AMAL JYOTHI
COLLEGE OF ENGINEERING

MASTER OF COMPUTER APPLICATIONS

Course : E-Commerce

Code : RLIMCA303

Course No.	Course Name	L-T-P Credits	Year of Introduction
RLIMCA303	**E-Commerce**	**3-1-0-4**	**2016**

Course Objectives

- Define E-commerce and describe how it differs from e-business.
- Describe major business models of E-Commerce
- Describe how Internet and Web features support E-Commerce
- Understand the key dimensions of E-Security
- Understand the features of E- Payment systems
- Understand the concepts and technologies of E- marketing systems

Syllabus

Introduction to e-Commerce, Business Models and Concepts, Technology Infrastructure for E-Commerce, E-Security , E-Payment and E-Marketing

Expected Outcome

At the end of the course,

- The students are expected to realise the problems involved in designing and building e-commerce systems.
- Understand the need to design E-Commerce systems that fully meet the requirements of the intended users.

References

1. Kenneth C. Laundon, Carol Guercio Traver, “E-Commerce”, Pearson India, 2016
2. P T Joseph, S.J., “E-Commerce An Indian Perspective”, PHI, Fifth edition ,2015
3. Whiteley,”e-Commerce Strategies, Technologies and Applications”, McGraw Hill, 2014
4. Tharam Dillon, Henry Chan, “E-Commerce Fundamentals and Applications”, John Wiley & Sons Ltd, 2014

Course Plan			
Module	**Contents**	**Hours Allotted**	**% of marks in End-Semester Examination**
I	Introduction to e-Commerce- e-Commerce v/s e-Business, Types of E-Commerce, E-commerce Infrastructure ***Text : 1***	6	15
II	Business Models and Concepts - B2C, B2B, C2C, C2B -Brokerage Model, Aggregator Model, Info-mediary Model, Community Model, Value Chain Model, Manufacturer Model, Advertising Model, Subscription Model, Affiliate Model *Text: 2*	10	20
FIRST INTERNAL EXAM			
III	E-Security:E-Commerce Security Environment, Security Threats, Technology Solutions, SSL, Protecting Networks- Firewalls, Proxy-Servers *Text :1*	8	15
IV	E-Payment: Types of Payment Systems, Credit card E-Commerce Transactions- How an Online Card Transaction works - Credit Card E-Commerce Enablers - Limitations of Online Credit Card Payment Systems, Secure Electronic Transaction Protocol *Text :1*	8	15
V	E-Commerce digital payment systems in B2C-Digital Wallets- Digital Cash -Online stored Value Systems -Digital Credit Card Payment systems - Digital Checking Payment systems - B2B Payment systems *Text :1*	10	20
SECOND INTERNAL EXAM			
VI	E-Marketing: Basic Marketing Concepts, Internet Marketing Technologies, B2C and B2B-Commerce, Marketing and Branding Strategies, Online Market Research *Text :1*	8	15
END SEMESTER EXAM			
QUESTION PAPER PATTERN			

	There will be two parts in the Question paper -**Part A and Part B.** **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M).The maximum number of sub part questions in **Part B** tobe limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module, not to exceed the marks assigned to that module specified in the course plan in the syllabus.		

CHAPTER 1

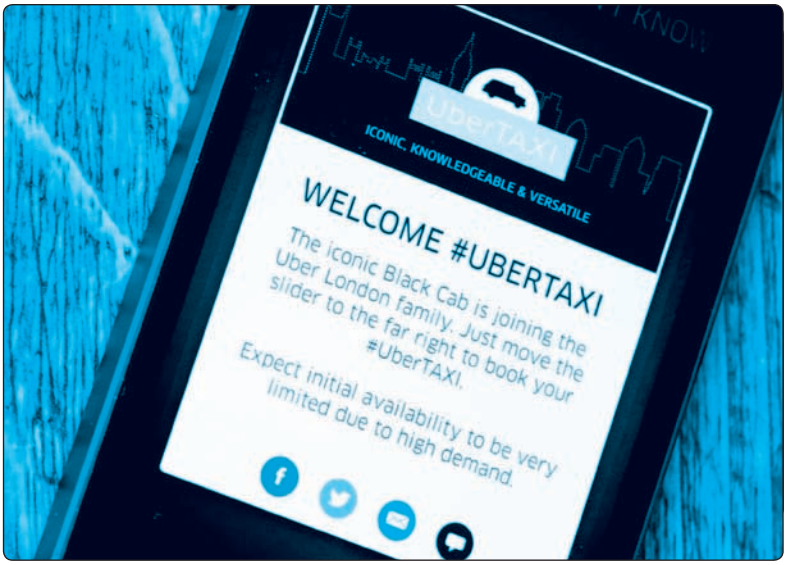
Introduction to E-commerce

LEARNING OBJECTIVES

After reading this chapter, you will be able to:

- Define e-commerce and describe how it differs from e-business.
- Identify and describe the unique features of e-commerce technology and discuss their business significance.
- Describe the major types of e-commerce.
- Understand the evolution of e-commerce from its early years to today.
- Describe the major themes underlying the study of e-commerce.
- Identify the major academic disciplines contributing to e-commerce.

The Uber-ization of Everything



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If you were trying to pick iconic examples of e-commerce in the two decades since it began in 1995, it is likely that companies such as Amazon, eBay, Google, Apple, and Facebook would be high on the list. Today, there's a new company that may become the face of e-commerce as it enters its third decade: Uber. Uber and other firms with similar business models, such as Lyft (a ride service similar to Uber's), Airbnb (rooms for rent), Heal (doctor home visits), Handy and Homejoy (part-time household helpers), Instacart (grocery shopping), Washio (laundry service), and BloomThat (flower delivery), are the pioneers of a new on-demand service e-commerce business model that is sweeping up billions of investment dollars in 2015 and disrupting major industries from transportation to hotels, real estate, house cleaning, maintenance, and grocery shopping. On-demand service firms have collected over $26 billion in venture capital funding over the last five years, making this the hottest business model in e-commerce for 2015.

Uber provides two major services: UberTaxi (also called UberX), which provides taxi service, and UberBlack, which provides a higher-priced town car service for business executives. UberPool is a ride-sharing service that allows users to share a ride with another person who happens to be going to same place. Google is working with Uber on developing this new service. In several cities, Uber is developing UberEats, a food delivery service; UberRush, a same-day delivery service; and UberCargo, a trucking service.

Uber was founded in 2009 by Travis Kalanick and Garrett Camp, and has grown explosively since then to over 300 cities and 60 countries. Drivers are signing up at an exponential rate, doubling every year; as of the beginning of 2015, there were over 160,000. According to an Uber-sponsored survey, over 44% of Uber drivers have college degrees (compared to 15% of taxi drivers), 71% say they have boosted their income and financial security by driving for Uber, and 73% say they prefer a job where they choose their hours rather than a 9-to-5 job. In 2015, Uber's revenue is estimated to be $10 billion, with profits (after paying its drivers) of $2 billion. This is five times as much as it made in 2014, when net revenue was about $400 million, which itself is about four times as much as its net revenue in 2013. Uber appears to be growing at

300% a year! As a result, in 2015, Uber is the most richly valued start-up in history and is currently valued at more than $50 billion.

Uber has a compelling value proposition for both customers and drivers. Customers can sign up for free, request and pay for a ride (at a cost Uber claims is 40% less than a traditional taxi) using a smartphone and credit card, and get picked up within a few minutes. No need to stand on a street corner frantically waving, competing with others, or waiting and waiting for an available cab to drive by without knowing when that might happen. Instead, customers can use the Uber app to secure a ride, and they know just how long it will take for the ride to arrive and how much it will cost. With UberPool, the cost of a ride drops by 50%, making it cost-competitive with owning a car in an urban area, according to Uber. For drivers, Uber's value proposition is: set your own hours, work when you like, and put your own car to use generating revenue.

Uber is the current poster child for "digital disruption." It is easy see to why Uber has ignited a firestorm of opposition from existing taxi services around the world. Who can compete in a market where a new upstart firm offers a 50% price reduction? If you've paid €240,000 for a license to drive a taxi in Paris, what is it worth now that Uber has arrived? Even governments find Uber to be a disruptive threat. Cities and states do not want to give up regulatory control over passenger safety, driver training, or the healthy revenue stream generated by charging taxi firms for a taxi license and sales taxes.

Uber's business model differs from traditional retail e-commerce. Uber doesn't sell goods. Instead, it has created a smartphone-based platform that enables people who want a service—like a taxi—to find a provider with the resources, such as a personal automobile that spends much of its time parked and a driver with available time, to fill the demand. It's important to understand that although Uber and similar firms were initially called "sharing economy" companies, this is a misnomer. Uber drivers are selling their services as drivers and the temporary use of their car. Uber the company is not in the sharing business either: it charges a hefty fee for every transaction on its platform. Uber is not an example of "peer-to-peer" e-commerce because Uber transactions involve an online intermediary: a third party that takes a cut of all transactions and arranges for the marketplace to exist in the first place.

Uber has disrupted the traditional taxi business model because it offers a superior, fast, convenient taxi-hailing service when compared to traditional taxi companies that rely on the telephone, a central dispatcher using antiquated radio communications to direct cabs, or, as in many urban areas, customers standing on street corners frantically waving their hands. With traditional taxi services, there is no guarantee you will find a cab or that a cab will arrive when you really need one. Customers have no way of knowing how long a traditional taxi will take to arrive. Uber reduces that uncertainty: using a smartphone, the customer enters a request for pickup, and nearly instantly (under the best of circumstances) a provider will be found by Uber and the estimated time of arrival established along with the price. Riders can accept the price or find an alternative.

Uber's business model is much more efficient than a traditional taxi firm. Uber does not own taxis and has no maintenance or financing costs. It does not have employees but instead calls its drivers "independent contractors." Uber is not encumbered with the costs

for workers compensation, minimum wage requirements, background checks on drivers, driver training, health insurance, or commercial licensing.

Quality control would seem to be a nightmare with over 160,000 contract drivers. But Uber relies on user reviews of drivers and the ride experience to identify problematic drivers, and driver reviews of customers to identify problematic passengers. It also sets standards for cleanliness. The reviews can be used to discipline drivers: drivers are evaluated by riders on a 5-point scale, and if drivers fall below 4.5, they are warned and may be dropped if they don't improve. Anything less than a 5 is a sign to the company that something was not right about the ride experience. Customers are also rated with a 5-point system. Drivers can refuse to pick up troublesome customers, and the Uber server can delay service to problematic people with low ratings or ban them entirely. Uber does not publicly report on how many poorly rated drivers or passengers there are in its system. Academic articles have found that in similar on-demand companies, such as Airbnb, there's a built-in bias for both sellers and buyers to give good reviews regardless of the actual experience. If you routinely give low reviews to sellers (drivers), they will think you are too demanding and not service you in the future. If a driver gives low reviews to passengers, they might not rate you highly in return.

Rather than having a dispatcher in every city, Uber has an Internet-based app service running on cloud servers located throughout the world. It does not provide radios to its drivers, who instead must use their own smartphones and cell service, which the drivers pay for. It does not provide insurance or maintenance for its drivers' cars. Uber has shifted the costs of running a taxi service entirely to the drivers. Uber charges prices that vary dynamically with demand: the higher the demand, the greater the price of a ride. Therefore, it is impossible using public information to know if Uber's prices are lower than traditional taxis. Clearly, in high-demand situations they are higher, sometimes ten times higher, than a regulated taxi. There is no regulatory taxi commission setting uniform per mile fares. Consumers do face some traditional uncertainties regarding availability: during a rain storm, a convention, or a sports event, when demand peaks, not enough drivers may be available at any price.

What could be wrong with Uber's apparent over-the-top success? It is digitally disrupting a staid, highly regulated, and decidedly non-digital industry that employs over 200,000 people, most of whom are full-time employees, and who have a median pay of $22,820 per year, or about $11 an hour. In the not-so-distant future, Uber's part-time drivers will likely outnumber full-time taxi drivers worldwide.

If Uber is the poster child for the new on-demand service economy, it's also the iconic example of the social costs and conflicts associated with this new kind of e-commerce. Uber has been accused by attorney generals in many countries of misclassifying its drivers as contractors as opposed to employees, thereby denying the drivers the benefits of employee status, such as minimum wages, social security, workers compensation, and health insurance.

Uber has also been accused of violating public transportation laws and regulations throughout the world; abusing the personal information it has collected on users of the service; seeking to use personal information to intimidate journalists; failing to protect

public safety by refusing to do adequate criminal, medical, and financial background checks on its drivers; taking clandestine actions against its chief competitor Lyft in order to disrupt its business; and being tone-deaf to the complaints of its own drivers against the firm's efforts to reduce driver fees in 2015. Uber has met with heavy resistance in Europe's largest cities in 2015. In London, regulators hope to impose a mandatory five-minute wait before passengers can begin a ride as a protection for traditional taxicab drivers. In Paris, Uber executives appeared in court to stand trial for running an illegal taxi service, and the company was forced to shut down service in Paris due to "violent attacks" during protests against Uber following similar shutdowns of Uber service in Germany and Italy. In Amsterdam, law enforcement has searched Uber offices for evidence of transport law infractions. The EU's most powerful court, the European Court of Justice, is likely to rule on whether Uber is a transportation service that violates the existing laws in many countries or an "information society service" that requires more flexible rules and regulations.

Critics also fear that on-demand firms will create a society of part-time, low-paid temp work, displacing traditionally full-time, secure jobs—the so-called Uber-ization of work. As one critic put it, Uber is not the Uber for rides so much as it is the Uber for low-paid jobs. Uber responds to this fear by claiming that it is lowering the cost of transportation, making better use of spare human and financial resources, expanding the demand for ride services, and expanding opportunities for car drivers, whose pay is about the same as other taxi drivers. In reality, the point is moot: on-demand service companies will continue to grow explosively until the supply of part-time workers is exhausted. This means, inevitably, the continued growth of a part-time work economy, and growing political pressure to bring benefits to these workers.

Does Uber have a sustainable business model? Is the company really worth over $50 billion based on $2 billion in net revenue a year? If the company continues to triple its net revenue every year, the answer is yes. But Uber does have a few competitors already, such as Lyft in the United States, GrabTaxi in Southeast Asia, Cabify in Spain and Latin America, and a host of local firms around the world. Lyft is currently about one-tenth the size of Uber but growing rapidly, thanks to the support of Alibaba and several prominent venture capitalists. Uber faces a bevy of new, smaller competing firms, including Sidecar, Via, Tripda, and Shuddle, all of whom offer app-based hailing services. Many of these firms prioritize following the law and local regulations, which dramatically reduces expenses compared to Uber's growth-at-any-cost approach and its attendant legal fees. China has its own cab hailing services, Kuaidi Dache and Didi Dache, although Uber reports that 30% of its rides take place in China. Uber may find that its strong brand may be its most important asset going forward.

SOURCES: "Uber CEO Travis Kalanick: 30% of Our Trips Take Place in China," by Douglas MacMillan, *Wall Street Journal,* October 20, 2015; "Uber vs GrabCar: Who's Speeding Ahead in Southeast Asia?," by Nadine Freischlad, Techinasia.com, October 17, 2015; "Spanish Uber Rival Cabify Seeks to Expand in Latin America after Rakuten-led Funding Round," by Robert Schoon, Latinpost.com, October 12, 2015; "Uber Faces New Threat in London," by Amir Mizroch, Bdlive.co.za, October 1, 2015; "Uber Under Fire in Europe... Again," by Alanna Petroff, Cnnmoney.com, September 30, 2015; "Twisting Words to Make 'Sharing' Apps Seem Selfless," by Natasha Singer, *New York Times,* August 9, 2015; "Uber Valued at More Than $50 Billion," by Douglas Macmillan and Telis Demos, *Wall Street Journal,* July 31, 2015; "Uber to Fight EU Rules in Europe's Top Court," by Sam Schechner, *Wall Street Journal,* July 20, 2015; "Uber Dealt Setback on Labor Rules," by Lauren Weber, *Wall Street Journal*, June 18, 2015; "The $50 Billion Question: Can Uber Deliver?," by Douglas Macmillan, *Wall Street Journal,* June 15, 2015; "George Zimmer Starts an 'Uber for Tailors,'" by David Gelles, *New York Times*, May 31, 2015; "Coming Next: The On-Demand Sales Force," by Christopher Mims, *Wall Street Journal,* May 31, 2015; "How Everyone Misjudges the Sharing Economy," by Christopher Mims, *Wall Street Journal,* May 25, 2015; "Icahn Puts Big Wager on Uber Rival Lyft," by Douglas Macmillan, *Wall Street Journal,* May 16, 2015; "An Uber for Doctor Housecalls," by Jennifer Jolly, *New York Times*, May 5, 2015; "Uber Expands Funding Round as Revenue Growth Accelerates," by Douglas Macmillan, *Wall Street Journal,* February 18, 2015; "The On-Demand Economy Is Reshaping Companies and Careers," *The Economist,* January 4, 2015; "The On-Demand Economy: Workers on Tap," *The Economist,* January 3, 2015.

In 1994, e-commerce as we now know it did not exist. In 2015, just 21 years later, around 1.4 billion consumers worldwide are expected to spend about €1.96 trillion, and businesses around €14.2 trillion, purchasing goods, services, and digital content online or via a mobile device. And in this short period of time, e-commerce has been reinvented not just once, but twice.

The early years of e-commerce, during the late 1990s, were a period of business vision, inspiration, and experimentation. It soon became apparent, however, that establishing a successful business model based on those visions would not be easy. There followed a period of retrenchment and reevaluation, which led to the stock market crash of 2000–2001, with the value of e-commerce, telecommunications, and other technology stocks plummeting. After the bubble burst, many people were quick to write off e-commerce. But they were wrong. The surviving firms refined and honed their business models, and the technology became more powerful and less expensive, ultimately leading to business firms that actually produced profits. Between 2002–2008, retail e-commerce grew at more than 25% per year.

Today, we are in the middle of yet another transition. Social networks such as Facebook, Twitter, YouTube, Pinterest, and Tumblr, which enable users to distribute their own content (such as videos, music, photos, personal information, commentary, blogs, and more), have rocketed to prominence. Never before in the history of media have such large audiences been aggregated and made so accessible. Businesses are grappling with how best to approach this audience from a marketing, advertising, and sales perspective. At the same time, the traditional desktop platform and Web browser that most consumers have used to access the Internet in the past is being augmented by mobile devices such as smartphones and tablet computers, and mobile apps. Facilitated by technologies such as cloud computing, mobile devices have become advertising, shopping, reading, and media viewing machines, and in the process, consumer behavior is being transformed yet again. Mobile, social, and local have become driving forces in e-commerce. The mobile platform infrastructure is also giving birth to yet another e-commerce innovation: on-demand services that are local and personal. From hailing a taxi, to shopping, to washing your clothes, these new businesses are creating a marketspace where owners of resources such as cars, spare bedrooms, and spare time can find a market of eager consumers looking to buy a service in a few minutes using their smartphones. The opening case on Uber is a leading example of these new on-demand service firms that are disrupting traditional business models.

1.1 E-COMMERCE: THE REVOLUTION IS JUST BEGINNING

Table 1.1 describes the major trends in e-commerce in 2015–2016. The mobile platform based on smartphones and tablet computers has finally arrived with a bang, making true mobile e-commerce a reality. Social networks are enabling social e-commerce by providing search, advertising, and payment services to vendors and customers. More

TABLE 1.1 MAJOR TRENDS IN E-COMMERCE 2015–2016

BUSINESS

- Retail e-commerce continuesto grow worldwide, with a global growth rate of almost 25%, and even higher in emerging markets such as China, India, and Brazil.
- Mobile retail e-commerce explodes and in the United Kingdom now accounts for over 30% of total U.K retail e-commerce, totaling an estimated £19 billion in 2015.
- The mobile app ecosystem continues to grow, with around 2 billion people using mobile apps worldwide.
- Social e-commerce, based on social networks and supported by advertising, emerges and grows by 25% from 2013 to 2014, generating over $3.3 billion in revenue for the top 500 social media retailers in the United States.
- Local e-commerce, the third dimension of the mobile, social, local e-commerce wave, also is growing, fueled by an explosion of interest in on-demand services such as Uber.
- On-demand service firms like Uber and Airbnb attract billions in capital, garner multi-billion dollar valuations, and show explosive growth.
- Mobile and social advertising platforms show strong growth and begin to challenge search engine marketing.
- Small businesses and entrepreneurs continue to flood into the e-commerce marketplace, often riding on the infrastructures created by industry giants such as Apple, Facebook, Amazon, Google, and eBay.
- B2B e-commerce worldwide continues to strengthen and grow to €14.2 trillion.

TECHNOLOGY

- A mobile computing and communications platform based on smartphones, tablet computers, and mobile apps becomes a reality, rivaling the PC platform and creating an alternative platform for online transactions, marketing, advertising, and media viewing. Mobile messaging services like WhatsApp and Snapchat are used by 40% of smartphone users.
- Cloud computing completes the transformation of the mobile platform by storing consumer content and software on Internet servers and making it available to any consumer-connected device from the desktop to a smartphone.
- Computing and networking component prices continue to fall dramatically.
- As firms track the trillions of online interactions that occur each day, a flood of data, typically referred to as Big Data, is being produced.
- In order to make sense out of Big Data, firms turn to sophisticated software called business analytics (or Web analytics) that can identify purchase patterns as well as consumer interests and intentions in milliseconds.

SOCIETY

- User-generated content, published online as social network posts, tweets, blogs, and pins, as well as video and photo-sharing, continues to grow and provides a method of self-publishing that engages millions.
- Social networks encourage self-revelation, while threatening privacy.
- Participation by adults in social networks increases; Facebook becomes ever more popular in all demographic categories.
- Conflicts over copyright management and control continue, but there is substantial agreement among online distributors and copyright owners that they need one another.
- Taxation of online sales poses challenges for governments.
- Surveillance of online communications by both repressive regimes and Western democracies grows.
- Concerns over commercial and governmental privacy invasion increase.
- Online security continues to decline as major sites are hacked and lose control over customer information.
- Spam remains a significant problem.
- On-demand service e-commerce produces a flood of temporary, poorly paid jobs without benefits.

and more people and businesses are using the Internet and mobile devices to conduct commerce; smaller, local firms are taking advantage of the Internet and mobile platform as e-commerce technologies become less and less expensive. New e-commerce brands have emerged while traditional retail brands such as Tesco and Carrefour are further extending their omnichannel strategies and retaining their dominant retail positions by strengthening their e-commerce operations. At the societal level, other trends are apparent. The Internet and mobile platform provide an environment that allows millions of people to create and share content, establish new social bonds, and strengthen existing ones through social network, photo- and video-posting, and blogging sites and apps, while at the same time creating significant privacy issues. The major digital copyright owners have increased their pursuit of online file-sharing services with mixed success, while reaching broad agreements with the big technology players like Apple, Amazon, and Google to protect intellectual property rights. Taxation of online sales continues to pose challenges for governments. Sovereign nations have expanded their surveillance of, and control over, online communications and content as a part of their anti-terrorist activities and their traditional interest in snooping on citizens. Privacy seems to have lost some of its meaning in an age when millions create public online personal profiles.

THE FIRST 30 SECONDS

It is important to realize that the rapid growth and change that has occurred in the first 21 years of e-commerce represents just the beginning—what could be called the first 30 seconds of the e-commerce revolution. Technology continues to evolve at exponential rates. This underlying ferment presents entrepreneurs with new opportunities to both create new businesses and new business models in traditional industries, and also to destroy old businesses. Business change becomes disruptive, rapid, and even destructive, while offering entrepreneurs new opportunities and resources for investment. For instance, on-demand service firms such as Uber and Airbnb threaten the traditional taxi and low-cost hotel industries.

Improvements in underlying information technologies and continuing entrepreneurial innovation in business and marketing promise as much change in the next decade as was seen in the previous decade. The twenty-first century will be the age of a digitally enabled social and commercial life, the outlines of which we can barely perceive at this time. Analysts estimate that by 2019, U.S. consumers will be spending over $775 billion and businesses over $8.5 trillion in digital transactions. It appears likely that e-commerce will eventually impact nearly all commerce, and that most commerce will be e-commerce by the year 2050.

Can e-commerce continue to grow indefinitely? It's possible that at some point, e-commerce growth may slow simply as a result of overload: people may just not have the time to watch yet another online video, open another e-mail, or read another blog, tweet, or Facebook update. However, currently, there is no foreseeable limit to the continued rapid development of e-commerce technology, or limits on the inventiveness of entrepreneurs to develop new uses for the technology. Therefore, for now at least, it is likely that the disruptive process will continue.

Business fortunes are made—and lost—in periods of extraordinary change such as this. The next five years hold out exciting opportunities—as well as risks—for new and traditional businesses to exploit digital technology for market advantage. For society as a whole, the next few decades offer the possibility of extraordinary gains in social wealth as the digital revolution works its way through larger and larger segments of the world's economy, offering the possibility of high rates of productivity and income growth in an inflation-free environment.

As a business or technology student, this book will help you perceive and understand the opportunities and risks that lie ahead. By the time you finish, you will be able to identify the technological, business, and social forces that have shaped, and continue to shape, the growth of e-commerce, and ready to participate in, and ultimately guide, discussions of e-commerce in the firms where you work.

WHAT IS E-COMMERCE?

e-commerce
the use of the Internet, the Web, and mobile apps and browsers running on mobile devices to transact business. More formally, digitally enabled commercial transactions between and among organizations and individuals

Our focus in this book is **e-commerce**—the use of the Internet, the World Wide Web (Web), and mobile apps and browsers running on mobile devices to transact business. Although the terms Internet and Web are often used interchangeably, they are actually two very different things. The *Internet* is a worldwide network of computer networks, and the *Web* is one of the Internet's most popular services, providing access to billions of Web pages. An *app* (short-hand for application) is a software application. The term is typically used when referring to mobile applications, although it is also sometimes used to refer to desktop computer applications as well. A *mobile browser* is a version of Web browser software accessed via a mobile device. (We describe the Internet, Web, and mobile platform more fully later in this chapter and in Chapters 2 and 3.) More formally, we focus on digitally enabled commercial transactions between and among organizations and individuals. Each of these components of our working definition of e-commerce is important. *Digitally enabled transactions* include all transactions mediated by digital technology. For the most part, this means transactions that occur over the Internet, the Web, and/or via mobile devices. *Commercial transactions* involve the exchange of value (e.g., money) across organizational or individual boundaries in return for products and services. Exchange of value is important for understanding the limits of e-commerce. Without an exchange of value, no commerce occurs.

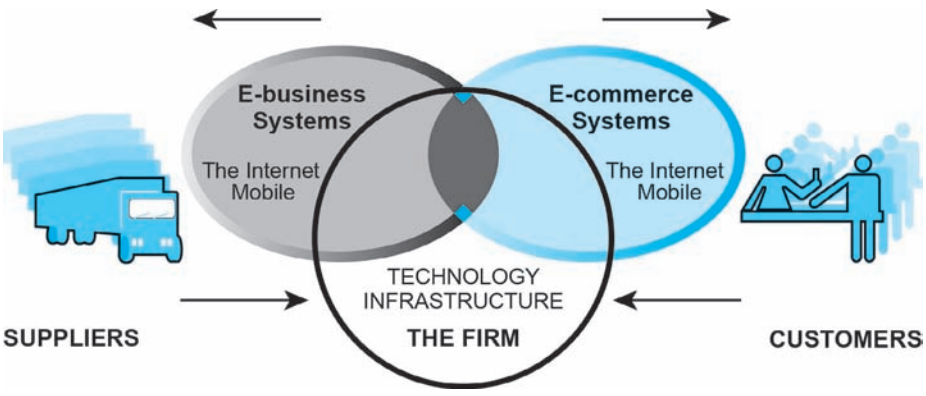
The professional literature sometimes refers to e-commerce as digital commerce. For our purposes, we consider e-commerce and digital commerce to be synonymous.

THE DIFFERENCE BETWEEN E-COMMERCE AND E-BUSINESS

There is a debate about the meaning and limitations of both e-commerce and e-business. Some argue that e-commerce encompasses the entire world of electronically based organizational activities that support a firm's market exchanges—including a firm's entire information system's infrastructure (Rayport and Jaworski, 2003). Others argue, on the other hand, that e-business encompasses the entire world of internal and external electronically based activities, including e-commerce (Kalakota and Robinson, 2003).

We think it is important to make a working distinction between e-commerce and e-business because we believe they refer to different phenomena. E-commerce is not

FIGURE 1.1 THE DIFFERENCE BETWEEN E-COMMERCE AND E-BUSINESS



E-commerce primarily involves transactions that cross firm boundaries. E-business primarily involves the application of digital technologies to business processes within the firm.

"anything digital" that a firm does. For purposes of this text, we will use the term **e-business** to refer primarily to the digital enabling of transactions and processes *within* a firm, involving information systems under the control of the firm. For the most part, in our view, e-business does not include commercial transactions involving an exchange of value across organizational boundaries. For example, a company's online inventory control mechanisms are a component of e-business, but such internal processes do not directly generate revenue for the firm from outside businesses or consumers, as e-commerce, by definition, does. It is true, however, that a firm's e-business infrastructure provides support for online e-commerce exchanges; the same infrastructure and skill sets are involved in both e-business and e-commerce. E-commerce and e-business systems blur together at the business firm boundary, at the point where internal business systems link up with suppliers or customers (see **Figure 1.1**). E-business applications turn into e-commerce precisely when an exchange of value occurs (see Mesenbourg, U.S. Department of Commerce, 2001, for a similar view). We will examine this intersection further in Chapter 12.

e-business
the digital enabling of transactions and processes within a firm, involving information systems under the control of the firm

WHY STUDY E-COMMERCE?

Why are there college courses and textbooks on e-commerce when there are no courses or textbooks on "TV Commerce," "Radio Commerce," "Railroad Commerce," or "Highway Commerce," even though these technologies had profound impacts on commerce in the twentieth century and account for far more commerce than e-commerce?

The reason for the interest specifically in e-commerce is that e-commerce technology (discussed in detail in Chapters 2 and 3) is different and more powerful than any of the other technologies we have seen in the past century. E-commerce technologies—and the digital markets that result—have brought about some fundamental, unprecedented shifts in commerce. While these other technologies transformed

economic life in the twentieth century, the evolving Internet and other information technologies are shaping the twenty-first century.

Prior to the development of e-commerce, the marketing and sale of goods was a mass-marketing and sales force–driven process. Marketers viewed consumers as passive targets of advertising campaigns and branding "blitzes" intended to influence their long-term product perceptions and immediate purchasing behavior. Companies sold their products via well-insulated channels. Consumers were trapped by geographical and social boundaries, unable to search widely for the best price and quality. Information about prices, costs, and fees could be hidden from the consumer, creating profitable information asymmetries for the selling firm. **Information asymmetry** refers to any disparity in relevant market information among parties in a transaction. It was so expensive to change national or regional prices in traditional retailing (what are called *menu costs*) that one national price was the norm, and dynamic pricing to the marketplace let alone to individuals in the marketplace—changing prices in real time—was unheard of. In this environment, manufacturers prospered by relying on huge production runs of products that could not be customized or personalized. One of the shifts that e-commerce is bringing about is a reduction in information asymmetry among market participants (consumers and merchants). Preventing consumers from learning about costs, price discrimination strategies, and profits from sales becomes more difficult with e-commerce, and the entire marketplace potentially becomes highly price competitive. At the same time, online merchants gain considerable market power over consumers by using consumer personal information in ways inconceivable 10 years ago to maximize their revenues.

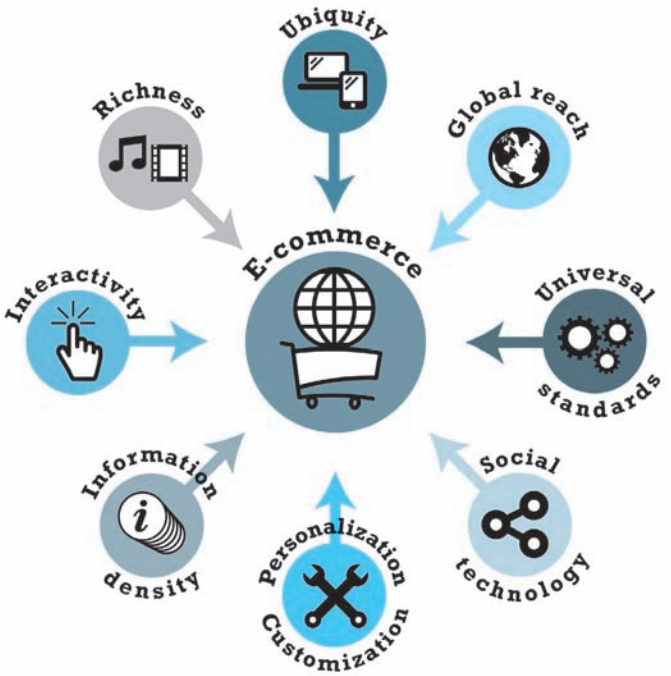
information asymmetry
any disparity in relevant market information among parties in a transaction

EIGHT UNIQUE FEATURES OF E-COMMERCE TECHNOLOGY

Figure 1.2 illustrates eight unique features of e-commerce technology that both challenge traditional business thinking and explain why we have so much interest in e-commerce. These unique dimensions of e-commerce technologies suggest many new possibilities for marketing and selling—a powerful set of interactive, personalized, and rich messages are available for delivery to segmented, targeted audiences. E-commerce technologies make it possible for merchants to know much more about consumers and to be able to use this information more effectively than was ever true in the past. Online merchants can use this new information to develop new information asymmetries, enhance their ability to brand products, charge premium prices for high-quality service, and segment the market into an endless number of subgroups, each receiving a different price. To complicate matters further, these same technologies make it possible for merchants to know more about other merchants than was ever true in the past. This presents the possibility that merchants might collude on prices rather than compete and drive overall average prices up. This strategy works especially well when there are just a few suppliers (Varian, 2000a). We examine these different visions of e-commerce further in Section 1.2 and throughout the book.

Each of the dimensions of e-commerce technology illustrated in Figure 1.2 deserves a brief exploration, as well as a comparison to both traditional commerce and other forms of technology-enabled commerce.

FIGURE 1.2 EIGHT UNIQUE FEATURES OF E-COMMERCE TECHNOLOGY



E-commerce technologies provide a number of unique features that have impacted the conduct of business.

Ubiquity

In traditional commerce, a **marketplace** is a physical place you visit in order to transact. For example, television and radio typically motivate the consumer to go someplace to make a purchase. E-commerce, in contrast, is characterized by its **ubiquity**: it is available just about everywhere, at all times. It liberates the market from being restricted to a physical space and makes it possible to shop from your desktop, at home, at work, or even from your car, using mobile e-commerce. The result is called a **marketspace**—a marketplace extended beyond traditional boundaries and removed from a temporal and geographic location. From a consumer point of view, ubiquity reduces *transaction costs*—the costs of participating in a market. To transact, it is no longer necessary that you spend time and money traveling to a market. At a broader level, the ubiquity of e-commerce lowers the cognitive energy required to transact in a marketspace. *Cognitive energy* refers to the mental effort required to complete a task. Humans generally seek to reduce cognitive energy outlays. When given a choice, humans will choose the path requiring the least effort—the most convenient path (Shapiro and Varian, 1999; Tversky and Kahneman, 1981).

marketplace
physical space you visit in order to transact

ubiquity
available just about everywhere, at all times

marketspace
marketplace extended beyond traditional boundaries and removed from a temporal and geographic location

Global Reach

E-commerce technology permits commercial transactions to cross cultural, regional, and national boundaries far more conveniently and cost-effectively than is true in traditional commerce. As a result, the potential market size for e-commerce merchants is roughly equal to the size of the world's online population (an estimated 3.1 billion in 2015) (eMarketer, Inc., 2015a). More realistically, the Internet makes it much easier for start-up e-commerce merchants within a single country to achieve a national audience than was ever possible in the past. The total number of users or customers an e-commerce business can obtain is a measure of its **reach** (Evans and Wurster, 1997).

reach
the total number of users or customers an e-commerce business can obtain

In contrast, most traditional commerce is local or regional—it involves local merchants or national merchants with local outlets. Television and radio stations, and newspapers, for instance, are primarily local and regional institutions with limited but powerful national networks that can attract a national audience. In contrast to e-commerce technology, these older commerce technologies do not easily cross national boundaries to a global audience.

Universal Standards

One strikingly unusual feature of e-commerce technologies is that the technical standards of the Internet, and therefore the technical standards for conducting e-commerce, are **universal standards**—they are shared by all nations around the world. In contrast, most traditional commerce technologies differ from one nation to the next. For instance, television and radio standards differ around the world, as does cell phone technology. The universal technical standards of e-commerce greatly lower *market entry costs*—the cost merchants must pay just to bring their goods to market. At the same time, for consumers, universal standards reduce *search costs*—the effort required to find suitable products. And by creating a single, one-world marketspace, where prices and product descriptions can be inexpensively displayed for all to see, *price discovery* becomes simpler, faster, and more accurate (Banerjee et al., 2005; Bakos, 1997; Kambil, 1997). Users, both businesses and individuals, also experience *network externalities*—benefits that arise because everyone uses the same technology. With e-commerce technologies, it is possible for the first time in history to easily find many of the suppliers, prices, and delivery terms of a specific product anywhere in the world, and to view them in a coherent, comparative environment. Although this is not necessarily realistic today for all or even most products, it is a potential that will be exploited in the future.

universal standards
standards that are shared by all nations around the world

Richness

Information **richness** refers to the complexity and content of a message (Evans and Wurster, 1999). Traditional markets, national sales forces, and small retail stores have great richness: they are able to provide personal, face-to-face service using aural and visual cues when making a sale. The richness of traditional markets makes them a powerful selling or commercial environment. Prior to the development of the Web,

richness
the complexity and content of a message

there was a trade-off between richness and reach: the larger the audience reached, the less rich the message. E-commerce technologies have the potential for offering considerably more information richness than traditional media such as printing presses, radio, and television because they are interactive and can adjust the message to individual users. Chatting with an online sales person, for instance, comes very close to the customer experience in a small retail shop. The richness enabled by e-commerce technologies allows retail and service merchants to market and sell "complex" goods and services that heretofore required a face-to-face presentation by a sales force to a much larger audience.

Interactivity

Unlike any of the commercial technologies of the twentieth century, with the possible exception of the telephone, e-commerce technologies allow for **interactivity**, meaning they enable two-way communication between merchant and consumer and among consumers. Traditional television, for instance, cannot ask viewers questions or enter into conversations with them, or request that customer information be entered into a form. In contrast, all of these activities are possible on an e-commerce site and are now commonplace with smartphones, social networks, and Twitter. Interactivity allows an online merchant to engage a consumer in ways similar to a face-to-face experience.

interactivity
technology that allows for two-way communication between merchant and consumer

Information Density

E-commerce technologies vastly increase **information density**—the total amount and quality of information available to all market participants, consumers, and merchants alike. E-commerce technologies reduce information collection, storage, processing, and communication costs. At the same time, these technologies greatly increase the currency, accuracy, and timeliness of information—making information more useful and important than ever. As a result, information becomes more plentiful, less expensive, and of higher quality.

information density
the total amount and quality of information available to all market participants

A number of business consequences result from the growth in information density. In e-commerce markets, prices and costs become more transparent. *Price transparency* refers to the ease with which consumers can find out the variety of prices in a market; *cost transparency* refers to the ability of consumers to discover the actual costs merchants pay for products (Sinha, 2000). But there are advantages for merchants as well. Online merchants can discover much more about consumers; this allows merchants to segment the market into groups willing to pay different prices and permits them to engage in *price discrimination*—selling the same goods, or nearly the same goods, to different targeted groups at different prices. For instance, an online merchant can discover a consumer's avid interest in expensive exotic vacations, and then pitch expensive exotic vacation plans to that consumer at a premium price, knowing this person is willing to pay extra for such a vacation. At the same time, the online merchant can pitch the same vacation plan at a lower price to more price-sensitive consumers. Merchants also have enhanced abilities to differentiate their products in terms of cost, brand, and quality.

Personalization/Customization

personalization
the targeting of marketing messages to specific individuals by adjusting the message to a person's name, interests, and past purchases

customization
changing the delivered product or service based on a user's preferences or prior behavior

E-commerce technologies permit **personalization**: merchants can target their marketing messages to specific individuals by adjusting the message to a person's name, interests, and past purchases. Today this is achieved in a few milliseconds and followed by an advertisement based on the consumer's profile. The technology also permits **customization**—changing the delivered product or service based on a user's preferences or prior behavior. Given the interactive nature of e-commerce technology, much information about the consumer can be gathered in the marketplace at the moment of purchase. With the increase in information density, a great deal of information about the consumer's past purchases and behavior can be stored and used by online merchants. The result is a level of personalization and customization unthinkable with traditional commerce technologies. For instance, you may be able to shape what you see on television by selecting a channel, but you cannot change the contents of the channel you have chosen. In contrast, the online version of the *Financial Times* allows you to select the type of news stories you want to see first, and gives you the opportunity to be alerted when certain events happen. Personalization and customization allow firms to precisely identify market segments and adjust their messages accordingly.

Social Technology: User-Generated Content and Social Networks

In a way quite different from all previous technologies, e-commerce technologies have evolved to be much more social by allowing users to create and share content with a worldwide community. Using these forms of communication, users are able to create new social networks and strengthen existing ones. All previous mass media in modern history, including the printing press, used a broadcast model (one-to-many) where content is created in a central location by experts (professional writers, editors, directors, actors, and producers) and audiences are concentrated in huge aggregates to consume a standardized product. The telephone would appear to be an exception but it is not a mass communication technology. Instead the telephone is a one-to-one technology. E-commerce technologies have the potential to invert this standard media model by giving users the power to create and distribute content on a large scale, and permit users to program their own content consumption. E-commerce technologies provide a unique, many-to-many model of mass communication.

Table 1.2 provides a summary of each of the unique features of e-commerce technology and their business significance.

TYPES OF E-COMMERCE

There are several different types of e-commerce and many different ways to characterize them. **Table 1.3** on page 58 lists the major types of e-commerce discussed in this book.[1] For the most part, we distinguish different types of e-commerce by the nature of

[1] For the purposes of this text, we subsume business-to-government (B2G) e-commerce within B2B e-commerce, viewing the government as simply a form of business when it acts as a procurer of goods and/or services.

TABLE 1.2 BUSINESS SIGNIFICANCE OF THE EIGHT UNIQUE FEATURES OF E-COMMERCE TECHNOLOGY

E-COMMERCE TECHNOLOGY DIMENSION	BUSINESS SIGNIFICANCE
Ubiquity—E-commerce technology is available everywhere: at work, at home, and elsewhere via mobile devices, anytime.	The marketplace is extended beyond traditional boundaries and is removed from a temporal and geographic location. "Marketspace" is created; shopping can take place anywhere. Customer convenience is enhanced, and shopping costs are reduced.
Global reach—The technology reaches across national boundaries, around the earth.	Commerce is enabled across cultural and national boundaries seamlessly and without modification. "Marketspace" includes potentially billions of consumers and millions of businesses worldwide.
Universal standards—There is one set of technology standards.	There is a common, inexpensive, global technology foundation for businesses to use.
Richness—Video, audio, and text messages are possible.	Video, audio, and text marketing messages are integrated into a single marketing message and consuming experience.
Interactivity—The technology works through interaction with the user.	Consumers are engaged in a dialog that dynamically adjusts the experience to the individual, and makes the consumer a co-participant in the process of delivering goods to the market.
Information density—The technology reduces information costs and raises quality.	Information processing, storage, and communication costs drop dramatically, while currency, accuracy, and timeliness improve greatly. Information becomes plentiful, cheap, and accurate.
Personalization/Customization—The technology allows personalized messages to be delivered to individuals as well as groups.	Personalization of marketing messages and customization of products and services are based on individual characteristics.
Social technology—User-generated content and social networks.	New online social and business models enable user content creation and distribution, and support social networks.

the market relationship—who is selling to whom. Mobile, social, and local e-commerce can be looked at as subsets of these types of e-commerce.

Business-to-Consumer (B2C) E-commerce

The most commonly discussed type of e-commerce is **business-to-consumer (B2C) e-commerce**, in which online businesses attempt to reach individual consumers. B2C commerce includes purchases of retail goods, travel services, and online content. B2C has grown exponentially since 1995, and is the type of e-commerce that most

business-to-consumer (B2C) e-commerce online businesses selling to individual consumers

TABLE 1.3 MAJOR TYPES OF E-COMMERCE

TYPE OF E-COMMERCE	EXAMPLE
B2C—business-to-consumer	Amazon is a general merchandiser that sells consumer products to retail consumers.
B2B—business-to-business	Go2Paper is an independent third-party marketplace that serves the paper industry.
C2C—consumer-to-consumer	Auction sites such as eBay, and listing sites such as Craigslist, enable consumers to auction or sell goods directly to other consumers. Airbnb and Uber provide similar platforms for services such as room rental and transportation.
M-commerce—mobile e-commerce	Mobile devices such as tablet computers and smartphones can be used to conduct commercial transactions.
Social e-commerce	Facebook is both the leading social network and social e-commerce site.
Local e-commerce	Groupon offers subscribers daily deals from local businesses in the form of Groupons, discount coupons that take effect once enough subscribers have agreed to purchase.

consumers are likely to encounter (see **Figure 1.3**). Within the B2C category, there are many different types of business models. Chapter 5 has a detailed discussion of seven different B2C business models: portals, online retailers, content providers, transaction brokers, market creators, service providers, and community providers.

Business-to-Business (B2B) E-commerce

business-to-business (B2B) e-commerce
online businesses selling to other businesses

Business-to-business (B2B) e-commerce, in which businesses focus on selling to other businesses, is the largest form of e-commerce, with around $6.3 trillion in transactions in the United States in 2015 (see **Figure 1.4** on page 60) and about €14.2 trillion worldwide. This is a small portion of total B2B commerce (which remains largely non-automated), suggesting that B2B e-commerce has significant growth potential. The ultimate size of B2B e-commerce is potentially huge. There are two primary business models used within the B2B arena: Net marketplaces, which include e-distributors, e-procurement companies, exchanges and industry consortia, and private industrial networks.

Consumer-to-Consumer (C2C) E-commerce

consumer-to-consumer (C2C) e-commerce
consumers selling to other consumers

Consumer-to-consumer (C2C) e-commerce provides a way for consumers to sell to each other, with the help of an online market maker (also called a platform provider) such as eBay or Etsy, the classifieds site Craigslist, or on-demand service companies such as Airbnb and Uber. Given that in 2014, eBay by itself generated around €76 billion in gross merchandise volume around the world, it is probably safe to estimate that the size of the global C2C market in 2015 is more than €92 billion (eBay, 2015). In C2C e-commerce, the consumer prepares the product for market, places the product for auction or

sale, and relies on the market maker to provide catalog, search engine, and transaction-clearing capabilities so that products can be easily displayed, discovered, and paid for.

Mobile E-commerce (M-commerce)

Mobile e-commerce, or m-commerce, refers to the use of mobile devices to enable online transactions. Described more fully in Chapter 2, m-commerce involves the use of cellular and wireless networks to connect laptops, smartphones such as the iPhone and Android phones, and tablet computers such as the iPad to the Internet. Once connected, mobile consumers can conduct transactions, including stock trades, in-store price comparisons, banking, travel reservations, and more. M-commerce purchases are expected to reach around £19 billion in 2015 in the United Kingdom, for instance, and to grow rapidly over the next five years (eMarketer, Inc., 2015b).

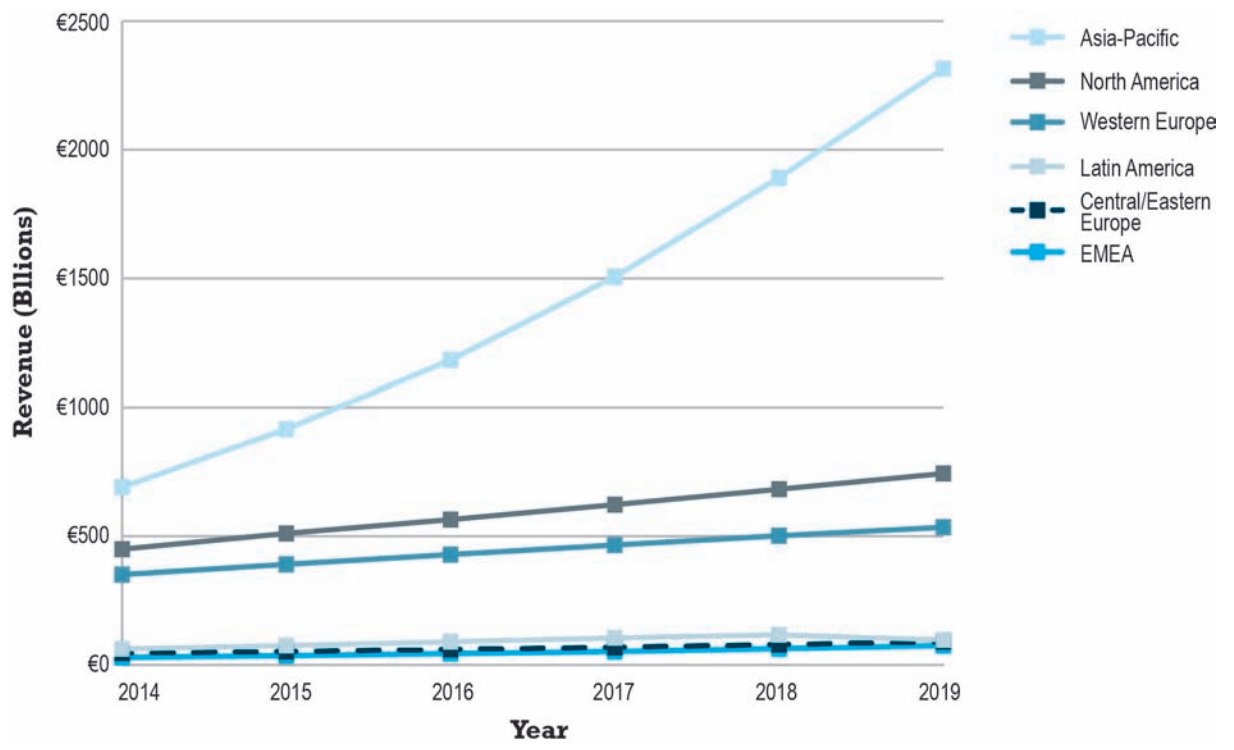
mobile e-commerce (m-commerce)
use of mobile devices to enable online transactions

Social E-commerce

Social e-commerce is e-commerce that is enabled by social networks and online social relationships. It is sometimes also referred to as Facebook commerce, but in actuality is a much larger phenomenon that extends beyond just Facebook. The growth

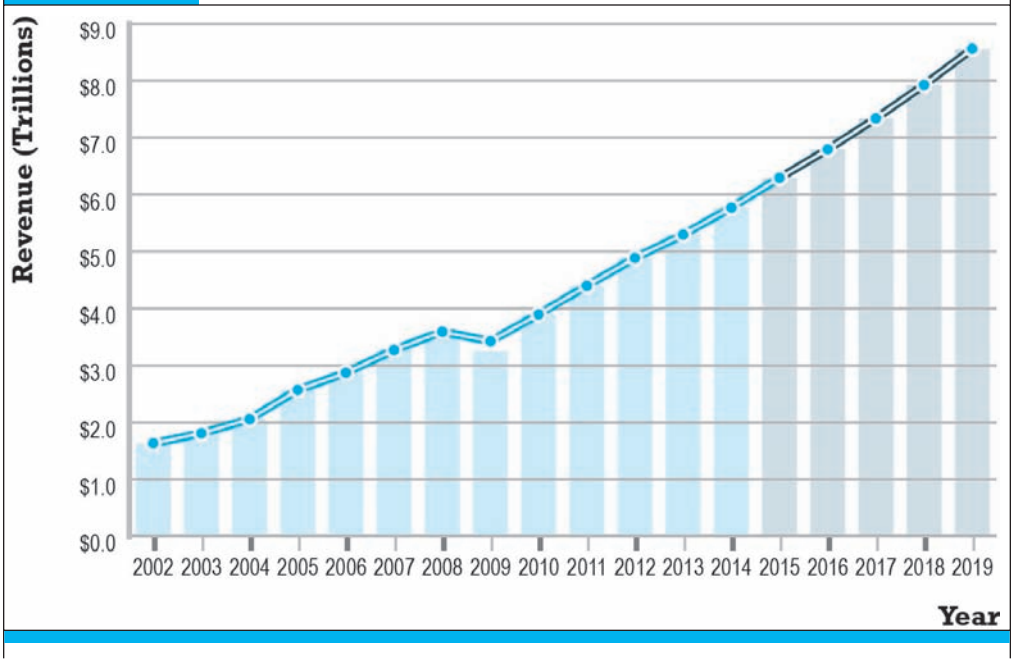
social e-commerce
e-commerce enabled by social networks and online social relationships

FIGURE 1.3 THE WORLDWIDE GROWTH OF B2C E-COMMERCE



B2C e-commerce is growing rapidly in all regions. Overall global growth is about 25%, and is even higher in Asia-Pacific.
SOURCES: Based on data from eMarketer, Inc., 2015c, 2015d; authors' estimates.

FIGURE 1.4 THE GROWTH OF B2B E-COMMERCE IN THE UNITED STATES



B2B e-commerce in the United States is about 10 times the size of B2C e-commerce. In 2019, B2B e-commerce is projected to be over $8.5 trillion. (Note: Does not include EDI transactions.)

SOURCES: Based on data from U.S. Census Bureau, 2015; authors' estimates.

of social e-commerce is being driven by a number of factors, including the increasing popularity of social sign-on (signing onto Web sites using your Facebook or other social network ID), network notification (the sharing of approval or disapproval of products, services, and content via Facebook's Like button or Twitter tweets), online collaborative shopping tools, and social search (recommendations from online trusted friends). Social e-commerce is still in its infancy, but in 2014, the top 500 retailers in Internet Retailer's Social Media 500 earned about $3.3 billion from social commerce, a 25% increase over 2013, and shoppers clicking from social networks to Social Media 500 retailers' Web sites accounted for about 5.8% of all traffic to those Web sites in 2014, up from about 5.4% in the previous year (Zaroban, 2015).

Local E-commerce

local e-commerce
e-commerce that is focused on engaging the consumer based on his or her current geographic location

Local e-commerce, as its name suggests, is a form of e-commerce that is focused on engaging the consumer based on his or her current geographic location. Local merchants use a variety of online marketing techniques to drive consumers to their stores. Local e-commerce is the third prong of the mobile, social, local e-commerce wave, and fueled by an explosion of interest in local on-demand services such as Uber, is expected to grow in the United States to over $25 billion in 2015.

Figure 1.5 illustrates the relative size of all of the various types of e-commerce.

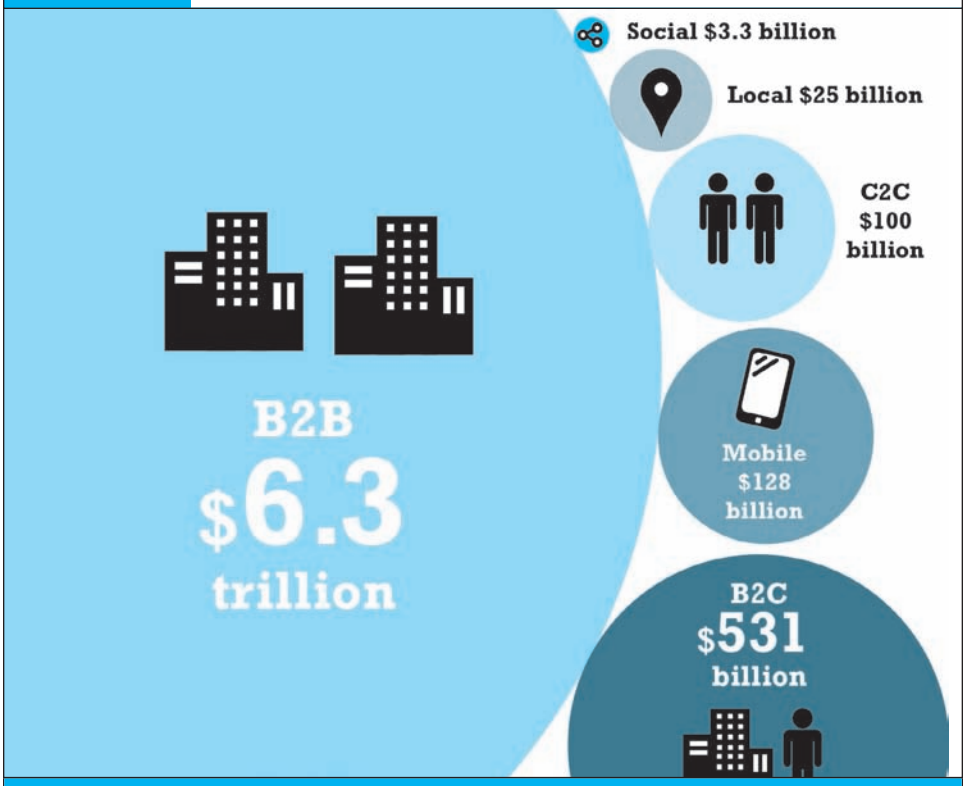
GROWTH OF THE INTERNET, WEB, AND MOBILE PLATFORM

The technology juggernauts behind e-commerce are the Internet, the Web, and increasingly, the mobile platform. We describe the Internet, Web, and mobile platform in some detail in Chapter 2. The **Internet** is a worldwide network of computer networks built on common standards. Created in the late 1960s to connect a small number of mainframe computers and their users, the Internet has since grown into the world's largest network. It is impossible to say with certainty exactly how many computers and other wireless access devices such as smartphones are connected to the Internet worldwide at any one time, but the number is clearly more than 1 billion. The Internet links businesses, educational institutions, government agencies, and individuals together, and provides users with services such as e-mail, document transfer, shopping, research, instant messaging, music, videos, and news.

Internet
worldwide network of computer networks built on common standards

One way to measure the growth of the Internet is by looking at the number of Internet hosts with domain names. (An *Internet host* is defined by the Internet Systems Consortium as any IP address that returns a domain name in the in-addr.arpa

FIGURE 1.5 THE RELATIVE SIZE OF DIFFERENT TYPES OF E-COMMERCE IN THE UNITED STATES



B2B e-commerce dwarfs all other forms of e-commerce; mobile, social, and local e-commerce, although growing rapidly, are still relatively small in comparison to "traditional" e-commerce.

domain, which is a special part of the DNS namespace that resolves IP addresses into domain names.) In July 2015, there were more than 1 billion Internet hosts in over 245 countries, up from just 70 million in 2000 (Internet Systems Consortium, 2015).

The Internet has shown extraordinary growth patterns when compared to other electronic technologies of the past. It took radio 38 years to achieve a 30% share of U.S. households. It took television 17 years to achieve a 30% share. It took only 10 years for the Internet/Web to achieve a 53% share of U.S. households once a graphical user interface was invented for the Web in 1993.

World Wide Web (the Web)
provides access to billions of Web pages

The **World Wide Web (the Web)** is one of the most popular services that runs on the Internet infrastructure. The Web was the original "killer app" that made the Internet commercially interesting and extraordinarily popular. The Web was developed in the early 1990s and hence is of much more recent vintage than the Internet. We describe the Web in some detail in Chapter 2. The Web provides access to billions of Web pages indexed by Google and other search engines. These pages are created in a language called *HTML (HyperText Markup Language)*. HTML pages can contain text, graphics, animations, and other objects. You can find an exceptionally wide range of information on Web pages, ranging from the entire collection of public records from the Securities and Exchange Commission, to the card catalog of your local library, to millions of music tracks and videos. The Internet prior to the Web was primarily used for text communications, file transfers, and remote computing. The Web introduced far more powerful and commercially interesting, colorful multimedia capabilities of direct relevance to commerce. In essence, the Web added color, voice, and video to the Internet, creating a communications infrastructure and information storage system that rivals television, radio, magazines, and even libraries.

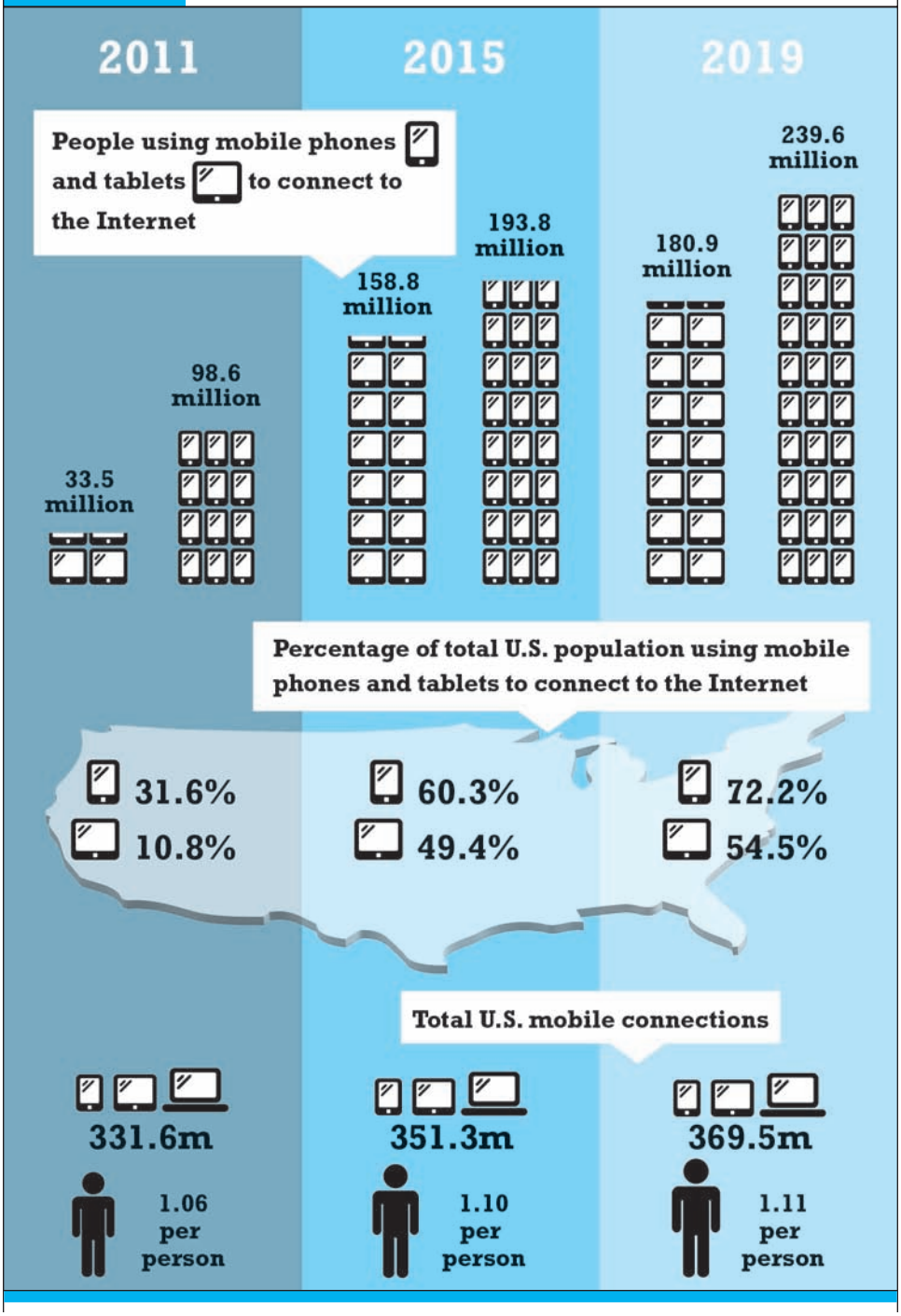
There is no precise measurement of the number of Web pages in existence, in part because today's search engines index only a portion of the known universe of Web pages, and also because the size of the Web universe is unknown. Google has identified over 60 trillion unique URLs, up from 1 trillion in 2008, although many of these pages do not necessarily contain unique content (Google, 2014). In addition to this "surface" or "visible" Web, there is also the so-called deep Web that is reportedly 500 to 1,000 times greater than the surface Web. The deep Web contains databases and other content that is not routinely indexed by search engines such as Google. Although the total size of the Web is not known, what is indisputable is that Web content has grown exponentially since 1993.

mobile platform
provides the ability to access the Internet from a variety of highly mobile devices such as smartphones, tablets, and other ultra-lightweight laptop computers

The mobile platform is the newest development in Internet infrastructure. The **mobile platform** provides the ability to access the Internet from a variety of mobile devices such as smartphones, tablets, and other ultra-lightweight laptop computers via wireless networks or cell phone service. In 2015, there are over 350 million mobile devices in the United States that can be connected to the Internet (more than 1 device for each person in the United States), and that number is expected to grow to around 370 million by 2019 (eMarketer, Inc., 2015e). **Figure 1.6** illustrates the rapid growth of mobile Internet access.

Read *Insight on Technology*: *Will Apps Make the Web Irrelevant?* for a look at the challenge that apps and the mobile platform pose to the Web's dominance of the Internet ecosphere.

FIGURE 1.6 MOBILE INTERNET ACCESS IN THE UNITED STATES



Continued growth in the number of people using mobile phones and tablets to connect to the Internet will provide a significant stimulus to m-commerce.

SOURCES: Based on data from eMarketer, Inc., 2013a, 2013b, 2013c, 2015e, 2015f, 2015g.

INSIGHT ON TECHNOLOGY

WILL APPS MAKE THE WEB IRRELEVANT?

Nowadays, it's hard to recall a time before the Web. How did we get along without the ability to pull up a Web browser and search for any item, learn about any topic, or play just about any type of game? Though the Web has come a remarkably long way from its humble beginnings, many experts claim that the Web's best days are behind it, and that there's a new player on the field: apps. Opinions vary widely over the future role of the Web in a world where apps have become an ever larger portion of the Internet marketspace. In 10 years, will Web browsers be forgotten relics, as we rely entirely on apps to do both our work and our play on the Internet? Will the Web and apps coexist peacefully as vital cogs in the Internet ecosystem? Or will the app craze eventually die down as tech users gravitate back toward the Web as the primary way to perform Internet-related tasks?

Apps have grown into a disruptive force ever since Apple launched its App Store in 2008. The list of industries apps have disrupted is wide-ranging: communications, media and entertainment, logistics, education, healthcare, and most recently, with Uber, the taxi industry. Despite not even existing prior to 2008, in 2015, sales of apps are expected to account for well over $30 billion in revenues worldwide, and the app economy is continuing to show robust growth, with estimates of $70 billion in revenue by 2017. More of those revenues are likely to come from in-app purchases than from paid app downloads. Not only that, but the growth is not coming from more users trying the same small number of apps. Although usage of apps tends to be highly concentrated, with nearly 80% of smartphone app minutes spent on an individual's top 3 apps, consumers are trying new apps all the time and visit about 25 apps per month, leaving plenty of room for new app developers to innovate and create best-selling apps. In fact, according to mobile advertising company Flurry, 280 million people worldwide qualify as mobile addicts, which they define as someone who launches a smartphone app more than 60 times a day. According to Flurry, the number of such addicts has increased by about 350% from 2013 to 2015.

In January 2014, for the first time ever, Americans used apps more than desktop computers to access the Internet. The time U.S. adults are spending using mobile apps has exploded, growing by 90% over the past two years, and now accounting for 53.8% of total digital media time spent; time spent on the desktop now accounts for just 38%, and mobile browsers just 8.2%. U.S. adults are spending 68 hours a month (over 2 hours a day) within apps on their smartphones, while young adults between the ages of 18–24 spend over 90 hours a month (3+ hours a day). Consumers have gravitated to apps for several reasons. First, smartphones and tablet computers enable users to use apps anywhere, instead of being tethered to a desktop or having to lug a heavy laptop around. Of course, smartphones and tablets enable users to use the Web too, but apps are often more convenient and boast more streamlined, elegant interfaces than mobile Web browsers.

Not only are apps more appealing in certain ways to consumers, they are much more appealing to content creators and media companies. Apps are much easier to control and monetize than Web sites, not to mention they can't be crawled by Google or other services. On the Web, the average price of ads per thousand impressions is falling, and after twenty years, many content providers are still mostly struggling to turn the Internet into a profitable content delivery platform. Much of software and media companies' focus has shifted to developing mobile apps for this reason.

These trends are why some pundits boldly proclaim that the Web is dead, and that the shift from the Web to apps has only just started. These analysts believe that the Internet will be used to transport data, but individual app interfaces will replace the Web browser as the most common way to access and display content. Even the creator of the Web, Tim Berners-Lee, feels that the Web as we know it is being threatened. That's not a good sign.

But there is no predictive consensus about the role of the Web in our lives in the next decade and beyond. Many analysts believe the demise of the Web has been greatly exaggerated, and that the Web boasts many advantages over today's apps that users will be unwilling to relinquish. Although apps may be more convenient than the Web in many respects, the depth of the Web browsing experience trumps that of apps. The Web is a vibrant, diverse array of sites, and browsers have an openness and flexibility that apps lack. The connections between Web sites enhance their usefulness and value to users, and apps that instead seek to lock users in cannot offer the same experience.

Other analysts who are more optimistic about the Web's chances to remain relevant in an increasingly app-driven online marketplace feel this way because of the emergence of HTML5. HTML5 is a new markup language that will enable more dynamic Web content and allow for browser-accessible Web apps that are as appealing as device-specific apps. In fact, there is another group of analysts who believe that apps and the Web are going to come together, with HTML5 bringing the best of the app experience to the Web, and with apps developing new Web-like capabilities. Already, work is underway to create more "smart" apps that handle a wider array of tasks than today's apps can handle, such as apps with Siri integration.

A shift towards apps and away from the Web could have a ripple effect on e-commerce firms. As the pioneer of apps and the market leader in apps, smartphones, and tablet computers, Apple stands to gain from a shift towards apps, and although it will also face increasing opposition from other companies, including Google, the established success of the App Store will make it next to impossible to dethrone Apple. While Google's Google Play store has dwarfed the App Store in downloads in 2015, Apple nevertheless maintains a strong lead in app revenues. Google's search business is likely to suffer from all of the "walled garden" apps that it cannot access, but it also has a major stake in the world of smartphones, tablets, and apps itself with its Android operating system, which is used by over 80% of smartphones worldwide. Facebook has already seen its members make the transition from using its site on the Web to using its mobile app and has made, and continues to make, significant investments in standalone apps, such as Instagram and WhatsApp. Web-based companies that fail to find an answer to the growth of the mobile platform may eventually fall by the wayside.

SOURCES: "Smartphone OS Market Share, 2015 Q2," Idc.com, accessed September 24, 2015; "The 2015 U.S. Mobile App Report," by comScore, September 2015; "Mobile Addicts Multiply Across the Globe," by Simon Khalaf, Flurrymobile.tumblr.com, July 15, 2015; "App Annie Report: Google Play's Downloads Dwarf the App Store as Apple Retains Revenue Lead," by Jackie Dove, Thenextweb.com, July 15, 2015; "Mobile Apps Poised to Hit $70B in Revenues by 2017," by Per Petterson, Impactradius.com, December 3, 2014; "More People Are Opening More Mobile Apps Every Day," by Ewan Spence, Forbes.com, April 24, 2014; "The Rise of the Mobile Addict," by Simon Khalaf, Flurry.com, April 22, 2014; "How Apps Won the Mobile Web," by Thomas Claburn, Informationweek.com, April 3, 2014; "Apps Solidify Leadership Six Years into the Mobile Revolution," by Simon Khalaf, Flurry.com, April 1, 2014; "Mobile Apps Overtake PC Internet Usage in U.S.," by James O'Toole, Money.cnn.com, February 28, 2014; "Convergence of User Experiences," Savas.me, April 4, 2013; "Flurry Five-Year Report: It's an App World. The Web Just Lives in It," by Simon Khalaf, Flurry.com, April 3, 2013; "Here's Why Google and Facebook Might Completely Disappear in the Next 5 Years," by Eric Jackson, Forbes.com, April 30, 2012; "Is The Web Dead In the Face of Native Apps? Not Likely, But Some Think So," by Gabe Knuth, Brianmadden.com, March 28, 2012; "Imagining the Internet," by Janna Quitney Anderson and Lee Rainie, Pew Internet and American Life Project, March 23, 2012; "The Web Is Dead. Long Live the Internet," by Chris Anderson and Michael Wolff, Wired.com, August 17, 2010; "The Web Is Dead? A Debate," by Chris Anderson, Wired.com, August 17, 2010.

ORIGINS AND GROWTH OF E-COMMERCE

It is difficult to pinpoint just when e-commerce began. There were several precursors to e-commerce. In the late 1970s, a pharmaceutical firm named Baxter Healthcare initiated a primitive form of B2B e-commerce by using a telephone-based modem that permitted hospitals to reorder supplies from Baxter. This system was later expanded during the 1980s into a PC-based remote order entry system and was widely copied throughout the United States long before the Internet became a commercial environment. The 1980s saw the development of Electronic Data Interchange (EDI) standards that permitted firms to exchange commercial documents and conduct digital commercial transactions across private networks.

In the B2C arena, the first truly large-scale digitally enabled transaction system was deployed in France in 1981. The Minitel was a French videotext system that combined a telephone with an 8-inch screen. By the mid-1980s, more than 3 million Minitels were deployed, and more than 13,000 different services were available, including ticket agencies, travel services, retail products, and online banking. The Minitel service continued in existence until December 31, 2006, when it was finally discontinued by its owner, France Telecom.

However, none of these precursor systems had the functionality of the Internet. Generally, when we think of e-commerce today, it is inextricably linked to the Internet. For our purposes, we will say e-commerce begins in 1995, following the appearance of the first banner advertisements placed by AT&T, Volvo, Sprint, and others on Hotwired in late October 1994, and the first sales of banner ad space by Netscape and Infoseek in early 1995. Since then, e-commerce has been the fastest growing form of commerce in the United States.

The data suggests that, over the next five years, global retail e-commerce will grow by over 20% annually, much faster than traditional retail sales (which are growing at only about 6% a year). There is tremendous upside potential. Today, for instance, retail e-commerce is still a very small part (around 7%) of the overall €21 trillion retail market, and under current projections, in 2019, will still only be about 12% of total retail sales. There is obviously much room to grow (see **Figure 1.7**). However, it's not likely that retail e-commerce revenues will continue to expand forever at double-digit rates. As online sales become a larger percentage of all sales, online sales growth will likely eventually decline to that growth level. This point still appears to be a long way off. Online content sales, everything from music, to video, medical information, games, and entertainment, have an even longer period to grow before they hit any ceiling effects.

1.2 E-COMMERCE: A BRIEF HISTORY

Although e-commerce is not very old, it already has a tumultuous history. The history of e-commerce can be usefully divided into three periods: 1995–2000, the period of invention; 2001–2006, the period of consolidation; and 2007–present, a period of

FIGURE 1.7 ROOM TO GROW

E-commerce retail is still just a small part of the overall global retail market, but with much room to grow in the future.

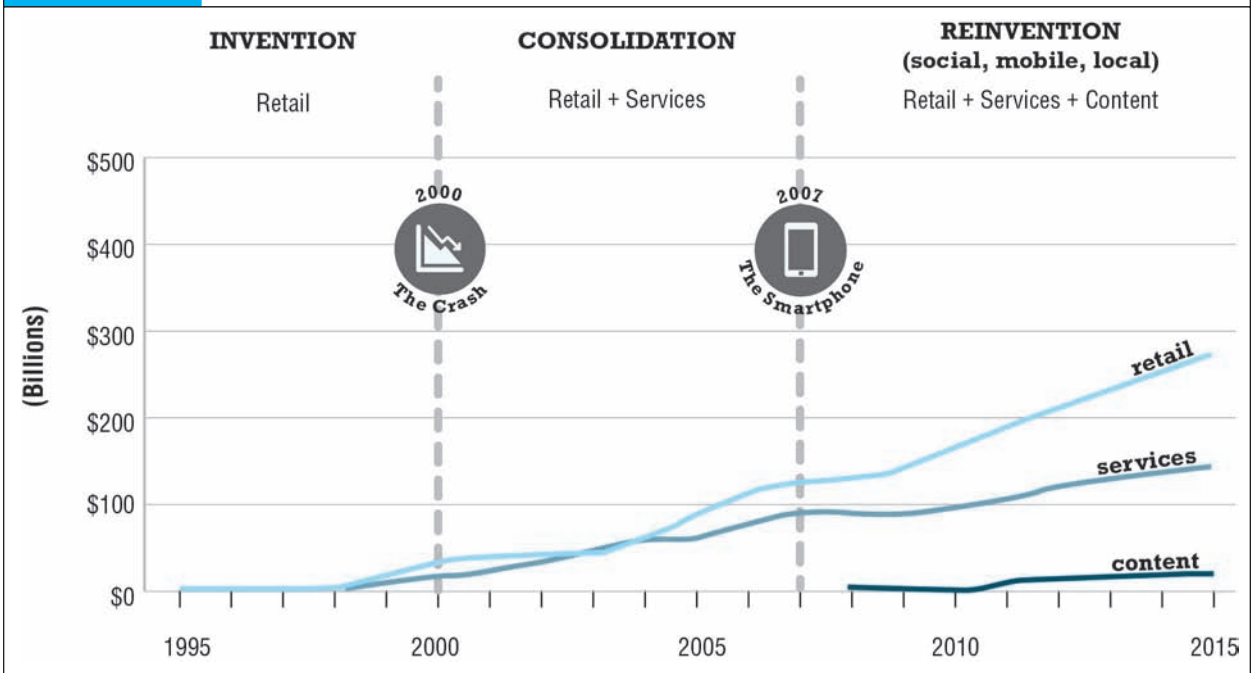
reinvention with social, mobile, and local expansion. The following examines each of these periods briefly, while **Figure 1.8** places them in context along a timeline.

E-COMMERCE 1995–2000: INVENTION

The early years of e-commerce were a period of explosive growth and extraordinary innovation, beginning in 1995 with the first widespread use of the Web to advertise products. During this Invention period, e-commerce meant selling retail goods, usually quite simple goods, on the Internet. There simply was not enough bandwidth for more complex products. Marketing was limited to unsophisticated static display ads and not very powerful search engines. The Web policy of most large firms, if they had one at all, was to have a basic static Web site depicting their brands. The rapid growth in e-commerce was fueled by over $125 billion in U.S. venture capital. This period of e-commerce came to a close in 2000 when stock market valuations plunged, with thousands of companies disappearing (the "dot-com crash").

The early years of e-commerce were also one of the most euphoric of times in commercial history. It was also a time when key e-commerce concepts were developed. For computer scientists and information technologists, the early success of e-commerce was a powerful vindication of a set of information technologies that had developed over a period of 40 years—extending from the development of the early Internet, to the PC, to local area networks. The vision was of a universal

FIGURE 1.8 PERIODS IN THE DEVELOPMENT OF E-COMMERCE



communications and computing environment that everyone on Earth could access with cheap, inexpensive computers—a worldwide universe of knowledge stored on HTML pages created by hundreds of millions of individuals and thousands of libraries, governments, and scientific institutes. Technologists celebrated the fact that the Internet was not controlled by anyone or any nation, but was free to all. They believed the Internet—and the e-commerce that rose on this infrastructure—should remain a self-governed, self-regulated environment.

For economists, the early years of e-commerce raised the realistic prospect of a nearly perfect competitive market: where price, cost, and quality information are equally distributed, a nearly infinite set of suppliers compete against one another, and customers have access to all relevant market information worldwide. The Internet would spawn digital markets where information would be nearly perfect—something that is rarely true in other real-world markets. Merchants in turn would have equal direct access to hundreds of millions of customers. In this near-perfect information marketspace, transaction costs would plummet because search costs—the cost of searching for prices, product descriptions, payment settlement, and order fulfillment—would all fall drastically (Bakos, 1997). For merchants, the cost of searching for customers would also fall, reducing the need for wasteful advertising. At the same time, advertisements could be personalized to the needs of every customer. Prices and even costs would be increasingly transparent to the consumer, who could now know exactly and instantly the worldwide

best price, quality, and availability of most products. Information asymmetry would be greatly reduced. Given the instant nature of Internet communications, the availability of powerful sales information systems, and the low cost involved in changing prices on a Web site (low menu costs), producers could dynamically price their products to reflect actual demand, ending the idea of one national price, or one suggested manufacturer's list price. In turn, market middlemen—the distributors and wholesalers who are intermediaries between producers and consumers, each demanding a payment and raising costs while adding little value—would disappear (**disintermediation**). Manufacturers and content originators would develop direct market relationships with their customers. The resulting intense competition, the decline of intermediaries, and the lower transaction costs would eliminate product brands, and along with these, the possibility of *monopoly profits* based on brands, geography, or special access to factors of production. Prices for products and services would fall to the point where prices covered costs of production plus a fair, "market rate" of return on capital, plus additional small payments for entrepreneurial effort (that would not last long). Unfair competitive advantages (which occur when one competitor has an advantage others cannot purchase) would be reduced, as would extraordinary returns on invested capital. This vision was called **friction-free commerce** (Smith et al., 2000).

disintermediation
displacement of market middlemen who traditionally are intermediaries between producers and consumers by a new direct relationship between producers and consumers

friction-free commerce
a vision of commerce in which information is equally distributed, transaction costs are low, prices can be dynamically adjusted to reflect actual demand, intermediaries decline, and unfair competitive advantages are eliminated

For real-world entrepreneurs, their financial backers, and marketing professionals, e-commerce represented an extraordinary opportunity to earn far above normal returns on investment. This is just the opposite of what economists hoped for. The e-commerce marketspace represented access to millions of consumers worldwide who used the Internet and a set of marketing communications technologies (e-mail and Web pages) that was universal, inexpensive, and powerful. These new technologies would permit marketers to practice what they always had done—segmenting the market into groups with different needs and price sensitivity, targeting the segments with branding and promotional messages, and positioning the product and pricing for each group—but with even more precision. In this new marketspace, extraordinary profits would go to **first movers**—those firms who were first to market in a particular area and who moved quickly to gather market share. In a "winner take all" market, first movers could establish a large customer base quickly, build brand name recognition early, create an entirely new distribution channel, and then inhibit competitors (new entrants) by building in *switching costs* for their customers through proprietary interface designs and features available only at one site. The idea for entrepreneurs was to create near monopolies online based on size, convenience, selection, and brand. Online businesses using the new technology could create informative, community-like features unavailable to traditional merchants. These "communities of consumption" also would add value and be difficult for traditional merchants to imitate. The thinking was that once customers became accustomed to using a company's unique Web interface and feature set, they could not easily be switched to competitors. In the best case, the entrepreneurial firm would invent proprietary technologies and techniques that almost everyone adopted, creating a network effect. A **network effect** occurs where all participants receive value from the fact that everyone else uses the same tool or product (for example, a common operating system, telephone system, or software application such as a proprietary instant

first mover
a firm that is first to market in a particular area and that moves quickly to gather market share

network effect
occurs where users receive value from the fact that everyone else uses the same tool or product

messaging standard or an operating system such as Windows), all of which increase in value as more people adopt them.[2]

To initiate this process, entrepreneurs argued that prices would have to be very low to attract customers and fend off potential competitors. E-commerce was, after all, a totally new way of shopping that would have to offer some immediate cost benefits to consumers. However, because doing business on the Web was supposedly so much more efficient when compared to traditional "bricks-and-mortar" businesses (even when compared to the direct mail catalog business) and because the costs of customer acquisition and retention would supposedly be so much lower, profits would inevitably materialize out of these efficiencies. Given these dynamics, market share, the number of visitors to a site ("eyeballs"), and gross revenue became far more important in the earlier stages of an online firm than earnings or profits. Entrepreneurs and their financial backers in the early years of e-commerce expected that extraordinary profitability would come, but only after several years of losses.

Thus, the early years of e-commerce were driven largely by visions of profiting from new technology, with the emphasis on quickly achieving very high market visibility. The source of financing was venture capital funds. The ideology of the period emphasized the ungoverned "Wild West" character of the Web and the feeling that governments and courts could not possibly limit or regulate the Internet; there was a general belief that traditional corporations were too slow and bureaucratic, too stuck in the old ways of doing business, to "get it"—to be competitive in e-commerce. Young entrepreneurs were therefore the driving force behind e-commerce, backed by huge amounts of money invested by venture capitalists. The emphasis was on *disrupting* (destroying) traditional distribution channels and disintermediating existing channels, using new pure online companies who aimed to achieve impregnable first-mover advantages. Overall, this period of e-commerce was characterized by experimentation, capitalization, and hypercompetition (Varian, 2000b).

E-COMMERCE 2001–2006: CONSOLIDATION

In the second period of e-commerce, from 2000 to 2006, a sobering period of reassessment of e-commerce occurred, with many critics doubting its long-term prospects. Emphasis shifted to a more "business-driven" approach rather than being technology driven; large traditional firms learned how to use the Web to strengthen their market positions; brand extension and strengthening became more important than creating new brands; financing shrunk as capital markets shunned start-up firms; and traditional bank financing based on profitability returned.

During this period of consolidation, e-commerce changed to include not just retail products but also more complex services such as travel and financial services. This period was enabled by widespread adoption of broadband networks in American homes and businesses, coupled with the growing power and lower prices of personal

[2] The network effect is quantified by Metcalfe's Law, which argues that the value of a network grows by the square of the number of participants.

computers that were the primary means of accessing the Internet, usually from work or home. Marketing on the Internet increasingly meant using search engine advertising targeted to user queries, rich media and video ads, and behavioral targeting of marketing messages based on ad networks and auction markets. The Web policy of both large and small firms expanded to include a broader "Web presence" that included not just Web sites, but also e-mail, display, and search engine campaigns; multiple Web sites for each product; and the building of some limited community feedback facilities. E-commerce in this period was growing again by more than 10% a year.

E-COMMERCE 2007–PRESENT: REINVENTION

Beginning in 2007 with the introduction of the iPhone, to the present day, e-commerce has been transformed yet again by the rapid growth of **Web 2.0** (a set of applications and technologies that enable user-generated content, such as online social networks, blogs, video and photo sharing sites, and wikis), widespread adoption of consumer mobile devices such as smartphones and tablet computers, the expansion of e-commerce to include local goods and services, and the emergence of an on-demand service economy enabled by millions of apps on mobile devices and cloud computing. This period can be seen as both a sociological, as well as a technological and business, phenomenon.

Web 2.0
set of applications and technologies that enable user-generated content

The defining characteristics of this period are often characterized as the "social, mobile, local" online world. Entertainment content has developed as a major source of e-commerce revenues and mobile devices have become entertainment centers, as well as on-the-go shopping devices for retail goods and services. Marketing has been transformed by the increasing use of social networks, word-of-mouth, viral marketing, and much more powerful data repositories and analytic tools for truly personal marketing. Firms have greatly expanded their online presence by moving beyond static Web pages to social networks such as Facebook, Twitter, Pinterest, and Instagram in an attempt to surround the online consumer with coordinated marketing messages. These social networks share many common characteristics. First, they rely on user-generated content. "Regular" people (not just experts or professionals) are creating, sharing, and broadcasting content to huge audiences. They are inherently highly interactive, creating new opportunities for people to socially connect to others. They attract extremely large audiences (about 1.5 billion monthly active users worldwide as of June 2015 in the case of Facebook). These audiences present marketers with extraordinary opportunities for targeted marketing and advertising.

More recently, the re-invention of the Web and e-commerce has resulted in a new set of on-demand, personal service businesses such as Uber, Airbnb, Instacart, Handy, and Homejoy. These businesses have been able to tap into a large reservoir of unused assets (cars, spare rooms, and personal spare time) and to create lucrative markets based on the mobile platform infrastructure. The *Insight on Business* case, *Rocket Internet,* takes a look at Rocket Internet, which has mentored a number of these new social, mobile, and local e-commerce ventures.

Table 1.4 on page 74 summarizes e-commerce in each of these three periods.

INSIGHT ON BUSINESS

ROCKET INTERNET

By now we've all heard the story of code written by Mark Zuckerberg in a Harvard dorm room blossoming into a multi-billion dollar business. These days, it's harder than ever to keep track of all the tech startups being bought for millions and even billions of euros, often even without any revenue to show for themselves. Many of them have something in common—they have been nurtured, and in some cases, whipped into shape, with the help of an "incubator."

Incubators have come to occupy a vital role in tech, helping new businesses move from little more than a great idea to an established, vibrant business. Rocket Internet is one such incubator. Founded in 2007 by German entrepreneurs Alexander, Oliver, and Marc Samwer, Rocket Internet launches e-commerce and other Internet start-ups in emerging markets, with the goal of becoming the world's largest Internet platform outside the United States and China. Headquartered in Berlin and with 25 international offices, Rocket Internet has over 75 independent companies active in 110 countries in its portfolio In 2014, Rocket went public on the Frankfurt Stock Exchange, in the largest German technology IPO in the past decade. The initial pricing valued the company at around €6.5 billion. In the previous two years, the company had raised nearly €3.2 billion from investors. In 2015, the share price dropped steeply for much of the year, but made a late rebound to approximately €30 per share.

Rocket bills itself as more than a venture capital firm or typical incubator. Rocket has a variety of teams that work closely with each of its ventures, including teams focused on engineering and product development, online marketing, CRM, business intelligence, operations, HR, and finance. Rocket also helps its start-ups by providing access to centralized logistics and other back-office functions to help them cut down on operational costs. The growing network of Rocket Internet companies is also a valuable resource. In many emerging markets, the most talented workers end up in established industries, but Rocket is ensuring that e-commerce also captures top talent in those regions. Prominent companies launched via Rocket Internet include Germany's Zalando, India's Jabong, Russia's Lamoda, Australia's The Iconic and Zanui, Pakistan's Azmalo (now Kaymu) and Daraz, and Southeast Asia's Zalora.

Former Rocket Internet employees also have a strong track record with their own independent start-ups once they've left the parent company. These employees note that their experience at Rocket has made the prospect of starting new businesses seem less intimidating. They also praise Oliver Samwer's attention to detail and emphasis on making decisions using data. Rocket Internet start-ups collect and analyze as much data as possible on their markets and customers. They also report that their association with Rocket Internet gives them more credibility with major investors.

Rocket Internet has yet to launch many new businesses in the United States, where the competitive environment is much more difficult than in emerging markets and even Europe. In 2015, Rocket Internet began the process of selling its holdings in India, including Jabong and on-demand food delivery company Foodpanda, due to increasingly heavy competition from India's booming startup environment. Many of Rocket's ventures focus on emerging markets because the profit margins are higher although the markets are smaller. This is in contrast to Amazon, for example, which has razor-thin margins but enormous scope and market reach. Critics of Rocket Internet claim that the company is less concerned with innovation than it is with launching clones of successful United States-based businesses in other markets.

For instance, in 2014, Rocket launched Zipjet, an on-demand laundry service modeled after U.S. counterpart Washio, and ShopWings, an online supermarket resembling Instacart, a similar service launched in major U.S. cities. Oliver Samwer counters talk of clones, noting that for the majority of these types of businesses, truly disruptive innovation is rare, and the business succeeds or not based on the efficiency of its business processes. Marc Samwer adds that Rocket Internet takes the best ideas and improves on them by localizing them to better fit specific areas. Investors are also concerned about the profitability of Rocket's portfolio. Many of Rocket's companies have market leader status in their respective areas, but hardly any of them are currently profitable. Rocket contends that by focusing on growth in emerging markets first, profits will come in time, but in 2015 Rocket amassed more than €46 million in yearly losses by the end of October, despite posting 142% revenue growth in its subset of "proven winner" businesses, nearly all of which are still unprofitable themselves.

Nevertheless, Rocket has captured significant market share in many industries by launching companies modeled after established businesses in emerging markets, and then selling these ventures to those established businesses when they're looking to expand into those markets. eBay's acquisition of Germany's leading auction site, Alando, where the Samwers got their start, is an example. Amazon was rumored to be interested in Jabong, though those talks were abandoned in 2015, and Africa-based Jumia and Southeast Asia-based Lazada, also modeled after Amazon, could conceivably be additional targets for Amazon. Payleven is a European mobile payment company modeled after Square and Paypal. Increasingly, however, Rocket is looking to create sustainable companies who are focused less on their eventual sale to bigger companies and more on their own growth. Oliver Samwer believes that in the past, it may have sold some businesses, such as Alando, too early, but that it was necessary in order for Rocket to build a track record. Now that it has one, it can afford to take a longer-term view.

Startupbootcamp is another start-up accelerator based in Europe that selects 10 start-ups from a pool of hundreds of applicants and provides cutting-edge training and a network of professionals to help them go from an idea to a thriving business. Applicants receive coaching from a network of volunteer mentors from successful tech companies as well as significant stipends for living expenses and partner deals. After 3 months, start-ups pitch their businesses to venture capitalists and investors. Established companies also have made deals with Startupbootcamp to mentor specific types of businesses, such as AVG Technologies' agreement to invest in Startupbootcamp's NFC and Contactless division. Though Internet start-ups have boomed, busted, and are now booming again, as the global economy continues to rely more on the Internet and Internet-based services, incubators and accelerators like Rocket Internet and Startupbootcamp are here to stay.

SOURCES: "About Startupbootcamp," Startupbootcamp.org, accessed November 30, 2015; "Rocket Internet: Waiting for Lift-Off," by Sarah Gordon and Dan McCrum, *Financial Times*, October 19, 2015; "Revenue Jumps at Rocket Internet's Top Start-ups," by Emma Thomason, Reuters.com, September 30, 2015; "Rocket Internet Plans to Sell Its Top Companies in India," by Biswarup Gooptu and Krithika Krishnamurthy, *Economic Times,* September 22, 2015; "Amazon-Jabong Call Off Talks for a Potential $1.2B Buyout Deal," by Priyanka Sahay , VCCircle.com, April 2, 2015; "Fear and Laundry in London as Rocket Internet's ZipJet Launches in the U.K. Capital City," by Steve O'Hear, Techcrunch.com, November 3, 2014; "With ShopWings, Instacart Gets a Wink and a Clone from Rocket Internet," by Ingrid Lunden, Techcrunch.com, October 13, 2014; "Rocket Internet – First Mover in Asia?" by Susan Cunningham, *Forbes*, October 5, 2014; "Rocket Internet Drops 13% in Debut," by Chase Gummer, *Wall Street Journal*, October 2, 2014; "Rocket Internet's Marc Samwar on Cloning: We Make Business Models Better Because We Localize," by Leena Rao, Techcrunch.com, October 28, 2013; "5 Reasons Why Rocket Internet Graduates Become Good Entrepreneurs," Ventureburn.com, October 17, 2013; "AVG Invests in Startupbootcamp NFC & Contactless Program in Amsterdam," *Wall Street Journal,* September 26, 2013; "Rocket Internet Raises $500M from Kinnevik and Access, Plans More E-Commerce in Emerging Markets," by Ingrid Lunden, TechCrunch.com, July 16, 2013; "Rocket Internet Raises $500M to Be the Biggest e-Commerce Incubator on Earth," by Sean Ludwig, VentureBeat.com, July 16, 2013; "eBay Acquires Germany's Leading Onine Person-to-Person Trading Site – Alando.de AG," Prnewswire.com, June 22, 2013; "Payleven, the Samwer's Square/PayPal Rival, Ramps Up Security with FSA Authorization, MasterCard mPOS Scheme," by Ingrid Lunden, TechCrunch.com, March 27, 2013; "Rocket Internet's New Site Reveals a Huge Global Cloning Operation in Full Flow," by Mike Butcher, TechCrunch.com, July 20, 2012.

TABLE 1.4 EVOLUTION OF E-COMMERCE

1995–2000 INVENTION	2001–2006 CONSOLIDATION	2007–PRESENT REINVENTION
Technology driven	Business driven	Mobile technology enables social, local, and mobile e-commerce
Revenue growth emphasis	Earnings and profits emphasis	Audience and social network connections emphasis
Venture capital financing	Traditional financing	Return of venture capital financing; buy-outs of start-ups by large firms
Ungoverned	Stronger regulation and governance	Extensive government surveillance
Entrepreneurial	Large traditional firms	Entrepreneurial social, mobile, and local firms
Disintermediation	Strengthening intermediaries	Proliferation of small online intermediaries renting business processes of larger firms
Perfect markets	Imperfect markets, brands, and network effects	Continuation of online market imperfections; commodity competition in select markets
Pure online strategies	Mixed "bricks-and-clicks" strategies	Return of pure online strategies in new markets; extension of bricks-and-clicks in traditional retail markets
First-mover advantages	Strategic-follower strength; complementary assets	First-mover advantages return in new markets as traditional Web players catch up
Low-complexity retail products	High-complexity retail products and services	Retail, services, and content

ASSESSING E-COMMERCE: SUCCESSES, SURPRISES, AND FAILURES

Looking back at the evolution of e-commerce, it is apparent that e-commerce has been a stunning technological success as the Internet and the Web ramped up from a few thousand to billions of e-commerce transactions per year, and this year will generate an estimated €1.96 trillion in total B2C revenues and around €14.2 trillion in B2B revenues, with around 1.4 billion online buyers in the United States. With enhancements

and strengthening, described in later chapters, it is clear that e-commerce's digital infrastructure is solid enough to sustain significant growth in e-commerce during the next decade. The Internet scales well. The "e" in e-commerce has been an overwhelming success.

From a business perspective, though, the early years of e-commerce were a mixed success, and offered many surprises. Only about 10% of dot-coms formed since 1995 have survived as independent companies in 2015. Only a very tiny percentage of these survivors are profitable. Yet online B2C sales of goods and services are still growing very rapidly. Contrary to economists' hopes, online sales are increasingly concentrated in the top ten retailers who account for over 50% of all online retail sales (Internet Retailer, 2015). So thousands of firms have failed, and those few that have survived dominate the market. The idea of thousands of suppliers competing on price has been replaced by a market dominated by giant firms. Consumers have learned to use the Web as a powerful source of information about products they actually purchase through other channels, such as at a traditional bricks-and-mortar store. For instance, a 2014 study found that almost 90% of those surveyed "webroomed" (researched a product online before purchasing at a physical store) (Interactions Consumer Experience Marketing, Inc., 2014). This is especially true of expensive consumer durables such as appliances, automobiles, and electronics. This offline "Internet-influenced" commerce is very difficult to estimate, but is believed to be somewhere around $1.5 trillion in 2015 (Forrester Research, 2014). Altogether then, B2C retail e-commerce (actual online purchases) and purchases influenced by online shopping but actually buying in a store (Internet-influenced commerce) are expected to amount to almost $1.9 trillion in 2015, or almost 40% of total retail sales in the United States. The "commerce" in e-commerce is basically very sound, at least in the sense of attracting a growing number of customers and generating revenues and profits for large e-commerce players.

Although e-commerce has grown at an extremely rapid pace in customers and revenues, it is clear that many of the visions, predictions, and assertions about e-commerce developed in the early years have not have been fulfilled. For instance, economists' visions of "friction-free" commerce have not been entirely realized. Prices are sometimes lower online, but the low prices are sometimes a function of entrepreneurs selling products below their costs. In some cases, online prices are higher than those of local merchants, as consumers are willing to pay a small premium for the convenience of buying online. Consumers are less price sensitive than expected; surprisingly, the Web sites with the highest revenue often have the highest prices. There remains considerable persistent and even increasing price dispersion: online competition has lowered prices, but price dispersion remains pervasive in many markets despite lower search costs (Levin, 2011; Ghose and Yao, 2010). In a study of 50,000 goods in the United Kingdom and the United States, researchers found Internet prices were sticky even in the face of large changes in demand, online merchants did not alter prices significantly more than offline merchants, and price dispersion across online sellers was somewhat greater than traditional brick and mortar stores (Gorodnichenko, et al., 2014). The concept of one world, one market, one price has not occurred in reality as entrepreneurs discover

new ways to differentiate their products and services. While for the most part Internet prices save consumers about 20% on average when compared to in-store prices, sometimes online prices are higher than for similar products purchased offline, especially if shipping costs are considered. For instance, prices on books and CDs vary by as much as 50%, and prices for airline tickets as much as 20% (Alessandria, 2009; Aguiar and Hurst, 2008; Baye, 2004; Baye et al., 2004; Brynjolfsson and Smith, 2000; Bailey, 1998a, b). Merchants have adjusted to the competitive Internet environment by engaging in "hit-and-run pricing" or changing prices every day or hour (using "flash pricing" or "flash sales") so competitors never know what they are charging (neither do customers); by making their prices hard to discover and sowing confusion among consumers by "baiting and switching" customers from low-margin products to high-margin products with supposedly "higher quality." Finally, brands remain very important in e-commerce—consumers trust some firms more than others to deliver a high-quality product on time and they are willing to pay for it (Rosso and Jansen, 2010).

The "perfect competition" model of extreme market efficiency has not come to pass. Merchants and marketers are continually introducing information asymmetries. Search costs have fallen overall, but the overall transaction cost of actually completing a purchase in e-commerce remains high because users have a bewildering number of new questions to consider: Will the merchant actually deliver? What is the time frame of delivery? Does the merchant really stock this item? How do I fill out this form? Many potential e-commerce purchases are terminated in the shopping cart stage because of these consumer uncertainties. Some people still find it easier to call a trusted catalog merchant on the telephone than to order on a Web site. Finally, intermediaries have not disappeared as predicted. Most manufacturers, for instance, have not adopted the manufacturer-direct sales model of online sales, and some that had, such as Sony, have returned to an intermediary model. Dell, one of the pioneers of online manufacturer-direct sales, has moved toward a mixed model heavily reliant on in-store sales where customers can "kick the tires;" Apple's physical stores are among the most successful stores in the world. People still like to shop in a physical store.

If anything, e-commerce has created many opportunities for middlemen to aggregate content, products, and services and thereby introduce themselves as the "new" intermediaries. Third-party travel sites such as Travelocity, Orbitz, and Expedia are an example of this kind of intermediary. E-commerce has not driven existing retail chains and catalog merchants out of business, although it has created opportunities for entrepreneurial online-only firms to succeed.

The visions of many entrepreneurs and venture capitalists for e-commerce have not materialized exactly as predicted either. First-mover advantage appears to have succeeded only for a very small group of companies, albeit some of them extremely well-known, such as Google, Facebook, Amazon, and others. Getting big fast sometimes works, but often not. Historically, first movers have been long-term losers, with the early-to-market innovators usually being displaced by established "fast-follower" firms with the right complement of financial, marketing, legal, and production assets needed to develop mature markets, and this has proved true for e-commerce as well. Many

e-commerce first movers, such as eToys, FogDog (sporting goods), Webvan (groceries), and Eve.com (beauty products), failed. Customer acquisition and retention costs during the early years of e-commerce were extraordinarily high, with some firms, such as E*Trade and other financial service firms, paying up to $400 to acquire a new customer. The overall costs of doing business online—including the costs of technology, site design and maintenance, and warehouses for fulfillment—are often no lower than the costs faced by the most efficient bricks-and-mortar stores. A large warehouse costs tens of millions of dollars regardless of a firm's online presence. The knowledge of how to run the warehouse is priceless, and not easily moved. The start-up costs can be staggering. Attempting to achieve or enhance profitability by raising prices has often led to large customer defections. From the e-commerce merchant's perspective, the "e" in e-commerce does not stand for "easy."

On the other hand, there have been some extraordinary, and unanticipated surprises in the evolution of e-commerce. Few predicted the impact of the mobile platform. Few anticipated the rapid growth of social networks or their growing success as advertising platforms based on a more detailed understanding of personal behavior than even Google has achieved. And few, if any, anticipated the emergence of on-demand e-commerce, which enables people to use their mobile devices to order up everything from taxis, to groceries, to laundry service.

1.3 UNDERSTANDING E-COMMERCE: ORGANIZING THEMES

Understanding e-commerce in its totality is a difficult task for students and instructors because there are so many facets to the phenomenon. No single academic discipline is prepared to encompass all of e-commerce. After teaching the e-commerce course for several years and writing this book, we have come to realize just how difficult it is to "understand" e-commerce. We have found it useful to think about e-commerce as involving three broad interrelated themes: technology, business, and society. We do not mean to imply any ordering of importance here because this book and our thinking freely range over these themes as appropriate to the problem we are trying to understand and describe. Nevertheless, as in previous technologically driven commercial revolutions, there is a historic progression. Technologies develop first, and then those developments are exploited commercially. Once commercial exploitation of the technology becomes widespread, a host of social, cultural, and political issues arise, and society is forced to respond to them.

TECHNOLOGY: INFRASTRUCTURE

The development and mastery of digital computing and communications technology is at the heart of the newly emerging global digital economy we call e-commerce. To understand the likely future of e-commerce, you need a basic understanding of the information technologies upon which it is built. E-commerce is above all else a technologically driven phenomenon that relies on a host of information technologies

as well as fundamental concepts from computer science developed over a 50-year period. At the core of e-commerce are the Internet and the Web, which we describe in detail in Chapter 2. Underlying these technologies are a host of complementary technologies: cloud computing, desktop computers, smartphones, tablet computers, local area networks, relational and non-relational databases, client/server computing, data mining, and fiber-optic switches, to name just a few. These technologies lie at the heart of sophisticated business computing applications such as enterprise-wide information systems, supply chain management systems, manufacturing resource planning systems, and customer relationship management systems. E-commerce relies on all these basic technologies—not just the Internet. The Internet, while representing a sharp break from prior corporate computing and communications technologies, is nevertheless just the latest development in the evolution of corporate computing and part of the continuing chain of computer-based innovations in business. **Figure 1.9** illustrates the major stages in the development of corporate computing and indicates how the Internet and the Web fit into this development trajectory.

To truly understand e-commerce, you will need to know something about packet-switched communications, protocols such as TCP/IP, client/server and cloud computing, mobile digital platforms, Web servers, HTML5, CSS, and software programming tools such as Flash and JavaScript on the client side, and Java, PHP, Ruby on Rails, and ColdFusion on the server side. All of these topics are described fully in Chapters 2 and 3.

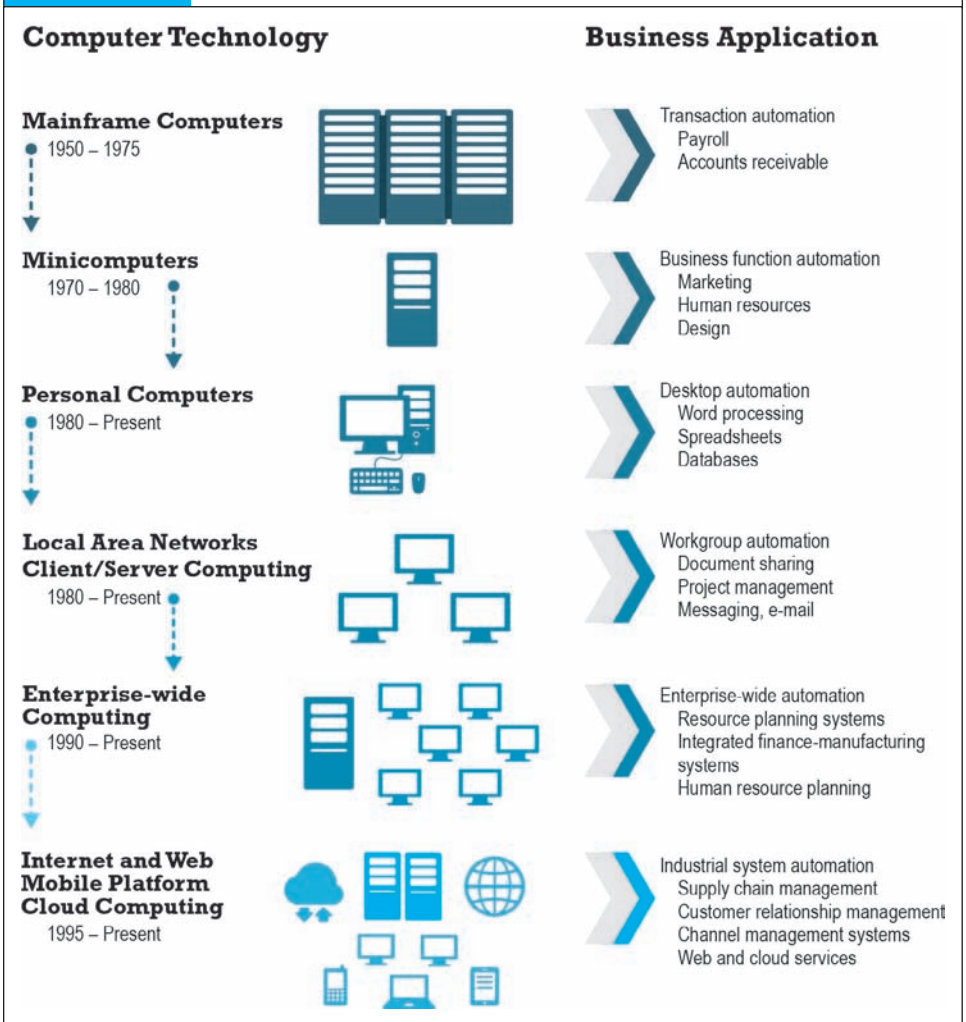
BUSINESS: BASIC CONCEPTS

While technology provides the infrastructure, it is the business applications—the potential for extraordinary returns on investment—that create the interest and excitement in e-commerce. New technologies present businesses and entrepreneurs with new ways of organizing production and transacting business. New technologies change the strategies and plans of existing firms: old strategies are made obsolete and new ones need to be invented. New technologies are the birthing grounds where thousands of new companies spring up with new products and services. New technologies are the graveyard of many traditional businesses. To truly understand e-commerce, you will need to be familiar with some key business concepts, such as the nature of digital markets, digital goods, business models, firm and industry value chains, value webs, industry structure, digital disruption, and consumer behavior in digital markets, as well as basic concepts of financial analysis. We'll examine these concepts further in Chapters 5 through 12.

SOCIETY: TAMING THE JUGGERNAUT

With 3.1 billion people now using the Internet worldwide, the impact of the Internet and e-commerce on society is significant and global. Increasingly, e-commerce is subject to the laws of nations and global entities. You will need to understand the pressures that global e-commerce places on contemporary society in order to conduct a successful

FIGURE 1.9 THE INTERNET AND THE EVOLUTION OF CORPORATE COMPUTING



The Internet and Web, and the emergence of a mobile platform held together by the Internet cloud, are the latest in a chain of evolving technologies and related business applications, each of which builds on its predecessors.

e-commerce business or understand the e-commerce phenomenon. The primary societal issues we discuss in this book are individual privacy, intellectual property, and public welfare policy.

Because the Internet and the Web are exceptionally adept at tracking the identity and behavior of individuals online, e-commerce raises difficulties for preserving privacy—the ability of individuals to place limits on the type and amount of

information collected about them, and to control the uses of their personal information. Read the *Insight on Society* case, *Facebook and the Age of Privacy,* to get a view of some of the ways e-commerce sites use personal information.

Because the cost of distributing digital copies of copyrighted intellectual property—tangible works of the mind such as music, books, and videos—is nearly zero on the Internet, e-commerce poses special challenges to the various methods societies have used in the past to protect intellectual property rights.

The global nature of e-commerce also poses public policy issues of equity, equal access, content regulation, and taxation. For instance, in the United States, public telephone utilities are required under public utility and public accommodation laws to make basic service available at affordable rates so everyone can have telephone service. Should these laws be extended to the Internet and the Web? If goods are purchased by a New York State resident from a Web site in California, shipped from a center in Illinois, and delivered to New York, what state has the right to collect a sales tax? Should some heavy Internet users who consume extraordinary amounts of bandwidth by streaming endless movies be charged extra for service, or should the Internet be neutral with respect to usage? What rights do nation-states and their citizens have with respect to the Internet, the Web, and e-commerce? We address issues such as these in Chapter 8, and also throughout the text.

ACADEMIC DISCIPLINES CONCERNED WITH E-COMMERCE

The phenomenon of e-commerce is so broad that a multidisciplinary perspective is required. There are two primary approaches to e-commerce: technical and behavioral.

Technical Approaches

Computer scientists are interested in e-commerce as an exemplary application of Internet technology. They are concerned with the development of computer hardware, software, and telecommunications systems, as well as standards, encryption, and database design and operation. Operations management scientists are primarily interested in building mathematical models of business processes and optimizing these processes. They are interested in e-commerce as an opportunity to study how business firms can exploit the Internet to achieve more efficient business operations. The information systems discipline spans the technical and behavioral approaches. Technical groups within the information systems specialty focus on data mining, search engine design, and artificial intelligence.

Behavioral Approaches

From a behavioral perspective, information systems researchers are primarily interested in e-commerce because of its implications for firm and industry value chains, industry structure, and corporate strategy. Economists have focused on online consumer behavior, pricing of digital goods, and on the unique features of digital electronic markets. The marketing profession is interested in marketing, brand development and extension, online consumer behavior, and the ability of e-commerce technologies to

INSIGHT ON SOCIETY

FACEBOOK AND THE AGE OF PRIVACY

In a January 2010 interview, Mark Zuckerberg, the founder of Facebook, proclaimed that the age of privacy had to come to an end. According to Zuckerberg, people were no longer worried about sharing their personal information with friends, friends of friends, or even the entire Web. Supporters of Zuckerberg's viewpoint believe the twenty-first century is a new era of openness and transparency. If true, this is good news for Facebook because its business model is based on selling access to a database of personal information.

However, not everyone is a true believer. Privacy—limitations on what personal information government and private institutions can collect and use—is a founding principle of democracies. A decade's worth of privacy surveys in the United States show that well over 80% of the American public fear the Internet is a threat to their privacy.

With about 1.5 billion monthly users worldwide, and around 165 million in North America, Facebook's privacy policies are going to shape privacy standards on the Internet for years to come. The economic stakes in the privacy debate are quite high, involving billions in advertising and transaction dollars. Facebook's business model is based on building a database of billions of users who are encouraged, or even perhaps deceived, into relinquishing control over personal information, which is then sold to advertisers and other third parties. The less privacy Facebook's users want or have, the more Facebook profits. Eliminating personal information privacy is built into Facebook's DNA.

Facebook's current privacy policies are quite a flip-flop from its original policy in 2004, which promised users near complete control over who could see their personal profile. However, every year since 2004, Facebook has attempted to extend its control over user information and content, often without notice. For instance, in 2007, Facebook introduced the Beacon program, which was designed to broadcast users' activities on participating Web sites to their friends. After a public outcry, Facebook terminated the Beacon program, and paid $9.5 million to settle a host of class action lawsuits. In 2009, undeterred by the Beacon fiasco, Facebook unilaterally decided that it would publish users' basic personal information on the public Internet, and announced that whatever content users had contributed belonged to Facebook, and that its ownership of that information never terminated. However, as with the Beacon program, Facebook's efforts to take permanent control of user information resulted in users joining online resistance groups and it was ultimately forced to withdraw this policy as well.

In 2011, Facebook began publicizing users' "likes" of various advertisers in Sponsored Stories (i.e., advertisements) that included the users' names and profile pictures without their explicit consent, without paying them, and without giving them a way to opt out. This resulted in yet another class action lawsuit, which Facebook settled for $20 million in June 2012. (Facebook dropped Sponsored Stories in April 2014.) In 2011, Facebook enrolled all Facebook subscribers into its facial recognition program without notice. This too raised the privacy alarm, forcing Facebook to make it easier for users to opt out.

In May 2012, Facebook went public, creating even more pressure to increase revenues and profits to justify its stock market value. Shortly thereafter, Facebook announced that it was launching a mobile advertising product that pushes ads to the mobile news feeds of

(continued)

users based on the apps they use through the Facebook Connect feature, without explicit permission from the user to do so. It also announced Facebook Exchange, a program that allows advertisers to serve ads to Facebook users based on their browsing activity while not on Facebook. Privacy advocates raised the alarm yet again and more lawsuits were filed by users. In 2013, Facebook agreed to partner with several data marketing companies that deliver targeted ads based on offline data. The firms provide customer data to Facebook, which then allows Facebook advertisers to target their ads to those users based on that data.

In December 2013, another class action lawsuit was filed against Facebook by users alleging that it violated their privacy by scanning users' private Facebook messages and mining them for data such as references to URLs that Facebook could then sell to advertisers. In May 2014, an enhancement to Facebook's mobile app that allows the app to recognize the music, television show, or movie playing in the background when a user makes a status update raised a new privacy alarm. In 2015, Facebook implemented a "new" privacy policy that allows it to share user personal data across partner sites and apps, including WhatsApp and Instagram. Also in 2015, Facebook admitted that its Facebook Messenger app collected and shared user geolocation as the default setting. After negative publicity, it changed the default to "do not share."

After all these lawsuits and online public protests, one might think that Facebook's privacy policy would improve. But an academic analysis of Facebook's privacy policies from 2008 to 2015 found that on most measures of privacy protection, Facebook's policies have worsened. Since 2008, Facebook has made it more difficult for users to find out what information is being shared with whom, how it builds profiles, or how to change privacy settings. Its privacy policies have become less readable, even inscrutable, according to the researchers.

Facebook is certainly aware of consumer suspicion of its privacy policies, and it changes its policies almost yearly in response to criticism. But the response is often not helpful for users, and typically extends the company's claims to do whatever it wants with personal information. Its latest privacy policy, implemented in 2015, claims to switch its default privacy settings for new users from Public to Friends, provide a Privacy Checkup tool for users, and give users the ability to see the data it keeps on their likes and interests, and enable users to change, delete, or add to that data. Facebook argues this new policy gives users more control of the ads they are shown. Analysts point out, however, that using these new features requires users to navigate a maze of check boxes and menus that are difficult to understand even for expert Facebook users. Facebook's growth in North America has steadily declined in part because users have come to realize that everything they post or say on Facebook will be given over to advertisers. There is no privacy on Facebook. People who are concerned about their privacy, analysts have concluded, should delete their Facebook accounts.

SOURCES: "Facebook Rescinds Internship to Harvard Student Who Exposed a Privacy Flaw in Messenger," by Robert Gabelhoff, *Washington Post,* August 14, 2015; "Did You Really Agree to That? The Evolution of Facebook's Privacy Policy," by Jennifer Shore and Jill Steinman, *Technology Science,* August 11, 2015; "Facebook's Privacy Incident Response: A Study of Geolocation Sharing on Facebook Messenger," by Aran Khanna, *Technology Science,* August 11, 2015; "Sharing Data, but Not Happily," by Natasha Singer, *New York Times*, June 4, 2015; "How Your Facebook Likes Could Cost You a Job," by Anna North, *New York Times,* January 20, 2015; "Facebook Stops Irresponsibly Defaulting Privacy of New Users' Posts to 'Public,' Changes to 'Friends,'" by Josh Constine, Techcrunch.com, May 22, 2014; "Facebook Users Revolt Over Privacy Feature—Enables Microphone in Apps," by Jan Willem Aldershoff, Myce.com, June 9, 2014; "Didn't Read Those Terms of Service? Here's What You Agreed to Give Up," by Natasha Singer, *New York Times*, April 28, 2014; "Facebook Eliminates Sponsored Stories—Will It Matter to Advertisers?," by Amy Durbin, Mediapost.com, February 25, 2014; "Facebook Sued for Allegedly Intercepting Private Messages," by Jennifer Van Grove, Cnet.com, January 2, 2014; "Facebook to Partner with Data Brokers," by Bob Sullivan, Redtape.nbcnews.com, February 26, 2013; "Facebook Exchange Ads Raise Privacy Concerns," by Mikal E. Belicove, Cnbc.com, June 21, 2012; "Facebook Suit Over Subscriber Tracking Seeks $15 Billion," by Kit Chellel and Jeremy Hodges, Bloomberg.com, May 19, 2012; "How Facebook Pulled a Privacy Bait and Switch," by Dan Tynan, *PC World*, May 2010.

segment and target consumer groups, and differentiate products. Economists share an interest with marketing scholars who have focused on e-commerce consumer response to marketing and advertising campaigns, and the ability of firms to brand, segment markets, target audiences, and position products to achieve above-normal returns on investment.

Management scholars have focused on entrepreneurial behavior and the challenges faced by young firms who are required to develop organizational structures in short time spans. Finance and accounting scholars have focused on e-commerce firm valuation and accounting practices. Sociologists—and to a lesser extent, psychologists—have focused on general population studies of Internet usage, the role of social inequality in skewing Internet benefits, and the use of the Web as a social network and group communications tool. Legal scholars are interested in issues such as preserving intellectual property, privacy, and content regulation.

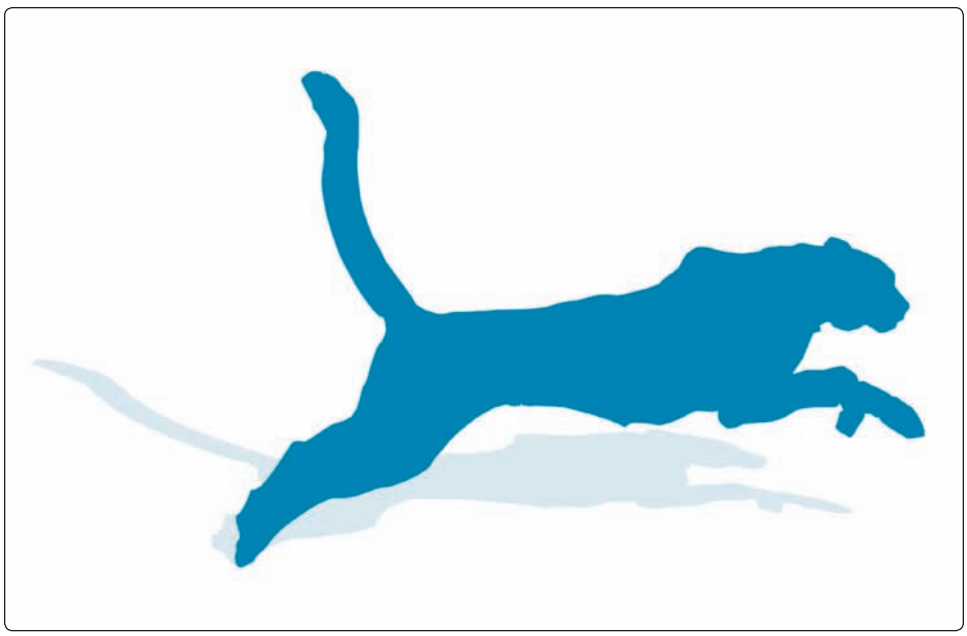
No one perspective dominates research about e-commerce. The challenge is to learn enough about a variety of academic disciplines so that you can grasp the significance of e-commerce in its entirety.

1.4 CASE STUDY

Puma
Goes Omni

When Puma, one of the world's top sports footwear, apparel, and accessories brands, conceived its Love=Football campaign in 2010, the goal was to create a memorable tagline in a language that would be understood the world over—pictures. In the process, the company stumbled upon the power of social marketing. Puma's ad agency, Droga5, filmed a light-hearted commercial featuring scruffy everyday men in a Tottenham pub singing love songs to their Valentines. The video went viral, garnering more than 130 million impressions and spawning hundreds of homemade response videos. In 2015, Puma launched an ad campaign called Forever Faster, featuring videos of celebrities and professional athletes training to meet their goals, including sprinter Usain Bolt and pop star Rihanna, whom the company also named its women's creative director. The campaign has been another major success, driving sales of Puma's Ignite XT shoe and further rejuvenating its brand.

Puma maintains an extensive presence on Facebook, Twitter, Instagram, Pinterest, and YouTube and closely integrates its social strategy with its other marketing channels



with an eye towards driving the conversation and deepening its engagement with consumers. It uses social media in part to better understand the different regional and sub-brand audiences within more than 120 countries in which it operates. Not all content is suitable for every one of its 14+ million global Facebook fans. Dedicated sport, country, region, and product category pages were created for each social network. For several years, Puma took a trial-and-error approach, focusing on building its follower base. Today, Puma uses a data-driven approach, geo-targeting posts at the appropriate times of day to maximize fan engagement and generate the right mix of online content to best drive sales. A tab for its iPhone app sends followers directly to Apple's App Store, substantially boosting sales. This integration of channels into a cohesive customer acquisition strategy is in fact a key element of the emerging world of omni-channel retailing.

The advent of the term omni-channel signals the evolution of multi-channel or cross-channel retailing to encompass all digital and social technologies. The idea is that customers can examine, access, purchase, and return goods from any channel, and even change channels during the process, and receive timely and relevant product information at each step along the way and in each channel. The rise of social networks and the personalized retail it engenders is a primary driver of omni-channel—the complete integration of the shopping and brand experience. Marketing efforts must be unified undertakings combining offline events and sales and online promotions and brand building that not only employ all available channels but provide multiple opportunities for customer involvement. For a company like Puma, with e-commerce sites in the United States, Russia, Canada, China, India, Switzerland, Germany, France, the United Kingdom, and a European site that serves multiple countries in multiple languages, this presents quite a challenge.

Puma's Global Head of E-Commerce, Tom Davis, has overseen a major restructuring of its e-commerce business. Puma was not fully prepared to compete with Adidas, Nike, and other sports apparel companies in a global market that was rapidly shifting away from mature Western markets and desktop commerce. To coordinate market rollouts and ensure a unified brand image, Puma's regional e-commerce teams needed oversight. A command center took over brand strategy and investment decisions, leaving daily operational and locality-based decision-making to the regional teams. Unified content and product strategies were developed in addition to a centralized product database. One central Web site replaced multiple e-commerce sites on different platforms. Demandware, Puma's main e-commerce platform, was used to simplify managing global e-commerce operations from a central digital platform, though several other e-commerce platforms are still used. The goal was to achieve a consistent and cohesive brand building strategy so that the teams would all be on the same page and decisions could be more quickly reached. Yet local customization of the message and ensuring that globally produced goods meet local requirements would still be most efficiently handled.

Puma assigned the overhaul of its Web site to Viget, a Web design firm. It created templates to unite several Puma sites into one and unify the look across numerous categories and content types. A dozen category sites now complement Puma.com, with a custom-built content management system (CMS) ensuring that consistent Puma branding

and navigation are maintained across all sub-sites and pages. Category managers can customize home pages outside of the template layout. The flexibility to roll out local, regional, or global campaigns is thus built into the Web site design. What's more, the CMS integrates with a language translation tool, a Storefinder tool that helps visitors locate Puma stores, and Puma's product inventory manager. The design changes have improved site visualization and navigation, prompting customers to spend twice as much time on the site and raising the order rate by 7.1%.

The Viget team then turned to the mobile site, first incorporating Storefinder into the interface. Using the GPS capability of the mobile device, Puma stores nearest to the user can be located, along with address and contact information. Users experience the same content and appearance as Puma.com and each of the category sites, managed by the same CMS. Puma's mobile site has also been rebuilt using responsive design features. Puma also incorporated mobile into its omni-channel marketing strategy. The Puma Joy Pad—32 synchronized iPads mounted on a wall—allows shoppers at its flagship Paris store and other select locations to play games and experiment with Web apps. In the near future, shoppers will be able to generate content that they can share with their social networks, and walls will be connected so that customers in stores around the globe will be able to share their shopping experiences. On Black Friday 2014, 3.4% of mobile visitors to Puma's site made a purchase, compared to just 1.6% the previous year. In 2013, Puma released PUMATRAC, an iPhone app that automatically analyzes environmental conditions to give runners feedback on how these variables impact their performance. The app offers multiple options to share statistics and routes with other runners.

In 2014, Puma focused on unifying its branding efforts and e-commerce Web sites within one centralized site. The company has also solidified its worldwide e-commerce teams. In the past, Puma maintained nine independent e-commerce teams on five continents. Currently, it is working towards teams divided into the three major segments that comprise the majority of its sales—North America, Europe, and Asia-Pacific—as well as a global unit that operates at a level above these regional segments. The goal is to centralize Puma's e-commerce business both at one e-commerce site as well as internally within the company. At the same time, the company hopes to pursue a strategy that is flexible and focused more on the precise local needs in individual markets. These changes have already reaped rewards, improving conversion rates from 10% to 20% and boosting average order value by 12%. Centralizing its e-commerce operations under a single site also helps Puma better collect customer data to personalize marketing and develop more appealing products.

Although over the past three years Puma has gained invaluable omni-channel experience, racked up social marketing accomplishments, and laid the groundwork for resurgent e-commerce success, implementing a successful omni-channel strategy is a monumental task. In 2013 and 2014, Puma's profits sagged, and the company claimed its increased marketing budget was the reason while insisting that their strategy would pay dividends in the future. Puma knows it cannot compete on price with mass merchandisers such as Amazon and Zappos, and it cannot control Puma product presentation in those venues.

SOURCES: "Puma's Sales Start Seeing Boost from Marketing Spend," Reuters.com, July 24, 2015; "Puma Share Price up, States Narrower Loss on 'Forever Faster,'" Binarytribune.com, February 20, 2015; "Puma Boss: Our Future Is Female," by Shona Ghosh, Marketingmagazine.co.uk, February 18, 2015; "Inside Puma's Branded Content Strategy," by Lucia Moses, Digiday.com, December 15, 2014; "The Case of Puma: Can Tmall and In-House E-Store Co-Exist in China?" by Gelati Ting, Fashionbi.com, June 26, 2014; "Puma Understands the Importance of Local Needs in a Global E-commerce Rollout," by Derek Du Preez, Diginomica.com, June 24, 2014; "Puma and Newegg Discuss Their Entry Into the China E-commerce Market," Cdnetworks.com, June 3, 2014; "How Puma Is Improving Sales Operations Through E-commerce," by Paul Demery, Internetretailer.com, May 20, 2014; "Clients: Puma," Demandware.com, accessed October 20, 2013; "Droga5 Case Studies: The HardChorus," Droga5.com, accessed October 20, 2013; "Puma Launches Innovative New Running App," News.puma.com, October 2, 2013; "Puma's Unified Approach to Global E-commerce," Ecommercefacts.com, August 5, 2013; "Puma's Head of E-Commerce: Changes and Challenges of Customization in the Apparel Industry," Masscustomization.de, July 16, 2013; "Puma Tries Out Mobile Photo-sharing with Rewards-based Campaign," by Lauren Johnson, Mobilemarketer.com, June 21, 2013; "PUMA: Challenges in an Omni-channel World," Embodee.com, May 3, 2013; "Puma Goes Mobile to Create Urban Playgrounds in Asia,"

External loss of brand control necessitates superior product content, product information management, and shopping experience internally, precisely the skills it has been nurturing. Puma's ability to adapt its strategy to individual areas is also likely to help the company advance into China, a growing market where Puma has traditionally had minimal presence. This flexibility allowed Puma to adapt to Chinese e-commerce giant Alibaba's Tmall platform, where it holds a strong brand score. In 2015, Puma finally began to see results from its innovative advertising, product development, and centralization efforts as its earnings rebounded to beat analysts' estimates, growing by 18% over its second quarter from 2014. Puma CEO Bjorn Gulden believes that 2014 and 2015 represent a turning point for the Puma brand back to profitability.

by Adaline Lau, Clickz.com, November 23, 2012; "Puma Embraces Mobile, Fun Tech to Attract Buyers," by Mark Walsh, Mediapost.com, November 14, 2012; "The 10 Best-Branded Companies on Instagram," by Allyson Galle, Blog.hubspot.com, May 18, 2012; "3 Shoe Brands Kicking Butt with Social Media," by Lauren Indvik, Mashable.com, February 6, 2012; "Why Brands Like Puma and GE Are Flocking to Instagram," by Cotton Delo, Adage.com, January 17, 2012.

Case Study Questions

1. What is the purpose of Puma's content management system?
2. Why did Puma build a single centralized Web site rather than continue with multiple Web sites serving different countries and regions?
3. What social media sites does Puma use, and what do they contribute to Puma's marketing effort?

1.5 REVIEW

KEY CONCEPTS

■ **Define e-commerce and describe how it differs from e-business.**

- E-commerce involves digitally enabled commercial transactions between and among organizations and individuals. Digitally enabled transactions include all those mediated by digital technology, meaning, for the most part, transactions that occur over the Internet, the Web, and/or via mobile devices. Commercial transactions involve the exchange of value (e.g., money) across organizational or individual boundaries in return for products or services.
- E-business refers primarily to the digital enabling of transactions and processes within a firm, involving information systems under the control of the firm. For the most part, e-business does not involve commercial transactions across organizational boundaries where value is exchanged.

■ **Identify and describe the unique features of e-commerce technology and discuss their business significance.**

There are eight features of e-commerce technology that are unique to this medium:

- *Ubiquity*—available just about everywhere, at all times, making it possible to shop from your desktop, at home, at work, or even from your car.
- *Global reach*—permits commercial transactions to cross cultural and national boundaries far more conveniently and cost-effectively than is true in traditional commerce.

- *Universal standards*—shared by all nations around the world, in contrast to most traditional commerce technologies, which differ from one nation to the next.
- *Richness*—enables an online merchant to deliver marketing messages in a way not possible with traditional commerce technologies.
- *Interactivity*—allows for two-way communication between merchant and consumer and enables the merchant to engage a consumer in ways similar to a face-to-face experience, but on a much more massive, global scale.
- *Information density*—is the total amount and quality of information available to all market participants. The Internet reduces information collection, storage, processing, and communication costs while increasing the currency, accuracy, and timeliness of information.
- *Personalization* and *customization*—the increase in information density allows merchants to target their marketing messages to specific individuals and results in a level of personalization and customization unthinkable with previously existing commerce technologies.
- *Social technology*—provides a many-to-many model of mass communications. Millions of users are able to generate content consumed by millions of other users. The result is the formation of social networks on a wide scale and the aggregation of large audiences on social network platforms.

■ Describe the major types of e-commerce.

There are six major types of e-commerce:

- *B2C e-commerce* involves businesses selling to consumers and is the type of e-commerce that most consumers are likely to encounter.
- *B2B e-commerce* involves businesses selling to other businesses and is the largest form of e-commerce.
- *C2C e-commerce* is a means for consumers to sell to each other. In C2C e-commerce, the consumer prepares the product for market, places the product for auction or sale, and relies on the market maker to provide catalog, search engine, and transaction clearing capabilities so that products can be easily displayed, discovered, and paid for.
- *Social e-commerce* is e-commerce that is enabled by social networks and online social relationships.
- *M-commerce* involves the use of wireless digital devices to enable online transactions.
- *Local e-commerce* is a form of e-commerce that is focused on engaging the consumer based on his or her current geographic location.

■ Understand the evolution of e-commerce from its early years to today.

E-commerce has gone through three stages: innovation, consolidation, and reinvention.

- The early years of e-commerce were a technological success, with the digital infrastructure created during the period solid enough to sustain significant growth in e-commerce during the next decade, and a mixed business success, with significant revenue growth and customer usage, but low profit margins.
- E-commerce entered a period of consolidation beginning in 2001 and extending into 2006.
- E-commerce entered a period of reinvention in 2007 with the emergence of the mobile digital platform, social networks, and Web 2.0 applications that attracted huge audiences in a very short time span.

■ Describe the major themes underlying the study of e-commerce.

E-commerce involves three broad interrelated themes:

- *Technology*—To understand e-commerce, you need a basic understanding of the information technologies upon which it is built, including the Internet, the Web, and mobile platform, and a host of complementary technologies—cloud computing, desktop computers, smartphones, tablet computers, local area networks, client/server computing, packet-switched communications, protocols such as TCP/IP, Web servers, HTML, and relational and non-relational databases, among others.

- *Business*—While technology provides the infrastructure, it is the business applications—the potential for extraordinary returns on investment—that create the interest and excitement in e-commerce. Therefore, you also need to understand some key business concepts such as electronic markets, information goods, business models, firm and industry value chains, industry structure, and consumer behavior in digital markets.
- *Society*—Understanding the pressures that global e-commerce places on contemporary society is critical to being successful in the e-commerce marketplace. The primary societal issues are intellectual property, individual privacy, and public policy.

■ Identify the major academic disciplines contributing to e-commerce.

There are two primary approaches to e-commerce: technical and behavioral. Each of these approaches is represented by several academic disciplines. On the technical side, this includes computer science, operations management, and information systems. On the behavioral side, it includes information systems as well as sociology, economics, finance and accounting, management, and marketing.

QUESTIONS

1. What does omni-channel mean in terms of e-commerce presence?
2. What is information asymmetry?
3. What are some of the unique features of e-commerce technology?
4. What are some of the factors driving the growth of social e-commerce?
5. What are three benefits of universal standards?
6. How does the ubiquity of e-commerce impact consumers?
7. Name three of the business consequences that can result from growth in information density.
8. What difficulties are presented in trying to measure the number of Web pages in existence?
9. Give examples of B2C, B2B, C2C, and social, mobile, and local e-commerce besides those listed in the chapter.
10. How are e-commerce technologies similar to or different from other technologies that have changed commerce in the past?
11. Describe the three different stages in the evolution of e-commerce.
12. Define disintermediation and explain the benefits to Internet users of such a phenomenon. How does disintermediation impact friction-free commerce?
13. What are some of the major advantages and disadvantages of being a first mover?
14. What is a network effect, and why is it valuable?
15. Discuss the ways in which the early years of e-commerce can be considered both a success and a failure.
16. What are five of the major differences between the early years of e-commerce and today's e-commerce?
17. Why is a multidisciplinary approach necessary if one hopes to understand e-commerce?
18. Why is the term "sharing economy" a misnomer?
19. What are those who take a behavioral approach to studying e-commerce interested in?
20. Why has Rocket Internet been criticized, and how do the Samwer brothers respond to that criticism?

PROJECTS

1. Choose an e-commerce company and assess it in terms of the eight unique features of e-commerce technology described in Table 1.2. In your opinion, which of the features does the company implement well, and which features poorly? Prepare a short memo to the president of the company you have chosen detailing your findings and any suggestions for improvement you may have.

2. Search the Web for an example of each of the major types of e-commerce described in Section 1.1 and listed in Table 1.3. Create a presentation or written report describing each company (take a screenshot of each, if possible), and explain why it fits into the category of e-commerce to which you have assigned it.

3. Given the development and history of e-commerce in the years from 1995–2015, what do you predict we will see during the next five years of e-commerce? Describe some of the technological, business, and societal shifts that may occur as the Internet continues to grow and expand. Prepare a brief presentation or written report to explain your vision of what e-commerce will look like in 2019.

4. Prepare a brief report or presentation on how companies are using Instagram or another company of your choosing as a social e-commerce platform.

5. Follow up on events at Uber since October 2015 (when the opening case was prepared). Prepare a short report on your findings.

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CHAPTER 2

E-commerce Infrastructure

LEARNING OBJECTIVES

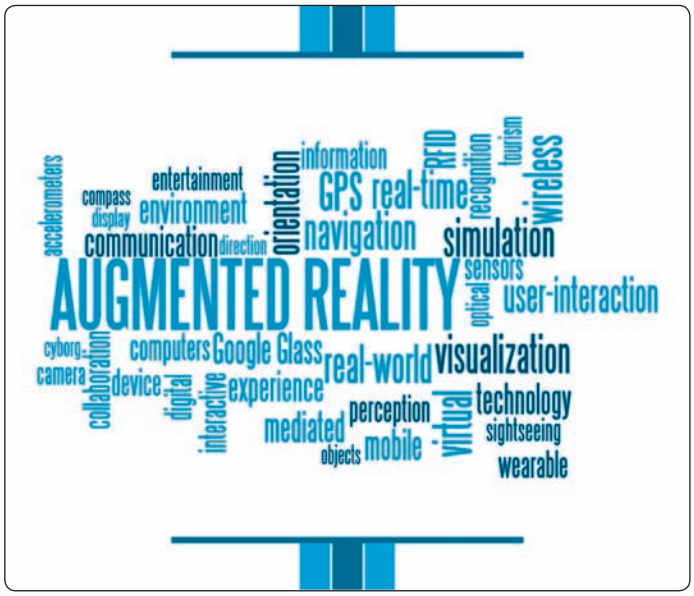
After reading this chapter, you will be able to:

- Discuss the origins of, and the key technology concepts behind, the Internet.
- Explain the current structure of the Internet.
- Understand the limitations of today's Internet and 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.

Wikitude, Layar, and Blippar:

Augment My Reality

Walk down the street in any city and count the number of people pecking away at their smartphones. Ride the train, and observe how many fellow travelers are using a tablet. Today, one of the primary means of accessing the Internet is via a mobile device. Traditional desktop computers still play a role, but in 2015, 2.25 billion people worldwide use a mobile device to access the Internet, and over 45% of total Internet traffic comes from mobile devices. That percentage is only going to grow. The mobile platform provides the foundation for a number of unique new services, including augmented reality, which involves content (text, video, and sound) that is superimposed over live images in order to enrich the user's experience.



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Augmented reality combines the geolocating functionality built into smartphones to bring together location, and context, helping the user understand his or her environment better. Wikitude is one of the most prominent examples of the many augmented reality platforms in development. It is a "points of interest" location-based service that uses the same kind of wiki tools that power Wikipedia, the online encyclopedia. The Wikitude 8 app is available for all major mobile operating systems, and the company released the latest edition of its developer kit, SDK 5.0 in August 2015. When users examine objects and locations using the Wikitude app on their smartphones, the app uses smartphone features like GPS and the accelerometer to display information on over 100 million points of interest gathered from Wikipedia, Yelp, and other third-party services. Wikitude most often functions as a very sophisticated travel guide as well as an advertising platform, allowing merchants to advertise their local offerings and discount coupons based on where the user is located.

Organizations throughout Europe and the rest of world are using Wikitude to create custom apps for a variety of purposes. Fashion retailer Zalando and concept car manufacturer Rinspeed collaborated with Wikitude to produce an augmented reality display inside Rinspeed's latest vehicle. Wikitude and eoVision, which offers services and products related to Earth's observation and geoinformation, collaborated on a book entitled "one

earth," which has 119 pages of satellite images that analyze the environment and display maps, descriptions, 3D modeling, and advanced augmented reality technology to deliver an entirely new media experience. Wikitude technology also features prominently in the companion app to "Who We Are: One Direction," an autobiography of the popular band One Direction, released in 2014. App users can place their mobile device over photographs and other areas of the book, allowing them to view exclusive videos, interviews, and other interactive material. The app was downloaded more than 60,000 times in the two weeks after its launch. Wikitude's app platform was used in a 2015 exhibit of dinosaurs at the St. Louis Science Center, allowing kids to interact with virtual dinosaurs in a jungle environment.

Layar, a Wikitude competitor that also offers an augmented reality browser, also offers services that allow users to hold up a smartphone to a real-life object and receive an overlay of data about it, including advertising offers. In 2014, Layar was acquired by fellow augmented reality start-up Blippar, an image recognition platform used in digital advertising. Blippar creates "blipps" in which users snap pictures of products to view content-rich, interactive experiences via mobile devices. The move gives Layar the ability to compete with a wider array of AR and VR companies. Although Blippar announced losses of approximately $7.5 million over its last financial year in 2015, the company's revenue grew 45% over that span, and after a $45 million round of funding, Blippar reached a valuation of $1.5 billion. Advertisers are lining up to work with Blippar, including hundreds of the top newsstand magazines in the world, which agreed in 2015 to make their magazines compatible with Blippar advertising and interactive features.

More and more commercial applications of augmented reality technology are being introduced every day. Yellow Pages has tested 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. Yelp, TripAdvisor, and Lonely Planet are just a few of the travel companies that have introduced some aspects of augmented reality to their apps.

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 try on clothing from online shops.

Gaming is another area where augmented reality is expected to make a big splash. Oculus VR is gaining traction despite the fact that its Oculus Rift headset is not slated to ship to consumers until 2016. Although the headset was originally conceived as a gaming platform, Oculus Rift has potential applications for virtual reality training programs, performing advanced medical procedures, and any number of other more practical uses. And the VR gaming landscape is getting more crowded. Two former employees from gaming company Valve received over $400,000 in Kickstarter funding in under two days

SOURCES: "Blippar Bringing Augmented Reality to Newsstand Mags," by Peter Graham, Vrfocus.com, October 15, 2015; "Dinosaurs Invading St. Louis Science Center," Wikitude.com, accessed October 2015; "Why It's Taken So Long for the Oculus Rift to Ship," by Lily Prasuethsut, Techradar.com, September 24, 2015; "Here's Everything We Know About Apple's Augmented Reality Plans," by Chris Neiger, Fool.com, September 3, 2015; "How Will the Vive Headset Delay Affect the IR Market?" by Chris Morris, *Fortune*, August 28, 2015; "British Tech Startup Blippar Eyes New Funding After £4.96m Loss," by Stuart Dredge, *The Guardian,* August 18, 2015; "Google Glass Isn't Dead—But It's All About Enterprise for Now," by Eric Johnson and Mark Bergen, Recode.com, July 30, 2015; "Watch What castAR's Projected Augmented Reality Can Do," by Nicole Lee, Engadget.com, February 21, 2015; "One Direction '1D Official Book' Companion App," Wikitude.com, accessed November 25, 2014; "castAR Bets Big on Its Augmented Reality Hardware with Move to Silicon Valley," by Nicole Lee, Engadget.com, October 17, 2014; "Apple's iPhone-based Augmented Reality Navigation Concept Has 'X-Ray Vision' Features," by Mikey Campbell, Appleinsider.com, September 4, 2014; "UK Startup Blippar Confirms It Has Acquired AR Pioneer Layar," by Mike Butcher, Techcrunch.com, June 18, 2014; "Augmented Reality Augmentation: Blippar Has Bought Layar," by Ingrid Lunden, Techcrunch.com, June 10, 2014; "Layar Now Wants to Augment Your Reality with Its Google Glass App," by Ben Woods, Thenextweb.com, March 19, 2014; "Wikitude Opens Its Augmented Reality SDK to Glass Developers," by Matt McGee, Glassalmanac.com, February 21, 2014; "Trentino 2013 Fiemme Nordic Ski Championships," Wikitude.com, accessed October 2013; "Augmented Reality Tech Hits Funding Goal," by Eddie Makuch, Gamespot.com, October 16, 2013; "Google Niantic's Ingress Augmented-Reality Game Grows with Real-Time Events," by

and over $1 million in total for its castAR augmented reality gaming project, which uses glasses, an RFID tracking grid, and a controller to enable augmented reality gaming. The company moved to Silicon Valley in 2014 to hire more talented hardware engineers and meet increased production demands. In 2015, the castAR developers released a video of the headset in action, showing users playing 3D and virtual reality games, viewing building plans in 3D, and browsing the Web in an immersive environment. Many other gaming companies are considering the possibilities for augmented reality in future projects, including the HTC Vive and Sony's Playstation VR.

One of the most promising platforms for augmented reality was Google Glass, a pair of glasses capable of a variety of augmented and virtual reality applications, but the device failed to gain traction and was discontinued in 2015. However, Google plans to release an updated version of the technology in late 2015, with an emphasis on use in the workplace.

Rumor also has it that Apple may be planning its own augmented reality foray, which may be the final push needed to put augmented reality squarely into the mainstream. Apple has applied for and won patents involving augmented reality technologies from 2013 to 2015. Apple appears to be developing a system that can provide virtual overlays of their surroundings akin to Layar, but which also will include "x-ray vision" that allows users to look behind walls of select structures. A combination of a live feed from the iPhone's camera and local sensor information would pinpoint a user's position and generate an interactive wireframe model of their immediate surroundings. Users will be able to manipulate the frame so that it matches their view. Applications for the service could be as an advanced version of Apple's Maps service, complete with capability for local businesses to advertise and generate special offers based on Apple's granular user data.

Dean Takahashi, VentureBeat, October 15, 2013; "Wikitude and eoVision Bring Augmented Reality to the Frankfurt Book Fair," Wikitude.com, October 10, 2013; "Meet the Toronto STar's Layar Edition," Thestar.com, September 18, 2013; "Zalando Scans Fashion with Wikitude Augmented Reality at 83rd Annual Geneva Motor Show," Wikitude.com, March 5, 2013; "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," Telecrunch.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; "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 the importance of understanding how the Internet and related technologies work, and to be aware of what's new. The Internet and its underlying technology are not static phenomena, but instead continue 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 are expanding rapidly; self-publishing on the Web via social networks and blogging now engages millions of Internet users; and software technologies such as 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 and new ones, such as different types of wearable technology, the Internet of Things, and the "smart/connected" movement (smart homes, smart TVs, and connected cars) to deliver products and services to consumers. **Table 2.1** summarizes some of the most important developments in e-commerce infrastructure for 2015–2016.

2.1 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.

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

Web
one of the Internet's most popular services, providing access to billions, and perhaps trillions, of Web pages

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 3.1 billion people around the world with services such as e-mail, apps, newsgroups, shopping, research, instant messaging, music, videos, and news (eMarketer, Inc., 2015a, 2015b). 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 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

TABLE 2.1 TRENDS IN E-COMMERCE INFRASTRUCTURE 2015–2016

BUSINESS
• Mobile devices become the primary access point to social network services and a rapidly expanding social marketing and advertising platform, and create a foundation for location-based Web services and business models. • Explosion of Internet content services and mobile access devices strains the business models of Internet backbone providers (the large telecommunication carriers). • The growth in cloud computing and bandwidth capacity enables new business models for distributing music, movies, and television. • Search becomes more social and local, enabling social and local commerce business models. • Internet backbone carriers initiate differential pricing models so that users pay for bandwidth usage. • "Big Data" produced by the Internet creates new business opportunities for firms with the analytic capability to understand it.
TECHNOLOGY
• Mobile devices such as smartphones and tablet computers have become the dominant mode of access to the Internet. The new client is mobile. • The explosion of mobile apps threatens the dominance of the Web as the main source of online software applications and leads some to claim the Web is dead. • HTML5 grows in popularity among publishers and developers and makes possible Web applications that are just as visually rich and lively as native mobile apps. • Cloud computing reshapes computing and storage, and becomes an important force in the delivery of software applications and online content. • The Internet runs out of IPv4 addresses; the transition to IPv6 continues. • The decreased cost of storage and advances in database software lead to explosion in online data collection known as Big Data and creates new business opportunities for firms with the analytic capability to understand it. • The Internet of Things, with millions of sensor-equipped devices connecting to the Internet, starts to become a reality, and is powering the development of smart connected "things" such as televisions, houses, cars, and wearable technology.
SOCIETY
• Governance of the Internet becomes more involved with conflicts between nations; the United States plans to give up control over IANA, which administers the Internet's IP addressing system. • Government control over, and surveillance of, the Internet is expanded in most advanced nations, and in many nations the Internet is nearly completely controlled by government agencies. • The growing infrastructure for tracking online and mobile consumer behavior conflicts with individual claims to privacy and control over personal information.

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

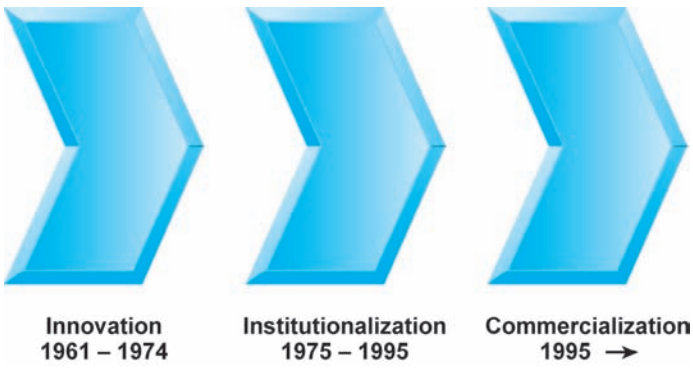
Today's Internet has evolved over the last 55 or so years. In this sense, the Internet is not "new;" it did not happen yesterday. Although journalists talk glibly about "Internet" time—suggesting a fast-paced, nearly instant, worldwide global change mechanism—in fact, it has taken about 55 years of hard work to arrive at today's Internet.

The history of the Internet can be segmented into three phases (see **Figure 2.1**). 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 U.S. 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 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 the world who were not students on campuses. By 2000, the Internet's use had expanded well beyond military installations and research universities. See **Table 2.2** on pages 100–102 for a closer look at the development of the Internet from 1961 on.

FIGURE 2.1 STAGES IN THE DEVELOPMENT OF THE INTERNET



The Internet has developed in three stages over approximately a 55-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.

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 (see **Figure 2.2**).

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 the Internet of the future.

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 2.3** on page 103). 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

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

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

FIGURE 2.2 RESOLUTION OF THE U.S. FEDERAL NETWORKING COUNCIL

"The Federal Networking Council (FNC) agrees that the following language reflects our definition of the term 'Internet.'

'Internet' refers to the global information system that—

(i) is logically linked together by a globally unique address space based on the Internet Protocol (IP) or its subsequent extensions/follow-ons;

(ii) is able to support communications using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite or its subsequent extensions/follow-ons, and/or other IP-compatible protocols; and

(iii) provides, uses or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure described herein."

Last modified on October 30, 1995.

SOURCE: Federal Networking Council, 1995

TABLE 2.2 DEVELOPMENT OF THE INTERNET TIMELINE

YEAR	EVENT	SIGNIFICANCE
INNOVATION PHASE 1961–1974		
1961	Leonard Kleinrock (MIT) publishes a paper on "packet switching" networks.	The concept of packet switching is born.
1962	J.C.R. Licklider (MIT) writes memo calling for an "Intergalatic Computer Network."	The vision of a global computer network is born.
1969	BBN Technologies awarded ARPA contract to build ARPANET.	The concept of a packet-switched network moves closer toward physical reality.
1969	The first packet-switched message is sent on ARPANET from UCLA to Stanford.	The communications hardware underlying the Internet is implemented for the first time. The initial ARPANET consisted of four routers (then called Interface Message Processors (IMPs)) at UCLA, Stanford, UCSB, and the University of Utah.
1972	E-mail is invented by Ray Tomlinson of BBN. Larry Roberts writes the first e-mail utility program permitting listing, forwarding, and responding to e-mails.	The first "killer app" of the Internet is born.
1973	Bob Metcalfe (XeroxParc Labs) invents Ethernet and local area networks.	**Client/server computing is invented.** Ethernet permitted the development of local area networks and client/server computing in which thousands of fully functional desktop computers could be connected into a short-distance (<1,000 meters) network to share files, run applications, and send messages.
1974	"Open architecture" networking and TCP/IP concepts are presented in a paper by Vint Cerf (Stanford) and Bob Kahn (BBN).	**TCP/IP invented.** The conceptual foundation for a single common communications protocol that could potentially connect any of thousands of disparate local area networks and computers, and a common addressing scheme for all computers connected to the network, are born. Prior to this, computers could communicate only if they shared a common proprietary network architecture. With TCP/IP, computers and networks could work together regardless of their local operating systems or network protocols.
INSTITUTIONALIZATION PHASE 1975–1995		
1977	Lawrence Landweber envisions CSNET (Computer Science Network)	CSNET is a pioneering network for U.S. universities and industrial computer research groups that could not directly connect to ARPANET, and was a major milestone on the path to the development of the global Internet.
1980	TCP/IP is officially adopted as the DoD standard communications protocol.	The single largest computing organization in the world adopts TCP/IP and packet-switched network technology.
1980	Personal computers are invented.	Altair, Apple, and IBM personal desktop computers are invented. These computers become the foundation for today's Internet, affording millions of people access to the Internet and the Web.

TABLE 2.2 DEVELOPMENT OF THE INTERNET TIMELINE (CONTINUED)

YEAR	EVENT	SIGNIFICANCE
1984	Apple Computer releases the HyperCard program as part of its graphical user interface operating system called Macintosh.	The concept of "hyperlinked" documents and records that permit the user to jump from one page or record to another is commercially introduced.
1984	Domain Name System (DNS) introduced.	DNS provides a user-friendly system for translating IP addresses into words that people can easily understand.
1989	Tim Berners-Lee of CERN in Switzerland proposes a worldwide network of hyperlinked documents based on a common markup language called HTML—HyperText Markup Language.	**The concept of an Internet-supported service called the World Wide Web based on HTML pages is born**. The Web would be constructed from "pages" created in a common markup language, with "hyperlinks" that permitted easy access among the pages.
1990	NSF plans and assumes responsibility for a civilian Internet backbone and creates NSFNET.[1] ARPANET is decommissioned.	The concept of a "civilian" Internet open to all is realized through nonmilitary funding by NSF.
1993	The first graphical Web browser called Mosaic is invented by Marc Andreessen and others at the National Center for Supercomputing Applications at the University of Illinois.	Mosaic makes it very easy for ordinary users to connect to HTML documents anywhere on the Web. The browser-enabled Web takes off.
1994	Andreessen and Jim Clark form Netscape Corporation.	The first commercial Web browser—Netscape—becomes available.
1994	The first banner advertisements appear on Hotwired.com in October 1994.	**The beginning of e-commerce**.
COMMERCIALIZATION PHASE 1995–PRESENT		
1995	NSF privatizes the backbone, and commercial carriers take over backbone operation.	**The fully commercial civilian Internet is born**. Major long-haul networks such as AT&T, Sprint, GTE, UUNet, and MCI take over operation of the backbone. Network Solutions (a private firm) is given a monopoly to assign Internet addresses.
1995	Jeff Bezos founds Amazon; Pierre Omidyar forms AuctionWeb (eBay).	E-commerce begins in earnest with pure online retail stores and auctions.
1998	The U.S. federal government encourages the founding of the Internet Corporation for Assigned Names and Numbers (ICANN).	Governance over domain names and addresses passes to a private nonprofit international organization.
1999	The first full-service Internet-only bank, First Internet Bank of Indiana, opens for business.	Business on the Web extends into traditional services.
2003	The Internet2 Abilene high-speed network is upgraded to 10 Gbps.	A major milestone toward the development of ultra-high-speed transcontinental networks several times faster than the existing backbone is achieved.

[1] "Backbone" refers to the U.S. domestic trunk lines that carry the heavy traffic across the nation, from one metropolitan area to another. Universities are given responsibility for developing their own campus networks that must be connected to the national backbone.

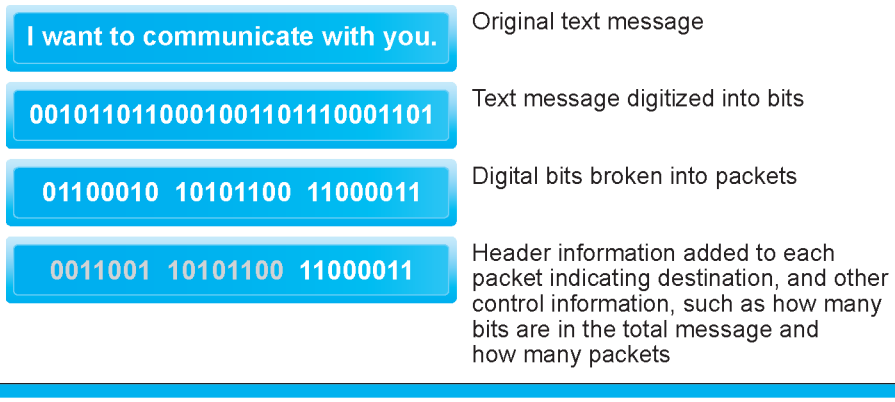
(continued)

TABLE 2.2 DEVELOPMENT OF THE INTERNET TIMELINE (CONTINUED)

YEAR	EVENT	SIGNIFICANCE
2005	NSF proposes the Global Environment for Network Innovations (GENI) initiative to develop new core functionality for the Internet.	Recognition that future Internet security and functionality needs may require the thorough rethinking of existing Internet technology.
2006	The U.S. Senate Committee on Commerce, Science, and Transportation holds hearings on "Network Neutrality."	The debate grows over differential pricing based on utilization that pits backbone utility owners against online content and service providers and device makers.
2007	The Apple iPhone is introduced.	The introduction of the iPhone represents the beginning of the development of a viable mobile platform that will ultimately transform the way people interact with the Internet.
2008	The Internet Society (ISOC) identifies Trust and Identity as a primary design element for every layer of the Internet, and launches an initiative to address these issues.	The leading Internet policy group recognizes the current Internet is threatened by breaches of security and trust that are built into the existing network.
2008	Internet "cloud computing" becomes a billion-dollar industry.	Internet capacity is sufficient to support on-demand computing resources (processing and storage), as well as software applications, for large corporations and individuals.
2009	Internet-enabled smartphones become a major new Web access platform.	Smartphones extend the reach and range of the Internet to more closely realize the promise of the Internet anywhere, anytime, anyplace.
2009	Broadband stimulus package and Broadband Data Improvement Act enacted.	President Obama signs stimulus package containing $7.2 billion for the expansion of broadband access in the United States.
2011	ICANN expands domain name system.	ICANN agrees to permit the expansion of generic top-level domain names from about 300 to potentially thousands using any word in any language.
2012	World IPv6 Launch day.	Major ISPs, home networking equipment manufacturers, and Web companies begin to permanently enable IPv6 for their products and services as of June 6, 2012.
2013	The Internet of Things (IoT) starts to become a reality.	Internet technology spreads beyond the computer and mobile device to anything that can be equipped with sensors, leading to predictions that up to 100–200 billion uniquely identifiable objects will be connected to the Internet by 2020.
2014	Apple introduces Apple Pay and Apple Watch.	Apple Pay is likely to become the first widely adopted mobile payment system; Apple Watch may usher in a new era of wearable Internet-connected technology and is a further harbinger of the Internet of Things.
2015	Federal Communications Commission adopts regulations mandating net neutrality.	ISPs are required to treat all data on the Internet equally and are not allowed to discriminate or charge differentially based on user, content, site, platform, application, type of equipment, or mode of communication.

SOURCES: Based on Leiner et al., 2000; Zakon, 2005; Gross, 2005; Geni.net, 2007; ISOC.org, 2010; Arstechnica.com, 2010; ICANN, 2011a; Internet Society, 2012; IEEE Computer Society, 2013.

FIGURE 2.3 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.

circuit segments, both of which increase the length of time required to find and connect circuits. A better technology was needed.

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 second.[2]) 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

[2] 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.

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.

protocol
a set of rules and standards for data transfer

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

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

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, 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.

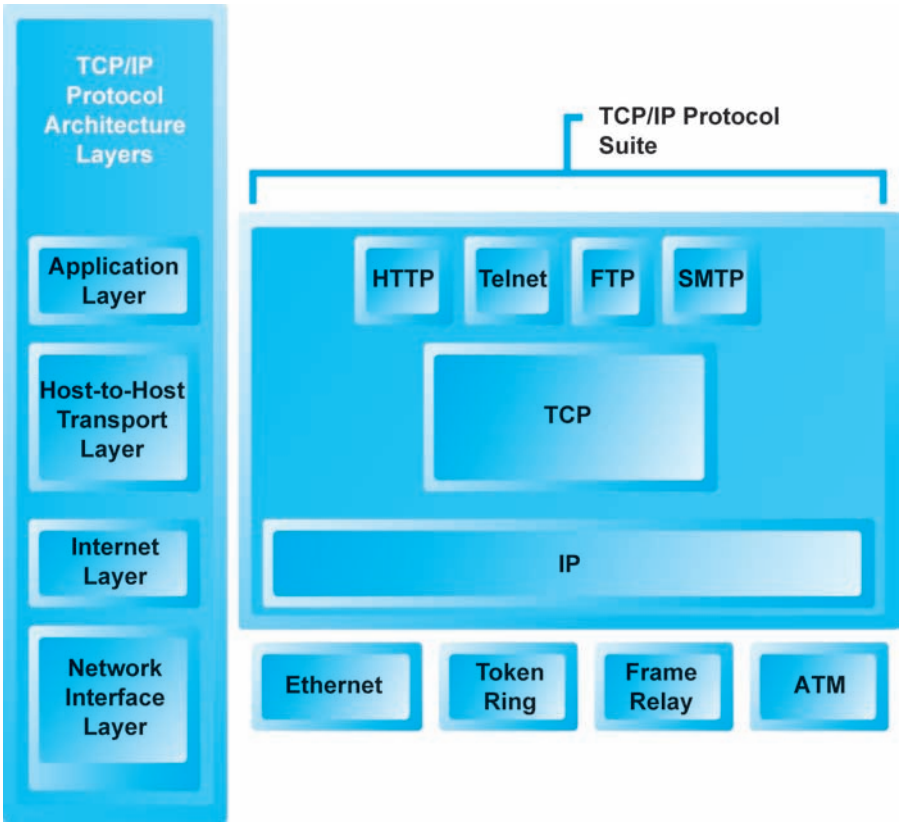
Transmission Control Protocol/Internet Protocol (TCP/IP) has become the core communications protocol for the Internet (Cerf and Kahn, 1974). **TCP** establishes the connections among sending and receiving Web computers, and makes sure that packets sent by one computer are received in the same sequence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

TCP/IP is divided into four separate layers, with each layer handling a different aspect of the communication problem (see **Figure 2.4**). 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.

FIGURE 2.4 THE TCP/IP ARCHITECTURE AND PROTOCOL SUITE



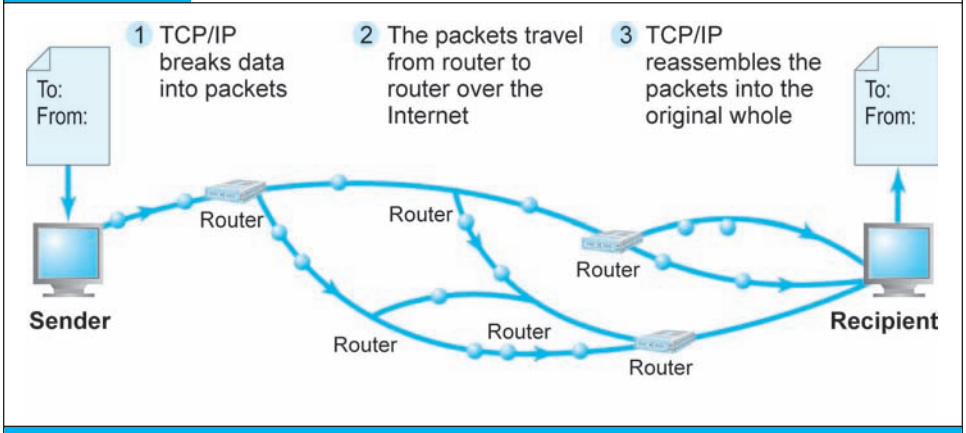
TCP/IP is an industry-standard suite of protocols for large internetworks. The purpose of TCP/IP is to provide high-speed communication network links.

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.

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

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, in 2015, the number of IPv4 addresses available to be assigned has shrunk significantly. In North America, only about 3.4 million remain available from the American Registry for Internet Numbers; registries in Asia and Europe have already essentially run out (McMillan, 2015). IPv6 was created to address

FIGURE 2.5 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.

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

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. According to Akamai, in the United States, about 20% of Internet traffic now occurs over IPv6. Belgium leads the way globally, with almost 40% of Internet traffic converted to IPv6 (Akamai, 2015).

Figure 2.5 illustrates how TCP/IP and packet switching work together to send data over the Internet.

Domain Names, DNS, and URLs

domain name
IP address expressed in natural language

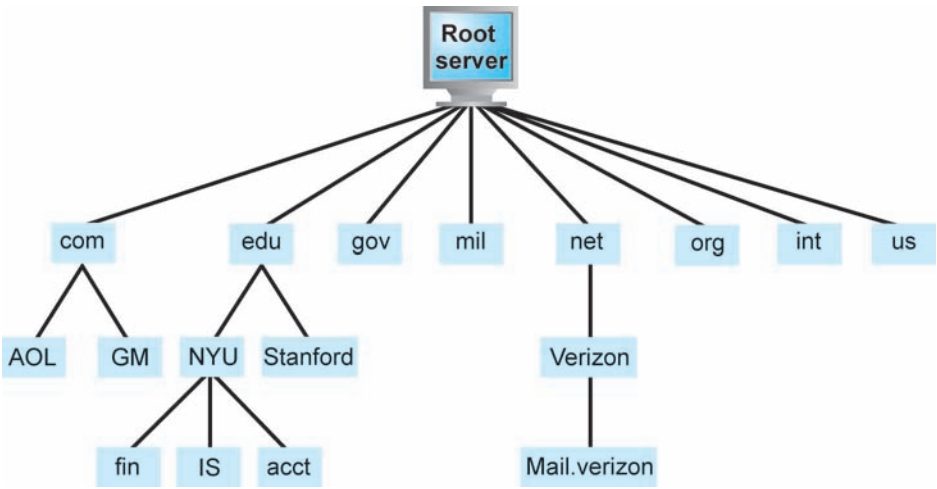
Domain Name System (DNS)
system for expressing numeric IP addresses in natural language

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

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).[3] A **Uniform Resource Locator (URL)**, which 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 2.4. **Figure 2.6** illustrates the Domain Name System and **Table 2.3** summarizes the important components of the Internet addressing scheme.

[3] 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 2.6 THE HIERARCHICAL DOMAIN NAME SYSTEM



The Domain Name System is a hierarchical namespace with a root server at the top. Top-level domains appear next and identify the organization type (such as .com, .gov, .org, etc.) or geographic location (such as .uk [Great Britain] or .ca [Canada]). Second-level servers for each top-level domain assign and register second-level domain names for organizations and individuals such as IBM.com, Microsoft.com, and Stanford.edu. Finally, third-level domains identify a particular computer or group of computers within an organization, e.g., www.finance.nyu.edu.

Client/Server Computing

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 **client** computers are connected in a

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

client
a powerful desktop computer that is part of a network

TABLE 2.3 PIECES OF THE INTERNET PUZZLE: NAMES AND ADDRESSES

IP addresses	Every device connected to the Internet must have a unique address number called an Internet Protocol (IP) address.
Domain names	The Domain Name System allows expressions such as Pearsoned.com (Pearson Education's Web site) to stand for numeric IP locations.
DNS servers	DNS servers are databases that keep track of IP addresses and domain names on the Internet.
Root servers	Root servers are central directories that list all domain names currently in use for specific domains; for example, the .com root server. DNS servers consult root servers to look up unfamiliar domain names when routing traffic.

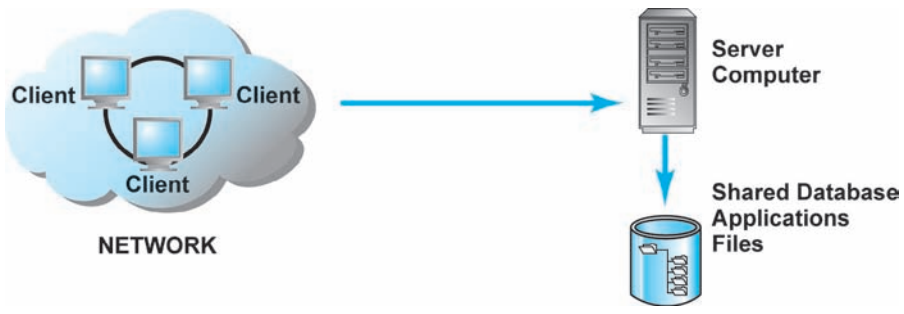
server
networked computer dedicated to common functions that the client computers on the network need

network with one or more **servers**, which are computers that are dedicated to performing common functions that the client computers on the network need, such as file storage, software applications, printing, and Internet access. The client computers are themselves sufficiently powerful to accomplish complex tasks. 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 2.7**). 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.

To appreciate what client/server computing makes possible, you must understand what preceded it. In the mainframe computing environment of the 1960s and 1970s, computing power was very expensive and limited. For instance, the largest commercial mainframes of the late 1960s had 128k of RAM and 10-megabyte disk drives, and occupied hundreds of square feet. There was insufficient computing capacity to support graphics or color in text documents, let alone sound files, video, or hyperlinked documents. In this period, computing was entirely centralized: all work was done by a single mainframe computer, and users were connected to the mainframe using terminals.

With the development of personal computers and local area networks during the late 1970s and early 1980s, client/server computing became possible. Client/server computing has many advantages over centralized mainframe computing. For instance, it is easy to expand capacity by adding servers and clients. Also, client/server networks are less vulnerable than centralized computing architectures. If one server goes down, backup or mirror servers can pick up the slack; if a client computer is inoperable, the rest of the network continues operating. Moreover, processing load is balanced over many powerful smaller computers rather than being concentrated in a single huge computer that performs processing for everyone. Both software and hardware in client/server environments can be built more simply and economically.

FIGURE 2.7 THE CLIENT/SERVER COMPUTING MODEL



In the client/server model of computing, client computers are connected in a network together with one or more servers.

In 2015, there were about 1.8 billion personal computers in use around the world (Imbert, 2015). Personal computing capabilities have also moved to smartphones and tablet computers (all much "thinner" clients with a bit less computing horsepower, and limited memory, but which rely on Internet servers to accomplish their tasks). In the process, more computer processing will be performed by central servers.

THE NEW CLIENT: THE MOBILE PLATFORM

There's a new client in town. The primary means of accessing the Internet worldwide is now through highly portable smartphones and tablet computers, and not traditional desktop or laptop PCs. This means that the primary platform for e-commerce products and services is also changing to a mobile platform.

The change in hardware has reached a tipping point. The form factor of PCs has changed from desktops to laptops and tablet computers such as the iPad (and more than 100 other competitors). Tablets are lighter, do not require a complex operating system, and rely on the Internet cloud to provide processing and storage. And, while there are an estimated 1.8 billion PCs in the world, the number of cell phones long ago exceeded the population of PCs. In 2015, there are an estimated 4.43 billion worldwide mobile phone users, with 258 million in the United States, around 1 billion in China, and 638 million in India. The population of mobile phone users is almost three times that of PC owners. Around 42%, or 1.84 billion, of the world's mobile phone users are smartphone users. Around 2.25 billion people around the world access the Internet using mobile devices, mostly smartphones and tablets (eMarketer, Inc., 2015c, 2015d, 2015e). Briefly, the Internet world is turning into a lighter, mobile platform. The tablet is not replacing PCs so much as supplementing PCs for use in mobile situations.

Smartphones are a disruptive technology that radically alters the personal computing and e-commerce landscape. Smartphones have created a major shift in computer processors and software that has disrupted the dual monopolies long established by Intel and Microsoft, whose chips, operating systems, and software applications began dominating the PC market in 1982. Few smartphones use Intel chips, which power 90% of the world's PCs; only a small percentage of smartphones use Microsoft's operating system (Windows Mobile). Instead, smartphone manufacturers either purchase operating systems such as Symbian, the world leader, or build their own, such as Apple's iPhone iOS, typically based on Linux and Java platforms. Smartphones do not use power-hungry hard drives but instead use flash memory chips with storage up to 64 gigabytes that also require much less power.

The mobile platform has profound implications for e-commerce because it influences how, where, and when consumers shop and buy.

THE INTERNET "CLOUD COMPUTING" MODEL: HARDWARE AND SOFTWARE AS A SERVICE

Cloud computing is a model of computing in which computer processing, storage, software, and other services are provided as a shared pool of virtualized resources over the Internet. These "clouds" of computing resources can be accessed on an as-needed

cloud computing
model of computing in which computer processing, storage, software, and other services are provided as a shared pool of virtualized resources over the Internet

FIGURE 2.8 THE CLOUD COMPUTING MODEL

In the cloud computing model, hardware and software services are provided on the Internet by vendors operating very large server farms and data centers.

basis from any connected device and location. **Figure 2.8** illustrates the cloud computing concept.

The U.S. National Institute of Standards and Technology (NIST) defines cloud computing as having the following essential characteristics:

- **On-demand self-service:** Consumers can obtain computing capabilities such as server time or network storage as needed automatically on their own.
- **Ubiquitous network access:** Cloud resources can be accessed using standard network and Internet devices, including mobile platforms.
- **Location-independent resource pooling:** Computing resources are pooled to serve multiple users, with different virtual resources dynamically assigned according to user demand. The user generally does not know where the computing resources are located.
- **Rapid elasticity:** Computing resources can be rapidly provisioned, increased, or decreased to meet changing user demand.
- **Measured service:** Charges for cloud resources are based on the amount of resources actually used.

Cloud computing consists of three basic types of services:

- **Infrastructure as a service (IaaS):** Customers use processing, storage, networking, and other computing resources from third-party providers called cloud service providers (CSPs) to run their information systems. For example, Amazon used the spare capacity of its information technology infrastructure to develop Amazon Web Services, which offers a cloud environment for a myriad of different IT infrastructure services. See **Table 2.4** for a description of the range of services that AWS offers, such as its Simple Storage Service (S3) for storing customers' data and its

TABLE 2.4 AMAZON WEB SERVICES

NAME	DESCRIPTION
COMPUTING SERVICES	
Elastic Compute Cloud (EC2)	Scalable cloud computing services
Elastic Load Balancing (ELB)	Distributes incoming application traffic among multiple EC2 instances
STORAGE SERVICES	
Simple Storage Service (S3)	Data storage infrastructure
Glacier	Low-cost archival and backup storage
DATABASE SERVICES	
DynamoDB	NoSQL database service
Redshift	Petabyte-scale data warehouse service
Relational Database Service (RDB)	Relational database service for MySQL, Oracle, SQL Server, and PostgreSQL databases
ElastiCache	In-memory cache in the cloud
SimpleDB	Non-relational data store
NETWORKING AND CONTENT DELIVERY SERVICES	
Route 53	DNS service in the cloud, enabling business to direct Internet traffic to Web applications
Virtual Private Cloud (VPC)	Creates a VPN between the Amazon cloud and a company's existing IT infrastructure
CloudFront	Content delivery services
Direct Connect	Provides alternative to using the Internet to access AWS cloud services
ANALYTICS	
Elastic MapReduce (EMR)	Web service that enables users to perform data-intensive tasks
Kinesis	Big Data service for real-time data streaming ingestion and processing
APPLICATION SERVICES	
AppStream	Provides streaming services for applications and games from the cloud
CloudSearch	Search service that can be integrated by developers into applications
MESSAGING SERVICES	
Simple Email Service (SES)	Cloud e-mail sending service
Simple Notification Service (SNS)	Push messaging service
Simple Queue Service (SQS)	Queue for storing messages as they travel between computers

(continued)

TABLE 2.4 AMAZON WEB SERVICES (CONT.)

DEPLOYMENT AND MANAGEMENT SERVICES	
Identity and Access Management (IAM)	Enables securely controlled access to AWS services
CloudWatch	Monitoring service
Elastic Beanstalk	Service for deploying and scaling Web applications and services developed with Java, .Net, PHP, Python, Ruby, and Node.js
CloudFormation	Service that allows developers an easy way to create a collection of related AWS resources
MOBILE	
Cognito	Allows developers to securely manage and synchronize app data for users across mobile devices
Mobile Analytics	Can collect and process billions of events from millions of users a day
PAYMENT SERVICES	
Flexible Payment Service (FPS)	Payment services for developers
DevPay	Online billing and account management service for developers who create an Amazon cloud application
MISCELLANEOUS	
Amazon Mechanical Turk	Marketplace for work that requires human intelligence
Alexa Web Information Service	Provides Web traffic data and information for developers

Elastic Compute Cloud (EC2) service for running applications. Users pay only for the amount of computing and storage capacity they actually use.

- **Software as a service (SaaS):** Customers use software hosted by the vendor on the vendor's cloud infrastructure and delivered as a service over a network. Leading SaaS examples are Google Apps, which provides common business applications online, and Salesforce.com, which provides customer relationship management and related software services over the Internet. Both charge users an annual subscription fee, although Google Apps also has a pared-down free version. Users access these applications from a Web browser, and the data and software are maintained on the providers' remote servers.
- **Platform as a service (PaaS):** Customers use infrastructure and programming tools supported by the CSP to develop their own applications. For example, IBM offers Bluemix for software development and testing on its cloud infrastructure. Another example is Salesforce.com's Force.com, which allows developers to build applications that are hosted on its servers as a service.

public cloud
third-party service providers that own and manage large, scalable data centers that offer computing, data storage, and high speed Internet to multiple customers who pay for only the resources they use

A cloud can be private, public, or hybrid. A **public cloud** is owned and maintained by CSPs, such as Amazon Web Services, IBM, HP, and Dell, and made available to

multiple customers, who pay only for the resources they use. A public cloud offers relatively secure enterprise-class reliability at significant cost savings. Because organizations using public clouds do not own the infrastructure, they do not have to make large investments in their own hardware and software. Instead, they purchase their computing services from remote providers and pay only for the amount of computing power they actually use (utility computing) or are billed on a monthly or annual subscription basis. The term *on-demand computing* is also used to describe such services. As such, public clouds are ideal environments for small and medium-sized businesses who cannot afford to fully develop their own infrastructure; for applications requiring high performance, scalability, and availability; for new application development and testing; and for companies that have occasional large computing projects. Gartner estimates that spending on public cloud services worldwide will grow over 15% in 2015, to €162 billion (Gartner, Inc., 2015a). Companies such as Google, Apple, Dropbox, and others also offer public clouds as a consumer service for online storage of data, music, and photos. Google Drive, Dropbox, and Apple iCloud are leading examples of this type of consumer cloud service.

A **private cloud** provides similar options as a public cloud but is operated solely for the benefit of a single tenant. It might be managed by the organization or a third party and hosted either internally or externally. Like public clouds, private clouds can allocate storage, computing power, or other resources seamlessly to provide computing resources on an as-needed basis. Companies that have stringent regulatory compliance or specialized licensing requirements that necessitate high security, such as financial services or healthcare companies, or that want flexible information technology resources and a cloud service model while retaining control over their own IT infrastructure, are gravitating toward these private clouds.

private cloud
provides similar options as public cloud but only to a single tenant

Large firms are most likely to adopt a **hybrid cloud** computing model, in which they use their own infrastructure for their most essential core activities and adopt public cloud computing for less-critical systems or for additional processing capacity during peak business periods. **Table 2.5** compares the three cloud computing models. Cloud computing will gradually shift firms from having a fixed infrastructure capacity

hybrid cloud
offers customers both a public cloud and a private cloud

TABLE 2.5 CLOUD COMPUTING MODELS COMPARED

TYPE OF CLOUD	DESCRIPTION	MANAGED BY	USES
Public cloud	Third-party service offering computing, storage, and software services to multiple customers	Third-party service providers (CSPs)	Companies without major privacy concerns Companies seeking pay-as-you-go IT services Companies lacking IT resources and expertise
Private cloud	Cloud infrastructure operated solely for a single organization and hosted either internally or externally.	In-house IT or private third-party host	Companies with stringent privacy and security requirements Companies that must have control over data sovereignty
Hybrid cloud	Combination of private and public cloud services that remain separate entities	In-house IT, private host, third-party providers	Companies requiring some in-house control of IT that are also willing to assign part of their IT infrastructures to a public cloud partition on their IT infrastructures

toward a more flexible infrastructure, some of it owned by the firm, and some of it rented from giant data centers owned by CSPs.

Cloud computing has some drawbacks. Unless users make provisions for storing their data locally, the responsibility for data storage and control is in the hands of the provider. Some companies worry about the security risks related to entrusting their critical data and systems to an outside vendor that also works with other companies. Companies expect their systems to be available 24/7 and do not want to suffer any loss of business capability if cloud infrastructures malfunction. Nevertheless, the trend is for companies to shift more of their computer processing and storage to some form of cloud infrastructure.

Cloud computing has many significant implications for e-commerce. For e-commerce firms, cloud computing radically reduces the cost of building and operating Web sites because the necessary hardware infrastructure and software can be licensed as a service from CSPs at a fraction of the cost of purchasing these services as products. This means firms can adopt "pay-as-you-go" and "pay-as-you-grow" strategies when building out their Web sites. For instance, according to Amazon, hundreds of thousands of customers use Amazon Web Services. For individuals, cloud computing means you no longer need a powerful laptop or desktop computer to engage in e-commerce or other activities. Instead, you can use much less-expensive tablet computers or smartphones that cost a few hundred dollars. For corporations, cloud computing means that a significant part of hardware and software costs (infrastructure costs) can be reduced because firms can obtain these services online for a fraction of the cost of owning, and they do not have to hire an IT staff to support the infrastructure.

OTHER INTERNET PROTOCOLS AND UTILITY PROGRAMS

There are many other Internet protocols and utility programs that provide services to users in the form of Internet applications that run on Internet clients and servers. These Internet services are based on universally accepted protocols—or standards—that are available to everyone who uses the Internet. They are not owned by any organization, but they are services that have been developed over many years and made available to all Internet users.

HyperText Transfer Protocol (HTTP)
the Internet protocol used for transferring Web pages

HyperText Transfer Protocol (HTTP) is the Internet protocol used to transfer Web pages (described in the following section). HTTP was developed by the World Wide Web Consortium (W3C) and the Internet Engineering Task Force (IETF). HTTP runs in the Application Layer of the TCP/IP model shown in Figure 2.4 on page 105. An HTTP session begins when a client's browser requests a resource, such as a Web page, from a remote Internet server. When the server responds by sending the page requested, the HTTP session for that object ends. Because Web pages may have many objects on them—graphics, sound or video files, frames, and so forth—each object must be requested by a separate HTTP message. For more information about HTTP, you can consult RFC 2616, which details the standards for HTTP/1.1, the version of HTTP most commonly used today (Internet Society, 1999). (An RFC is a document published by the Internet Society [ISOC] or one of the other organizations involved in Internet governance that sets forth the standards for various Internet-related technologies. You will learn more about the organizations involved in setting standards for the Internet later in the chapter.)

E-mail is one of the oldest, most important, and frequently used Internet services. Like HTTP, the various Internet protocols used to handle e-mail all run in the Application Layer of TCP/IP. **Simple Mail Transfer Protocol (SMTP)** is the Internet protocol used to send e-mail to a server. SMTP is a relatively simple, text-based protocol that was developed in the early 1980s. SMTP handles only the sending of e-mail. To retrieve e-mail from a server, the client computer uses either **Post Office Protocol 3 (POP3)** or **Internet Message Access Protocol (IMAP)**. You can set POP3 to retrieve e-mail messages from the server and then delete the messages on the server, or retain them on the server. IMAP is a more current e-mail protocol supported by all browsers and most servers and ISPs. IMAP allows users to search, organize, and filter their mail prior to downloading it from the server.

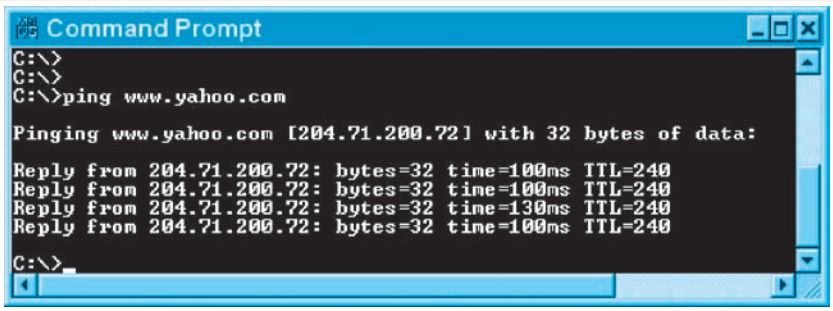
File Transfer Protocol (FTP) is one of the original Internet services. FTP runs in TCP/IP's Application Layer and permits users to transfer files from a server to their client computer, and vice versa. The files can be documents, programs, or large database files. FTP is the fastest and most convenient way to transfer files larger than 1 megabyte, which some e-mail servers will not accept. More information about FTP is available in RFC 959 (Internet Society, 1985).

Telnet is a network protocol that also runs in TCP/IP's Application Layer and is used to allow remote login on another computer. The term Telnet also refers to the Telnet program, which provides the client part of the protocol and enables the client to emulate a mainframe computer terminal. (The industry-standard terminals defined in the days of mainframe computing are VT-52, VT-100, and IBM 3250.) You can then attach yourself to a computer on the Internet that supports Telnet and run programs or download files from that computer. Telnet was the first "remote work" program that permitted users to work on a computer from a remote location.

Secure Sockets Layer (SSL)/Transport Layer Security (TLS) are protocols that operate between the Transport and Application Layers of TCP/IP and secure communications between the client and the server. SSL/TLS helps secure e-commerce communications and payments through a variety of techniques, such as message encryption and digital signatures, that we will discuss further in Chapter 4.

Packet InterNet Groper (Ping) is a utility program that allows you to check the connection between a client computer and a TCP/IP network (see **Figure 2.9**). Ping

FIGURE 2.9 THE RESULT OF A PING



A ping is used to verify an address and test the speed of the round trip from a client computer to a host and back.

Simple Mail Transfer Protocol (SMTP)
the Internet protocol used to send mail to a server

Post Office Protocol 3 (POP3)
a protocol used by the client to retrieve mail from an Internet server

Internet Message Access Protocol (IMAP)
a more current e-mail protocol that allows users to search, organize, and filter their mail prior to downloading it from the server

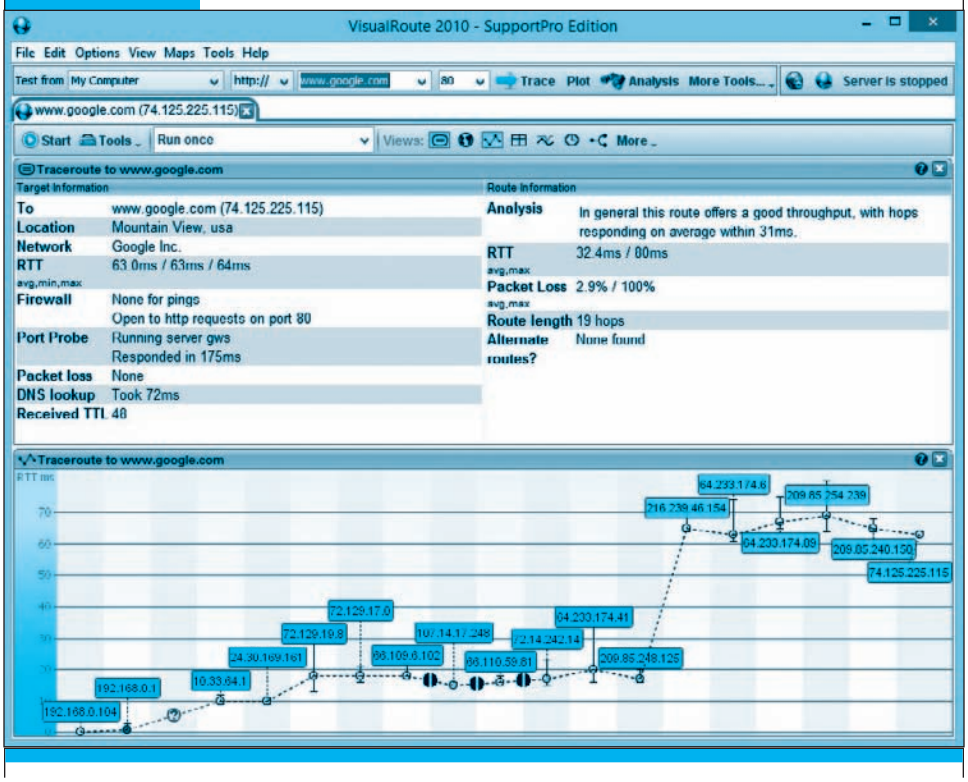
File Transfer Protocol (FTP)
one of the original Internet services. Part of the TCP/IP protocol that permits users to transfer files from the server to their client computer, and vice versa

Telnet
a terminal emulation program that runs in TCP/IP

Secure Sockets Layer (SSL) /Transport Layer Security (TLS)
protocols that secure communications between the client and the server

Ping
a program that allows you to check the connection between your client and the server

FIGURE 2.10 TRACING THE ROUTE A MESSAGE TAKES ON THE INTERNET



VisualRoute and other tracing programs provide some insight into how the Internet uses packet switching. This particular message traveled to a Google server in Mountain View, California.

SOURCE: Visualware, Inc., 2014.

Tracert
one of several route-tracing utilities that allow you to follow the path of a message you send from your client to a remote computer on the Internet

will also tell you the time it takes for the server to respond, giving you some idea about the speed of the server and the Internet at that moment. You can run Ping from the DOS prompt on a personal computer with a Windows operating system by typing: ping <domain name>. We will discuss Ping further in Chapter 4, because one way to slow down or even crash a domain server is to send it millions of ping requests.

Tracert is one of several route-tracing utilities that allow you to follow the path of a message you send from your client to a remote computer on the Internet. **Figure 2.10** shows the result of a message sent to a remote host using a visual route-tracing program called VisualRoute (available from Visualware).

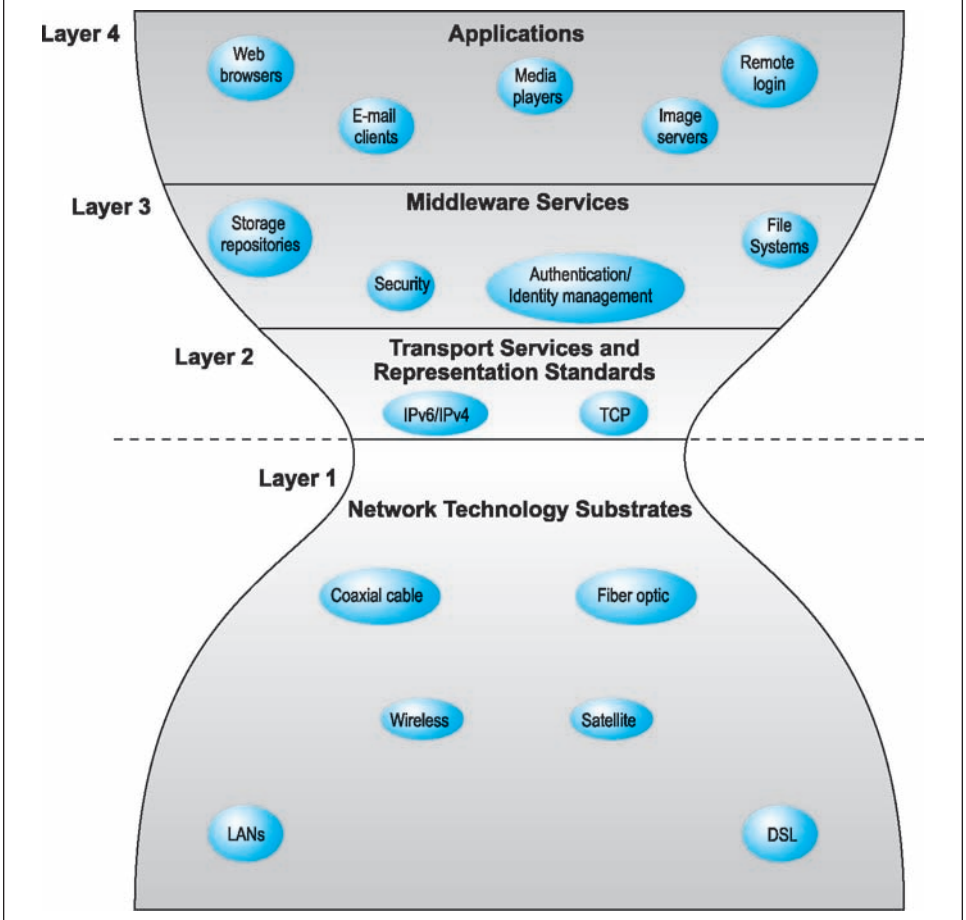
2.2 THE INTERNET TODAY

In 2015, there are an estimated 3.1 billion Internet users worldwide, up from 100 million users at year-end 1997. While this is a huge number, it represents only about 40% of the world's population (eMarketer, Inc., 2015a). Although Internet user growth has slowed in the United States and Western Europe to about 1%–2% annually, worldwide, the growth

rate is about 6.7%, with the highest growth areas being the Asia-Pacific region and the Middle East and Africa (both still growing at over 8%). By 2019, it is expected that there will be almost 3.9 billion Internet users worldwide. One would think the Internet would be overloaded with such incredible growth; however, this has not been true for several reasons. First, client/server computing is highly extensible. By simply adding servers and clients, the population of Internet users can grow indefinitely. Second, the Internet architecture is built in layers so that each layer can change without disturbing developments in other layers. For instance, the technology used to move messages through the Internet can go through radical changes to make service faster without being disruptive to your desktop applications running on the Internet.

Figure 2.11 illustrates the "hourglass" and layered architecture of the Internet. The Internet can be viewed conceptually as having four layers: Network Technology

FIGURE 2.11 THE HOURGLASS MODEL OF THE INTERNET



The Internet can be characterized as an hourglass modular structure with a lower layer containing the bit-carrying infrastructure (including cables and switches) and an upper layer containing user applications such as e-mail and the Web. In the narrow waist are transportation protocols such as TCP/IP.

Network Technology Substrate layer
layer of Internet technology that is composed of telecommunications networks and protocols

Transport Services and Representation Standards layer
layer of Internet architecture that houses the TCP/IP protocol

Applications layer
layer of Internet architecture that contains client applications

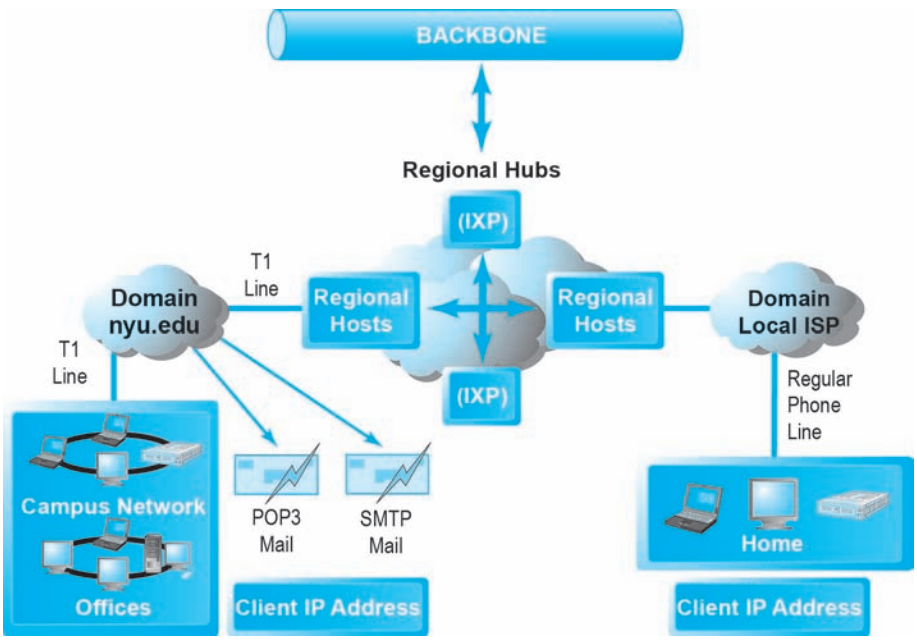
Middleware Services layer
the "glue" that ties the applications to the communications networks and includes such services as security, authentication, addresses, and storage repositories

Substrates, Transport Services and Representation Standards, Middleware Services, and Applications.[4] The **Network Technology Substrate layer** is composed of telecommunications networks and protocols. The **Transport Services and Representation Standards layer** houses the TCP/IP protocol. The **Applications layer** contains client applications such as the World Wide Web, e-mail, and audio or video playback. The **Middleware Services layer** is the glue that ties the applications to the communications networks and includes such services as security, authentication, addresses, and storage repositories. Users work with applications (such as e-mail) and rarely become aware of middleware that operates in the background. Because all layers use TCP/IP and other common standards linking all four layers, it is possible for there to be significant changes in the Network layer without forcing changes in the Applications layer.

THE INTERNET BACKBONE

Figure 2.12 illustrates some of the main physical elements of today's physical Internet. Originally, the Internet had a single backbone, but today's Internet is woven together from numerous privately owned networks comprised of high-bandwidth fiber-optic

FIGURE 2.12 INTERNET NETWORK ARCHITECTURE



Today's Internet has a multi-tiered open network architecture featuring multiple backbones, regional hubs, campus area networks, and local client computers.

[4] Recall that the TCP/IP communications protocol also has layers, not to be confused with the Internet architecture layers.

TABLE 2.6	MAJOR TIER 1 INTERNET SERVICE PROVIDERS
AT&T	Sprint
CenturyLink	Tata Communications
Cogent Communications	Verio (NTT Communications)
Level 3 Communications	Verizon

cable that are physically connected with each other and that transfer information from one private network to another. These long-haul fiber-optic networks are owned by the major cable providers and firms which are sometimes referred to as **Tier 1 Internet Service Providers (Tier 1 ISPs)** (see **Table 2.6**). For the sake of clarity we will refer to these networks of backbones as a single "backbone." The **backbone** has been likened to a giant pipeline that transports data around the world in milliseconds. The backbone is typically composed of fiber-optic cable with bandwidths ranging from 155 Mbps to 2.5 Gbps. **Bandwidth** measures how much data can be transferred over a communications medium within a fixed period of time and is usually expressed in bits per second (Bps), kilobits (thousands of bits) per second (Kbps), megabits (millions of bits) per second (Mbps), or gigabits (billions of bits) per second (Gbps).

Connections to other continents are made via a combination of undersea fiber-optic cable and satellite links. The backbones in foreign countries typically are operated by a mixture of private and public owners. The backbone has built-in redundancy so that if one part breaks down, data can be rerouted to another part of the backbone. **Redundancy** refers to multiple duplicate devices and paths in a network. A recent study of the Internet's physical structure in the United States has created one of the first maps of the Internet's long-haul fiber network as it currently exists. The map reveals that, not surprisingly, there are dense networks of fiber in the Northeast and coastal areas of the United States, while there is a pronounced absence of infrastructure in the Upper Plains and Four Corners regions. The U.S. Department of Homeland Security has made the map, as well as the data that underlies it, available to government, private, and public researchers, believing that doing so could make the Internet more resilient by improving knowledge (Simonite, 2015; Durairajan et al., 2015).

Tier 1 Internet Service Providers (Tier 1 ISPs)
own and control the major long-haul fiber-optic cable networks comprising the Internet's backbone

backbone
high-bandwidth fiber-optic cable that transports data across the Internet

bandwidth
measures how much data can be transferred over a communications medium within a fixed period of time; is usually expressed in bits per second (bps), kilobits per second (Kbps), megabits per second (Mbps), or gigabits per second (Gbps)

redundancy
multiple duplicate devices and paths in a network

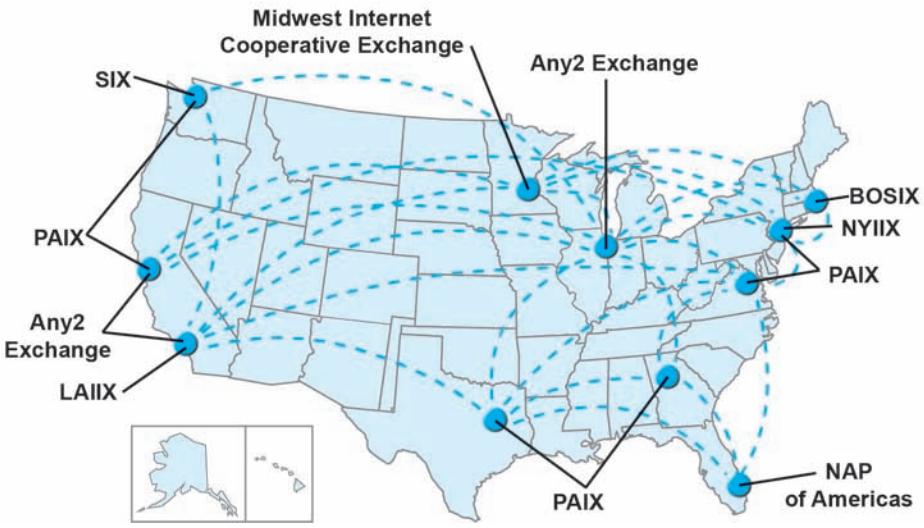
INTERNET EXCHANGE POINTS

Hubs where the backbone intersects with regional and local networks, and where the backbone owners connect with one another were originally called Network Access Points (NAPs) or Metropolitan Area Exchanges (MAEs), but now are more commonly referred to as **Internet Exchange Points (IXPs)** (see **Figure 2.13**). IXPs use high-speed switching computers to connect the backbone to regional and local networks, and exchange messages with one another. The regional and local networks are owned by private telecommunications firms; they generally are fiber-optic networks operating at more than 100 Mbps. The regional networks lease access to ISPs, private companies, and government institutions.

Internet Exchange Point (IXP)
hub where the backbone intersects with local and regional networks and where backbone owners connect with one another

FIGURE 2.13 SOME MAJOR U.S. INTERNET EXCHANGE POINTS (IXPs)

Region	Name	Location	Operator
EAST	Boston Internet Exchange (BOSIX)	Boston	Markley
	New York International Internet Exchange (NYIIX)	New York	Telehouse
	Peering and Internet Exchange (PAIX)	New York, Virginia, Atlanta	Equinix
	NAP of the Americas	Miami	Verizon Terremark
CENTRAL	Any2 Exchange	Chicago	CoreSite
	Peering and Internet Exchange (PAIX)	Dallas	Equinix
	Midwest Internet Cooperative Exchange (MICE)	Minneapolis	Members
WEST	Peering and Internet Exchange (PAIX)	Seattle, Palo Alto	Equinix
	Los Angeles International Internet Exchange (LAIIX)	Los Angeles	Telehouse
	Any2 Exchange	San Jose, Los Angeles	CoreSite
	Seattle Internet Exchange (SIX)	Seattle	Members



CAMPUS AREA NETWORKS

Campus area networks (CANs) are generally local area networks operating within a single organization—such as New York University or Microsoft Corporation. In fact, most large organizations have hundreds of such local area networks. These organizations are sufficiently large that they lease access to the Web directly from regional and national carriers. These local area networks generally are running Ethernet (a local area network protocol) and have network operating systems such as Windows Server or Linux that permit desktop clients to connect to the Internet through a local Internet server attached to their campus networks. Connection speeds in campus area networks are in the range of 10–100 Mbps to the desktop.

campus area network (CAN)
generally, a local area network operating within a single organization that leases access to the Web directly from regional and national carriers

INTERNET SERVICE PROVIDERS

The firms that provide the lowest level of service in the multi-tiered Internet architecture by leasing Internet access to home owners, small businesses, and some large institutions are called **Internet Service Providers (ISPs)**. ISPs are retail providers. They deal with "the last mile of service" to the curb—homes and business offices. ISPs typically connect to IXPs with high-speed telephone or cable lines (45 Mbps and higher).

There are a number of major ISPs throughout Europe, such as BT (Plusnet), Sky Broadband, Virgin Media, and TalkTalk in the United Kingdom; Orange, Free, and Alice in France; and Tiscali, BT Italia, and Fastweb in Italy. If you have home or small business Internet access, an ISP likely provides the service to you. Satellite firms also offer Internet access, especially in remote areas where broadband service is not available.

Internet Service Provider (ISP)
firm that provides the lowest level of service in the multi-tiered Internet architecture by leasing Internet access to home owners, small businesses, and some large institutions

Table 2.7 summarizes the variety of services, speeds, and costs of ISP Internet connections. There are two types of ISP service: narrowband and broadband. **Narrowband** service is the traditional telephone modem connection now operating at 56.6 Kbps (although the actual throughput hovers around 30 Kbps due to line noise that

narrowband
the traditional telephone modem connection, now operating at 56.6 Kbps

TABLE 2.7 U.S. ISP SERVICE LEVELS AND BANDWIDTH CHOICES

SERVICE	COST/MONTH	SPEED TO DESKTOP (DOWNLOAD)
Telephone modem	$10–$25	30–56 Kbps
DSL	$20–$30	1–15 Mbps
FiOS	$50–$300	25 Mbps–500 Mbps
Cable Internet	$35–$199	1 Mbps–500 Mbps
Satellite	$39–$129	5–15 Mbps
T1	$200–$300	1.54 Mbps
T3	$2,500–$10,000	45 Mbps

causes extensive resending of packets). This used to be the most common form of connection worldwide but it has been largely replaced by broadband connections in the United States, Europe, and Asia. Broadband service is based on DSL (including high speed fiber-optic service), cable, telephone (T1 and T3 lines), and satellite technologies. **Broadband**, in the context of Internet service, refers to any communication technology that permits clients to play streaming audio and video files at acceptable speeds. In January 2015, the U.S. Federal Communications Commission updated its broadband benchmark speeds to 25 Mbps for downloads and 3 Mbps for uploads. According to Akamai, the global average connection speed in 2015 was 5.1 Mbps, and the global average peak connection speed was 32.5 Mbps. The United States ranks 20th with an 11.7 Mbps average connection speed (South Korea leads, at 23.1 Mbps) and 24th with a 50.4 Mbps average peak connection speed (Singapore leads, at 108.3 Mbps) (Akamai, 2015). The FCC found that 17% of all Americans lack access to 25 Mbps/3 Mbps service, and that rural America is particularly underserved, with more than half lacking such access (Federal Communication Commission, 2015). In 2015, there are an estimated 670 million broadband households (almost 32% of all households) (eMarketer, Inc., 2014).

broadband
refers to any communication technology that permits clients to play streaming audio and video files at acceptable speeds

The actual throughput of data will depend on a variety of factors including noise in the line and the number of subscribers requesting service. Service-level speeds quoted are typically only for downloads of Internet content; upload speeds tend to be slower, although a number of broadband ISPs have plans that offer the same upload as download speed. T1 and T3 lines are publicly regulated utility lines that offer a guaranteed level of service, but the actual throughput of the other forms of Internet service is not guaranteed.

Digital Subscriber Line (DSL) service is a telephone technology that provides high-speed access to the Internet through ordinary telephone lines found in a home or business. Service levels typically range from about .5 to 15 Mbps. DSL service requires that customers live within two miles (about 4,000 meters) of a neighborhood telephone switching center. In order to compete with cable companies, telephone companies now also offer an advanced form of DSL called **FiOS (fiber-optic service)** that provides up to 500 Mbps to homes and businesses.

Digital Subscriber Line (DSL)
delivers high-speed access through ordinary telephone lines found in homes or businesses

FiOS (fiber-optic service)
a form of DSL that provides speeds of up to 500 Mbps

Cable Internet refers to a cable television technology that piggybacks digital access to the Internet using the same analog or digital video cable providing television signals to a home. Cable Internet is a major broadband alternative to DSL service, generally providing faster speeds and a "triple play" subscription: telephone, television, and Internet for a single monthly payment. Cable Internet services typically range from 1 Mbps up to 500 Mbps. Deutsche Telekom, Vodafone, Telefonica, and Liberty Global are some of the major cable Internet providers in Europe.

cable Internet
piggybacks digital access to the Internet on top of the analog video cable providing television signals to a home

T1 and T3 are international telephone standards for digital communication. **T1** lines offer guaranteed delivery at 1.54 Mbps, while **T3** lines offer 45 Mbps. T1 lines cost about $200–$300 per month, and T3 lines around $2500–$6000 per month. These are leased, dedicated, guaranteed lines suitable for corporations, government agencies, and businesses such as ISPs requiring high-speed guaranteed service levels.

T1
an international telephone standard for digital communication that offers guaranteed delivery at 1.54 Mbps

T3
an international telephone standard for digital communication that offers guaranteed delivery at 45 Mbps

Satellite Internet is offered by satellite companies that provide high-speed broadband Internet access primarily to homes and offices located in rural areas where DSL

satellite Internet
high-speed broadband Internet access provided via satellite

TABLE 2.8 TIME TO DOWNLOAD A 10-MEGABYTE FILE BY TYPE OF INTERNET SERVICE

TYPE OF INTERNET SERVICE	TIME TO DOWNLOAD
NARROWBAND SERVICES	
Telephone modem	25 minutes
BROADBAND SERVICES	
DSL @ 1 Mbps	1.33 minutes
Cable Internet @ 10 Mbps	8 seconds
T1	52 seconds
T3	2 seconds

or cable Internet access is not available. Access speeds and monthly costs are comparable to DSL and cable, but typically require a higher initial payment for installation of a small (18-inch) satellite dish. Upload speeds tend to be slower, typically 1–5 Mbps. Satellite providers typically have policies that limit the total megabytes of data that a single account can download within a set period, usually monthly. Major satellite providers in Europe include Hughes, Telefonica, Europasat, and Bentley Walker, among others.

Nearly all business firms and government agencies have broadband connections to the Internet. Demand for broadband service has grown so rapidly because it greatly speeds up the process of downloading Web pages and large video and audio files (see **Table 2.8**). As the quality of Internet service offerings continues to expand, the demand for broadband access will continue to swell.

INTRANETS

The very same Internet technologies that make it possible to operate a worldwide public network can also be used by private and government organizations as internal networks. An **intranet** is a TCP/IP network located within a single organization for purposes of communications and information processing. Internet technologies are generally far less expensive than proprietary networks, and there is a global source of new applications that can run on intranets. In fact, all the applications available on the public Internet can be used in private intranets. The largest provider of local area network software is Microsoft, followed by open source Linux, both of which use TCP/IP networking protocols.

intranet
a TCP/IP network located within a single organization for purposes of communications and information processing

WHO GOVERNS THE INTERNET?

Aficionados and journalists often claim that the Internet is governed by no one, and indeed cannot be governed, and that it is inherently above and beyond the law. What these people forget is that the Internet runs over private and public

telecommunications facilities that are themselves governed by laws, and subject to the same pressures as all telecommunications carriers. In fact, the Internet is tied into a complex web of governing bodies, national governments, and international professional societies. There is no one single governing organization that controls activity on the Internet. Instead, there are a number of organizations that influence the system and monitor its operations. Among the governing bodies of the Internet are:

- The *Internet Corporation for Assigned Names and Numbers (ICANN)*, which coordinates the Internet's systems of unique identifiers: IP addresses, protocol parameter registries, and the top-level domain systems. ICANN was created in 1998 as a nonprofit organization and currently manages the Internet Assigned Numbers Authority (IANA), which is in charge of assigning IP addresses, under a contract from the U.S. National Telecommunications and Information Administration (NTIA), an agency of the U.S. Department of Commerce.
- The *Internet Engineering Task Force (IETF)*, which is an open international community of network operators, vendors, and researchers concerned with the evolution of the Internet architecture and operation of the Internet. The IETF has a number of working groups, organized into several different areas, that develop and promote Internet standards, which influence the way people use and manage the Internet.
- The *Internet Research Task Force (IRTF)*, which focuses on the evolution of the Internet. The IRTF has a number of long-term research groups working on various topics such as Internet protocols, applications, applications, and technology.
- The *Internet Engineering Steering Group (IESG)*, which is responsible for technical management of IETF activities and the Internet standards process.
- The *Internet Architecture Board (IAB)*, which helps define the overall architecture of the Internet and oversees the IETF and IRTF.
- The *Internet Society (ISOC)*, which is a consortium of corporations, government agencies, and nonprofit organizations that monitors Internet policies and practices.
- The *Internet Governance Forum (IGF)*, which is a multi-stakeholder open forum for debate on issues related to Internet governance.
- The *World Wide Web Consortium (W3C)*, which is a largely academic group that sets HTML and other programming standards for the Web.
- The *Internet Network Operators Groups (NOGs),* which are informal groups that are made up of ISPs, IXPs, and others that discuss and attempt to influence matters related to Internet operations and regulation.

While none of these organizations has actual control over the Internet and how it functions, they can and do influence government agencies, major network owners, ISPs, corporations, and software developers with the goal of keeping the Internet operating as efficiently as possible. ICANN comes closest to being a manager of the Internet and reflects the powerful role that the U.S. Department of Commerce has played historically in Internet governance. The United States has been responsible for the IANA function since the beginning of the Internet. After the creation of ICANN,

however, the expectation was the function would eventually be transferred out of the U.S. government's control. In 2006, however, the U.S. Department of Commerce announced that the U.S. government would retain oversight over the root servers, contrary to initial expectations. There were several reasons for this move, including the use of the Internet for basic communications services by terrorist groups and the uncertainty that might be caused should an international body take over. In 2008, the Department of Commerce reaffirmed this stance, stating that it did not have any plans to transition management of the authoritative root zone file to ICANN (U.S. Department of Commerce, 2008). At the same time, growing Internet powers China and Russia were lobbying for more functions of the Internet to be brought under the control of the United Nations, raising fears that governance of the Internet could become even more politicized (Pfanner, 2012). In 2014, the United States, under continued pressure from other countries, finally announced its willingness to transition control of IANA, provided that certain stipulations are met, including that the organization managing the IANA functions not be specifically controlled by any other government or inter-governmental organization (such as the United Nations). The transition is intended to take place by September 2016, although it could be extended to as late as September 2019.

In addition to these professional bodies, the Internet must also conform to the laws of the sovereign nation-states in which it operates, as well as the technical infrastructures that exist within each nation-state. Although in the early years of the Internet there was very little legislative or executive interference, this situation is changing as the Internet plays a growing role in the distribution of information and knowledge, including content that some find objectionable.

Read *Insight on Society: Government Regulation and Surveillance of the Internet* for a further look at the issue of censorship of Internet content and substance.

2.3 THE FUTURE INTERNET INFRASTRUCTURE

The Internet is changing as new technologies appear and new applications are developed. The next era of the Internet is being built today by private corporations, universities, and government agencies. To appreciate the potential benefits of the Internet of the future, you must first understand the limitations of the Internet's current infrastructure.

LIMITATIONS OF THE CURRENT INTERNET

Much of the Internet's current infrastructure is several decades old (equivalent to a century in Internet time). It suffers from a number of limitations, including:

- *Bandwidth limitations*. There is insufficient capacity throughout the backbone, the metropolitan switching centers, and most importantly, the "last mile" to the house and small businesses. The result is slow peak-hour service (congestion) and a limited ability to handle high volumes of video and voice traffic.

INSIGHT ON SOCIETY

GOVERNMENT REGULATION AND SURVEILLANCE OF THE INTERNET

Hardly a week goes by without reports that a massive protest has occurred in the streets of a big city somewhere in the world. Invariably, the Internet, social media, and mobile phones are either blamed or praised for enabling these popular expressions of discontent with political regimes, corrupt officials, unemployment, or wealth inequality. Events such as the Jasmine Revolution in Tunisia and the Arab Spring in Egypt in 2010, and more recently, protests in Madrid, Caracas, Moscow, Pakistan, Syria, and even heretofore quiet U.S. Midwestern towns like Ferguson, Missouri, encourage us all to think of the Internet and the Web as an extraordinary technology unleashing torrents of human creativity, innovation, expression, and sometimes, popular rebellion, and even democracy.

How ironic then that the same Internet has spawned an explosion in government control and surveillance of individuals on the Internet. Totalitarian dictators of the mid-twentieth century would have given their eyeteeth for a technology such as this, that can track what millions of people do, say, think, and search for in billions of e-mails, searches, blogs, and Facebook posts every day.

In the early years of the Internet and the Web, many people assumed that because the Internet is so widely dispersed, it must be difficult to control or monitor. But the reality is quite different. We now know that just about all governments assert some kind of control and surveillance over Internet content and messages, and in many nations this control over the Internet and the people who use it is very extensive.

While the Internet is a decentralized network, Internet traffic in all countries runs through large fiber-optic trunk lines that are controlled by national authorities or private firms. In China, there are three such lines, and China requires the companies that own these lines to configure their routers for both internal and external service requests. When a request originates in China for a Web page in Chicago, Chinese routers examine the request to see if the site is on a blacklist, and then examine words in the requested Web page to see if it contains blacklisted terms. The system is often referred to as "The Great Firewall of China" and is implemented with the assistance of Cisco Systems (the U.S. firm that is the largest manufacturer of routers in the world) and California-based Blue Coat, which provides deep packet inspection software. Other U.S. Internet firms are also involved in China's censorship and surveillance efforts, including Yahoo, Microsoft, and Juniper Networks, among many others.

In 2015, China strengthened and extended its regulation of the Internet in the name of social stability as political unrest in the country has worsened. Recently passed legislation allows Web users to be jailed for up to three years if they post defamatory rumors that are read by more than 5,000 people. China also issued new rules to restrict the dissemination of political news and opinions on instant messaging applications such as WeChat, a text messaging app similar to Twitter and WhatsApp. Users are required to post political opinions and news only to state-authorized media outlets and are required to use their own names when establishing accounts. In 2015, Chinese Internet companies deleted over 60,000 accounts with names that failed to adhere to the new regulations. In 2015, China also issued guidelines to regulate Internet-based financial institutions, such as peer-to-peer lending platforms.

Displeased by China's censorship efforts, Google began to encrypt searches originating in

China in order to prevent surveillance by state agencies in 2014. In response, Chinese authorities severely disrupted Google search access, as well as popular services like Google Maps and Gmail. The disruption occurred on the 25th anniversary of the government's crackdown on the pro-democracy demonstrations in Tiananmen Square. Facebook, Twitter, Flickr, and YouTube have been blocked in China for years. Access to Google was eventually restored, but in 2015 China continued to battle Google, this time over Google's decision to no longer recognize security certificates for Chinese sites issued by major Chinese Internet authorities, instead displaying them as "distrusted sites." Google and China are also battling to bring greater Internet connectivity to Cuba, which ranks near the bottom in Internet penetration worldwide. Google's proposed plan for Cuba would focus on mobile connectivity and favor openness, and China's would allow the Cuban government to conduct significant surveillance on their citizens' Internet activities.

While China is often criticized for its extensive Internet controls, other countries are not far behind. Iran's Internet surveillance of its citizens is considered by security experts to be one of the world's most sophisticated mechanisms for controlling and censoring the Internet, allowing it to examine the content of individual online communications on a massive scale, far more sophisticated than even China's Internet surveillance activities. The Iranian system goes far beyond preventing access to specific sites such as BBC World News, Google, and Facebook. One technique is deep packet inspection of every e-mail, text, or tweet. Deep packet inspection allows governments to read messages, alter their contents for disinformation purposes, and identify senders and recipients. It is accomplished by installing computers in the line between users and ISPs, opening up every digitized packet, inspecting for keywords and images, reconstructing the message, and sending it on. This is done for all Internet traffic including Skype, Facebook, e-mail, tweets, and messages sent to proxy servers. In 2015, Iran acknowledged an overarching effort to surveil social networks, resulting in the elimination of 130 Facebook pages and 12 arrests for crimes such as insulting the Ayatollah Khomeini.

In Russia, a new law took effect in February 2014 that allows the government to close Web sites without a court decision. Sites can be closed if the General Prosecutor's office declares the material on a site to be "extremist." In August 2014, Russia expanded Internet regulations to the blogosphere, requiring bloggers with more than 3,000 daily readers to register their real names and contact information with Russia's communications regulator. In 2015, Russia passed laws requiring domestic Internet companies to store their data on Russian soil, allowing the government to control it and limit access.

In January 2014, the Turkish government shut down the file-sharing site SoundCloud after recordings of Prime Minister Recep Tayyip Erdogan arranging to obtain two villas for his family in return for a zoning change granted to a construction tycoon surfaced. When the recordings moved to YouTube, Turkey shut down YouTube. Turkey already has extensive regulations prohibiting online pornography, gambling, and criticism of the founder of modern Turkey, Mustafa Kemal Attaturk. In April 2014, the Turkish Constitutional Court ordered the government to restore access to YouTube, Twitter, SoundCloud, and other sites because the shutdowns were a violation of freedom of expression, but the culture of censorship remains. In 2015, the Turkish parliament voted to expand Turkish law enforcement's ability to conduct online surveillance without court orders.

Both Europe and the United States have, at various times, also taken steps to control access to Internet sites, censor Web content, and engage in extensive surveillance of communications, although not to the extent of Iran, China, and many other nations nor to attack specific political groups or inhibit the freedom of expression. For instance,

(continued)

Great Britain has a list of blocked sites, as do Germany and France. The Australian Communications and Media Authority has developed a list of several hundred Web sites that have been refused registration in Australia, mostly violent video game and online pornography sites. The United States and European countries generally ban the sale, distribution, and/or possession of online child pornography. Both France and Germany bar online Nazi memorabilia. Even in South Korea, one of the world's most wired countries, there are restrictions on pornographic sites, games sites, and limits on Google Maps.

In response to terrorism threats and other crimes, European governments and the U.S. government also perform deep packet inspection on e-mail and text communications of terrorist suspects. This surveillance is not limited to cross-border international data flows and includes large-scale domestic surveillance and analysis of routine e-mail, tweets, and other messages. In 2013, National Security Agency (NSA) contractor Edward Snowden made headlines by leaking classified NSA documents shedding light on the NSA's PRISM program, which grants the agency unauthorized access to the servers of major Internet companies such as Facebook, Google, Apple, Microsoft, and many others. Additionally, the documents revealed the existence of the NSA's XKeyscore program, which allows analysts to search databases of e-mails, chats, and browsing histories of individual citizens without any authorization. Warrants, court clearance, or other forms of legal documentation are not required for analysts to use the technology. Snowden's documents also showed spy agencies were tapping data from smartphone apps like Candy Crush, and most others, and that the NSA was tapping the flow of personal user information between Google and Yahoo. The NSA claimed that the program was only used to monitor foreign intelligence targets and that the information it collects has assisted in apprehending terrorists. The FBI also has an Internet surveillance unit, the National Domestic Communications Assistance Center. The NDCAC's mission is to assist in the development of new surveillance technologies that will allow authorities to increase the interception of Internet, wireless, and VoIP communications.

However, efforts are underway in the United States to curb domestic and international counterterrorist agencies like the NSA from conducting dragnet surveillance of the entire American population, strengthen court oversight of surveillance, limit surveillance to specific individuals, and ease disclosure rules for Internet firms who receive requests from government agencies. In 2015, Congress passed the USA Freedom Act, which limits the bulk collection of Americans' phone records. However, equally concerted efforts are underway to expand these types of spying powers. In 2015, for instance, the Obama administration expanded the NSA's ability to perform warrantless wiretaps on suspected malicious hackers, allowing them to monitor international Internet traffic from these suspects as well as domestic traffic.

SOURCES: "Russian Data Law Fuels Web Surveillance Fears," by Shaun Walker, *The Guardian,* September 1, 2015; "Google and China in Battle Over Cuba's Internet Future," by Michelle Caruso-Cabrera, Cnbc.com, August 12, 2015; "China Looks To Regulate Internet Finance," by Gillian Wong, *Wall Street Journal,* July 20, 2015; "China Passes New National Security Law Extending Control Over Internet," *The Guardian,* July 1, 2015; "Hunting for Hackers, N.S.A. Secretly Expands Internet Spying at U.S. Border," by Charlie Savage et al., *New York Times,* June 4, 2015; "The State of Surveillance In Iran," by Arta Shams, Ifex.org, May 22, 2015; "Why Google and China Are in a War Over the Internet," by Arjun Kharpal, Cnbc.com, April 2, 2015; "House Moves to Curb Government Surveillance of Phone, Internet Records," by Cristina Maza, Csmonitor.com, May 1, 2015; "Turkey's Parliament Issues Contested Security, Surveillance Laws," Bloombergnews.com, March 27, 2015; "China Censorship Sweep Deletes More Than 60,000 Internet Accounts," Reuters.com, February 27, 2015; "China Tightens Message App Rules for Public Information," by Bloomberg.com, September 1, 2014; "Russia Forces Its Popular Bloggers to Register—Or Else," by Ilya Khrennikov, Bloomberg.com, August 19, 2014; "Access to Google Services Within China Returns," by Paul Carsten, Reuters.com, July 10, 2014; "Turkey Lifts Twitter Ban After Court Ruling," by Daren Butler, Reuters.com, April 3, 2014; "NSA Top Lawyer Says Tech Giants Knew About Data Collection," Cnet.com, March 19, 2014; "Documents Say NSA Pretends to Be Facebook in Surveillance," by Reed Albergotti, *Wall Street Journal*, March 12, 2014; "Amid Flow of Leaks, Turkey Moves to Crimp Internet," by Tim Arango and Ceylan Yeginsu, *New York Times*, February 6, 2014; "Spy Agencies Tap Data Streaming From Phone Apps," by James Glanz, Jeff Larson, and Andrew Lehren, *New York Times,* January 27, 2014; "Big Web Crash in China: Experts Suspect Great Firewall," by Nicole Perlroth, *New York Times*, January 22, 2014; "NSA Surveillance Covers 75 Percent of U.S. Internet Traffic: WSJ," by Reuters, News.Yahoo.com, August 20, 2013; "New Snowden Leak: NSA Program Taps All You Do Online," by Amanda Wills, Mashable.com, August 1, 2013; "Snowden: NSA Collects 'Everything,' Including Content of Emails," by Eyder Peralta, NPR.org, June 17, 2013; "FBI Quietly Forms Secret Net-Surveillance Unit," by Declan McCullagh, News.cnet.com, May 22, 2012; "Bullets Stall Youthful Push for Arab Spring," by Michael Slackman, *New York Times*, March 17, 2011.

- *Quality of service limitations*. Today's information packets take a circuitous route to get to their final destinations. This creates the phenomenon of **latency**—delays in messages caused by the uneven flow of information packets through the network. In the case of e-mail, latency is not noticeable. However, with streaming video and synchronous communication, such as a telephone call, latency is noticeable to the user and perceived as "jerkiness" in movies or delays in voice communication. Today's Internet uses "best-effort" quality of service (QOS), which makes no guarantees about when or whether data will be delivered, and provides each packet with the same level of service, no matter who the user is or what type of data is contained in the packet. A higher level of service quality is required if the Internet is to keep expanding into new services, such as video on demand and telephony.
- *Network architecture limitations*. Today, a thousand requests for a single music track from a central server will result in a thousand efforts by the server to download the music to each requesting client. This slows down network performance, as the same music track is sent out a thousand times to clients that might be located in the same metropolitan area. This is very different from television, where the program is broadcast once to millions of homes.
- *Wired Internet*. The Internet is still largely based on cables—fiber-optic and coaxial copper cables. Copper cables use a centuries-old technology, and fiber-optic cable is expensive to place underground. The wired nature of the Internet restricts mobility of users although it is changing rapidly as Wi-Fi hotspots proliferate, and cellular phone technology advances. However, cellular systems are often overloaded due to the growth in the number of smartphones.

latency
delays in messages caused by the uneven flow of information packets through the network

Now imagine an Internet at least 1,000 times as powerful as today's Internet, one that is not subjected to the limitations of bandwidth, protocols, architecture, physical connections, and language detailed previously. Welcome to the world of the future Internet, and the next generation of e-commerce services and products!

THE INTERNET2® PROJECT

Internet2® is an advanced networking consortium of more than 450 member institutions including universities, corporations, government research agencies, and not-for-profit networking organizations, all working in partnership to facilitate the development, deployment, and use of revolutionary Internet technologies. The broader Internet2 community includes more than 93,000 institutions across the United States and international networking partners in more than 100 countries. Internet2's work is a continuation of the kind of cooperation among government, private, and educational organizations that created the original Internet.

Internet2®
advanced networking consortium of more than 350 member institutions working in partnership to facilitate the development, deployment, and use of revolutionary Internet technologies

The advanced networks created and in use by Internet2 members provide an environment in which new technologies can be tested and enhanced. For instance, Internet2 provides a next-generation, nationwide 100 gigabit-per-second network that not only makes available a reliable production services platform for current high-performance needs but also creates a powerful experimental platform for the development of new network capabilities. See **Table 2.9** to get some sense of just how fast a 100-Gbps network is in terms of data transmission times. The fourth generation of this network, built through a federal stimulus grant from the National Telecommunications

TABLE 2.9 HOW FAST IS A 100-GBPS NETWORK?

DATA	TIME TO TRANSMIT
8.5 million electronic records	1 minute
300,000 X-rays	1 minute
1.8 million e-books simultaneously downloaded	2 minute

and Information Administration's Broadband Technology Opportunities Program, has now been deployed. The hybrid optical and packet network provides 8.8 terabits of capacity with the ability to seamlessly scale as requirements grow, includes over 15,000 miles of owned fiber optic cable, and reaches into underserved areas of the country, supporting connectivity for approximately 200,000 U.S. community anchor institutions (schools, local libraries, and museums), and enabling them to provide citizens across the country with telemedicine, distance learning, and other advanced applications not possible with consumer-grade Internet services. The infrastructure supports a wide range of IP and optical services already available today and also will stimulate a new generation of innovative services. The goal is to create an intelligent global ecosystem that will enable researchers, scientists, and others to "turn on" high-capacity network connections whenever and wherever they are needed. **Table 2.10** describes some of the projects that Internet2's 100-Gbps network is enabling. Other initiatives involve science and engineering (advanced network applications in support of distributed lab environments, remote access to rare scientific instruments, and distributed large-scale computation and data access), health sciences and health networks (telemedicine, medical and biological research, and health education and awareness), and arts and humanities (collaborative live performances, master classes, remote auditions, and interactive performing arts education and media events).

THE FIRST MILE AND THE LAST MILE

The Internet2 project is just the tip of the iceberg when it comes to future enhancements to the Internet. In 2007, the NSF began work on the Global Environment for Network Innovations (GENI) initiative. GENI is a unique virtual laboratory for exploring future internets at scale. GENI aims to promote innovations in network science, security technologies, services, and applications. GENI is a partnership of leading academic centers and private corporations such as Cisco, IBM, and HP, among many others. To date, awards have been made to 83 academic/industry teams for various projects to build, integrate, and operate early prototypes of the GENI virtual laboratory (Geni.net, 2014). Over the next two years, GENI will transition from being overseen by NSF's GENI Project Office to a community governance model (Geni.net, 2015).

The most significant privately initiated (but often government-influenced) changes are coming in two areas: fiber-optic trunk line bandwidth and wireless Internet services. Fiber optics is concerned with the first mile or backbone Internet services that carry bulk traffic long distances. Wireless Internet is concerned with the last mile—from the larger Internet to the user's smartphone, tablet computer, or laptop.

TABLE 2.10 PROJECTS BEING ENABLED BY INTERNET2'S 100-GBPS NETWORK

PROJECT	DESCRIPTION
XSEDE (Extreme Science and Engineering Discovery Environment)	In 2013, XSEDE upgraded from a 10-Gbps network to Internet2's 100-Gbps network. XSEDE supports over 8,000 members of the global scientific community and 17 supercomputers, and is being used for: • Galaxy, a data-intensive cancer research program, with more than 10,000 users who run 4,000–5,000 DNA sequence analyses daily. • Advanced chemistry research, which has discovered new materials such as two-dimensional metals. • Simulations of the impact of orbital debris on spacecraft and fragment impacts on body armor. • Research into healthcare contract economics.
CloudLab	Cloud computing test beds based at the University of Utah, Clemson, and the University of Wisconsin-Madison, connected by Internet2's 100-Gbps network. Focusing on the development of novel cloud architectures and new cloud computing applications. Will enable researchers to build their own clouds and experiment with applications such as real-time disaster response and medical record security. Awarded $10 milllion NSF grant in 2014.
University of Florida	Support for Compact Muon Solenoid (CMS) experiments at CERN's Hadron collider (contributed to discovery of the Higgs Particle, which earned 2013 Nobel Prize).

Fiber Optics and the Bandwidth Explosion in the First Mile

Fiber-optic cable consists of up to hundreds of strands of glass that use light to transmit data. It often replaces existing coaxial and twisted pair cabling because it can transmit much more data at faster speeds, with less interference and better data security. Fiber-optic cable is also thinner and lighter, taking up less space during installation. The hope is to use fiber optics to expand network bandwidth capacity in order to prepare for the expected increases in Web traffic once next-generation Internet services are widely adopted.

fiber-optic cable consists of up to hundreds of strands of glass or plastic that use light to transmit data

Telecommunication firms have made substantial investments in fiber optic cross-country and regional cable systems in the last decade. For instance, Verizon has spent over $23 billion since 2004, building and expanding its FiOS fiber-optic Internet service that can provide speeds of up to 500 Mbps, and currently has about 6.6 million FiOS customers. In 2012, Google joined the fray with Google Fiber, a 1-Gbps fiber-optic network, that is currently available in 3 cities. This installed base of fiber-optic cable represents a vast digital highway that is currently being exploited by YouTube (Google), Facebook, and other high-bandwidth applications. But despite the interest in fiber, only about 7.7% of U.S. homes had fiber connections as of 2014, a much lower percentage than a number of other countries around the world (Murphy, 2014). **Table 2.11** illustrates several optical bandwidth standards and compares them to traditional T lines.

The Last Mile: Mobile Internet Access

Fiber-optic networks carry the long-haul bulk traffic of the Internet—and in the future will play an important role in bringing high-speed broadband to the household and

TABLE 2.11 HIGH-SPEED OPTICAL BANDWIDTH STANDARDS

STANDARD	SPEED
T1	1.544 Mbps
T3	43.232 Mbps
OC-3	155 Mbps
OC-12	622 Mbps
OC-48	2.5 Gbps
OC-192	9.6 Gbps
OC-768	38.5 Gbps

Note: "OC" stands for Optical Carrier and is used to specify the speed of fiber-optic networks conforming to the SONET standard. SONET (Synchronous Optical Networks) includes a set of signal rate multiples for transmitting digital signals on optical fiber. The base rate (OC-1) is 51.84 Mbps.

small business. The goal of the Internet2 and GENI projects is to bring gigabit and ultimately terabit bandwidth to the household over the next 20 years. But along with fiber optics, arguably the most significant development for the Internet and Web in the last five years has been the emergence of mobile Internet access.

Wireless Internet is concerned with the last mile of Internet access to the user's home, office, car, smartphone, or tablet computer, anywhere they are located. Up until 2000, the last-mile access to the Internet—with the exception of a small satellite Internet connect population—was bound up in land lines of some sort: copper coaxial TV cables or telephone lines or, in some cases, fiber-optic lines to the office. Today, in comparison, high-speed cell phone networks and Wi-Fi network hotspots provide a major alternative.

Today, sales of desktop computers have been eclipsed by sales of smartphones, and tablet and ultramobile laptop computers with built-in wireless networking functionality. Clearly, a large part of the Internet is now mobile, access-anywhere broadband service for the delivery of video, music, and Web search. According to eMarketer, there are almost more than 2.25 billion mobile Internet users worldwide in 2015 (eMarketer, Inc., 2015e; 2015f).

Telephone-based versus Computer Network-based Wireless Internet Access

There are two different basic types of wireless Internet connectivity: telephone-based and computer network-based systems.

Telephone-based wireless Internet access connects the user to a global telephone system (land, satellite, and microwave) that has a long history of dealing with millions of users simultaneously and already has in place a large-scale transaction billing system and related infrastructure. Cellular telephones and the telephone industry are currently the largest providers of wireless access to the Internet today. In 2014, there were almost 1.9 billion mobile phones sold worldwide (of which 1.2 billion were smartphones), with a similar amount expected to be sold in 2015 (Gartner, Inc.,

TABLE 2.12 WIRELESS INTERNET ACCESS TELEPHONE TECHNOLOGIES

TECHNOLOGY	SPEED	DESCRIPTION	PLAYERS
3G (THIRD GENERATION)			
CDMA2000 EV-DO HSPA (W-CDMA)	144 Kbps–2 Mbps	High-speed, mobile, always on for e-mail, browsing, instant messaging. Implementing technologies include versions of CDMA2000 EV-DO (used by CDMA providers) and HSPDA (used by GSM providers). Nearly as fast as Wi-Fi.	Verizon, Sprint, AT&T, T-Mobile, Vodafone
3.5G (3G+)			
CDMA2000 EV-DO, Rev.B	Up to 14.4 Mbps	Enhanced version of CDMA 2000 EV-DO.	Verizon, Sprint
HSPA+	Up to 11 Mbps	Enhanced version of HSPA.	AT&T, T-Mobile
4G (FOURTH GENERATION)			
Long-Term Evolution (LTE)	Up to 100 Mbps	True broadband on cell phone; lower latency than previous generations.	AT&T, Verizon, Sprint, T-Mobile (in 2013)
5G (FIFTH GENERATION)			
Standards under development; expected by 2020	Up to 10 Gbps	Goals include 1-10 Gbps connectivity; sub-1 millisecond latency enabling services such as autonomous driving, augmented reality, virtual reality, and immersive/ tactile Internet.	Ericsson, SK Telecom, Huawei, Samsung, NTT DoCoMo, Verizon, national governments

2015b). **Table 2.12** summarizes the various telephone technologies used and under development for wireless Internet access.

Smartphones combine the functionality of a cell phone with that of a laptop computer with Wi-Fi capability. This makes it possible to combine in one device music, video, Web access, and telephone service. Tablet computers can also access cellular networks.

Wireless local area network (WLAN)-based Internet access derives from a completely different background from telephone-based wireless Internet access. Popularly known as **Wi-Fi**, WLANs are based on computer local area networks where the task is to connect client computers (generally stationary) to server computers within local areas of, say, a few hundred meters. WLANs function by sending radio signals that are broadcast over the airwaves using certain radio frequency ranges (2.4 GHz to 5.875

Wi-Fi
Wireless standard for Ethernet networks with greater speed and range than Bluetooth

TABLE 2.13 WIRELESS INTERNET ACCESS NETWORK TECHNOLOGIES

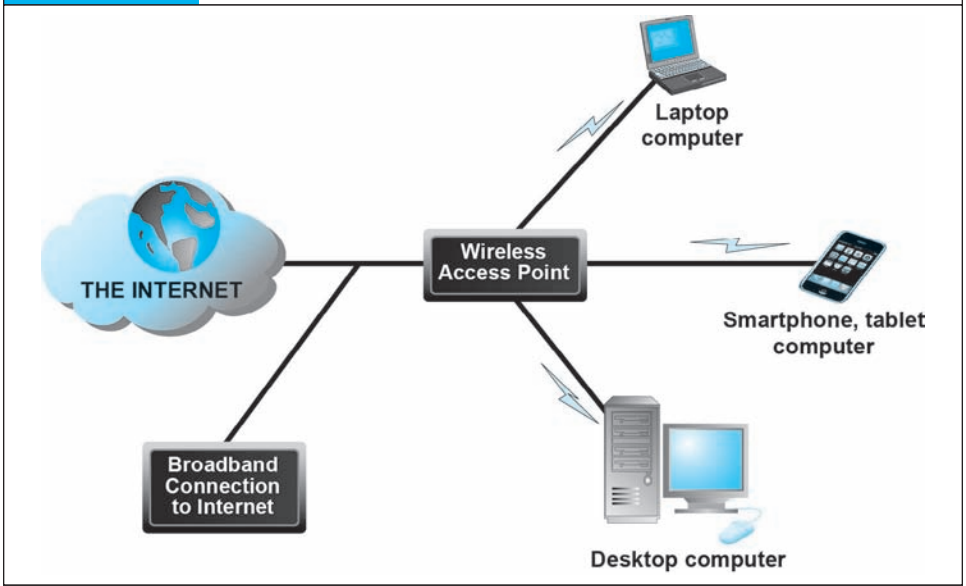
TECHNOLOGY	RANGE/ SPEED	DESCRIPTION	PLAYERS
Wi-Fi (IEEE 802.11 a/b/g/n)	300 feet/ 11–70 Mbps	Evolving high-speed, fixed broadband wireless local area network for commercial and residential use	Linksys, Cisco, and other Wi-Fi router manufacturers; entrepreneurial network developers
802.11ac	500 Mbps-1 Gbps		
802.11ad	less than 10 meters/up to 7 Gbps		
WiMax (IEEE 802.16)	30 miles/ 50–70 Mbps	High-speed, medium-range, broadband wireless metropolitan area network	Clearwire, Sprint, Fujitsu, Intel, Alcatel, Proxim
Bluetooth (wireless personal area network)	1–30 meters/ 1–3 Mbps	Modest-speed, low-power, short-range connection of digital devices	Sony Ericsson, Nokia, Apple, HP, and other device makers

GHz, depending on the type of standard involved). The major technologies here are the various versions of the Wi-Fi standard, WiMax, and Bluetooth (see **Table 2.13**).

In a Wi-Fi network, a *wireless access point* (also known as a "hot spot") connects to the Internet directly via a broadband connection (cable, DSL telephone, or T1 line) and then transmits a radio signal to a transmitter/receiver installed in a tablet or laptop computer or smartphone. **Figure 2.14** illustrates how a Wi-Fi network works.

Wi-Fi provided under the 802.11 a/b/g/n specifications offers high-bandwidth capacity from 11 Mbps up to a maximum of 7 Gbps—far greater than any 3G or 4G service currently in existence—but has a limited range of 300 meters, with the exception of WiMax discussed below. Wi-Fi is also exceptionally inexpensive. The cost of creating a corporate Wi-Fi network in a single 14-story building with an access point for each floor is less than $100 an access point. It would cost well over $500,000 to wire the same building with Ethernet cable. IEEE 802.11ac is a version of the 802.11 specification adopted in December 2013 that provides for throughputs of between 500 Mbps to over 1 Gbps. The newest standard, IEEE 802.11ad provides for throughput up to 7 Gbps. The first 802.11ad devices are likely to begin shipping by the end of 2015. Next-generation Wi-Fi standards currently being worked on by the IEEE 802.11 Working Group include 802.11ay, which deals with 60 Ghz wireless operations, and will provide for data rates of up to 20 Gbps, and 802.11ax, aimed at high-efficiency WLANs used for stadiums and other areas where many people want to access a Wi-Fi network at the same time. A next-generation 802.11ah standard aimed at the Internet of Things is also being developed (Weiss, 2015; Hsu, 2015).

FIGURE 2.14 WI-FI NETWORKS



In a Wi-Fi network, wireless access points connect to the Internet using a land-based broadband connection. Clients, which could be laptops, desktops, or tablet computers, connect to the access point using radio signals.

While initially a grass roots, "hippies and hackers" public access technology, billions of dollars have subsequently been poured into private ventures seeking to create for-profit Wi-Fi networks. One of the most prominent networks has been created by Boingo Wireless with more than 1 million hot spots around the globe. Optimum WiFi (available to Optimum Online customers for free) also offers over 1 million hotspots around the world. AT&T Wi-Fi Services (formerly Wayport) created another large network that provides Wi-Fi service at hotels, airports, McDonald's, and IHOP restaurants, and Hertz airport rental offices, with more than 30,000 hot spots in the United States and access to Boingo's wireless network internationally. T-Mobile and Sprint have also established Wi-Fi services at 2,000 Starbucks coffee shops and thousands of other public locations in the United States. Apple, in turn, has made Wi-Fi automatically available to iPhone and iPad devices as an alternative to the more expensive and much slower 3G and 4G cellular systems.

Will WLAN compete directly against far more expensive telephone 4G services? The answer is "eventually, but not right now." Wi-Fi was originally a local area network technology of limited range, for stationary client computers, but with high capacity suitable for most Web surfing and some corporate uses with modest bandwidth demands. Cellular phone systems are wide area networks of nearly unlimited range, for mobile client computers and handhelds, and with modest but rapidly increasing capacity suitable for e-mail, photos, and Web browsing (on very small screens). However, the rock-bottom price of Wi-Fi coupled with ambitious plans for a 30-mile-range WiMax (802.16) service suggests that Wi-Fi could drain significant business from far more capital-intensive cellular systems.

Bluetooth
technology standard for short-range wireless communication under 30 feet

A second WLAN technology for connecting to the Internet, and for connecting Internet devices to one another, is called Bluetooth. **Bluetooth** is a personal connectivity technology that enables links between mobile devices and connectivity to the Internet (Bluetooth.com, 2015). Bluetooth is the universal cable cutter, promising to get rid of the tangled mess of wires, cradles, and special attachments that plague the current world of personal computing. With Bluetooth, users can wear a wireless earbud, share files in a hallway or conference room, synchronize their smartphone with their laptop without a cable, send a document to a printer, and even pay a restaurant bill from the table to a Bluetooth-equipped cash register. Bluetooth is also an unregulated media operating in the 2.4 GHz spectrum but with a very limited range of 30 feet or less. It uses a frequency hopping signal with up to 1,600 hops per second over 79 frequencies, giving it good protection from interference and interception. Bluetooth-equipped devices constantly scan their environments looking for connections to compatible devices. Today, almost all mobile devices are Bluetooth-enabled. Bluetooth may also play a role in the future as a platform for the Internet of Things (see page 137).

INTERNET ACCESS DRONES

A new method of providing Internet access to areas that are not well served by wired or cellular networks is being explored by companies such as Google and Facebook. Both companies have recently purchased companies that make drones (unmanned aircraft/satellites) that may be used to provide Internet access to remote parts of the world.

In April 2014, Google purchased Titan Aerospace, which makes solar-powered drones that can fly for several years at 65,000 feet. In October 2015, Google filed paperwork with the Federal Aviation Administration covering two drones from Project Titan. Google is also experimenting with high-altitude balloons with its Project Loon. Google envisions a network of balloons circling high above the earth in the stratosphere, establishing a ring of uninterrupted connectivity. A pilot test of the concept was conducted over New Zealand in 2013, and in 2014, Google sent a prototype of a networked hot-air balloon around the world in 22 days, even taking photos for its Street View program, and in July 2015, the government of Sri Lanka announced that Sri Lanka would be the first country to use Project Loon to provide universal Internet access across Sri Lanka.

In a similar effort, Facebook has put together the Facebook Connectivity Lab, where engineers will focus on solar-powered drones, satellites, and infrared lasers capable of providing Internet access. To propel that effort, Facebook has purchased the British company Ascenta, whose founders helped create the world's longest flying solar-powered drone. In July 2015, Facebook announced that a prototype of its first Internet access solar-powered drone, Aquila, was complete and ready for testing. Created from carbon fiber, the drone has the wingspan of a Boeing 737 but weighs less than a small car, and is designed to fly at 60,000 to 90,000 feet for up to three months at a time. It reportedly uses a laser communications system that can beam data from the sky.

THE FUTURE INTERNET

The increased bandwidth and expanded wireless network connectivity of the Internet of the future will result in benefits beyond faster access and richer communications.

First-mile enhancements created by fiber-optic networks will enhance reliability and quality of Internet transmissions and create new business models and opportunities. Some of the major benefits of these technological advancements include latency solutions, guaranteed service levels, lower error rates, and declining costs. Widespread wireless access to the Internet will also essentially double or even triple the size of the online shopping marketspace because consumers will be able to shop and make purchases just about anywhere. We describe some of these benefits in more detail in the following sections.

Latency Solutions

One of the challenges of packet switching, where data is divided into chunks and then sent separately to meet again at the destination, is that the Internet does not differentiate between high-priority packets, such as video clips, and those of lower priority, such as self-contained e-mail messages. Because the packets cannot yet be simultaneously reassembled, the result can be distorted audio and video streams.

Differentiated quality of service (**diffserv**) is a technology that assigns levels of priority to packets based on the type of data being transmitted. Video conference packets, for example, which need to reach their destination almost instantaneously, receive much higher priority than e-mail messages. In the end, the quality of video and audio will skyrocket without undue stress on the network. Differential service is very controversial because it means some users may get more bandwidth than others, and potentially they may have to pay a higher price for more bandwidth.

differentiated quality of service (diffserv)
a new technology that assigns levels of priority to packets based on the type of data being transmitted

Guaranteed Service Levels and Lower Error Rates

In today's Internet, there is no service-level guarantee and no way to purchase the right to move data through the Internet at a fixed pace. Today's Internet promises only "best effort." The Internet is democratic—it speeds or slows everyone's traffic alike. In the future, it might be possible to purchase the right to move data through the network at a guaranteed speed in return for higher fees.

Declining Costs

As the Internet pipeline is upgraded, the availability of broadband service will expand beyond major metropolitan areas, significantly reducing the cost of access. More users mean lower cost, as products and technology catch on in the mass market. Higher volume usage enables providers to lower the cost of both access devices, or clients, and the service required to use such products. Both broadband and wireless service fees are expected to decline as geographic service areas increase, in part due to competition for that business.

The Internet of Things

No discussion of the future Internet would be complete without mentioning the **Internet of Things (IoT)**, also sometimes referred to as the Industrial Internet. Internet technology is spreading beyond the desktop, laptop, and tablet computer, and

Internet of Things (IoT)
Use of the Internet to connect a wide variety of devices, machines, and sensors

beyond the smartphone, to consumer electronics, electrical appliances, cars, medical devices, utility systems, machines of all types, even clothing—just about anything that can be equipped with sensors that can collect data and connect to the Internet, enabling the data to be analyzed with data analytics software.

IoT builds on a foundation of existing technologies, such as RFID, and is being enabled by the availability of low-cost sensors, the drop in price of data storage, the development of "Big Data" analytics software that can work with trillions of pieces of data, as well as implementation of IPv6, which will allow Internet addresses to be assigned to all of these new devices. Although IoT devices don't necessarily have to be wireless, most use wireless communications technology previously discussed, such as cellular networks, Wi-Fi, Bluetooth, or other wireless protocols such as ZigBee or Z-Wave, to connect either directly or via a mobile app to the Internet (often a cloud service).

IoT technology is powering the development of "smart" connected "things"—televisions, houses, and cars, as well as wearable technology—clothing and devices like the Apple Watch. Smart televisions that integrate the Internet directly into the set and can run apps have become very popular, with 45% of TVs sold in the United States in the second quarter of 2015 being smart, and 50% of U.S. homes with Internet access now owning a connected TV device (NPD, 2015). Smart houses have attracted even more interest, fueled by Google's purchase of Nest Labs for $3.2 billion in 2014. Nest Labs makes smart thermostats, home security cameras, and smoke and carbon monoxide alarms. In October 2015, Nest Labs announced that it was making Nest Weave, a protocol it had developed that enables appliances, thermostats, door locks, and other devices to communicate with each other and other Nest products, available to third-party developers and manufacturers. Apple announced a smart home platform that it calls HomeKit in June 2014. HomeKit is a framework and network protocol for controlling devices in the home that is programmed directly into Apple's iOS software for iPhones and iPads, and is integrated with Siri, Apple's voice-activiated artificial intelligence assistant. By October 2015, a number of devices were designed specifically for use with HomeKit, such as a smart thermostat, a smart deadbolt lock, a home sensor that provides temperature, humidity, and air quality readings, and an iDevices switch that enables you to turn electronic devices on and off using Siri. Many cable companies such as Time Warner Cable, Comcast, and AT&T already offer connected home systems that include appliances and lights. All in all, the global market for smart house products was valued at about €18 billion in 2014, and is expected to grow to over €53 billion by 2020.

In September 2014, Apple introduced the Apple Watch. The Apple Watch features a fitness/activity tracker similar to offerings from Fitbit, Nike+, FuelBand, and Jawbone Up, is able to access a wide variety of apps, and also works with Apple Pay, Apple's mobile payment service. A number of other manufacturers, such as Samsung, LG, Motorola, and Swatch, also introduced smartwatches in 2014. Wearable computing is expected to grow into a €31 billion business worldwide by 2020.

Connected cars that have built-in Internet access have also arrived. Here too, Google and Apple are major players. In January 2014, Google announced the Open

Automotive Alliance, a group of leading automakers and technology companies focused on bringing the Android platform to cars. In March 2014, Apple announced CarPlay, a software platform that synchronizes iPhones to the car's infotainment system. Android Auto and CarPlay-enabled vehicles began to be introduced in 2015, and will become more widely available in 2016, when GM plans to make both available as an option on all models. Connected cars are likely to be integrated with smart home initiatives in the future. Already, iControl, which provides the software underlying automated home systems from Comcast, TimeWarner, ADT, and others, has entered into a partnership with Zubie, a provider of connected car services.

Despite all of the IoT activity, however, interoperability remains a major concern. As with many technologies in the early stages of development, many organizations are fighting to create the standards that participants in the market will follow. The AllSeen Alliance, formed by Qualcomm in December 2013 with 50 other companies, including Microsoft and Cisco, is one group that hopes to create an open source standard. Membership in the Alliance has soared by over 650% since its initial founding. Another group, the Open Interconnect Consortium, formed by Intel, Broadcom, Dell, and others apparently not happy with the AllSeen effort, formed in July 2014, and has also seen its membership soar to over 100 members. A different group, the Industrial Internet Consortium, has been formed by AT&T, Cisco, GE, IBM, and Intel to focus on engineering standards for industrial assets. The Wolfram Connected Devices Project is aimed at developing a database of IoT devices, and currently includes more than 2,000. And as with many other types of Internet-related technology, Google with its Android operating system and Apple with AirPlay wireless streaming protocol may be trying to create their own standards.

Other concerns include security and privacy. Security experts believe that IoT devices could potentially be a security disaster, with the potential for malware being spread through a connected network, and difficulty in issuing patches to devices, leaving them vulnerable (Internet Society, 2015). Data from stand-alone smart devices can reveal much personal detail about a consumer's life, and if those devices are all ultimately interconnected, there will be little that is truly private.

Although challenges remain before the Internet of Things is fully realized, it is coming closer and closer to fruition, with some experts projecting as many as 100 billion connected IoT devices and global economic impact of more than €10 trillion by 2025 (Internet Society, 2015).

2.4 THE WEB

Without the Web, there would be no e-commerce. The invention of the Web brought an extraordinary expansion of digital services to millions of amateur computer users, including color text and pages, formatted text, pictures, animations, video, and sound. In short, the Web makes nearly all the rich elements of human expression needed to establish a commercial marketplace available to nontechnical computer users worldwide.

While the Internet was born in the 1960s, the Web was not invented until 1989–1991 by Dr. Tim Berners-Lee of the European Particle Physics Laboratory, better known as CERN (Berners-Lee et al., 1994). Several earlier authors—such as Vannevar Bush (in 1945) and Ted Nelson (in the 1960s)—had suggested the possibility of organizing knowledge as a set of interconnected pages that users could freely browse (Bush, 1945; Ziff Davis Publishing, 1998). Berners-Lee and his associates at CERN built on these ideas and developed the initial versions of HTML, HTTP, a Web server, and a browser, the four essential components of the Web.

First, Berners-Lee wrote a computer program that allowed formatted pages within his own computer to be linked using keywords (hyperlinks). Clicking on a keyword in a document would immediately move him to another document. Berners-Lee created the pages using a modified version of a powerful text markup language called Standard Generalized Markup Language (SGML).

Berners-Lee called this language HyperText Markup Language, or HTML. He then came up with the idea of storing his HTML pages on the Internet. Remote client computers could access these pages by using HTTP (introduced earlier in Section 2.1 and described more fully in the next section). But these early Web pages still appeared as black and white text pages with hyperlinks expressed inside brackets. The early Web was based on text only; the original Web browser only provided a line interface.

Information being shared on the Web remained text-based until 1993, when Marc Andreessen and others at the National Center for Supercomputing Applications (NCSA) at the University of Illinois created a Web browser with a graphical user interface (GUI) called **Mosaic** that made it possible to view documents on the Web graphically—using colored backgrounds, images, and even primitive animations. Mosaic was a software program that could run on any graphically based interface such as Macintosh, Windows, or Unix. The Mosaic browser software read the HTML text on a Web page and displayed it as a graphical interface document within a GUI operating system such as Windows or Macintosh. Liberated from simple black and white text pages, HTML pages could now be viewed by anyone in the world who could operate a mouse and use a Macintosh or PC.

Mosaic
Web browser with a graphical user interface (GUI) that made it possible to view documents on the Web graphically

Aside from making the content of Web pages colorful and available to the world's population, the graphical Web browser created the possibility of **universal computing**, the sharing of files, information, graphics, sound, video, and other objects across all computer platforms in the world, regardless of operating system. A browser could be made for each of the major operating systems, and the Web pages created for one system, say, Windows, would also be displayed exactly the same, or nearly the same, on computers running the Macintosh or Unix operating systems. As long as each operating system had a Mosaic browser, the same Web pages could be used on all the different types of computers and operating systems. This meant that no matter what kind of computer you used, anywhere in the world, you would see the same Web pages. The browser and the Web have introduced us to a whole new world of computing and information management that was unthinkable prior to 1993.

universal computing
the sharing of files, information, graphics, sound, video, and other objects across all computer platforms in the world, regardless of operating system

In 1994, Andreessen and Jim Clark founded Netscape, which created the first commercial browser, **Netscape Navigator**. Although Mosaic had been distributed free of charge, Netscape initially charged for its software. In August 1995, Microsoft

Netscape Navigator
the first commercial Web browser

Corporation released its own free version of a browser, called **Internet Explorer**. In the ensuing years, Netscape fell from a 100% market share to less than .5% in 2009. The fate of Netscape illustrates an important e-commerce business lesson. Innovators usually are not long-term winners, whereas smart followers often have the assets needed for long-term survival. Much of the Netscape browser code survives today in the Firefox browser produced by Mozilla, a nonprofit heavily funded by Google.

Internet Explorer
Microsoft's Web browser

HYPERTEXT

Web pages can be accessed through the Internet because the Web browser software on your PC can request Web pages stored on an Internet host server using the HTTP protocol. **Hypertext** is a way of formatting pages with embedded links that connect documents to one another and that also link pages to other objects such as sound, video, or animation files. When you click on a graphic and a video clip plays, you have clicked on a hyperlink. For example, when you type a Web address in your browser such as http://www.sec.gov, your browser sends an HTTP request to the sec.gov server requesting the home page of sec.gov.

hypertext
a way of formatting pages with embedded links that connect documents to one another, and that also link pages to other objects such as sound, video, or animation files

HTTP is the first set of letters at the start of every Web address, followed by the domain name. The domain name specifies the organization's server computer that is housing the document. Most companies have a domain name that is the same as or closely related to their official corporate name. The directory path and document name are two more pieces of information within the Web address that help the browser track down the requested page. Together, the address is called a Uniform Resource Locator, or URL. When typed into a browser, a URL tells it exactly where to look for the information. For example, in the following URL:

http://www.megacorp.com/content/features/082602.html

http = the protocol used to display Web pages

www.megacorp.com = domain name

content/features = the directory path that identifies where on the domain Web server the page is stored

082602.html = the document name and its format (an HTML page)

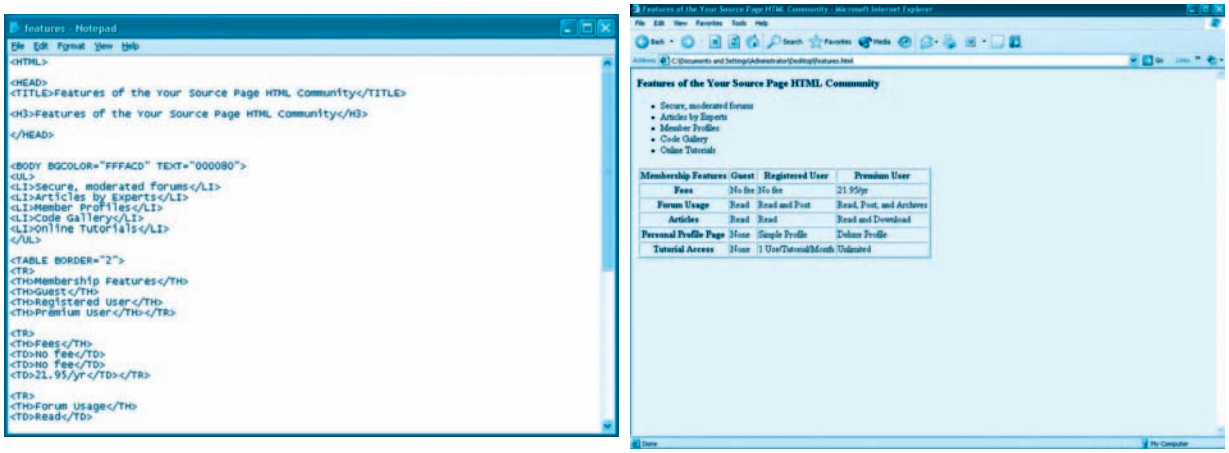
The most common domain extensions (known as general top-level domains, or gTLDs) currently available and officially sanctioned by ICANN are shown in **Table 2.14**. Countries also have domain names, such as .uk, .au, and .fr (United Kingdom, Australia, and France, respectively). These are sometimes referred to as country-code top-level domains, or ccTLDs. In 2008, ICANN approved a significant expansion of gTLDs, with potential new domains representing cities (such as .berlin), regions (.africa), ethnicity (.eus), industry/activities (such as .health), and even brands (such as .deloitte). In 2009, ICANN began the process of implementing these guidelines. In 2011, ICANN removed nearly all restrictions on domain names, thereby greatly expanding the number of different domain names available. As of October 2015, about 765 gTLDs have been applied for, acquired, and launched, and another 575

TABLE 2.14 EXAMPLES OF TOP-LEVEL DOMAINS

GENERAL TOP-LEVEL DOMAIN (GTLD)	YEAR(S) INTRODUCED	PURPOSE	SPONSOR/ OPERATOR
.com	1980s	Unrestricted (but intended for commercial registrants)	VeriSign
.edu	1980s	U.S. educational institutions	Educause
.gov	1980s	U.S. government	U.S. General Services Administration
.mil	1980s	U.S. military	U.S. Department of Defense Network Information Center
.net	1980s	Unrestricted (but originally intended for network providers, etc.)	VeriSign
.org	1980s	Unrestricted (but intended for organizations that do not fit elsewhere)	Public Interest Registry (was operated by VeriSign until December 31, 2002)
.int	1998	Organizations established by international treaties between governments	Internet Assigned Numbers Authority (IANA)
.aero	2001	Air-transport industry	Societé Internationale de Telecommunications Aeronautiques SC (SITA)
.biz	2001	Businesses	NeuLevel
.coop	2001	Cooperatives	DotCooperation LLC
.info	2001	Unrestricted use	Afilias LLC
.museum	2001	Museums	Museum Domain Name Association (MuseDoma)
.name	2001	For registration by individuals	Global Name Registry Ltd.
.pro	2002	Accountants, lawyers, physicians, and other professionals	RegistryPro Ltd
.jobs	2005	Job search	Employ Media LLC
.travel	2005	Travel search	Tralliance Corporation
.mobi	2005	Web sites specifically designed for mobile phones	mTLD Top Level Domain, Ltd.
.cat	2005	Individuals, organizations, and companies that promote the Catalan language and culture	Fundació puntCAT
.asia	2006	Regional domain for companies, organizations, and individuals based in Asia	DotAsia Organization
.tel	2006	Telephone numbers and other contact information	ICM Registry
.xxx	2010	New top-level domain for pornographic content	None yet approved

SOURCE: Based on data from ICANN, 2011b.

FIGURE 2.15 EXAMPLE HTML CODE (A) AND WEB PAGE (B)



(a) (b)

HTML is a text markup language used to create Web pages. It has a fixed set of "tags" that are used to tell the browser software how to present the content on screen. The HTML shown in Figure 2.15 (a) creates the Web page seen in Figure 2.15 (b).

are currently in the pipeline. The new gTLDs are in multiple languages and scripts/characters (including Arabic, Chinese, Japanese, and Russian) and include geographic place names such as .nyc, .london, and .paris; business identifiers such as .restaurant, .realtor, .technology, and .lawyer; brand names such as .bmw and .suzuki; and a whole host of other descriptive names.

MARKUP LANGUAGES

Although the most common Web page formatting language is HTML, the concept behind document formatting actually had its roots in the 1960s with the development of Generalized Markup Language (GML).

HyperText Markup Language (HTML)

HyperText Markup Language (HTML) is a GML that is relatively easy to use. HTML provides Web page designers with a fixed set of markup "tags" that are used to format a Web page (see **Figure 2.15**). When these tags are inserted into a Web page, they are read by the browser and interpreted into a page display. You can see the source HTML code for any Web page by simply clicking on the "Page Source" command found in all browsers. In Figure 2.15, the HTML code in the first screen produces the display in the second screen.

HyperText Markup Language (HTML) GML that is relatively easy to use in Web page design. HTML provides Web page designers with a fixed set of markup "tags" that are used to format a Web page

HTML defines the structure and style of a document, including the headings, graphic positioning, tables, and text formatting. Since its introduction, the major

browsers have continuously added features to HTML to enable programmers to further refine their page layouts. Unfortunately, some browser enhancements may work only in one company's browser. Whenever you build an e-commerce site, you should take care that the pages can be viewed by the major browsers, even outdated versions of browsers. HTML Web pages can be created with any text editor, such as Notepad or WordPad, using Microsoft Word (simply save the Word document as a Web page), or any one of several Web page development tools such as Microsoft Expression Web or Adobe Dreamweaver CC.[5]

The most recent version of HTML is HTML5. HTML5 introduces features like video playback and drag-and-drop that in the past were provided by plug-ins like Adobe Flash. HTML5 is also used in the development of mobile Web sites and mobile apps, and is an important tool in both responsive Web design and adaptive Web delivery, all of which are discussed more fully in Chapter 3. The *Insight on Technology* case, *The Rise of HTML5,* examines the increasing use of HTML5.

eXtensible Markup Language (XML)

eXtensible Markup Language (XML) a markup language specification developed by the World Wide Web Consortium (W3C) that is designed to describe data and information

eXtensible Markup Language (XML) takes Web document formatting a giant leap forward. XML is a markup language specification developed by the W3C that is similar to HTML, but has a very different purpose. Whereas the purpose of HTML is to control the "look and feel" and display of data on the Web page, XML is designed to describe data and information. For example, consider the sample XML document in **Figure 2.16**. The first line in the sample document is the XML declaration, which is always included; it defines the XML version of the document. In this case, the document conforms to the 1.0 specification of XML. The next line defines the first element of the document (the root element): <note>. The next four lines define four child elements of the root (to, from, heading, and body). The last line defines the end of the root element. Notice that XML says nothing about how to display the data, or how the text should look on the screen. HTML is used for information display in combination with XML, which is used for data description.

FIGURE 2.16 A SIMPLE XML DOCUMENT

```
<?xml version="1.0"?>
<note>
<to>George</to>
<from>Carol</from>
<heading>Just a Reminder</heading>
<body>Don't forget to order the groceries from FreshDirect!</body>
</note>
```

The tags in this simple XML document, such as <note>, <to>, and <from>, are used to describe data and information, rather than the look and feel of the document.

[5] A detailed discussion of how to use HTML is beyond the scope of this text.

INSIGHT ON TECHNOLOGY

THE RISE OF HTML5

In 2010, Apple founder Steve Jobs lambasted Adobe Flash for its poor security, its poor performance on mobile devices, and for being an energy hog. Jobs instead trumpeted HTML5 as the preferred method for displaying video online. Flash forward to 2015. A year after its official ratification by the W3C, the Web's standards-setting organization, HTML5 has become a de facto standard, proving once again Jobs' uncanny ability to see and perhaps shape the future.

HTML5 has become a catch-all term that encompasses not only the video element but also the use of the newest versions of Cascading Style Sheets (CSS3) and JavaScript, and another new tool, HTML5 Canvas. Also intended to replace plug-ins, it is used with a set of JavaScript functions to render simple animations, which reduces page load time. Multi-platform Web developers began using HTML5 because these new elements provided device independence, but soon discovered that they could do even more. The built-in functionality of mobile devices, including GPS and swiping, can be accessed, enabling m-commerce sites to build Web-based mobile apps that can replicate the native app experience. Web-based mobile apps (HTML5 apps) work just like Web pages. When a user navigates to the page containing the mobile app, the page content, including graphics, images, and video, are loaded into the browser from the Web server, rather than residing in the mobile device hardware like a native app. This concept has been embraced by mobile developers, who naturally dream of being able to reach all platforms with a single product.

For businesses, the cost savings of HTML5 are obvious. A single HTML5 app requires far less effort to build than multiple native apps for the iOS, Android, Windows Phone, and other platforms. HTML5 apps can more easily be linked to and shared on social networks, encouraging viral distribution. Some HTML5 apps can even be designed so that they can be run on mobile devices when they are offline. Differences in how apps run across different platforms and workarounds are eliminated. It used to be the case that HTML5 apps couldn't approach the smooth and speedy user experience of a native app, but thanks to many advancements in the underlying technologies behind HTML5 and improvements in the expertise of HTML5 developers, that is no longer the case. And plug-ins like Flash require installation, whereas HTML5 does not.

In 2014, the Interactive Advertising Bureau (IAB), together with a number of the largest publishers and advertising firms, urged advertisers to implement HTML5 as the standard for mobile ads in order to guarantee that ads will run and look good on different platforms, and in 2015 released guidelines that fully embrace HTML5, citing interoperability and the improved effectiveness of HTML5 ads. The rise of HTML5 has mirrored the growth of the mobile platform as it supplants Flash, which was developed for the desktop, as the preferred media delivery platform on the Web. In 2015, the number of Flash vulnerabilities reported nearly doubled to 133 from just over 70 in the previous year. Many of the Web's most prominent advertisers responded accordingly. In 2015, Facebook announced it would introduce HTML5 capability to its News Feed, and Google signaled a shift towards HTML5 by blocking Flash advertisements from autoplaying in Chrome, in part due to their notorious security issues. Mozilla followed suit with Firefox, meaning that over 80% of the Web browser market is now blocking Flash. Amazon also switched to HTML5-only promos in

(continued)

2015. The moves from these advertising and tech juggernauts have solidified the downfall of Flash and the rise of HTML5 as the future of advertising.

Retailers have taken notice. In 2015, almost 50% of Internet Retailer's top 500 mobile retailers use HTML5 for their smartphone or tablet mobile sites. One example of a company using HTML5 with success is Rakuten Shopping, an online retailer that offers a wide variety of goods online, and is currently ranked as one of Internet Retailer's top 30 mobile retailers in 2015. Using HTML5 has enabled Rakuten to shift away from using cookies to store customer attributes and has lightened the load on its servers, which are receiving fewer calls from mobile devices because once content is downloaded, it is stored locally in the device's browser. HTML5's video tag has also enabled Rakuten to embed video within HTML pages on a mobile device.

Another example is the *Financial Times,* whose HTML5 app has proven to be an important driver for FT's business. FT first switched from a native app to HTML5 in 2011, in part to make maintaining the app across multiple platforms and devices easier. In 2013, FT rolled out a redesign of the app, featuring even more videos and personalization features. FT's managing director, Robert Grimshaw, believes that those who have chosen to develop native apps in parallel will struggle with the overhead of maintaining and developing them.

In fact, according to Indeed, which searches millions of jobs from thousands of different job sites, "HTML5" continues to be one of the fastest-growing keywords found in online job postings in 2015, ahead of iOS and Android. As a result, HTML5 projects typically take longer to develop than planned, according to a Forrester survey.

According to Tim Berners-Lee, founder and chief of the W3C, and an ardent opponent of native apps because they remove functionality from the Web, HTML5 security and access control issues are currently being addressed. For instance, HTML5 has not consistently supported digital rights management (DRM). In the past, media companies developed their own copy protection standards based on geographical region and/or whether payment had been proffered. These were enforced through their own media players. Because HTML5 does not require plug-ins to play video (or audio), and further, because HTML5 is an official W3C standard charged with remaining vendor neutral, this presents a challenge to the HTML5 working group. HTML5 also allows Web sites to track how much battery power their site visitors have remaining. This feature was implemented so that sites could warn users to recharge their battery, but the reporting is so detailed that sites can determine what sites you've come from last solely based on your battery information. However, the security issues with HTML5 pale in comparison to those associated with Flash, and it's still early in the development cycle for HTML5.

Although HTML5 is being widely adopted on e-commerce and m-commerce sites, native apps aren't going anywhere. Instead, many developers are incorporating HTML5 code into native apps, creating a kind of hybrid or mixed mode app. Gartner expects that more than 50% of mobile applications will be hybrid by 2016.

SOURCES: "Transforming the Web with HTML5," by Christina Mulligan, Sdtimes.com, October 5, 2015; "With Digital Ads Shifting to HTML5, the Industry Now Has a New Set of Guidelines," by Christopher Heine, Adweek.com, September 28, 2015; "HTML5 Looks Good in Light of Google, Facebook and IAB Moves," by Carl Weinschenk, September 22, 2015; "Ad Firms Are the Reason Adobe's Flash Still Exists—Despite Its Many, Many Security Flaws," by Alice Truong, Qz.com, August 6, 2015; "How Your Smartphone's Battery Life Can Be Used to Invade Your Privacy," by Alex Hern, *The Guardian,* August 4, 2015; "Mozilla Firefox Temporarily Blocks Flash by Default," Ian Paul, Macworld.com, June 14, 2015; "Mobile HTML5 Remains Relevant, But Faces Challenges," by George Lawton, Techtarget.com, August 28, 2014; "RIP Flash: Why HTML5 Will Finally Take Over Video and the Web This Year," by Erika Trautman, Thenextweb.com, April 19, 2014; "Top Mobile Retailers Reap Rewards Using the Magical HTML5," by Bill Siwicki, Internetretailer.com, December 13, 2013; "Financial Times: 'There Is No Drawback to Working in HTML5'," by Stuart Dredge, TheGuardian.com, April 29, 2013; "The HTML5 Promise: Responsive Web Design for Any Screen," by Tom Foremski, Siliconvalleywatcher.com, April 16, 2013; "Adobe's Flash Surrender Proves Steve Jobs and Apple Were Right All Along with HTML5," by Nigam Arora, *Forbes*, November, 9, 2011.

FIGURE 2.17 SAMPLE XML CODE FOR A COMPANY DIRECTORY

```
<?xml version="1.0"?>
<Companies>
    <Company>
          <Name>Azimuth Interactive Inc.</Name>
       <Specialties>
                <Specialty>HTML development</Specialty>
                  <Specialty>technical documentation</Specialty>
               <Specialty>ROBO Help</Specialty>
                <Country>United States</Country>
       </Specialties>
      <Location>
                <Country>United States</Country>
             <State />
              <City>Chicago</City>
      </Location>
            <Telephone>301-555-1212</Telephone>
    </Company>
    <Company>
       ...
    </Company>
   ...
</Companies>
```

This XML document uses tags to define a database of company names.

Figure 2.17 shows how XML can be used to define a database of company names in a company directory. Tags such as <Company>, <Name>, and <Specialty> can be defined for a single firm, or an entire industry. On an elementary level, XML is extraordinarily easy to learn and is very similar to HTML except that you can make up your own tags. At a deeper level, XML has a rich syntax and an enormous set of software tools, which make XML ideal for storing and communicating many types of data on the Web.

XML is "extensible," which means the tags used to describe and display data are defined by the user, whereas in HTML the tags are limited and predefined. XML can also transform information into new formats, such as by importing information from a database and displaying it as a table. With XML, information can be analyzed and displayed selectively, making it a more powerful alternative to HTML. This means that business firms, or entire industries, can describe all of their invoices, accounts payable, payroll records, and financial information using a Web-compatible markup language. Once described, these business documents can be stored on intranet Web servers and shared throughout the corporation.

WEB SERVERS AND CLIENTS

We have already described client/server computing and the revolution in computing architecture brought about by client/server computing. You already know that a server is a computer attached to a network that stores files, controls peripheral devices,

interfaces with the outside world—including the Internet—and does some processing for other computers on the network.

Web server software software that enables a computer to deliver Web pages written in HTML to client computers on a network that request this service by sending an HTTP request

But what is a Web server? **Web server software** refers to the software that enables a computer to deliver Web pages written in HTML to client computers on a network that request this service by sending an HTTP request. Apache, which works with Linux and Unix operating systems, is the most commonly used type of Web server software. Microsoft's Internet Information Services (IIS) also has significant market share (Netcraft, 2015).

Aside from responding to requests for Web pages, all Web servers provide some additional basic capabilities such as the following:

- *Security services*—These consist mainly of authentication services that verify that the person trying to access the site is authorized to do so. For Web sites that process payment transactions, the Web server also supports SSL and TLS, the protocols for transmitting and receiving information securely over the Internet. When private information such as names, phone numbers, addresses, and credit card data needs to be provided to a Web site, the Web server uses SSL to ensure that the data passing back and forth from the browser to the server is not compromised.
- *FTP*—This protocol allows users to transfer files to and from the server. Some sites limit file uploads to the Web server, while others restrict downloads, depending on the user's identity.
- *Search engine*—Just as search engine sites enable users to search the entire Web for particular documents, search engine modules within the basic Web server software package enable indexing of the site's Web pages and content and permit easy keyword searching of the site's content. When conducting a search, a search engine makes use of an index, which is a list of all the documents on the server. The search term is compared to the index to identify likely matches.
- *Data capture*—Web servers are also helpful at monitoring site traffic, capturing information on who has visited a site, how long the user stayed there, the date and time of each visit, and which specific pages on the server were accessed. This information is compiled and saved in a log file, which can then be analyzed. By analyzing a log file, a site manager can find out the total number of visitors, the average length of each visit, and the most popular destinations, or Web pages.

The term *Web server* is also used to refer to the physical computer that runs Web server software. Leading manufacturers of Web server computers include Lenovo, Dell, and Hewlett-Packard. Although any desktop computer can run Web server software, it is best to use a computer that has been optimized for this purpose. To be a Web server, a computer must have the Web server software installed and be connected to the Internet. Every public Web server computer has an IP address. For example, if you type http://www.pearsonhighered.com/laudon in your browser, the browser software sends a request for HTTP service to the Web server whose domain name is pearsonhighered.com. The server then locates the page named "laudon" on its hard drive, sends the page back to your browser, and displays it on your screen. Of course, firms also can use Web servers for strictly internal local area networking in intranets.

database server server designed to access specific information within a database

ad server server designed to deliver targeted banner ads

mail server server that provides e-mail messages

Aside from the generic Web server software packages, there are actually many types of specialized servers on the Web, from **database servers** that access specific information within a database, to **ad servers** that deliver targeted banner ads, to **mail servers** that

provide e-mail messages, and **video servers** that provide video clips. At a small e-commerce site, all of these software packages might be running on a single computer, with a single processor. At a large corporate site, there may be hundreds or thousands of discrete server computers, many with multiple processors, running specialized Web server functions. We discuss the architecture of e-commerce sites in greater detail in Chapter 3.

video server
server that serves video clips

A **Web client**, on the other hand, is any computing device attached to the Internet that is capable of making HTTP requests and displaying HTML pages. The most common client is a Windows or Macintosh desktop computer, with various flavors of Unix/Linux computers a distant third. However, the fastest growing category of Web clients is not computers at all, but mobile devices. In general, a Web client can be any device—including a printer, refrigerator, stove, home lighting system, or automobile instrument panel—capable of sending and receiving information from a Web server.

Web client
any computing device attached to the Internet that is capable of making HTTP requests and displaying HTML pages, most commonly a Windows PC or Macintosh

WEB BROWSERS

A **Web browser** is a software program whose primary purpose is to display Web pages. Browsers also have added features, such as e-mail and newsgroups (an online discussion group or forum). As of September 2015, the leading Web browser remains Microsoft Internet Explorer, with about 52% of the market. The second most popular browser, with about a 30% market share, is Google's Chrome, a small, yet technologically advanced open source browser. Mozilla Firefox has dropped to third place, with only about 11.5% of the U.S. Web browser market. First released in 2004, Firefox is a free, open source Web browser for the Windows, Linux, and Macintosh operating systems, based on Mozilla open source code (which originally provided the code for Netscape). It is small and fast and offers many features such as pop-up blocking and tabbed browsing. Apple's Safari browser is fourth, with about 5% of the market (Marketshare.hitslink.com, 2015). In July 2015, Microsoft introduced Edge, an entirely new browser bundled with its new operating system, Windows 10. Edge is designed to replace Internet Explorer. However, despite the popularity of Windows 10 (it has already been installed on 110 million devices as of October 2015), Edge has thus far been largely ignored by Windows 10 adopters. Instead, Chrome is the dominant browser on Windows 10 (Keizer, 2015).

Web browser
software program whose primary purpose is to display Web pages

2.5 THE INTERNET AND THE WEB: FEATURES AND SERVICES

The Internet and the Web have spawned a number of powerful software applications upon which the foundations of e-commerce are built. You can think of all these as Web services, and it is interesting as you read along to compare these services to other traditional media such as television or print media. If you do, you will quickly realize the richness of the Internet environment.

electronic mail (e-mail)
the most-used application of the Internet. Uses a series of protocols to enable messages containing text, images, sound, and video clips to be transferred from one Internet user to another

E-MAIL

Since its earliest days, **electronic mail**, or **e-mail**, has been the most-used application of the Internet. Worldwide, there are an estimated 4.4 billion e-mail accounts, sending

an estimated 205 billion e-mails a day. There are an estimated 1.4 billion mobile e-mail users worldwide, and their number is expected to almost double, to 2.5 billion, by 2019 (Radicati Group, 2015). Estimates vary on the amount of spam, ranging from 40% to 90%. E-mail marketing and spam are examined in more depth in Chapter 6.

E-mail uses a series of protocols to enable messages containing text, images, sound, and video clips to be transferred from one Internet user to another. Because of its flexibility and speed, it is now the most popular form of business communication—more popular than the phone, fax, or snail mail (the U.S. Postal Service). In addition to text typed within the message, e-mail also allows **attachments**, which are files inserted within the e-mail message. The files can be documents, images, sounds, or video clips.

attachment
a file inserted within an e-mail message

INSTANT MESSAGING

Instant messaging (IM) allows you to send messages in real time, one line at a time, unlike e-mail. E-mail messages have a time lag of several seconds to minutes between when messages are sent and received. IM displays lines of text entered on a computer almost instantaneously. Recipients can then respond immediately to the sender the same way, making the communication more like a live conversation than is possible through e-mail. To use IM, users create a buddy list they want to communicate with, and then enter short text messages that their buddies will receive instantly (if they are online at the time). And although text remains the primary communication mechanism in IM, more advanced systems also provide voice and video chat functionality. Instant messaging over the Internet competes with cell phone Short Message Service (SMS) texting, which is far more expensive than IM.

instant messaging (IM)
displays words typed on a computer almost instantaneously. Recipients can then respond immediately to the sender the same way, making the communication more like a live conversation than is possible through e-mail

The major IM systems are Skype, Yahoo Messenger, Google Talk, and AIM (AOL Instant Messenger). Facebook also offers instant messaging services via Facebook Chat. IM systems were initially developed as proprietary systems, with competing firms offering versions that did not work with one another. Today, there still is no built-in interoperability among the major IM systems. Mobile messaging apps, such as Facebook Messenger, WhatsApp (purchased by Facebook for $22 billion in 2014), Snapchat (which allows users to send pictures, videos, and texts that will disappear after a short period of time), Viber, and others are also becoming very popular, providing competition for both traditional desktop IM systems and SMS text messaging.

SEARCH ENGINES

Search engines identify Web pages that appear to match keywords, also called queries, entered by a user and then provide a list of the best matches (search results). Almost 85% of U.S. Internet users regularly use search engines from either desktop or mobile devices, and they generate around 18 billion queries a month (eMarketer, Inc., 2015g). There are hundreds of different search engines, but in the United States, the vast majority of the search results are supplied by the top five providers (see **Figure 2.18**). Google, Bing, Ask and Yahoo are also major search providers in Europe. Other European search providers include T-Online (Germany), Qwant (France) and the anonymous search engine Unbubble. In China, Baidu, Qihoo 360, Sohu Sogou and Tencent Soso are major search engine providers.

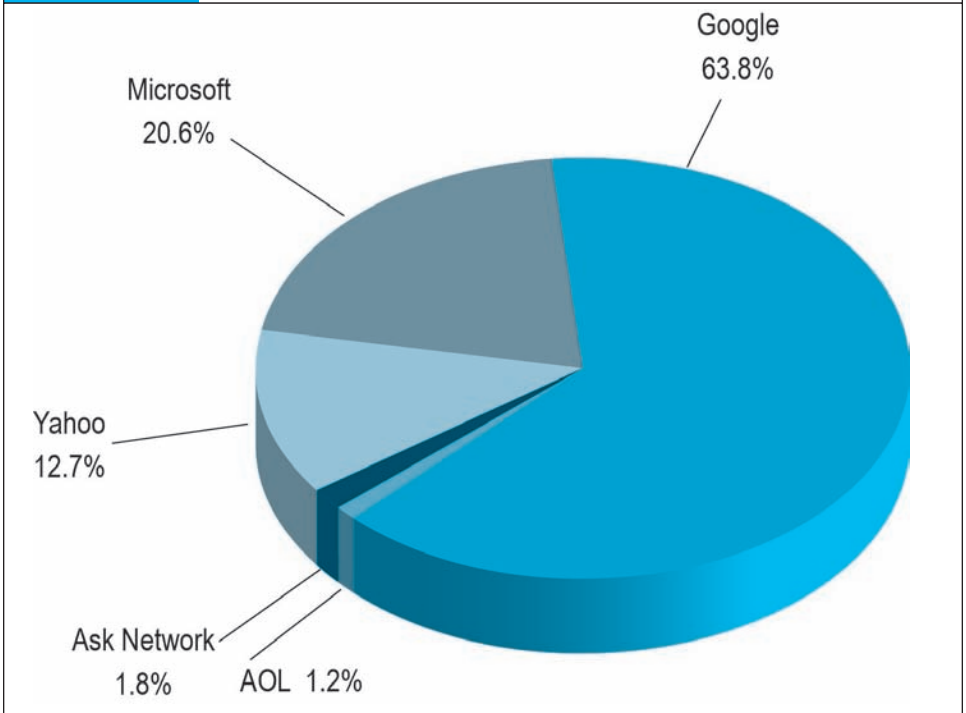
search engine
identifies Web pages that appear to match keywords, also called queries, entered by the user and then provides a list of the best matches

Web search engines started out in the early 1990s shortly after Netscape released the first commercial Web browser. Early search engines were relatively simple software

programs that roamed the nascent Web, visiting pages and gathering information about the content of each Web page. These early programs were called variously crawlers, spiders, and wanderers; the first full-text crawler that indexed the contents of an entire Web page was called WebCrawler, released in 1994. AltaVista (1995), one of the first widely used search engines, was the first to allow "natural language" queries such as "history of Web search engines" rather than "history + Web + search engine."

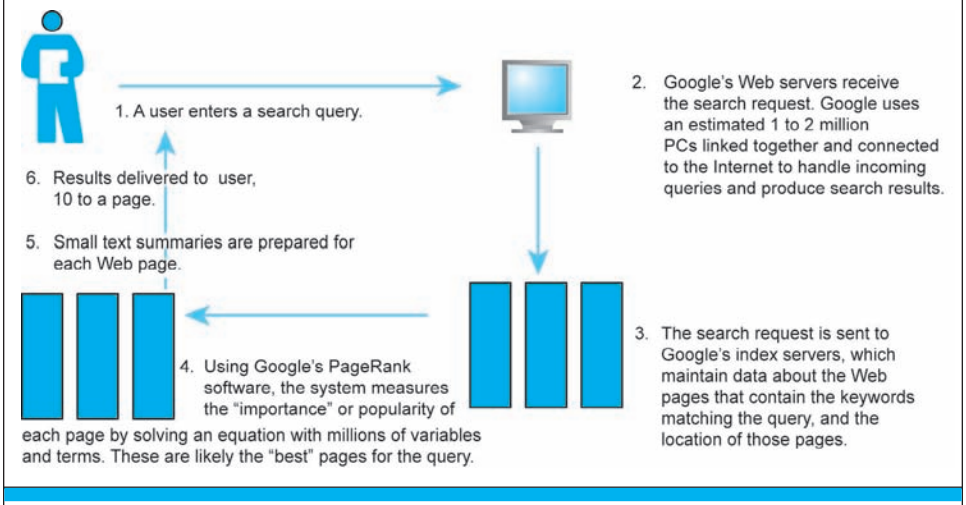
The first search engines employed simple keyword indexes of all the Web pages visited. They would count the number of times a word appeared on the Web page, and store this information in an index. These search engines could be easily fooled by Web designers who simply repeated words on their home pages. The real innovations in search engine development occurred through a program funded by the Department of Defense called the Digital Library Initiative, designed to help the Pentagon find research papers in large databases. Stanford, Berkeley, and three other universities became hotbeds of Web search innovations in the mid-1990s. At Stanford in 1994, two computer science students, David Filo and Jerry Yang, created a hand-selected list of their favorite Web pages and called it "Yet Another Hierarchical Officious Oracle," or Yahoo!. Yahoo initially was not a real search engine, but rather an edited selection of Web sites organized by categories the editors found useful. Yahoo later developed "true" search engine capabilities.

FIGURE 2.18 TOP FIVE U.S. SEARCH ENGINES



Google is, by far, the leading search engine based on its percentage share of the number of searches.
SOURCE: Based on data from comScore, 2015.

FIGURE 2.19 HOW GOOGLE WORKS



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

In 1998, Larry Page and Sergey Brin, two Stanford computer science students, released their first version of the Google search engine. This search engine was different: not only did it index each Web page's words, but Page had discovered that the AltaVista search engine not only collected keywords from sites but also calculated what other sites linked to each page. By looking at the URLs on each Web page, they could calculate an index of popularity. AltaVista did nothing with this information. Page took this idea and made it a central factor in ranking a Web page's appropriateness to a search query. He patented the idea of a Web page ranking system (PageRank System), which essentially measures the popularity of the Web page. Brin contributed a unique Web crawler program that indexed not just keywords on a Web page, but combinations of words (such as authors and their article titles). These two ideas became the foundation for the Google search engine (Brandt, 2004). **Figure 2.19** illustrates how Google works.

Initially, few understood how to make money from search engines. That changed in 2000 when Goto.com (later Overture) allowed advertisers to bid for placement on their search engine results, and Google followed suit in 2003 with its AdWords program, which allowed advertisers to bid for placement of short text ads on Google search results. The spectacular increase in Internet advertising revenues (which have been growing at around 20%–25% annually over the last few years) has helped search engines transform themselves into major shopping tools and created an entire new industry called "search engine marketing."

When users enter a search term at Google, Bing, Yahoo, or any of the other Web sites serviced by these search engines, they receive two types of listings: sponsored links, for which advertisers have paid to be listed (usually at the top of the search results page), and unsponsored "organic" search results. Advertisers can also purchase small text ads on the right side of the search results page. In addition, search engines have extended their services to include news, maps, satellite images, computer images, e-mail, group calendars, group meeting tools, and indexes of scholarly papers.

Although the major search engines are used for locating general information of interest to users, search engines have also become a crucial tool within e-commerce sites. Customers can more easily search for the product information they want with the help of an internal search program; the difference is that within Web sites, the search engine is limited to finding matches from that one site. For instance, more online shoppers use Amazon's internal search engine to look for products than conducting a product search using Google, a fact noted by Google's executive chairman Eric Schmidt, who believes that Amazon search poses a significant threat to Google (Mangalindan, 2014).

ONLINE FORUMS

An **online forum** (also referred to as a message board, bulletin board, discussion board, discussion group, or simply a board or forum) is a Web application that enables Internet users to communicate with each other, although not in real time. A forum provides a container for various discussions (or "threads") started (or "posted") by members of the forum, and depending on the permissions granted to forum members by the forum's administrator, enables a person to start a thread and reply to other people's threads. Most forum software allows more than one forum to be created. The forum administrator typically can edit, delete, move, or otherwise modify any thread on the forum. Unlike an electronic mailing list (such as a listserv), which automatically sends new messages to a subscriber, an online forum typically requires that the member visit the forum to check for new posts. Some forums offer an "e-mail notification" feature that notifies users that a new post of interest to them has been made.

online forum
a Web application that allows Internet users to communicate with each other, although not in real time

STREAMING MEDIA

Streaming media enables live Web video, music, video, and other large-bandwidth files to be sent to users in a variety of ways that enable the user to play back the files. In some situations, such as live Web video, the files are broken into chunks and served by specialized video servers to users in chunks. Client software puts the chunks together and plays the video. In other situations, such as YouTube, a single large file is downloaded from a standard Web server to users who can begin playing the video before the entire file is downloaded. Streamed files must be viewed "live;" they cannot be stored on client hard drives without special software. Streamed files are "played" by a software program such as Windows Media Player, Apple QuickTime, Adobe Flash, and RealMedia Player. There are a number of tools used to create streaming files,

streaming media
enables music, video, and other large files to be sent to users in chunks so that when received and played, the file comes through uninterrupted

including HTML5 and Adobe Flash, as well as technologies specifically adapted for the mobile platform such as the Meerkat and Periscope apps.

Sites such as YouTube, Metacafe, and Facebook have popularized user-generated video streaming. Web advertisers increasingly use video to attract viewers. Streaming audio and video segments used in Web ads and news stories are perhaps the most frequently used streaming services. As the capacity of the Internet grows, streaming media will play an even larger role in e-commerce.

COOKIES

cookie
a tool used by Web sites to store information about a user. When a visitor enters a Web site, the site sends a small text file (the cookie) to the user's computer so that information from the site can be loaded more quickly on future visits. The cookie can contain any information desired by the site designers

A **cookie** is a tool used by a Web site to store information about a user. When a visitor enters a Web site, the site sends a small text file (the cookie) to the user's computer so that information from the site can be loaded more quickly on future visits. The cookie can contain any information desired by the Web site designers, including customer number, pages visited, products examined, and other detailed information about the behavior of the consumer at the site. Cookies are useful to consumers because the Web site will recognize returning patrons and not ask them to register again. Cookies are also used by advertisers to ensure visitors do not receive the same advertisements repeatedly. Cookies can also help personalize a Web site by allowing the site to recognize returning customers and make special offers to them based on their past behavior at the site. Cookies allow Web marketers to customize products and segment markets—the ability to change the product or the price based on prior consumer information (described more fully in Chapter 6). As we will discuss throughout the book, cookies also can pose a threat to consumer privacy, and at times they are bothersome. Many people clear their cookies at the end of every day. Some disable them entirely using tools built into most browsers.

WEB 2.0 FEATURES AND SERVICES

Today's broadband Internet infrastructure has greatly expanded the services available to users. These capabilities have formed the basis for new business models. Digital content and digital communications are the two areas where innovation is most rapid. Web 2.0 applications and services are "social" in nature because they support communication among individuals within groups or social networks.

Online Social Networks

Online social networks are services that support communication within networks of friends, colleagues, and entire professions. Online social networks have developed very large worldwide audiences and form the basis for new advertising platforms and for social e-commerce (see Chapters 6, 7, and 10). The largest social networks are Facebook (1.5 billion members worldwide), Instagram (400 million members worldwide), LinkedIn (more than 380 million members worldwide), Twitter (more than 315 million active users worldwide), and Pinterest (around 100 million active users). These networks rely on user-generated content (messages, photos, and

videos) and emphasize sharing of content. All of these features require significant broadband Internet connectivity and equally large cloud computing facilities to store content.

Blogs

A **blog** (originally called a **weblog**) is a personal Web page that typically contains a series of chronological entries (newest to oldest) by its author, and links to related Web pages. The blog may include a blogroll (a collection of links to other blogs) and trackbacks (a list of entries in other blogs that refer to a post on the first blog). Most blogs allow readers to post comments on the blog entries as well. The act of creating a blog is often referred to as "blogging." Blogs are either hosted by a third-party site such as Blogger, LiveJournal, TypePad, Xanga, WordPress, and Tumblr, or prospective bloggers can download software such as Movable Type to create a blog that is hosted by the user's ISP. Blog pages are usually variations on templates provided by the blogging service or software and hence require no knowledge of HTML. Therefore, millions of people without HTML skills of any kind can post their own Web pages, and share content with friends and relatives. The totality of blog-related Web sites is often referred to as the "blogosphere."

blog
personal Web page that is created by an individual or corporation to communicate with readers

Blogs have become hugely popular. Tumblr, WordPress, and LiveJournal together hosted over 330 million blogs as of October 2015, so it is likely that the total number is significantly higher. According to eMarketer, there are an estimated 28 million active U.S. bloggers, and 79 million U.S. blog readers (eMarketer, Inc., 2015h; 2015i). No one knows how many of these blogs are kept up to date or are just yesterday's news. And no one knows how many of these blogs have a readership greater than one (the blog author). In fact, there are so many blogs you need a search engine just to find them, or you can just go to a list of the most popular 100 blogs and dig in.

Really Simple Syndication (RSS)

The rise of blogs is correlated with a distribution mechanism for news and information from Web sites that regularly update their content. **Really Simple Syndication (RSS)** is an XML format that allows users to have digital content, including text, articles, blogs, and podcast audio files, automatically sent to their computers over the Internet. An RSS aggregator software application that you install on your computer gathers material from the Web sites and blogs that you tell it to scan and brings new information from those sites to you. Sometimes this is referred to as "syndicated" content because it is distributed by news organizations and other syndicators (or distributors). Users download an RSS aggregator and then "subscribe" to the RSS "feeds." When you go to your RSS aggregator's page, it will display the most recent updates for each channel to which you have subscribed. RSS has rocketed from a "techie" pastime to a broad-based movement. Although Google has closed down Google Reader, a popular RSS product, a number of other RSS reader options remain, including Feedly, Reeder, and NewsBlur.

Really Simple Syndication (RSS)
program that allows users to have digital content, including text, articles, blogs, and podcast audio files, automatically sent to their computers over the Internet

Podcasting

podcast
an audio presentation—such as a radio show, audio from a movie, or simply a personal audio presentation—stored as an audio file and posted to the Web

A **podcast** is an audio presentation—such as a radio show, audio from a movie, or simply a personal audio presentation—stored as an audio file and posted to the Web. Listeners download the files from the Web and play them on their players or computers. While commonly associated with Apple's iPod portable music player, you can listen to MP3 podcast files with any MP3 player. Podcasting has transitioned from an amateur independent producer media in the "pirate radio" tradition to a professional news and talk content distribution channel. For instance, National Public Radio's This American Life's Serial podcast has been downloaded over 90 million times, and in October 2015, WNYC, a major public radio station, announced it would create a new division devoted solely to the production of podcasts.

Wikis

wiki
Web application that allows a user to easily add and edit content on a Web page

A **wiki** is a Web application that allows a user to easily add and edit content on a Web page. (The term wiki derives from the "wiki wiki" (quick or fast) shuttle buses at Honolulu Airport.) Wiki software enables documents to be written collectively and collaboratively. Most wiki systems are open source, server-side systems that store content in a relational database. The software typically provides a template that defines layout and elements common to all pages, displays user-editable source code (usually plain text), and then renders the content into an HTML-based page for display in a Web browser. Some wiki software allows only basic text formatting, whereas others allow the use of tables, images, or even interactive elements, such as polls and games. Because wikis by their very nature are very open in allowing anyone to make changes to a page, most wikis provide a means to verify the validity of changes via a "Recent Changes" page, which enables members of the wiki community to monitor and review the work of other users, correct mistakes, and hopefully deter "vandalism."

The most well-known wiki is Wikipedia, an online encyclopedia that contains more than 4.9 million English-language articles on a variety of topics, appears in 288 languages, and has around 500 million unique visitors each month worldwide. The Wikimedia Foundation, which operates Wikipedia, also operates a variety of related projects, including Wikibooks, a collection of collaboratively written free textbooks and manuals; Wikinews, a free content news source; and Wiktionary, a collaborative project to produce a free multilingual dictionary in every language, with definitions, etymologies, pronunciations, quotations, and synonyms.

Music and Video Services

With the low-bandwidth connections of the early Internet, audio and video files were difficult to download and share, but with the huge growth in broadband connections, these files are not only commonplace but today constitute the majority of Web traffic. Spurred on by the worldwide sales of more than 1 billion iOS devices (iPhones, iPads, and iPod Touches) as of January 2015, as well as millions of other smartphones, the Internet has become a virtual digital river of music and video files.

The Apple iTunes store is probably the most well-known repository of digital music tracks online, with a catalog of more than 43 million songs in its catalog as of May 2015. Google Play offers over 30 million, and there are hundreds of other sites offering music downloads as well. In addition, streaming music services (see the *Insight on Technology* case study, *Music: Battle of the Titans and Lilliputians,* in Chapter 5) and Internet radio add to the bandwidth devoted to the delivery of online music.

Online video viewing has also exploded in popularity. In June 2015, for instance, around 193 million U.S. Internet users watched online video content via a desktop computer, while 100 million watched on smartphones and tablet computers (comScore, 2015b). Cisco estimates that consumer Internet video traffic constituted a whopping 64% of all consumer Internet traffic in 2014, not including the video exchanged through P2P file sharing (Cisco, 2015). By far, the most common type of Internet video is provided by YouTube, with more than 1 billion unique visitors worldwide each month who watch more than 6 billion hours of video, most of it short clips taken from television shows, or user-generated content. The largest sources of legal, paid television content are the iTunes Store, where you can purchase specific episodes or entire seasons of TV shows, Netflix, and Hulu.

Internet advertising makes extensive use of streaming video ads. Companies that want to demonstrate use of their products have found video clips to be extremely effective. And audio reports and discussions also have become commonplace, either as marketing materials or customer reports.

Future digital video networks will be able to deliver better-than-broadcast-quality video over the Internet to computers and other devices in homes and on the road. High-quality interactive video and audio makes sales presentations and demonstrations more effective and lifelike and enables companies to develop new forms of customer support. The Internet has become a major distribution channel for movies, television shows, and sporting events (see Chapter 9).

Internet Telephony

If the telephone system were to be built from scratch today, it would be an Internet-based, packet-switched network using TCP/IP because it would be less expensive and more efficient than the alternative existing system, which involves a mix of circuit-switched legs with a digital backbone. In fact, AT&T has begun testing all-digital IP phone networks in several U.S. cities. Likewise, if cable television systems were built from scratch today, they most likely would use Internet technologies for the same reasons.

IP telephony is a general term for the technologies that use **Voice over Internet Protocol (VoIP)** and the Internet's packet-switched network to transmit voice, fax, and other forms of audio communication over the Internet. VoIP can be used over a traditional handset as well as over a mobile device. VoIP avoids the long distance charges imposed by traditional phone companies.

There were about 224 million residential VoIP subscribers worldwide in 2014, and in the United States, more than half of residential customers are now using VoIP, and

IP telephony
a general term for the technologies that use VoIP and the Internet's packet-switched network to transmit voice and other forms of audio communication over the Internet

Voice over Internet Protocol (VoIP)
protocol that allows for transmission of voice and other forms of audio communication over the Internet

this number is expanding rapidly as cable systems provide telephone service as part of their "triple play": voice, Internet, and TV as a single package. This number is dwarfed, however, by the number of mobile VoIP subscribers, which has grown explosively over the last several years, fueled by the rampant growth of mobile messaging apps that now also provide free VoIP services, such as Facebook Messenger, WhatsApp, Viber, WeChat, Line, KakaoTalk, and others (Infonetics Research, 2015; BuddeComm, 2015).

VoIP is a disruptive technology. In the past, voice and fax were the exclusive provenance of the regulated telephone networks. With the convergence of the Internet and telephony, however, this dominance is already starting to change, with local and long distance telephone providers and cable companies becoming ISPs, and ISPs getting into the phone market. Key players in the VoiP market include independent service providers such as VoIP pioneers Vonage and Skype (now owned by Microsoft), as well as traditional players such as telephone and cable companies that have moved aggressively into the market. Skype currently dominates the international market and carries 50 billion minutes (one-third of the world's long distance traffic) each month (Skype for Business Team, 2015).

Video Conferencing, Video Chatting, and Telepresence

Internet video conferencing is accessible to anyone with a broadband Internet connection and a Web camera (webcam). The most widely used Web conferencing suite of tools is WebEx (now owned by Cisco). VoIP companies such as Skype and ooVoo also provide more limited Web conferencing capabilities, commonly referred to as video chatting. Apple's FaceTime is another video chatting technology available for iOS mobile devices with a forward-facing camera and Macintosh computers equipped with Apple's version of a webcam, called a FaceTime camera.

Telepresence takes video conferencing up several notches. Rather than single persons "meeting" by using webcams, telepresence creates an environment in a room using multiple cameras and screens, which surround the users. The experience is uncanny and strange at first because as you look at the people in the screens, they are looking directly at you. Broadcast quality and higher screen resolutions help create the effect. Users have the sensation of "being in the presence of their colleagues" in a way that is not true for traditional webcam meetings. Providers of telepresence software and hardware include Cisco, HP, and Dimension Data (formerly Teliris).

Intelligent Personal Assistants

The idea of having a conversation with a computer, having it understand you and be able to carry out tasks according to your direction, has long been a part of science fiction, from the 1968 Hollywood movie *2001: A Space Odyssey*, to an old Apple promotional video depicting a professor using his personal digital assistant to organize his life, gather data, and place orders at restaurants. That was all fantasy. But Apple's Siri, billed as an intelligent personal assistant and knowledge navigator and released in 2011, has many of the capabilities of the computer assistants found in fiction. Siri has a natural language, conversational interface, situational awareness, and is capable of carrying out many tasks based on verbal commands by delegating requests to a variety

of different Web services. For instance, you can ask Siri to find a restaurant nearby that serves Italian food. Siri may show you an ad for a local restaurant in the process. Once you have identified a restaurant you would like to eat at, you can ask Siri to make a reservation using OpenTable. You can also ask Siri to place an appointment on your calendar, search for airline flights, and figure out what's the fastest route between your current location and a destination using public transit. The answers are not always completely accurate, but critics have been impressed with its uncanny abilities. Siri is currently available on the Apple Watch, the iPhone 4S and later versions, iPads with Retina display, the iPad Mini, and iPod Touches (fifth generation and later versions).

In 2012, Google released its version of an intelligent assistant for Android-based smartphones, which it calls Google Now. Google Now is part of the Google Search mobile application. While Google Now has many of the capabilities of Apple's Siri, it attempts to go further by predicting what users may need based on situational awareness, including physical location, time of day, previous location history, calendar, and expressed interests based on previous activity, as described in its patent application (United States Patent Office, 2012). For instance, if you often search for a particular musician or style of music, Google Now might provide recommendations for similar music. If it knows that you go to a health club every other day, Google Now will remind you not to schedule events during these periods. If it knows that you typically read articles about health issues, the system might monitor Google News for similar articles and make recommendations. Other intelligent personal assistants include Samsung's S Voice, LG's Voice Mate, and Microsoft's Cortana.

2.6 MOBILE APPS: THE NEXT BIG THING IS HERE

The use of mobile devices such as smartphones and tablet computers in e-commerce has truly exploded, as has the use of mobile apps. Worldwide, according to 451 Research, there are around 2 billion active mobile app users worldwide, and this number is expected to increase to over 3 billion by 2018. Although the United States accounts for the most mobile app downloads on an absolute basis, countries in Asia, such as Malaysia, Indonesia, the Philippines, South Korea, and Taiwan, have much higher app download rates on a per-user basis, based on activity on InMobi's mobile ad network (see the opening case in Chapter 6, *InMobi's Global Mobile Ad Network* for further information on InMobi).

Although using mobile browsers to access mobile Web sites remains popular, increasingly more and more time is being spent with mobile apps. For instance, in United Kingdom, 46% of total digital media time is spent using an app on a mobile device, compared to only 10% using a mobile browser. A much higher percentage of social media time is spent by users in the United Kingdom on a mobile app (61%) versus a mobile browser (only 8%) (comScore, 2015). However, U.K. mobile phone users are still more likely to use a mobile Web browser for shopping than an app.

In Finland, 80% of smartphone owners in 2014 used mobile apps on their devices, a 150% increase from 2012. Activities that are popular on apps include accessing

social networks such as Facebook and Instagram, using Google Maps, using messaging apps such as WhatsApp, listening to music on Spotify, watching online video on YouTube, and playing games. Social networks are the dominant mobile app activity in Australia, with almost two-thirds of mobile Internet users using such apps monthly. As with Finland, games, maps, and entertainment apps are also popular. In France, the top mobile app ranked by unique visitors is YouTube. We examine development of mobile apps and mobile Web sites in further detail in Chapter 3. *Insight on Business: Apps For Everything: The App Ecosystem* also gives you some further background on mobile apps.

PLATFORMS FOR MOBILE APPLICATION DEVELOPMENT

Unlike mobile Web sites, which can be accessed by any Web-enabled mobile device, native apps, which are designed specifically to operate using the mobile device's hardware and operating system, are platform-specific. Applications for the iPhone, iPad, and other iOS devices are written in the Objective-C programming language using the iOS SDK (software developer kit). Applications for Android operating system–based phones typically are written using Java, although portions of the code may be in the C or C++ programming language. BlackBerry apps also are written in Java. Applications for Windows mobile devices are written in C or C++. In addition to creating native apps using a programming language such as Objective C or Java, there are also hundreds of low-cost or open source app development toolkits that make creating cross-platform mobile apps relatively easy and inexpensive without having to use a device-specific programming language. See Section 3.6 in Chapter 3 for more information.

APP MARKETPLACES

Once written, applications are distributed through various marketplaces. Android apps for Android-based phones are distributed through Google Play, which is controlled by Google. iPhone applications are distributed through Apple's App Store. BlackBerry applications can be found in RIM's App World, while Microsoft operates the Windows Phone Marketplace for Windows mobile devices. Apps can also be purchased from third-party vendors such as Amazon's Appstore. It is important to distinguish "native" mobile apps, which run directly on a mobile device and rely on the device's internal operating system, from Web apps referred to in Section 2.5, which install into your browser, although these can operate in a mobile environment as well.

INSIGHT ON BUSINESS

APPS FOR EVERYTHING: THE APP ECOSYSTEM

When Steve Jobs introduced the iPhone in January 2007, no one—including himself—envisioned that the device would launch a revolution in consumer and business software or become a major e-commerce platform, let alone a game platform, advertising platform, and general media platform for television shows, movies, videos, and e-books. In short, it's become the personal computer all over again, just in a much smaller form factor.

The iPhone's original primary functions, beyond being a cell phone, were to be a camera, text messaging device, and Web browser. What Apple initially lacked for the iPhone were software applications that would take full advantage of its computing capabilities. The solution was software developed by outside developers—tens of thousands of outside developers—who were attracted to the mission by potential profits and fame from the sale or free distribution of their software applications on a platform approved by the leading innovator in handheld computing and cellular devices. More than two-thirds of apps are free. Every month, Apple receives thousands of new apps from over 9 million registered developers who may be teenagers in a garage, major video game developers, or major publishers, as well as Fortune 500 consumer products firms using apps for marketing and promotion.

In July 2008, Apple introduced the App Store, which provides a platform for the distribution and sale of apps by Apple as well as by independent developers. Following in the footsteps of the iTunes music store, Apple hoped that the software apps—most of them free—would drive sales of the iPhone device. It was not expecting the App Store itself to become a major source of revenue. Fast forward to 2015: there are now an estimated 1.5 million approved apps available for download from the App Store. Other smartphone developers also followed suit: by 2015, there were over 1.6 million apps available for Android devices as well. As of June 2015, more than 100 billion apps had been downloaded from the App Store, and approximately 8 million apps are downloaded from the App Store every day. Apple has reported that customers spent about $15 billion in the App Store in 2014, generating an estimated profit for Apple of nearly $5 billion. Even so, Apple's primary goal in offering apps is not to make money from them but instead to drive sales of devices—the iPhones, iPads, and iPods that need software to become useful. It's the reverse of printer companies who make cheap printers in order to sell expensive ink. At the same time, apps tie the customer to a hardware platform: the cost of switching to a different platform rises with each new app installed.

The app phenomenon has spawned a new digital ecosystem: tens of thousands of developers, a wildly popular hardware platform, and millions of consumers looking for a computer in their pocket that can replace their now clunky desktop-laptop Microsoft Windows computers, do a pretty good job as a digital media center while on the road, and, by the way, serve as a cell phone. And the mobile platform has even started to usurp TV as the most popular entertainment medium. A 2015 report from Flurry found that the average U.S. consumer now spends nearly 200 minutes per day within apps, well ahead of the 168 minutes spent watching TV. As recently as 2014, TV was still comfortably ahead of apps. More consumers are opting to consume media on their phones than ever before, which is more good news for app developers.

The range of applications among the 1.5 million or so apps on the Apple platform is staggering and defies brief description. Currently, there are 24 different categories. You can use the Genius

(continued)

feature to recommend new apps based on ones you already have. The most popular app categories are games, education, business, lifestyle, and entertainment.

The implications of the app ecosystem for e-commerce are significant. The smartphone in your pocket becomes not only a general-purpose computer but also an always-present shopping tool for consumers, as well as an entirely new marketing and advertising platform for vendors. Early e-commerce applications using desktops and laptops were celebrated as allowing people to shop in their pajamas. Smartphones extend this range from pajamas to office desktops to trains, planes, and cars—all while fully clothed. You can shop anywhere, shop everywhere, and shop all the time, in between talking, texting, watching video, and listening to music.

Almost all of the top 100 brands have a presence in at least one of the major app stores, and more than 90% have an app in the Apple App Store. Here are a few examples of how some firms are using apps to advance and support their brands:

- Coca-Cola Freestyle: Allows users to create custom drinks by combining choices and use the Location Finder to find a Freestyle machine to actually create the drink
- Benjamin Moore's Color Capture: Enables users to match colors and paints
- Colgate-Palmolive's Max White Photo Recharger: Enables users to whiten their teeth in photos
- Tiffany's Engagement Ring Finder: Lets users view diamonds by size, shape, setting, metal, and design
- Charmin's SitOrSquat Restroom Finder: Provides users with locations of nearest public bathrooms, including cleanliness reviews, availability of changing tables, and handicapped access.

There are, of course, dangers in any ecosystem dominated by a single company. The Apple iOS platform is a closed sandbox, inviting the potential for censorship. Whether that censorship is justified depends upon who you ask. For instance, Apple has removed applications because of sexually themed content. Clearly Apple is concerned the App Store might become an adult digital theme park that would turn off parents and families who are the target audience for iPhone and iPad sales. In 2015, Apple removed all games and apps featuring images of the Confederate flag, including a game intended to teach users about Civil War history. After some backlash, they reinstated many of these games, but required the game developers to remove the flag from screenshots and app icons. Apple has also had to fight to keep malware off of the App Store. For instance, a Russian app entitled "Find and Call" purported to simplify users' contacts lists, but instead stole those contacts and uploaded the address book to a remote server, spamming those addresses. In 2013, researchers at Georgia Tech created an app that was able to elude all of Apple iOS's most current security tools, including sandboxing, code signing, and various anti-exploit technologies. Thus far, most Apple app malware has been targeted toward jailbroken iPhones. However, in 2015, security researchers exposed flaws in the App Store that allow malicious apps to steal passwords and private user data. Clearly, the app ecosystem is not immune to many of the same issues that apply to the Internet and e-commerce at large.

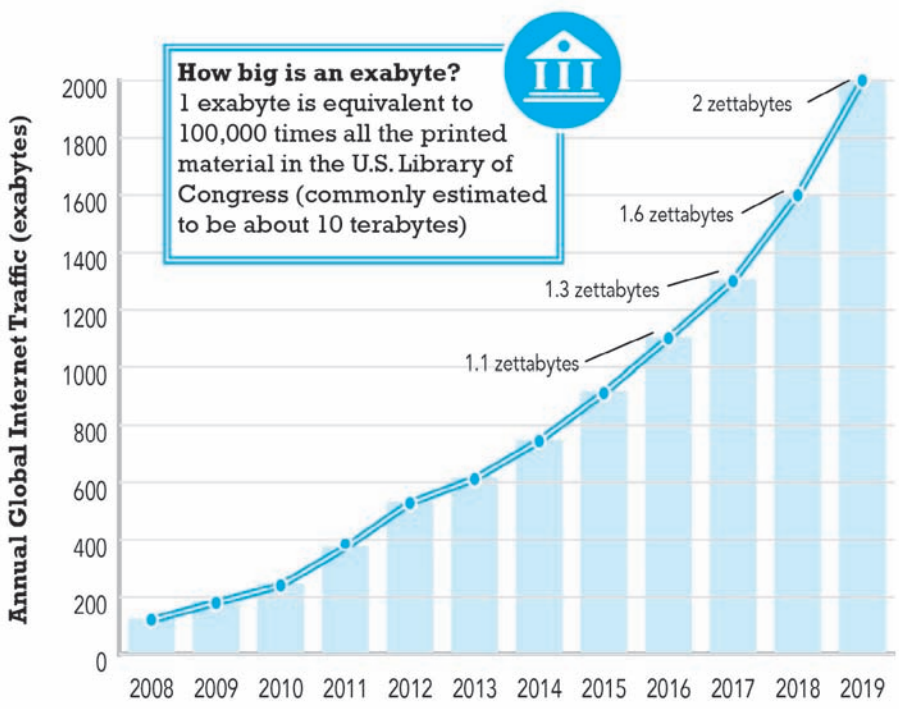
SOURCES: "U.S. Consumers Now Spend More Time in Apps Than Watching TV," by Sarah Perez, Techcrunch.com, September 10, 2015; "Tim Cook Takes Apple Down the Dark Road of Censorship," by Jim Lynch, CIO.com, June 25, 2015; "Zero-day Exploit Lets App Store Malware Steal OS X and iOS Passwords," by Glenn Fleishman, Macworld.com, June 17, 2015; "App Downloads Jump Again as January Sets a New Record," by Heather Newman, Venturebeat.com, February 26, 2015; "Google Play Now Has More Apps Than Apple's App Store, Report Says," by Karissa Bell, Mashable.com, January 15, 2015; "Apple Says App Store Sales Rose 50% in 2014," by Daisuke Wakabayashi, *Wall Street Journal,* January 8, 2015; "Apple's iOS App Store Reaches Record 7.8M Daily Downloads," by Katie Marsal, Appleinsider.com, November 24, 2014; "Global Brands in the Mobile Landscape," by Anne Hezemans, *Distimo,* October 2013; "Researchers Outwit Apple, Plant Malware in App Store," by Gregg Keizer, *Computerworld*, August 20, 2013; "First Instance of iOS App Store Malware Detected, Removed," by Christina Bonnington, Wired.com, July 5, 2012; "The Apps Strategies of the Top 100 Brands," by Haydn Shaughnessy, Forbes.com, October 27, 2011; "Mobile Apps and Consumer Product Brands," by Tobi Elkin, eMarketer, March 2010; "Apple Bans Some Apps for Sex-Tinged Content," by Jenna Wortham, *New York Times*, February 22, 2010; "Inside the App Economy," by Douglas MacMillan, *BusinessWeek*, October 22, 2009.

2.7 CASE STUDY

Akamai Technologies:
Attempting to Keep Supply Ahead of Demand

In 2015, the amount of Internet traffic generated by YouTube alone is greater than the amount of traffic on the entire Internet in 2000. Because of video streaming and the explosion in mobile devices demanding high-bandwidth applications, Internet traffic has increased over 500% since 2010 and is predicted to nearly triple over the next five years (see **Figure 2.20**). Internet video is now a majority of Internet traffic and will reach 80% by 2019, according to Cisco. Experts call services like YouTube, Netflix, and high definition streaming video "net bombs" because they threaten the effective operation of the Internet. Mobile platform traffic

FIGURE 2.20 THE GROWTH OF INTERNET TRAFFIC



is growing at nearly 70% and will soon push cellular networks and the Internet to their capacities. Cisco estimates that annual global Internet traffic will be around 2 zettabytes in 2019: that's 2,000 exabytes, or, in other words, 20 with 19 zeroes behind it!

Analysts differ on how fast Internet capacity is growing. Large telecommunication companies argue that demand will soon overwhelm capacity, while other experts argue that Internet bandwidth can double every year for a very long time and easily keep up with demand. Perhaps they're both right: Internet capacity can expand to keep up with demand if sufficient capital is invested in backbone and local networks. That's a big "if." As a result, and in order to raise revenue, many large ISPs have bandwidth caps that require heavy users of video to pay more for their Internet service. More charges based on usage are in the pipeline.

In today's broadband environment, the threshold of patience is very low. Increased video and audio customer expectations are bad news for anyone seeking to use the Web for delivery of high-quality multimedia content and high definition video. Akamai is one of the Web's major helpers, and an overwhelming majority of the Web's top companies use Akamai's services to speed the delivery of content. Akamai serves more than 25 terabits of Web traffic per second.

Slow-loading Web pages and Web content sometimes result from poor design, but more often than not, the problem stems from the underlying infrastructure of the Internet. The Internet is a collection of networks that has to pass information from one network to another. Sometimes the handoff is not smooth. Every 1,500-byte packet of information sent over the Internet must be verified by the receiving server and an acknowledgment sent to the sender. This slows down not only the distribution of content such as music, but also interactive requests such as purchases, which require the client computer to interact with an online shopping cart. Moreover, each packet may go through many different servers on its way to its final destination, multiplying by several orders of magnitude the number of acknowledgments required to move a packet from New York to San Francisco. The Internet today spends much of its time and capacity verifying packets, contributing to a problem called "latency" or delay. For this reason, a single e-mail with a 1-megabyte attached PDF file can create more than 50 megabytes of Internet traffic and data storage on servers, client hard drives, and network backup drives.

Akamai Technologies was founded by Tom Leighton, an MIT professor of applied mathematics, and Daniel Lewin, an MIT grad student, with the idea of expediting Internet traffic to overcome these limitations. Lewin's master's thesis was the theoretical starting point for the company. It described storing copies of Web content such as pictures or video clips at many different locations around the Internet so that one could always retrieve a nearby copy, making Web pages load faster.

Officially launched in August 1998, Akamai's current products are based on the Akamai Intelligent Platform, a cloud platform made up of over 200,000 servers in 110 countries within over 1,400 networks around the world, and all within a single network hop of 85% of all Internet users. Akamai software on these servers allows the platform to identify and block security threats and provide comprehensive knowledge of network conditions, as well as instant device-level detection and optimization.

Akamai's site performance products allow customers to move their Web content closer to end users so a user in New York City, for instance, will be served L.L.Bean pages from the New York Metro area Akamai servers, while users of the L.L.Bean site in San Francisco will be served pages from Akamai servers in San Francisco. Akamai has a wide range of large corporate and government clients: 1 out of every 3 global Fortune 500 companies, the top 30 media and entertainment companies, 97 of the top 100 online U.S. retailers, all branches of the U.S. military, all the top Internet portals, all the major U.S. sports leagues, and so on. In 2015, Akamai delivers between 15% and 30% of all Web traffic, and over 2 trillion daily Internet interactions. Other competitors in the content delivery network (CDN) industry include Limelight Networks, Level 3 Communications, and Mirror Image Internet.

Accomplishing this daunting task requires that Akamai monitor the entire Internet, locating potential sluggish areas and devising faster routes for information to travel. Frequently used portions of a client's Web site or large video or audio files that would be difficult to send to users quickly are stored on Akamai's servers. When a user requests a song or a video file, his or her request is redirected to an Akamai server nearby and the content served from this local server. Akamai's servers are placed in Tier 1 backbone supplier networks, large ISPs, universities, and other networks. Akamai's software determines which server is optimum for the user and then transmits the "Akamaized" content locally. Web sites that are "Akamaized" can be delivered anywhere from 4 to 10 times as fast as non-Akamaized content. Akamai has developed a number of other business services based on its Internet savvy, including targeted advertising based on user location and zip code, content security, business intelligence, disaster recovery, on-demand bandwidth and computing capacity during spikes in Internet traffic, storage, global traffic management, and streaming services. Akamai also offers a product called Advertising Decision Solutions, which provides companies with intelligence generated by the Internet's most accurate and comprehensive knowledge base of Internet network activity. Akamai's massive server deployment and relationships with networks throughout the world enable optimal collection of geography and bandwidth-sensing information. As a result, Akamai provides a highly accurate knowledge base with worldwide coverage. Customers integrate a simple program into their Web server or application server. This program communicates with the Akamai database to retrieve the very latest information. The Akamai network of servers is constantly mapping the Internet, and at the same time, each company's software is in continual communication with the Akamai network. The result: data is always current. Advertisers can deliver ads based on country, region, city, market area, area code, county, zip code, connection type, and speed. You can see several interesting visualizations of the Internet that log basic real-time Web activity by visiting the Akamai Web site.

The shift toward cloud computing and the mobile platform as well as the growing popularity of streaming video have provided Akamai with new growth opportunities. As more businesses and business models are moving to the Web, Akamai has seen its client base continue to grow beyond the most powerful Internet retailers and online content providers. In 2014, Akamai made a push to encourage Hollywood studios to

SOURCES: "Facts & Figures," Akamai.com, accessed October 15, 2015; "Akamai in 60 Seconds," Akamai.com, accessed October 15, 2015; "The State of the Internet, 2nd Quarter 2015 Report," by Akamai Technologies, Inc., August 18, 2015; "Akamai Opens Dubai Office to Support Its Growing Middle East Business," Akamai.com, June 14, 2015; "Akamai, Trustwave to Promote, Sell Each Other's Security Services," by Sean Michael Kerner, Eweek.com, June 1, 2015; "Cisco Visual Networking Index, 2014–2019" by Cisco Systems, Inc., May 27, 2015; "Akamai and China Unicom Establish Strategic Cloud Services Partnership," Akamai.com, May 26, 2015; "Akamai Appeals to Hollywood Studios at NAB 2014," by Troy Dreier, Streamingmedia.com, April 7, 2014; "Akamai Completes Acquisition of Prolexic," Akamai.com, February 18, 2014; "You Think the Internet Is Big Now? Akamai Needs to Grow 100-Fold," by Mathew Ingram, GigaOM.com, June 20, 2012; "Akamai Eyes Acceleration Boost for Mobile Content," by Stephen Lawson, *Computerworld*, March 20, 2012; "To Cash In on Wave of Web Attacks, Akamai Launches Standalone Security Business," by Andy Greenberg, Forbes.com, February 21, 2012.

use the cloud for feature films. Akamai announced that it was partnering with Aspera, a high-speed file transfer company, to develop the capability to upload and download large video files fast enough for business use, including feature films. Akamai had already developed partnerships with companies that allow movie studios to convert movie files from one format to another as well as to apply DRM protections all in one step. Establishing partnerships with movie studios represents big business for Akamai, with an increasing amount of media consumption taking place on mobile devices through the cloud. To that end, Akamai acquired video streaming optimization start-up Octoshape in 2015, improving its ability to deliver high quality streaming video.

Akamai is also acutely aware of the increase in cybercrime as more traffic migrates to the Internet. Growth in Internet traffic is good news for Akamai, but the company must also now deal with politically motivated cyberattacks, organized crime online, and state-sponsored cyberwarfare. In 2014, Akamai improved its Kona Site Defender tool, which offers a variety of security measures for Akamai clients. The tool protects against Distributed Denial of Service (DDoS) attacks and includes a firewall for Web applications. Akamai also upgraded Site Defender's Web Application Firewall feature and developed modifications to the tool that make it easier for its users to use. Akamai has continued to acquire security companies in 2014, purchasing Prolexic Technologies, a cloud-based security provider specializing in protecting data centers from DDoS attacks. With so many businesses now dependent on the uninterrupted flow of content over the Internet, Akamai is in a very strong position to sell security services to its customers. In 2015, Akamai partnered with top information security firm Trustwave to cross-sell each other's services and products, expanding their offerings and reaching even further. They made a similar agreement with China Unicom, a provider of cloud services in the fast-growing Chinese market. Akamai has also moved into areas of the world with less developed broadband infrastructure, such as the Middle East. In 2015, Akamai opened an office in Dubai, hoping to bolster its presence in an area where the adoption rate for broadband is skyrocketing. However, as impressive as Akamai's operation has become, it may not be nearly enough to cope with the next 5 to 10 years of Internet growth.

Case Study Questions

1. Why does Akamai need to geographically disperse its servers to deliver its customers' Web content?
2. If you wanted to deliver software content over the Internet, would you sign up for Akamai's service? Why or why not?
3. What advantages does an advertiser derive from using Akamai's service? What kinds of products might benefit from this kind of service?
4. Do you think Internet users should be charged based on the amount of bandwidth they consume, or on a tiered plan where users would pay in rough proportion to their usage?

2.8 REVIEW

KEY CONCEPTS

■ Discuss the origins of, and the key technology concepts behind, the Internet.

- The Internet has evolved from a collection of mainframe computers located on a few U.S. college campuses to an interconnected network of thousands of networks and millions of computers worldwide.
- The history of the Internet can be divided into three phases: the Innovation Phase (1961–1974), the Institutionalization Phase (1975–1995), and the Commercialization Phase (1995 to the present).
- Packet switching, TCP/IP, and client/server technology are key technology concepts behind the Internet.
- The mobile platform has become the primary means for accessing the Internet.
- Cloud computing refers to a model of computing in which firms and individuals obtain computing power and software applications over the Internet, rather than purchasing the hardware and software and installing it on their own computers.
- Internet protocols and utility programs such as HTTP, SMTP and POP, SSL and TLS, FTP, Telnet, Ping, and Tracert provide a number of Internet services.

■ Explain the current structure of the Internet.

- The main structural elements of the Internet are the backbone (composed primarily high-bandwidth fiber optic cable), IXPs (hubs that use high-speed switching computers to connect to the backbone), CANs (campus areas networks), and ISPs (which deal with the "last mile" of service to homes and offices).
- *Governing bodies*, such as IAB, ICANN, IESG, IETF, ISOC, and W3C, have influence over the Internet and monitor its operations, although they do not control it.

■ Understand the limitations of today's Internet and the potential capabilities of the Internet of the future.

- To envision what the Internet of tomorrow will look like, we must first look at the limitations of today's Internet, which include bandwidth limitations, quality of service limitations, network architecture limitations, language limitations, and limitations arising from the wired nature of the Internet.
- Internet2 is a consortium working together to develop and test new technologies for potential use on the Internet. Other groups are working to expand Internet bandwidth via improvements to fiber optics. Wireless LAN and 4G technologies are providing users of smartphones and tablet computers with increased access to the Internet and its various services. The increased bandwidth and expanded connections will result in a number of benefits, including latency solutions; guaranteed service levels; lower error rates; and declining costs. The Internet of Things will be a big part of the Internet of the future, with more and more sensor-equipped machines and devices connected to the Internet.

■ Understand how the Web works.

- The Web was developed during 1989–1991 by Dr. Tim Berners-Lee, who created a computer program that allowed formatted pages stored on the Internet to be linked using keywords (hyperlinks). In 1993, Marc Andreessen created the first graphical Web browser, which made it possible to view documents on the Web graphically and created the possibility of universal computing.
- The key concepts you need to be familiar with in order to understand how the Web works are hypertext, HTTP, URLs, HTML, XML, Web server software, Web clients, and Web browsers.

■ Describe how Internet and Web features and services support e-commerce.

- Together, the Internet and the Web make e-commerce possible by allowing computer users to access product and service information and to complete purchases online.
- Some of the specific features that support e-commerce include e-mail, instant messaging, search engines, online forums (message boards), streaming media, and cookies.
- Web 2.0 features and services include social networks, blogs, RSS, podcasts, wikis, music and video services, Internet telephony, and online software and services.

■ Understand the impact of m-commerce applications.

- M-commerce applications are part of the larger $128 billion m-commerce market.
- Smartphone and tablet users spent the majority of their time using mobile apps rather than the mobile Web.
- There are a variety of different platforms for mobile application development including Objective-C (for iOS devices), Java (BlackBerrys and Android smartphones), and C and C++ (Windows mobile devices and some BlackBerry coding).
- Mobile apps for the iPhone are distributed through Apple's App Store, for BlackBerrys through RIM's App World, for Android devices through Google Play, and for Windows mobile devices through Microsoft's Windows Phone Marketplace. There are also third-party vendors such as Amazon's Appstore.

QUESTIONS

1. What advantages does client/server computing have over mainframe computing?
2. What are three different types of cloud computing models that have been developed?
3. Why is packet switching so essential to the Internet?
4. What are four Internet protocols besides HTTP (the Web) and sending e-mail (SMTP)?
5. What are the three main phases in the evolution of the Internet? Briefly describe each.
6. What is the difference between video conferencing and telepresence?
7. Why is VoIP a disruptive technology?
8. How is Google aiming to provide Internet access to remote areas?
9. Identify the various types of narrowband and broadband ISP Internet connections. Of all, which is the fastest and which is the slowest?
10. What is the Internet of Things and how is it being created and enabled?
11. Explain what domain names, URLs, and IP addresses are and provide an example of each. How are they used when a user is browsing the Web?
12. What are the main mobile platforms used by mobile devices?
13. What technologies and tools do governments use to monitor, censor, and limit their citizens' activities on the Internet?
14. Identify the layers used in Internet technology. What is their importance to Internet communications?
15. Describe at least two differences between a public Web server connected to the Internet and an end-user's computer connected to the Internet.
16. Define and contrast the "First Mile" and "Last Mile." What is the importance of making these distinctions in Internet telecommunications?
17. What are three concerns about the Internet of Things?
18. What is the difference between HTML and XML?
19. What are some of the drawbacks of cloud computing?
20. Explain how apps are distributed once they have been created.

PROJECTS

1. Review the opening case on augmented reality. What developments have occurred since this case was written in December 2015?

2. Locate where cookies are stored on your computer. (They are probably in a folder entitled "Cookies" within your browser program.) List the top 10 cookies you find and write a brief report describing the kinds of sites that placed the cookies. What purpose do you think the cookies serve? Also, what do you believe are the major advantages and disadvantages of cookies? In your opinion, do the advantages outweigh the disadvantages, or vice versa?

3. Call or visit the Web sites of a cable provider, DSL provider, and satellite provider to obtain information on their Internet services. Prepare a brief report summarizing the features, benefits, and costs of each. Which is the fastest? What, if any, are the downsides of selecting any of the three for Internet service (such as additional equipment purchases)?

4. Select two countries (excluding the United States) and prepare a short report describing their basic Internet infrastructure. Are they public or commercial? How and where do they connect to backbones within the United States?

5. Investigate the Internet of Things. Select one example and describe what it is and how it works.

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