packets**, sending the packets along different communication paths as they become available, and then reassembling the packets once they arrive at their destination (see **Figure 3.2**). Prior to the development of packet switching, early computer networks used leased, dedicated telephone circuits to communicate with terminals and other computers. In circuit-switched networks such as the telephone system, a complete point-to-point circuit is put together, and then communication can proceed. However, these "dedicated" circuit-switching techniques were expensive and wasted available communications capacity—the circuit would be maintained regardless of whether any data was being sent. For nearly 70% of the time, a dedicated voice circuit is not being fully used because of pauses between words and delays in assembling the circuit segments, both of which increase the length of time required to find and connect circuits. A better technology was needed.

packet switching
a method of slicing digital messages into packets, sending the packets along different communication paths as they become available, and then reassembling the packets once they arrive at their destination

packet
the discrete units into which digital messages are sliced for transmission over the Internet

The first book on packet switching was written by Leonard Kleinrock in 1964 (Kleinrock, 1964), and the technique was further developed by others in the defense research labs of both the United States and England. With packet switching, the communications capacity of a network can be increased by a factor of 100 or more. (The communications capacity of a digital network is measured in terms of bits per

FIGURE 3.2 PACKET SWITCHING



In packet switching, digital messages are divided into fixed-length packets of bits (generally about 1,500 bytes). Header information indicates both the origin and the ultimate destination address of the packet, the size of the message, and the number of packets the receiving node should expect. Because the receipt of each packet is acknowledged by the receiving computer, for a considerable amount of time, the network is not passing information, only acknowledgments, producing a delay called latency.

second.[1]) Imagine if the gas mileage of your car went from 15 miles per gallon to 1,500 miles per gallon—all without changing too much of the car!

In packet-switched networks, messages are first broken down into packets. Appended to each packet are digital codes that indicate a source address (the origination point) and a destination address, as well as sequencing information and error-control information for the packet. Rather than being sent directly to the destination address, in a packet network, the packets travel from computer to computer until they reach their destination. These computers are called routers. A **router** is a special-purpose computer that interconnects the different computer networks that make up the Internet and routes packets along to their ultimate destination as they travel. To ensure that packets take the best available path toward their destination, routers use a computer program called a **routing algorithm**.

router
special-purpose computer that interconnects the computer networks that make up the Internet and routes packets to their ultimate destination as they travel the Internet

routing algorithm
computer program that ensures that packets take the best available path toward their destination

Packet switching does not require a dedicated circuit, but can make use of any spare capacity that is available on any of several hundred circuits. Packet switching makes nearly full use of almost all available communication lines and capacity. Moreover, if some lines are disabled or too busy, the packets can be sent on any available line that eventually leads to the destination point.

Transmission Control Protocol/Internet Protocol (TCP/IP)

While packet switching was an enormous advance in communications capacity, there was no universally agreed-upon method for breaking up digital messages into packets,

[1] A bit is a binary digit, 0 or 1. A string of eight bits constitutes a byte. A home telephone dial-up modem connects to the Internet usually at 56 Kbps (56,000 bits per second). Mbps refers to millions of bits per second, whereas Gbps refers to billions of bits per second.

routing them to the proper address, and then reassembling them into a coherent message. This was like having a system for producing stamps but no postal system (a series of post offices and a set of addresses). The answer was to develop a **protocol** (a set of rules and standards for data transfer) to govern the formatting, ordering, compressing, and error-checking of messages, as well as specify the speed of transmission and means by which devices on the network will indicate they have stopped sending and/or receiving messages.

protocol
a set of rules and standards for data transfer

Transmission Control Protocol/Internet Protocol (TCP/IP), which has become the core communications protocol for the Internet (Cerf and Kahn, 1974). **TCP** establishes the connections among sending and receiving Web computers, and makes sure that packets sent by one computer are received in the same sequence by the other, without any packets missing. **IP** provides the Internet's addressing scheme and is responsible for the actual delivery of the packets.

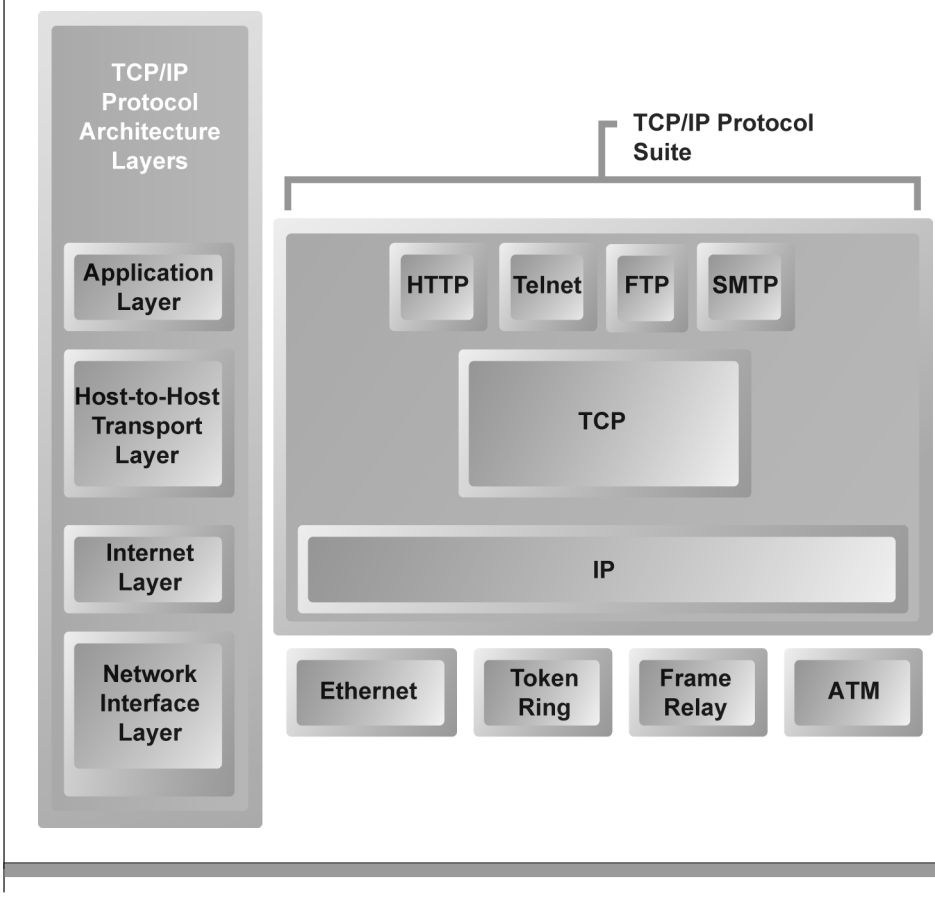
Transmission Control Protocol/Internet Protocol (TCP/IP)
the core communications protocol for the Internet

TCP
protocol that establishes the connections among sending and receiving Web computers and handles the assembly of packets at the point of transmission, and their reassembly at the receiving end

IP
protocol that provides the Internet's addressing scheme and is responsible for the actual delivery of the packets

TCP/IP is divided into four separate layers, with each layer handling a different aspect of the communication problem (see **Figure 3.3**).

FIGURE 3.3 THE TCP/IP ARCHITECTURE AND PROTOCOL SUITE



TCP/IP is an industry-standard suite of protocols for large internetworks. The purpose of TCP/IP is to provide high-speed communication network links.

Network Interface Layer
responsible for placing packets on and receiving them from the network medium

Internet Layer
responsible for addressing, packaging, and routing messages on the Internet

Transport Layer
responsible for providing communication with the application by acknowledging and sequencing the packets to and from the application

Application Layer
provides a wide variety of applications with the ability to access the services of the lower layers

IPv4 Internet address
Internet address expressed as a 32-bit number that appears as a series of four separate numbers marked off by periods, such as 64.49.254.91

IPv6 Internet address
Internet address expressed as an 128-bit number

domain name
IP address expressed in natural language

Domain Name System (DNS)
system for expressing numeric IP addresses in natural language

Uniform Resource Locator (URL)
the address used by a Web browser to identify the location of content on the Web

The **Network Interface Layer** is responsible for placing packets on and receiving them from the network medium, which could be a LAN (Ethernet) or Token Ring network, or other network technology. TCP/IP is independent from any local network technology and can adapt to changes at the local level. The **Internet Layer** is responsible for addressing, packaging, and routing messages on the Internet. The **Transport Layer** is responsible for providing communication with the application by acknowledging and sequencing the packets to and from the application. The **Application Layer** provides a wide variety of applications with the ability to access the services of the lower layers. Some of the best-known applications are HyperText Transfer Protocol (HTTP), File Transfer Protocol (FTP), and Simple Mail Transfer Protocol (SMTP), all of which we will discuss later in this chapter.

IP Addresses

The IP addressing scheme answers the question "How can billions of computers attached to the Internet communicate with one another?" The answer is that every computer connected to the Internet must be assigned an address—otherwise it cannot send or receive TCP packets. For instance, when you sign onto the Internet using a dial-up, DSL, or cable modem, your computer is assigned a temporary address by your Internet Service Provider. Most corporate and university computers attached to a local area network have a permanent IP address.

There are two versions of IP currently in use: IPv4 and IPv6. An **IPv4 Internet address** is a 32-bit number that appears as a series of four separate numbers marked off by periods, such as 64.49.254.91. Each of the four numbers can range from 0–255. This "dotted quad" addressing scheme supports up to about 4 billion addresses (2 to the 32nd power). In a typical Class C network, the first three sets of numbers identify the network (in the preceding example, 64.49.254 is the local area network identification) and the last number (91) identifies a specific computer.

Because many large corporate and government domains have been given millions of IP addresses each (to accommodate their current and future work forces), and with all the new networks and new Internet-enabled devices requiring unique IP addresses being attached to the Internet, by 2011, there were only an estimated 76 million IPv4 addresses left, declining at the rate of 1 million per week. IPv6 was created to address this problem. An **IPv6 Internet address** is 128 bits, so it can support up to 2^{128} (3.4×10^{38}) addresses, many more than IPv4.

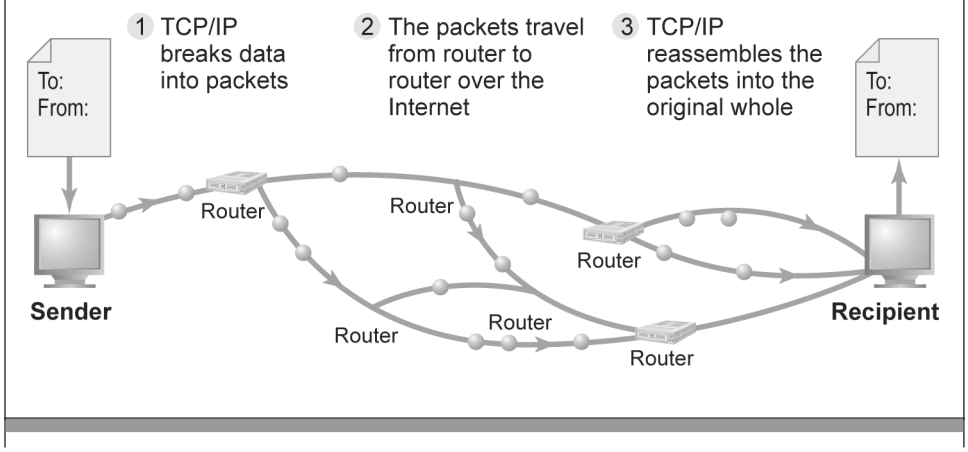
Figure 3.4 illustrates how TCP/IP and packet switching work together to send data over the Internet.

Domain Names, DNS, and URLs

Most people cannot remember 32-bit numbers. An IP address can be represented by a natural language convention called a **domain name**. The **Domain Name System (DNS)** allows expressions such as Cnet.com to stand for a numeric IP address (cnet.com's numeric IP is 216.239.113.101).[2] A **Uniform Resource Locator (URL)**, which

[2] You can check the IP address of any domain name on the Internet. In Windows 7 or Vista, use Start/cmd to open the DOS prompt. Type ping <Domain Name>. You will receive the IP address in return.

FIGURE 3.4 ROUTING INTERNET MESSAGES: TCP/IP AND PACKET SWITCHING



The Internet uses packet-switched networks and the TCP/IP communications protocol to send, route, and assemble messages. Messages are broken into packets, and packets from the same message can travel along different routes.

is the address used by a Web browser to identify the location of content on the Web, also uses a domain name as part of the URL. A typical URL contains the protocol to be used when accessing the address, followed by its location. For instance, the URL http://www.azimuth-interactive.com/flash_test refers to the IP address 208.148.84.1 with the domain name "azimuth-interactive.com" and the protocol being used to access the address, HTTP. A resource called "flash_test" is located on the server directory path /flash_test. A URL can have from two to four parts; for example, name1.name2.name3.org. We discuss domain names and URLs further in Section 3.4. **Figure 3.5** illustrates the Domain Name System and **Table 3.1** summarizes the important components of the Internet addressing scheme.

Client/Server Computing

client/server computing
a model of computing in which powerful personal computers are connected in a network together with one or more servers

client
a powerful personal computer that is part of a network

server
networked computer dedicated to common functions that the client computers on the network need

While packet switching exploded the available communications capacity and TCP/IP provided the communications rules and regulations, it took a revolution in computing to bring about today's Internet and the Web. That revolution is called client/server computing and without it, the Web—in all its richness—would not exist. **Client/server computing** is a model of computing in which powerful personal computers and other Internet devices called **clients** are connected in a network to one or more server computers. These clients are sufficiently powerful to accomplish complex tasks such as displaying rich graphics, storing large files, and processing graphics and sound files, all on a local desktop or handheld device. **Servers** are networked computers dedicated to common functions that the client computers on the network need, such as file storage, software applications, utility programs that provide Web connections, and printers (see **Figure 3.6** on page 79). The Internet is a giant example of client/server computing in which millions of Web servers located around the world can be easily accessed by millions of client computers, also located throughout the world.