Mobile Commerce and Ubiquitous Computing

6

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Learning Objectives

Upon completion of this chapter, you will be able to:

1. Discuss the value-added attributes, benefits, and fundamental drivers of m-commerce.
2. Describe the mobile computing infrastructure that supports m-commerce (devices, software, and services).
3. Describe the four major types of wireless telecommunications and networks.
4. Discuss m-commerce applications in banking and financial services.
5. Describe enterprise mobility applications.
6. Describe consumer and personal applications of m-commerce, including entertainment.
7. Understand the technologies and potential applications of location-based m-commerce.
8. Define and describe ubiquitous computing and sensory networks.
9. Describe wearable Google Glass, driverless cars, and mobile apps.
10. Describe the major implementation issues from security and privacy to barriers of m-commerce.

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OPENING CASE: HERTZ GOES MOBILE ALL THE WAY

The Problem

The car rental industry is very competitive, and Hertz Corporation (**hertz.com**), the world's largest car rental company, competes against hundreds of companies in approximately 10,400 locations in 150 countries. The strong competition negatively impacted profits. For Hertz Global Holdings, Inc. business profile and statistics, see **hoovers.com/company-information/cs/company-profile.Hertz_Global_Holdings_Inc.7b9c49d62787624c.html**. Hertz needs to constantly maintain a mobile presence. Customers can easily connect with the company through its mobile site. The Hertz mobile app is available for iPhone, iPad, Android, and Windows phone.

The Solution

Hertz pioneered several mobile commerce applications to increase its competitiveness. Mobile commerce is now embedded in the company's national wireless network. This information is needed to reserve a car, confirm or change reservations, and other customer-related services (e.g., review rental history, direct credit mileage to the proper loyalty program, etc.).

Here are some of Hertz's mobile services:

- **Easy and quick rentals.** Reservations can be made by phone, e-mail, and on the website (via smartphone, tablet, or desktop). Confirmations are e-mailed (or texted) within seconds of making the reservation. Upon arrival in a city, the renter receives a text message pinpointing the car's location in Hertz's parking area. In many rental locations, the cars are equipped with an RFID system. In such a case, the renter sweeps the Hertz keyfob/card over the RFID reader to unlock the doors. Alternatively, in some locations, Hertz's curbside attendant confirms the reservation on a handheld device, and transmits the arrival information wirelessly to the rental booth. This in return reveals the location of the car. All the renter needs to do is go to the slot where the car is parked and drive away. For interesting new features see Elliott (2013).
- **Instant returns (eReturn).** There is no longer any need to wait in line in Hertz's office to return the car. An attendant with a handheld device connected to the wireless system enters the return time, and the system calculates the cost of the rental and prints a receipt. The checkout time takes about a minute, right in the parking lot.
- **NeverLost® GPS Navigation System.** Many Hertz cars are equipped with the Hertz NeverLost® GPS system (**neverlost.com**) that includes a display screen and voice prompts (e.g., when to make a turn). A map (either Google Maps or MapQuest) shows the routes and business information (e.g., public and consumer services, such as the location of the nearest hospitals, gas stations, and eateries displayed). Hertz also offers the MyExplore™ NeverLost® Mobile Companion app (see **neverlost.com/Products/ProductDetail?ProductName=myexplore**). This app allows you to plan your trip on your smartphone and use the app to navigate selected cities such as Washington, D.C. and New York. Some of the app's features include augmented reality (turn your camera phone into a live map); social media integration (share your experiences on social networks such as Facebook and Twitter); and weather information (get live weather information and five day forecasts).

  For new functionalities see **finance.yahoo.com/news/navigation-solutions-hertz-neverlost-r-221503204.html**.
- **Additional customer services.** In addition to the location guide, the NeverLost® system provides driving directions, emergency telephone numbers, city maps, shopping guides, customer reviews of hotels, restaurants, and other consumer services. This content also is available to Hertz's club members at home, where they can print the information or load it into their mobile devices.
- **Car locations.** Hertz is experimenting with a GPS-based tracking system, which enables

the company to find the location of a rental car at any given time. Furthermore, the system may be able to report in real time th*e speed at which the* car is being driven. Although the company promises to keep the collected information secure, many view it as an *invasion of privacy.* However, some renters may feel safer knowing that they are being tracked at all times. Note: Currently, (May 2014) Hertz is using the system only to track stolen cars and to find when cars are returned.

- **Hertz 24/7 (with on demand technology).** According to their website, Hertz 24/7 with on demand technology offers self-service access to a rental vehicle for a short period of time (by the hour, or a day), competing with car sharing company Zipcar Inc. (**zipcar.com**). The Hertz 24/7 mobile app is available for download at **hertz.com/rentacar/productservice/index.jsp?targetPage=hertzmobilesite.jsp** and can be used to find car rental locations. This application is available on PCs and mobile devices (**hertz247.com/NewYork/en-US/About/Mobile**). The application includes ride sharing (e.g., rate comparisons of public transportation versus car rental).
- **Wi-Fi connection.** Free high-speed Internet access is available in Hertz's offices in all major Hertz locations in the United States, Canada, and some other countries.
- **Hertz mobile apps.** With the Hertz apps, which are available for iPhone, iPad, Windows, and Android, you can make reservations, search for store locations, enjoy special offers, and much more. See the Hertz Mobile page at **hertz.com/rentacar/productservice/index.jsp?targetPage=hertzmobilesite.jsp**. For recent mobile apps see *PR Newswire* (2014).

The Results

Despite the economic problems of 2008–2012, Hertz has retained the number one position in the car rental industry. Its earnings, which declined in 2008 and 2009, rebounded between 2010 and 2014. Hertz did better than most of its competitors. Its stock market share price, which bottomed out in 2009, more than tripled in 2010 and continued to climb from 2011 to 2014. The company is expanding its operations and maintaining an excellent reputation among customers, due in part to its mobile applications.

Sources: Based on **hertz.com** (accessed May 2014), Goodwin (2010), and Kahn et al. (2010).

LESSONS LEARNED FROM THE CASE

The Hertz case illustrates several mobile applications in the transportation industry that can help improve both customer service and the company's operations. The applications are run on mobile devices and supported by a wireless network. (Both topics are discussed in Section 6.2.) The mobile technology is based on a set of unique attributes (Section 6.1) that enable the use of many applications (Sections 6.3, 6.4, 6.5, 6.6 and 6.7).

The Hertz case is only one example of the impact of emerging mobile and wireless technologies on business and electronic commerce (EC). In this chapter, we explore a number of these emerging mobile and wireless technologies as well as their potential applications in the commercial and societal arenas. The chapter also deals with the mobile enterprise, location-based services, and ubiquitous computing, which are cutting-edge technologies.

6.1 MOBILE COMMERCE: CONCEPTS, LANDSCAPE, ATTRIBUTES, DRIVERS, APPLICATIONS, AND BENEFITS

As described in Chapter 1, businesses are becoming digital (Accenture Technology Vision 2014). In addition, many enterprises are going borderless and the need for mobile communication is increasing rapidly. According to GSMA (2013),

the mobile industry is already a major contributor to the global economy. More than half of the world's population already own mobile phones, many of which are smartphones. Obviously, all the above are drivers of mobile commerce.

Mobile commerce has its own framework, attributes landscape, concepts, and terminology. These provide many benefits. For an overview, see the 2:45 minute video titled "What is M-Commerce" at **youtube.com/watch?v=QtpTTpgpELg**.

One of the clearest trends in computing and e-commerce is that mobile computing is increasing exponentially. Each year, Gartner Inc. compiles a list of the top ten strategic technology trends that have the potential to offer numerous benefits to individuals, businesses, and IT organizations during the following 3 years. The 2014 list (**gartner.com/technology/research/top-10-technology-trends**) includes four topics, 40% of which are related to mobile computing, and are discussed later in this chapter.

Basic Concepts, Magnitude, and the Landscape

Mobile commerce (m-commerce), also known as *m-business*, refers to conducting e-commerce by using mobile devices and wireless networks. Activities include B2C, B2B, m-government, and m-learning transactions, as well as the transfer of information and money. Like regular EC applications, m-commerce is an electronic transaction conducted by using mobile devices via the Internet, corporate intranets, private communication lines, or over other wireless networks. For example, paying for an item in a vending machine or pay taxes with an iPhone is considered m-commerce. M-commerce provides an opportunity to deliver new services to existing customers and to attract new customers to EC anytime, anywhere. Initially, the small screen size and slow bandwidth limited the usefulness to consumers. However, this situation is changing rapidly due to the widespread use of smartphones and tablet computers. In addition, now consumers are more accepting of the handheld culture. Furthermore, the adoption of m-commerce is accelerating due to the spread of 3G and 4G networks. Finally, free Wi-Fi Internet access in many locations helps. As a result, smartphones now account for almost 60% of all mobile phones in the U.S. The *strategic value* of mobile systems is increasing significantly.

Note that m-commerce is quite different from traditional e-commerce and frequently uses specialized business models (see **mobilinfo.com/Mcommerce/differences.htm**). This results in many new applications and a change in the relationship between buyers and sellers (see **ibm.com/software/genservers/commerce/mobile**).

The Magnitude of M-Commerce

According to a 2013 eMarketer study, by 2017, approximately 25% of all online retail transactions in the U.S. will take place on mobile devices (reported by **mashable.com/2013/04/24/mcommerce-sales-forecast**). Forrester Research forecasts that m-commerce will top $38 billion in 2014 (reported by Fiegerman 2014 at **mashable.com/2014/05/12/mobile-commerce-sales**). A 2014 InMobi report found that 83% of customers plan to conduct mobile commerce in 2014, a 15% increase from the previous year. The full report can be downloaded from **inmobi.com/company/press/inmobi-report-finds-83-of-consumers-plan-to-conduct-mobile**.

Knight (2012a) provides some statistics that show the explosive growth of mobile commerce. For mobile marketing statistics (2012), see **snaphop.com/2012-mobile-marketing-statistics**. In addition, according to Leggatt (2012), m-commerce has quadrupled from April 2010 to May 2012. For more statistics see **snaphop.com/2013-mobile-marketing-statistics**.

In this chapter, we consider some of the distinguishing attributes and key drivers of m-commerce, some technical issues relevant to m-commerce, and some of the major m-commerce applications.

The Landscape of M-Commerce

The overall landscape of m-commerce is summarized in Figure 6.1.

Note that in the figure, the enabling technologies (e.g., devices, networks) are on the left side

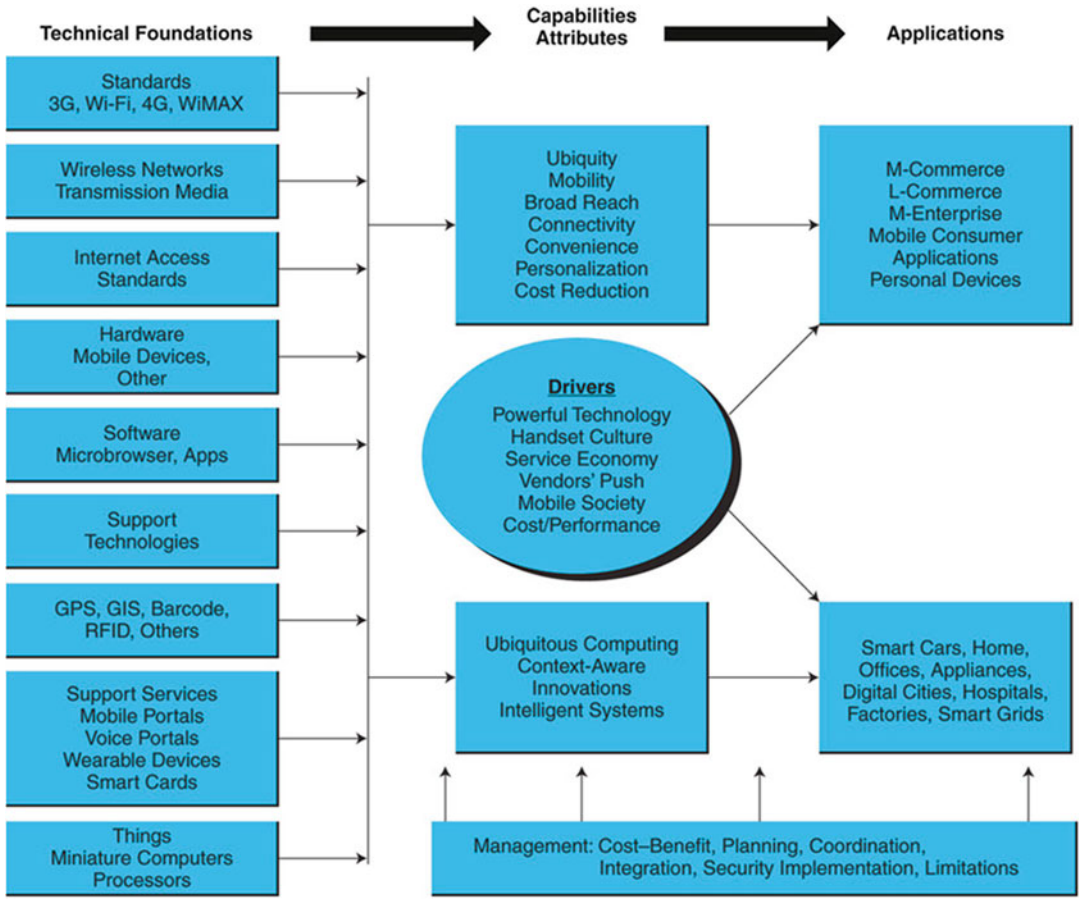

Figure 6.1 The landscape of mobile computing and m-commerce

and the resulting capabilities and attributes are in the middle. These provide the foundation for the applications that are shown on the right side of the figure. In this section, we describe the attributes and provide an overview of the applications. In Section 6.2, we present the essentials of the major technologies.

Mobile and Social: A Powerful EC Combination

M-commerce is a very powerful platform, but it can be even more powerful when combined with social commerce, as we will describe in Chapters 7 and 8. This combination will shape the future of e-commerce and could be its major facilitator in the future. The so-called mobile social networking application field is already growing rapidly (126% in 2011; see Eler 2011).

Example: The 2012 London Olympics

Mueller (2012) provides an interesting description of the use of a combination of mobile and social environments in the 2012 Olympic Games in London.

The Attributes of M-Commerce

Many of the EC applications described in this book also apply to m-commerce. For example, online shopping, e-travel, e-learning, e-entertainment, and online gaming are all gaining popularity in mobile B2C. Auction sites use m-commerce to send messages to bidders during the auction process, governments encourage m-government (Chapter 5), and wireless collaborative commerce

in B2B EC is on the rise. Some key attributes that enable new applications are possible only in the mobile environment. The major attributes include:

- **Ubiquity.** *Ubiquity* means being everywhere, especially at the same time. It is facilitated by wireless computing. Given that Wi-Fi access is available in more and more places, and that about half of all mobile phones are smartphones, we have easier ubiquity.
- **Convenience and capabilities.** Having a mobile device increases the convenience of communication. The functionality and usability of mobile devices is increasing while their physical size remains small and the cost is affordable. Unlike traditional computers, mobile devices connect to the Internet almost instantly.
- **Interactivity.** Mobile systems allow for fast and easy interactions (e.g., via Twitter, tablets, or smartphones).
- **Personalization.** Mobile devices are personal devices. While several people may share the same PC, a specific mobile device is usually used by one person.
- **Localization.** Knowing where a user is physically located in real time provides an opportunity to offer him or her relevant mobile advertisements, coupons, or other services. Such services are known as location-based m-commerce (see Section 6.6). Localization may be for the entire public (e.g., an announcement about an emergency) or it can be personalized for an individual.

Mobile vendors differentiate themselves from wireline vendors by offering unique services based on the above attributes. The drivers of m-commerce are illustrated in Figure in 6.2 and discussed in Online File W6.1.

An Overview of the Applications of M-Commerce

There are thousands of different m-commerce applications. Many of these are similar to those in a wireline environment, as described in Chapters 3 and 4. Others are available for mobile devices only.

To simplify our presentation, we divided the applications in this chapter into the following categories, adding consumer applications to the framework:

- Banking and financial services – Section 6.3
- Mobile enterprise applications – Section 6.4
- Consumer services (including shopping) and entertainment – Section 6.5
- Location-based mobile commerce – Section 6.6
- Ubiquitous computing – Section 6.7
- Emerging applications: Wearables, Google Glass, smart grid, and driverless cars – Section 6.8
- Mobile shopping is covered in Chapter 7
- Mobile marketing and advertising are covered in Chapter 9
- Mobile payment is introduced in Chapter 11

We categorized the *enterprise-related applications* by the framework used by Motorola Corp. See **motorolasolutions.com/US-EN/enterprise+mobility**. Note: Zebra Tech. acquired Motorola Solutions Enterprise Business in April 2014.

According to this framework, *enterprise applications* are created to meet specific business needs. These needs have some generic aspects as well as industry-specific aspects (see Figure 6.3). The four needs are:

1. **Field mobility** – the support of the mobile workforce
2. **Fleet mobility** – the support of vehicles in order to minimize downtime and increase effectiveness, efficiency, and utilization

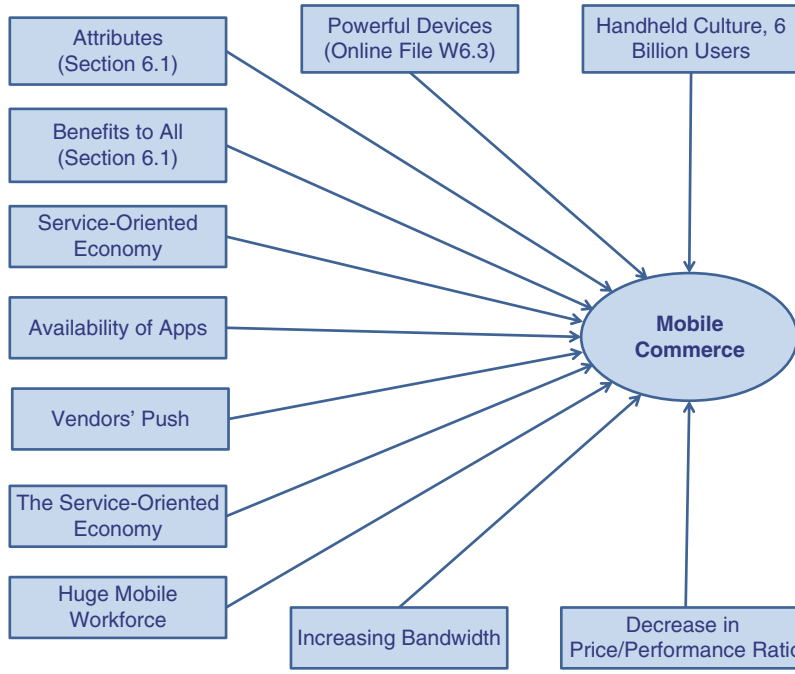

Figure 6.2 The drivers of m-commerce

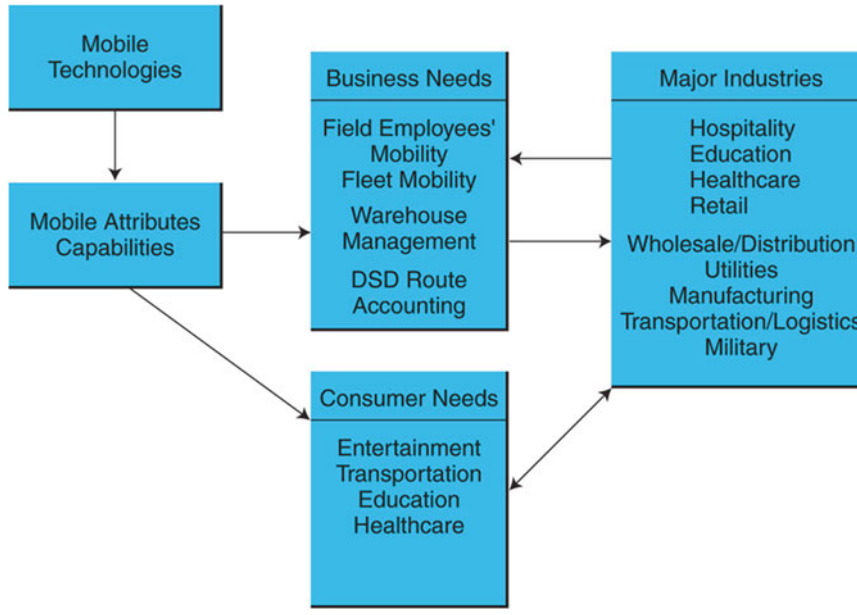

Figure 6.3 M-commerce applications and their classifications

3. **Warehouse management** – the improvement of the operations inside warehouses
4. **Direct store delivery (DSD) route accounting** – the increased usefulness by conducting pre-delivery activities (e.g. by texting information about a new shipment from the shipper to the receiver).

These needs can exist in any industry, and drive the use of m-commerce. The major industries that use m-commerce are hospitality, education, health care, retail, wholesale and distribution, utilities, manufacturing, transportation, and logistics. Each of these industries and its needs can be divided into 3 to 10 subcategories for which Motorola (and other vendors) provide specific solutions.

This chapter, as well as Olariu and Tiliute (2011), discuss the techniques and applications in the m-commerce field from a managerial point of view. A related application, ubiquitous computing, will be discussed in Section 6.7.

Also of interest is the emerging field of *mobile intelligence* (see Saylor 2012).

The Benefits of M-Commerce

M-commerce has many benefits to organizations, individuals, and society. As a result, many believe that the future of EC is mobile applications (watch the 5:06 minute video titled "The Future of E-Commerce Is: Mobile Applications" at **youtube.com/watch?v=kYSMP_RH67w**).

Benefits for Organizations

- Increases sales due to ease of ordering by customers from anywhere, anytime.
- Allows location-based commerce for more sales and revenue (Section 6.6).
- Provides an additional channel for advertising and distribution of coupons (wider reach).
- Increases customers' loyalty.
- Improves customer satisfaction through real-time apps.
- Enables many enterprise applications (Section 6.4).
- Facilitates CRM and collaboration.
- Reduces employee training time and help desk resources.
- Improves time utilization and productivity of mobile employees.
- Expedites information flow to and from mobile employees.
- Delivers digitized products and services directly to mobile devices.
- Reduces order lead-time and fulfillment cycle.
- Allows for lower, competitive pricing.

Benefits for Individuals and Customers

- Allows e-commerce from any place, anytime.
- Assists in shopping by providing real time information and other shopping aids.
- Helps organization of and communication while travelling.
- Expedites banking and financial services.
- Provides rich media entertainment anytime and anywhere.
- Facilitates the finding of new friends and whereabouts of existing ones.
- Provides a choice of mobile devices for transactions.
- Expedites communication (e.g., locate people; get fast answers to queries; compare prices while in physical stores or via shopping comparison sites/apps).
- Increases affordability over the cost of using desktop computing in some countries.

Benefits to Society

There are many benefits to society. For example, self-driving cars can reduce accidents; smart cities can benefit the population. Contributions are in almost any field, from medical care and

education to law enforcement. Significant reductions in energy expenses are achieved by using smart grids. Traffic jams can be reduced by using wireless sensors and much more.

There are also limitations to m-commerce, which are discussed in Section 6.9.

Other Benefits

In addition to the benefit of ubiquity, m-commerce enables true personalization, reduces costs, increases time available to employees, expedites business processes, and much more, as will be shown throughout this book.

SECTION 6.1 REVIEW QUESTIONS

1. Define m-commerce.
2. Briefly describe the five value-added attributes of m-commerce.
3. List and briefly describe eight major drivers of m-commerce (see Online File W6.1) and Figure 6.2.
4. Describe the framework of m-commerce applications.
5. What are the major categories of m-commerce applications?
6. Describe the landscape of m-commerce.
7. What are the major benefits of m-commerce?
8. Describe the major online enterprise applications.

6.2 THE ENABLING INFRASTRUCTURE: COMPONENTS AND SERVICES OF MOBILE COMPUTING

The technology that supports m-commerce is very diversified. Here we concentrate on some major technology items.

Overview of Mobile Computing

In the traditional computing environment, users were confined to desktop computers in fixed locations. A solution to this situation is **wireless mobile computing** (**mobile computing**), where computing is done by using mobile devices at any place connected to a wireless network. According to TechTarget Bitpipe, wireless mobile computing, also known as nomadic computing, is the use of portable computing devices (such as laptops and handheld computers) in conjunction with mobile communications technologies to enable users access to the Internet and data on their home or work computers from anywhere in the world (see **bitpipe.com/tlist/Wireless-Computing.html**).

An extensive hardware and software infrastructure enables mobile computing. First, there are mobile devices (e.g., tablets, smartphones, wearables, and hand held computers) that connect users wirelessly to networks and to other devices. Next, there are those features that provide the wireless connection, (e.g., network access points and Wi-Fi), as well as parts of the infrastructure that support the delivery of services over the connection (e.g., GPS locators). Finally, there are those components that support m-commerce activities in the same way they support typical e-commerce activities (e.g., a Web server, payment gateway, database server, and enterprise application server).

This section briefly discusses the major technologies of mobile computing systems. For an extensive list of related terms, see **mobileinfo.com/Glossary** and **webopedia/Mobile_computing**. For the importance and magnitude of mobile computing, see Gannes (2013), who presents the relevant highlights from Meeker's 2013 Internet Trends. For the introduction and history of mobile computing, see Livingston's (2013) presentation at **slideshare.net/davidjlivi/introduction-history-of-mobile-computing**.

Mobile Devices

Mobile devices come in all shapes and sizes – laptops, thin-and-light notebooks, tablet computers, smartphones, ultra portables, and ultra-mobile PCs (UMPCs). What distinguishes one type of mobile computer from another are its different capabilities, such as physical dimensions, shape, and the executions of the capabilities. Most of the major computer manufacturers (HP, Apple, Dell,

ASUS, Toshiba, ACER, and Lenovo) produce thin laptops and ultra portables.

A few years ago, portable computers, cell phones, and other mobile devices were different from each other and had unique features. Today, all of these devices are converging so that it is sometimes difficult to tell them apart (from a functional perspective).

Mobile devices can be large. Several manufacturers offer 17″ laptops or mobile workstations (e.g., Dell, HP and Lenovo). Tablets are available in a 7″ or 10″ screen. Smartphones come in a variety of sizes.

Smartphones

A **smartphone** is a mobile phone with Internet access and PC-like functionality (such as iPhone).

There is a wide range and variety of smartphone manufacturers. Note that smartphones get "smarter" with time and add features and capabilities. There is also a wide variety of operating systems, including Symbian, Google Apps, Android, Palm OS, Windows Mobile, Apple OS/X, RIM BlackBerry, and Google's Chrome OS. Like PDAs, smartphones have small screens, keyboards, memory, and storage. Most smartphones have built-in cameras and some are GPS-enabled.

Tablets

A fast growing category of mobile devices is the *tablet computer*. Tablet computers received a major boost in 2010 with the introduction of the Apple iPad and its competitors, all with a virtual keyboard (but a portable physical keyboard can be attached). Since then, many companies are manufacturing tablets. Notable are Amazon.com, Samsung, HP, Dell, Microsoft, HTC and Google. Like laptops, tablets can access the Web via Wi-Fi hotspots. The *iPad* weighs about 1 pound (in between a smartphone and a small laptop), and its screen measures 7.87 (the iPad mini, which weighs .73 pounds) or 9.5 (larger sizes coming soon). Tablets are replacing PCs and laptops in enterprises and schools. Tablets are also replacing hardcover textbooks in many schools. Tablets can be used as e-readers and can be used to access the Internet. Note that the price of tablets is declining while their capabilities are increasing. In India, for instance, Aakash students can buy tablets for as little as $35.

Tablets are becoming popular in enterprises as well. For example, Waste Management Inc. (**wm.com**) provides 7″ tablets to their truckers for finding optimal routes. For a comprehensive description, see Murphy (2012), **informationweek.com/mobile.asp**, and **apple.com/ipad**. A Yankee Group report found that "[t]ablets lead enterprises into a mobile computing transformation" (Lund and Signorini 2011). The enterprise tablets are used mostly by mobile professionals and field force employees. McCafferty (2012) reports that "tablets are changing how employees work."

A major use of a tablet is to facilitate communication and collaboration.

Example

Mydin is a large Malaysian retailer that operates 100 stores all over the country for budget-oriented consumers. The competition is fierce in this industry and the profit margin is low. Therefore, making faster informed decisions is critical for the company's success. To make timely decisions, managers needed appropriate communication and effective collaboration tools. In 2012, Mydin's managers began using a real-time telepresence solution from U.S.-based conferencing solutions provider Vidyo. According to Malik Murad Ali, Mydin's IT director, "Immediate benefits included enhanced real-time collaboration between staff, which has raised our quality standards with the accelerated decision-making during the course of the day's business." For Mydin's success story, see **cio-asia.com/resource/applications/mobile-telepresence-trims-costs-for-major-malaysian-retailer/?page=1** and the case study at **vidyo.com/wp-content/uploads/2013/10/vidyo_case_study_MYDIN.pdf**.

Google's Smart Glasses

In 2012, Google introduced its *Project Glass*, which takes the major functionalities of a smartphone and embeds them into a wearable device that looks like virtual reality glasses. Google Glass has a smartphone-like display, allowing you to take basic smartphone features (messaging, e-mail) and making them hands free. For more on

the features of Google Glass, see **gizmag.com/google-glass-review/30300**. The Google Glass Field Trip app can now be activated by voice commands (**mashable.com/2014/04/29/field-trip-google-glass-update**) (see Section 6.8).

Personal Digital Assistants: Enterprise Tablets

Originally called a **personal digital assistant (PDA)**, or *palmtop computer*, the early version of the device was a stand-alone handheld computer that provided access to a user's address book and calendar and supported calculations and some desktop applications, such as word processing and spreadsheets. PDAs were used mostly for enterprise applications. Most of the original PDAs had the ability to be synchronized with a user's desktop computer. This enabled a user to read e-mails offline. Over time, most PDAs have added support for wireless connectivity to the Internet through Wi-Fi. Most PDAs also provide multimedia support for audio and video. Today, PDAs are very similar to enterprise tablets. Most vendors changed the name PDA to tablets. An example is the Blackberry PlayBook. Another example is Motion Computing's CL910.

Wearable Devices

The smallest mobile devices are wearable. Notable are many devices used in the enterprise (e.g., mounted on the arm, head, or body and carried by employees). Samsung's Galaxy Gear SmartWatch, which was released in 2013, is one example. In April 2014, Samsung released its Gear Fit device, a "fitness tracker-smartwatch hybrid"(see**mashable.com/2014/04/08/samsung-gear-fit-review**). Apple iWatch is already in production and is scheduled to debut in the latter part of 2014. For more about wearable devices, see Section 6.8.

Other Mobile Devices

There are other kinds of mobile devices as well. For example, Microsoft offers a tablet with an attachable keyboard and Dell offers a foldable tablet with a keyboard, combining the capabilities of a laptop and a tablet. A representative list of mobile devices is available in Online File W6.2.

Radio-Frequency Identification (RFID)

Radio-Frequency Identification (RFID) enables the transfer of data wirelessly (non-contact), usually for the purpose of automatically identifying and tracking tags attached to objects. RFID does this by employing radio-frequency electromagnetic fields (see Online Tutorial T2). Most of the enterprise applications relate to logistics and inventory control. For details, see Chapter 12. Also related to EC is the use of RFID to enable mobile payments. For images of RFID applications, conduct a Google Images search for 'RFID applications.' For a comprehensive guide to RFID (e.g., white papers, case studies, definition), see the RFID technology Primer at **impinj.com/guide-to-rfid/what-is-rfid.aspx**. Finally, for 100 uses of RFID, see **rfid.thingmagic.com/ 100-uses-of-rfid**.

Mobile Computing Software and Services

Mobile devices offer some capabilities that desktops do not. These capabilities provide a foundation for newer applications such as location-based services.

Mobile Portals and Content Providers

A **mobile portal** is a gateway to the Internet from mobile devices. It combines content from several sources and can be personalized for mobile users. These portals offer services similar to those of desktop portals (see **gartner.com/it-glossary/mobile-portal** and **ehow.com/facts_7631652_definition-mobile-portal.html** for an additional discussion of mobile portals). An example of a pure mobile portal is Zed (**zed.com**; a wholly owned subsidiary of Finnish telecommunication company Sonera) headquartered in Spain. Japan's largest mobile provider, with over 60 million customers, is i-mode from NTT DOCOMO (see **nttdocomo.co.jp/english/service/imode** for the capabilities of i-mode).

The services provided by mobile portals are similar to those provided by desktop portals (e.g., news, health, sports, and downloading music). Mobile portals sometimes charge for their services.

Short Message Service

Short message service (SMS), frequently referred to as *text messaging*, or simply *texting*; the technology supports the transmittal of short text messages (up to 140 or 160 characters) between wireless devices. The cost of texting is very low compared to the charge per minute to talk on cell phones. The limited message length makes users use acronyms to convey standard messages. Examples of such acronyms include "how are you" becoming "HOW RU," or "HRU," and "in my opinion" becoming "IMO." Texting is popular worldwide due to the use of smartphones and microblogging (e.g., Twitter).

Multimedia Messaging Services (MMS)

Multimedia messaging service (MMS) is the new type of wireless messaging, delivering rich media content, such as videos, images, and audio to mobile devices. MMS is an extension of SMS (no extra charge with an SMS "bundle"). It allows for longer messages than with SMS.

For the difference between SMS and MMS and their benefits for mobile marketing, see **blog.mogreet.com/understanding-mobile-marketing-what-is-sms-mms-message-marketing**.

Location-Based Services

Retailers who use location-based services use the *global positioning system (GPS)* or other positioning techniques, to find a customer's location and then deliver services, such as ads for products and services, and coupons in real time. GPS also is used in emergency services, traffic management, and other applications (see Section 6.6).

Voice-Support Services

The most natural mode of human communication is voice. Voice recognition and voice synthesizing in m-commerce applications offer advantages such as hands- and eyes-free operation, better operation in dirty or moving environments, faster input (people talk about two-and-a-half times faster than they type), and ease-of-use for disabled people.

IVR Systems

Voice support applications such as **interactive voice response (IVR) systems** enable users to interact by telephones (of any kind) with a computerized system to request and receive information. These systems have been around since the 1980s but are now becoming more capable and widespread as artificial intelligence–based voice-recognition capabilities continue to evolve.

Voice Portals

A **voice portal** is a website with an audio interface that can be accessed through a telephone call. A user requests information by speaking, and the voice portal finds the information on the Web, transforms it into a computer-generated voice reply, and provides the answer by voice. For example, Bing Tell voice assistant (**bing.com/dev/speech**; a Microsoft company) allows callers to request information ranging from weather to current traffic conditions. IVR and voice portals are likely to become important ways of delivering m-commerce services over audio. Popular applications are used for banking, hospitals, airlines, government services, and online entertainment. A similar service, called Siri, is available on iPhones where you can place commands by voice, including sending messages asking questions, and receiving answers.

Wireless Telecommunications Networks

Wireless Application Protocol (WAP) is the technology protocol that enables Internet browsing using mobile devices. All mobile devices need to connect with a telecommunications network. How they do this depends on the purpose of the connection, the capabilities and location of the devices, and what connection options are in use. The major systems are:

- **Personal area networks.** A **personal area network (PAN)** provides very short-range device-to-device wireless connections (a distance up to 60 feet). The most common way to establish a PAN is with Bluetooth technology. **Bluetooth** is a set of wireless technologies standards for exchanging data between devices over a short range. For additional information, see **bluetooth.com** and the Bluetooth Special Interest Group (**bluetooth.org**).
- **Wireless local area networks and Wi-Fi.** As its name implies, a **wireless local area network (WLAN)** acts wirelessly (similar to how a wired LAN acts). Most WLANs run on a telecommunications standard known as *IEEE 802.11* (e.g., 802.11g), which is known as **Wi-Fi**. Figure 6.4 explains how Wi-Fi works by presenting the processes and components. Users need to find *access points* (or hotspots) to connect to the Internet. A wireless network card installed on your PC, for example, supports the connectivity throughout your house. The access point connects to the Internet in a similar manner as a wired LAN cable does. Wi-Fi access is now available almost everywhere: in many hotels, airlines, long distance bus services, shopping centers, trains, airports, university campuses, restaurants, coffee shops, cruise ships, libraries, and other public places. Google is bringing free Wi-Fi to several cities, including parts of New York City. Comcast Corp. is planning a similar service. The Comcast Wi-Fi network is projected to reach 8 million hotspots in select cities across the country by the end of 2014, with 325,000 hotspots installed in Chicago as of April 2014 (see **articles.chicagotribune.com/2014-04-30/business/chi-comcast-wif-otspot-rollout-20140430_1_own-xfinity-credentials-chicago-area-wi-fi-network-neighborhood-hot-spots-initiative** and Channick 2014).
- **Municipal Wi-Fi networks (WMAN).** A large number of connected hotspots can create a wireless campus or city. This is known as a *city-wide* or *municipal Wi-Fi network*. For example, Google created a network of 380 access points posted on light poles throughout the city of Mountain View, California, giving the city's residents free Wi-Fi access. The company also provides such service in parts of New York City. WMANs also are known as *grid* or *mesh networks.* Throughout the United States, there have been a number of municipal Wi-Fi projects, many of which, like Philadelphia, Pennsylvania's "Wireless Philadelphia" project, have experienced cost and schedule overruns, and were forced to close or limit the service area.
- **WiMAX.** Instead of relying on a mesh or grid of many access points, **WiMAX** (Worldwide Interoperability for Microwave Access) provides relatively fast (e.g., 75 Mbps to several GHz) broadband access over an area of up to 31 miles (50 kilometers). The usefulness of WiMAX is still uncertain. The WiMAX Forum (**wimaxforum.org**) provides detailed information about WiMAX capabilities and usage.
- **Wireless wide area networks.** A **wireless wide area network (WWAN)** offers the broadest wireless coverage. WWANs rely on the same network technologies as cell phones. For details, see **wireless.att.com/businesscenter/business-programs/mid-large/wireless-network**, **searchenterprisewan.techtarget.com/definition/wireless-WAN**, and **pcmag.com/category2/0,2806,2354098,00.asp**. For images of WWAN, do a Google Images search for 'wireless wide area network.'
- **LTE (Long Term Evolution).** This developing technology is supposed to replace the WiMAX. See **mashable.com/2012/06/12/4g-explained-what-is-lte**.

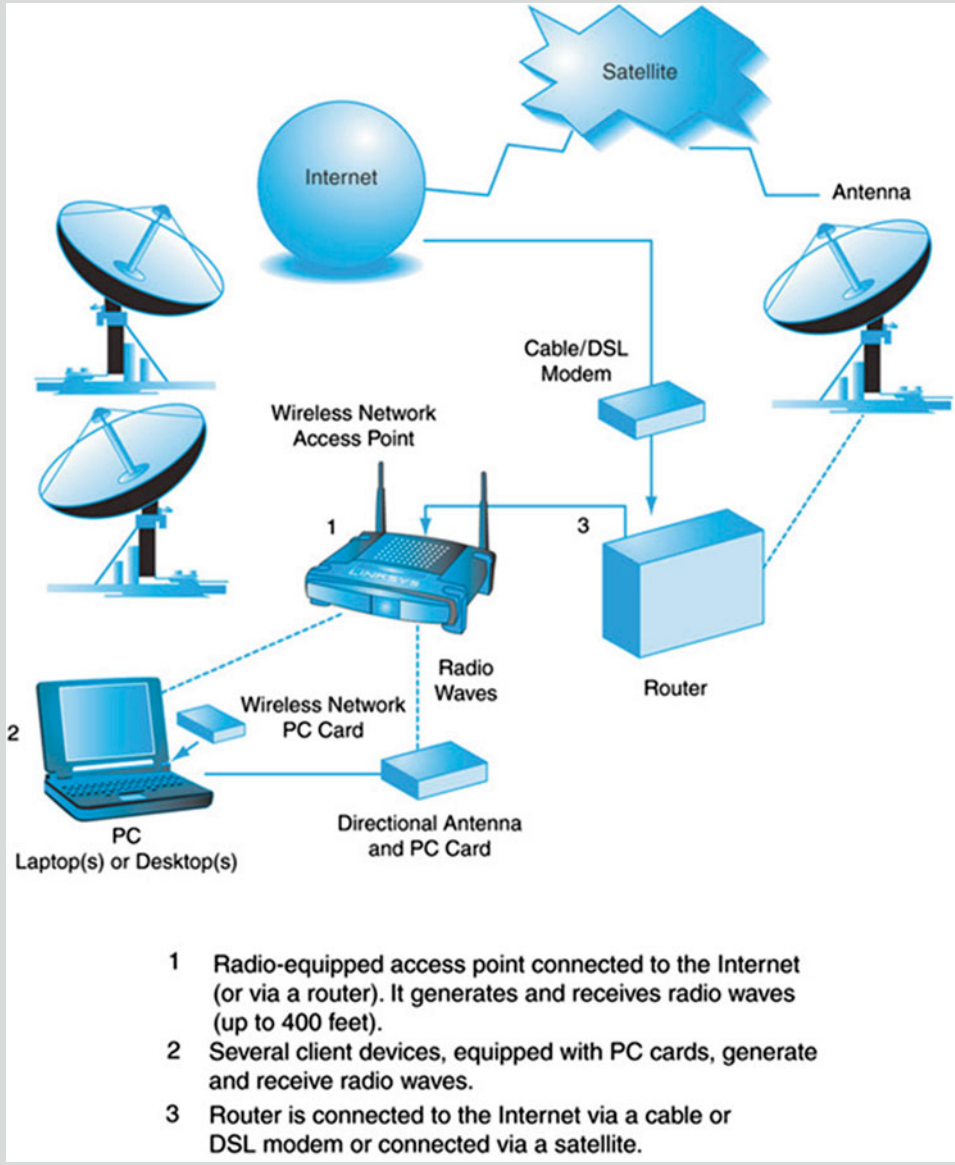

Figure 6.4 How Wi-Fi works

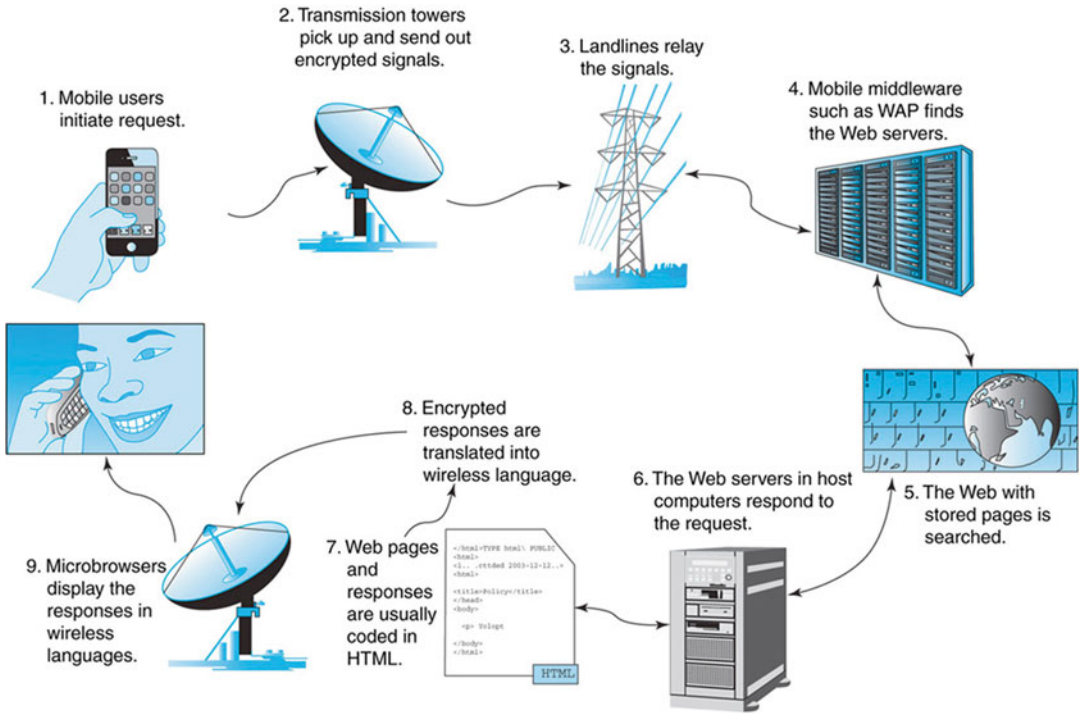

Figure 6.5 An m-commerce system at work

Note: Some companies are trying to connect to the Internet by sending signals from high in the sky and even from outer space (e.g., watch the video titled "Beaming the Internet from Outer Space" (1:36 minutes) at **money.cnn.com/video/technology/2014/02/26/t-beaming-internet-from-space-outernet-cubesat.cnnmoney**).

Putting It All Together

The previously mentioned software, hardware, and telecommunications are connected by a management system to support wireless electronic trading, as shown in Figure 6.5. The figure, which is self-explanatory, shows the flow of information from the user (Step 1) to the conclusion of the transaction (Step 9).

SECTION 6.2 REVIEW QUESTIONS

1. Briefly describe some of the key differences and similarities among the major mobile devices.
2. Briefly describe the types of messaging services offered for mobile devices.
3. Define mobile portal and voice portal.
4. Distinguish between MMS and SMS.
5. Define IVR.
6. What are the distinguishing features of PANs, WLANs, WMAN, LTE, and WWANs?

6.3 MOBILE FINANCIAL APPLICATIONS

Most mobile financial services are mobile versions of their wireline counterparts. However, they can be used anytime, anywhere. We divided these services into two broad categories: mobile banking and other mobile financial services. Mobile payments are described in Chapter 11.

Mobile Banking

Mobile banking (**m-banking**) describes the conducting of banking activities via a mobile device (mostly via smartphones, tablets, texting, or mobile website). The influx of smartphones and

tablets, especially iPhones and iPads, has led to an increased utilization of mobile banking. For details, a conceptual model, and challenges for mobile banking solutions, see Krishnan (2014) and Nicoletti (2014).

Throughout the world, more and more banks are offering mobile-based financial and accounting information.

Examples

Most banks deploy mobile services through a variety of channels, although the Internet and SMS are the most widely used. A blog written by Brandon McGee (**bmcgee.com**) provides links to a number of banking websites throughout the world that provide comprehensive wireless financial services. The Chase Mobile app and other mobile banking services offered by J.P. Morgan Chase Bank at **chase.com**, enable customers to access their accounts via smartphones and send text messages to request and receive account information.

In February 2014, mBank (**mbank.pl/en**) launched a mobile banking platform in Poland. The app allows access to the banking services, such as checking an account balance or a credit card limit (see **telecompaper.com/news/mbank-launches-new-mobile-banking-app-in-Poland**). For a case study on people in developing countries who have no need for a physical bank but do need access to financial services (e.g., to transfer money home to their families), see Nobel (2011).

Historically, the use of mobile banking has been relatively low. This situation is changing. Much of the change is being driven by the world economic crisis of 2008–2013. Bank and financial services' customers are utilizing their smartphones and cell phones to obtain current financial information and perform real time transactions. For comprehensive coverage, see Paulsen (2013) and Knowledge@Wharton and Ernst & Young (2013); Graham (2014) predicts some mobile banking trends for 2014.

Finally, *mobile payments*, including payments withdrawn from bank accounts via mobile devices, have become very popular (see Chapter 11).

Other Mobile Finance Applications

There are several other mobile finance applications (search Google for 'future of mobile finance'). Two applications follow.

Mobile Stock Trading

Several brokerage companies offer extensive mobile services and stock trading mobile tools.

Examples: E*TRADE Mobile

With *E*TRADE Mobile Pro for the iPad*, customers are able to trade anytime and anywhere using their smartphone. iPad users can:

- Get real-time news, quotes, and charts.
- Trade stocks (regular market sessions and extended hours).
- Check personalized stock watch lists and portfolios.
- Access and manage accounts.
- Prepare year-end tax documents.
- Stream live CNBC TV financial programs.

For about $10 (starting price), you can buy iMoblife.com's MobFinance software app for Symbian and BlackBerry that enables real time stock price monitoring, stock market research, and portfolio management, from 57 stock exchanges all over the world (including the United States, China, Germany, and Australia).

Free services are also available from Google (Realtime Stock Quotes app) and Yahoo! (Yahoo! Finance app). Both employ a search engine that provides real-time stock market information and financial news and research data. Similar services are available from TD Ameritrade (see **tdameritrade.com/tools-and-platforms/mobile-trading.page**). For the future of mobile finance, see **mint.com/blog/trends/the-future-of-mobile-finance**.

Real Estate Mobile Transactions

The real estate market can be an ideal place for mobile commerce since real estate brokers and buyers and sellers are constantly on the move. Most realtors offer a photo gallery for each property on your desktop or mobile device; but m-commerce can do more than that. Let us look at two examples.

Example 1: Mobile Video Marketing Platform at Partners Trust

According to *PR Newswire* (2010), Partners Trust Estate is a brokerage firm in the high-end real estate market. In 2010, the company launched an interactive mobile campaign to help buyers find their dream properties, using Mogreet's video platform. The mobile marketing video platform from Outspoken (**outspoken.com**) delivers informative mobile video tours to be viewed by potential buyers. The service enables brokers to better interact with customers any place, any time and gives consumers the tools for finding properties. For details, see *PR Newswire* (2010).

Example 2: Using Augmented Realty

Using augmented reality (see Chapter 2), some companies in Europe and the U.S. allow you to point your smartphone at certain buildings in a city (e.g., Paris) and then see the property value superimposed on the image of the particular building (Macintosh 2010). This technology is combined with a GPS to let the system know your location. HomeScan is an iPhone and McIntosh application developed by California-based ZipRealty.com that allows prospective real estate customers to find, see, and download properties in a mobile environment. For more about the HomeScan app, see **ziprealty.com/iphone**. A more generic application is available from HomeSpotter.

Several other mobile real estate applications are available or being developed, combining Google Maps and Google Earth with mobile applications. Note that some people object to other people taking photos of their houses on the basis that it is an invasion of privacy.

For a list of the top 20 AR apps of 2013 for iPhone/iPad and Android, videos, and an infographic, see **deepknowhow.com/2013/04/04/top-20-augmented-reality-apps-for-android-and-iphoneipad-users**.

SECTION 6.3 REVIEW QUESTIONS

1. Describe some of the services provided by mobile banking.
2. List some of the benefits derived from e-banking.
3. Describe mobile stock trading applications.
4. Describe mobile applications in real estate.

6.4 MOBILE ENTERPRISE SOLUTIONS: FROM SUPPORTING THE WORKFORCE TO IMPROVING INTERNAL OPERATIONS

Although B2C m-commerce gets considerable publicity in the media, for most organizations the greatest benefit from m-commerce is likely to come from applications within the enterprise. These applications mostly support the mobile workforce employees who spend a substantial part of their workday away from the corporate premises.

The majority of enterprise mobile applications are included in **enterprise mobility** or *mobile enterprise* (Fitton et al. 2012). Enterprise mobility includes the people and technology (e.g., devices and networks) that enable mobile computing applications within the enterprise. Enterprise mobility is one of the top 10 items in Gartner's 2013 and 2014 strategic technology lists. For the 2014 list see Cearley (2014).

Defining Mobile Enterprise (Enterprise Mobility)

Mobile technology is rapidly proliferating in the enterprise. In the previous sections, we introduced several business-oriented examples, in what we survey "mobile enterprise applications" or in short, "mobile enterprise." This term refers to mobile applications in enterprises (to distinguish from consumer-oriented applications, such as mobile entertainment). Obviously, there are many mobile enterprise applications; examples are illustrated in Section 6.1, Figure 6.3 (p. 263).

A Working Definition of Mobile Enterprise

Mobile enterprise refers to mobile applications used by companies to improve the operations of the employees, facilities, and relevant supply chains within the enterprise and with its business partners. For a comprehensive description of mobile enterprise including guidelines for implementation, best practices, and case studies, see

Fitton et al. (2012). The term is also known as *enterprise mobility*.

For details see **searchconsumerization.techtarget.com/definition/Enterprise-mobility**, and Mordhorst (2014). For a large collection of enterprise mobility and enterprise mobility applications, conduct a Google search. Finally, for a comprehensive guide to enterprise mobility, see Sathyan et al. (2013). Also do a Google images search for 'enterprise mobility.' For Gartner's analysis (with figures) of enterprise mobility and the impact on IT, see **gartner.com/doc/1985016/enterprise-mobility-impact-it**.

Many companies and experts believe that mobility can transform businesses. For a comprehensive presentation see SAP (2012) and Fonemine (2014).

The Framework and Content of Mobile Enterprise Applications

In addition to Motorola's framework that we introduced in Section 6.1, there are several other proprietary frameworks used by other vendors. For example, AT&T Enterprise Business provides categories such as vertical industry, healthcare, mobility, mobile productivity, at **business.att.com**.

Mobile Collaboration

Mobile collaboration refers to collaboration activities conducted on smartphones, tablets, and other mobile devices, enabling users to improve their performance. According to Schadler (2011), the major mobile collaboration software vendors who "lead the pack" in this area are Adobe, Box, Cisco, IBM, Salesforce, SugarSync, Skype, and Yammer.

Mobile Workers

A **mobile worker** is usually defined as any employee who is away from his or her primary work space at least 10 hours a week (or 25% of the time). In 2014, there were more than 150 million workers in the United States, of which approximately 50 million, or one-third, could be classified as mobile. This figure is growing rapidly. Using the definition of mobile workers, International Data Corporation (IDC) estimated that the number of mobile workers in 2013 was 1.2 billion.

Examples of mobile workers include members of sales teams, travelling professionals and managers, telecommuters, and repair people or installation employees who work off the company's premises. These individuals need access to the same office and work applications and data as those who work at the office. Online File W6.3 presents examples of mobile devices that support mobile workers in different areas including salesforce automation, along with issues that arise in providing this support. The major categories covered are *salesforce automation* (SFA) and *field force automation* (FFA). In addition, Online File W6.3 describes fleet and transportation management and warehouse management. For additional details, see Motorola (2007).

Other Enterprise Mobile Applications

Hundreds of other mobile applications exist. For examples, see Motorola Solutions Enterprise Mobility (**motorolasolutions.com/US-EN/Enterprise+Mobility**; now Zebra).

An example of a popular mobile application in the field of medical care is the use of communication devices in clinics, physicians' offices, and hospitals. For an interesting case study on Maryland's Frederick Memorial Hospital and their use of Panasonic laptops, see **mobileenterprise.edgl.com/news/Panasonic-Laptops-A-Key-Player-in-Hospital-s-Goals60630**.

Transportation Management

Another popular mobile application area is that of transportation management (e.g., trucks, forklifts, buses, vans, and so forth). In this area, mobility is used in communication with drivers, use of control systems, surveillance, and dispatching. Examples of these applications can be seen in the Hertz Corp. opening case. Mobile devices are used extensively in airports and by airlines, traffic control systems, public bus

systems, and more (see the NextBus case in Online File W6.4).

iPad in the Enterprise

Apple's iPad is now moving to the enterprise. Initially, the iPad was used as a communication and collaboration device connected to existing systems. However, many companies are using iPads for diversity of business applications especially in hotels, financial services, construction, and manufacturing. In addition, the iPad is replacing paper menus in restaurants. For example, sandwich and pastry chain Au Bon Pain uses iPads for taking customers' sandwich orders. In a collaboration between food and beverage provider OTG and Delta airlines, airports in certain cities (LaGuardia in NY, Pearson in Toronto, and Minneapolis-St. Paul International) are installing iPads so that customers can have free Wi-Fi, real-time flight access, and order food from a selection of restaurants and have it delivered to them at the gate (see **eatocracy.cnn.com/2012/12/21/ipad-ordering-becoming-the-new-norm-at-airport-restaurants**). Payment can be made via the iPad as well. For further descriptions, see **apple.com/ipad/business**. As of February 2014, Concessions International is providing the Atlanta airport with iPads for tabletop ordering (see **qsrmagazine.com/news/ci-launches-ipad-ordering-atlanta-airport**).

Trends for 2015 and Beyond

It is clear that the number of applications and their benefits is increasing. The large global software company Infosys ("Building Tomorrow's Enterprise") provides a paper titled "Trends 2014: The Mobility Collection" (see **infosys.com/mobility/pages/mobility-2014.aspx**). The website describes the challenges and opportunities of enterprise mobility as well as provides a large collection of mobility related resources (e.g., case studies, white papers).

SECTION 6.4 REVIEW QUESTIONS

1. Define mobile enterprise.
2. Describe the content of mobile enterprise applications.
3. Define mobile workers.
4. List the major segments of the mobile workforce.
5. What are some of the common benefits of mobile SFA, FFA, and CRM? (Consult Online File W6.3).

6.5 MOBILE ENTERTAINMENT, GAMING, CONSUMER SERVICES, AND MOBILE SHOPPING

Mobile entertainment applications have been around for years, but only recently they have expanded rapidly due to developments in wireless devices and mobile technology. Consumer applications started in the 1990s, but really soared after 2000. This section mainly describes mobile entertainment and briefly discusses some other areas of consumer services.

Overview of Mobile Entertainment

There is some debate about what actually constitutes mobile entertainment and which of its segments is really m-commerce. For example, assume you purchase a song from the Web and download it to your PC, and then download it to your MP3 player. Is this a form of mobile entertainment? What if you copy the song to a smartphone rather than to an MP3 player? What if you buy the song and download it directly from the Web to your smartphone? There are many similar "what ifs." A popular definition is: **mobile entertainment** refers to entertainment delivered on mobile devices over wireless networks or that interacts with mobile service providers.

According to a 2013 report by Juniper Research, it was estimated that the global market for mobile entertainment would jump from worldwide revenues of approximately $39 billion in 2013 to $75 billion in 2017 (Juniper Research 2013). For example, the National Basketball Association (NBA) offers the NBA League Pass (**nba.com/leaguepass**), which allows fans to watch games in real time on iPhones and other smartphones for a fee of $50 per season. There are a large number of

entertainment related apps; many are free. For the top free entertainment apps offered by Google Play, see **play.google.com/store/apps/category/ENTERTAINMENT/collection/topselling_free**. For *PC Magazine*'s list of the 100 top paid (some free) iPad apps of 2014, see **pcmag.com/article2/0,2817,2362576,00.asp**.

This section discusses some of the major types of mobile entertainment, including mobile music and video, mobile gaming, mobile gambling, and mobility and sports. Mobile entertainment in social networks is covered in Chapter 8.

Mobile Streaming Music and Video Providers

Apple is the clear leader in the digital distribution of music and video. Since 2001, Apple has offered consumers the ability to download songs and videos from the Apple iTunes store. iTunes customers purchase billions of songs annually. For example, in 2010, Apple's customers were downloading videos at the rate of 70,000 a day. According to Groth and Cortez (2012), Apple's annual sales in iTunes stores increased 36.9% in 2011 to $18.4 billion, becoming the third fastest growing retailer in the U.S. At the end of 2007, Amazon.com launched their Amazon MP3 and Amazon Video on Demand, a digital download service for music and video, respectively. Other major Internet music providers are **spotify.com**, **youtube.com**, **myspace.com**, and **facebook.com/FreeOnlineMp3**. Note that, cell phones today can display analog TV (popular in developing countries). Smartphones can display any programs offered on the Internet. For details, see **venturebeat.com/2010/12/01/telegent-ships-100mth-chip-for-tv-on-mobile-phones**. Note that with their Dish Anywhere mobile app, Dish Network works anywhere customers can access the Internet through their smartphone or tablet, and with their Sling Technology, customers can watch live TV or DVR content on their iPhone, iPad, Android, and Kindle Fire (see **dish.com/technology/dish-anywhere**). Netflix has a free app for its subscribers to watch TV shows and movies streaming from Netflix on their mobile device (e.g., iPhone, iPad, Android). See **get.it/netflix.**

Entertainment in Cars

Entertainment is coming to cars directly from the Internet. For example, in March 2014, Apple announced that it is teaming up with a major car maker for its *CarPlay* system. The system enables iPhones to plug into cars so drivers can request music with voice commands or with a touch on a vehicle dashboard screen. For details, see Liedtke (2014). JVC ("Experience Apps in a New Mobile Way") allows you to connect an iPod to a JVC receiver and "watch it come alive with your favorite apps." The JVC feature works with compatible car receivers and apps only. For more about JVC and its mobile features for cars, see **jvckenwood.com/english/car/applink**. Future opportunities include car diagnosis, driver health monitoring, usage-based insurance and even parental alerts. Some car brands already provide communication, telematics, social networking, and mobile commerce.

Mobile Games

A wide range of mobile games have been developed for different types of players. According to Knight (2012b), 46% of gamers play more on mobile devices than on PCs. The vast majority of players use smartphones. Many computer games can be played on mobile devices. For example, trading card games like "Magic: The Gathering" are online or plan to be (see **accounts.online-gaming.wizards.com**). Mobile games can be classified according to:

- **Technology.** Embedded, SMS/MMS, Web browsing, J2ME, BREW, native OS
- **Number of players.** Solo play or multiplay (from few to many players)
- **Social network-based.** Using smartphones, people can play games available in social networks, such as FarmVille on Facebook.

Several blogs provide information and discussions about the current state of the mobile gaming

market, including various game offerings, as well as the technologies and platforms used to develop the games. One of the best is **blog.mobilegames-blog.com**.

According to Soh and Tan (2008), and our authors' experience, the drivers of the popularity of mobile games are:

- Increasing spread of mobile devices. The more people use smartphones, the more people will play e-games.
- The inclusion of games in social networks, and particularly on Facebook.
- The streaming of quality videos is improving.
- The support for the gamification movement.
- The ability of vendors to generate money from ads attached to games.
- Technological improvements for downloading complex games.

The potential size and growth of the overall online gaming market is enormous. This explains the large number of companies involved in creating, distributing, and running mobile games.

Hurdles for Growth

Although the market is growing rapidly, game publishers (especially in China and India), are facing some major hurdles. For example, there is a lack of standards, unavailability of many different types of software and hardware, and increasing costs. The newest generation of games requires advanced capabilities available only in higher-end mobile devices and with at least 3G networks. The ad spending in mobile games has remained low, but it is growing.

To address these hurdles, game publishers are focusing their attention on Apple's iPhone and iPad and on similar popular devices.

Mobile Gambling

Unlike some of the other forms of mobile entertainment, the mobile gambling market has a high demand but also some unique hurdles. First, mobile gambling requires two-way financial transactions. Second, online gambling sites face major trust issues. Gamblers and bettors have to believe that the site is trustworthy and fair. Finally, while the legislative and regulatory picture is very restrictive, it is also unclear and keeps changing.

Online gambling is booming despite the fact that it is illegal in almost all U.S. states. In 2013, Delaware and Nevada were the first U.S. states to allow some online gambling, followed by New Jersey (in October 2013, Delaware became the first state to allow a "full suite" of Internet gambling). In February 2014, both Delaware and Nevada signed a deal to allow interstate online gambling. Note that Federal Law limits online gambling to players while they are physically present within each state. (This can be verified by using geolocation software.) Therefore, if one state allows online gambling, you can play only when you are in that state. As of February 2014, 10 states were considering legalizing or expanding online gambling (**washingtonpost.com/blogs/govbeat/wp/2014/02/05/at-least-10-states-expected-to-consider-allowing-online-gambling-this-year**). However, in March of 2014, a bill was introduced in Congress to outlaw any Internet gambling, including in the states where it is already legal (**reviewjournal.com/news/new-bill-would-prohibit-internet-gambling-including-where-already-legal**).

Mobility and Sports

There are many sports mobile applications (e.g., see the closing case about the NFL in Chapter 1).

Here are some representative examples of unique sports mobile applications:

- Nike and Apple introduced an iPod shoe called Nano (a best seller), which can calculate how many calories are burned during workouts. This is done via wireless sensors. In addition to calories burned, users can get information about the distance they run. The data collected by the sensors are transmitted to the runner's iPod and headphones. In addition, the Nike+iPod system delivers music

and voice entertainment, including podcasts on different sports topics. For details, see Frakes (2010).
- Personalized live sport events can be viewed on mobile devices. The user can select the event to watch. In the future, systems will be able even to predict users' preferred events during several simultaneous live sports competitions. Streaming live sports to mobile devices is becoming very popular. Unfortunately, there may a fee to enjoy this.
- In 2006, Levi Strauss featured the RedWire DLX iPod-compatible jeans. The $250 jeans come complete with all the necessary hardware.
- ESPN's SportsCenter offers WatchESPN, is a system where subscribers can watch ESPN on a desktop or on a mobile device. For details, see **espn.go.com/watchespn/index**.
- Eventbrite **eventbrite.com** is a company that provides several applications for event management online (e.g., creating tickets, promoting events, managing event entry).

Service Industry Consumer Applications

A large number of mobile applications are used in different service industries. Here are two examples.

Healthcare

Mobile devices are everywhere in the field of healthcare, as illustrated next:
- Using a handheld device, a physician can submit a prescription directly to participating pharmacies from her office or patient bedside. In addition, your physician can order tests, access medical information, scan billable items, and check costs and fees for services.
- Remote devices not only monitor patient vital signs while he/she is at home, but also can adjust operating medical equipment. This is done by using sensors.
- To reduce errors, mobile devices can validate the managing, tracking, and verifying of blood collected for transfusions. Promises Treatment Centers (alcohol and drug rehabilitation) uses a free mobile app (iPromises for iPhone; **ipromises.org**) that works as a virtual recovery tool (e.g., list of AA meetings in the U.S. and Canada, add friends, track progress, etc.) While the iPromises Recovery Companion does not generate revenue for the company, "it is aimed at bolstering Promises' reputation among patients and doctors" (see Del Rey 2010 for details).

For more applications, see **motorolasolutions.com/US-EN/Business+Solutions/Industry+Solutions/Healthcare** (now Zebra).

Hospitality Management

Many applications exist from travel reservations to ensuring safety in hotel rooms. Examples are: two-way radio communication, wireless hotspot solutions, food safety checks, parking lot management, asset location and management, guest services, safety and security on the premises, entertainment, inventory management, and much more. For details, see **motorolasolutions.com/en_us/solutions/hospitality.html**. One area in hospitality that benefits from a wireless system is restaurant operations.

Example 1: Dolphin Fast Food

Dolphin Fast Food Inc. operates 19 Burger King franchises in Minnesota (reported by *Baseline*, June 28, 2010). The company uses a wireless system to streamline operations, control costs, increase staff and customer satisfaction, and comply with regulations. The system includes free Wi-Fi access both in the restaurants and in a corporate management wireless network. The company realized that customers can use their mobile devices while waiting and during dining. Managers use mobile devices to increase effectiveness. The wireless system is also used for improved security on the premises (e.g., video surveillance). The secure Internet access is protected by a VPN (see Chapter 10) and it can block inappropriate content. The wireless system also operates the payment gateways and the POS terminals. For the deployment of the system and the security tools used, see Dolphin (2010).

For more recent material see **sonicwall.com/downloads/CS_BurgerKing_US.pdf**.

Note: In many full-service restaurants, there are several additional applications such as customers placing orders on handheld devices, where the orders go directly to the kitchen and to the cashiers, and mobile devices for advising waiting customers to come in when their tables are ready. A vendor that provides mobile programs for tablets for menus, food ordering, entertainment, and payments is Ziosk.

Example 2: Tablets and Other Mobile Devices in Restaurants

Several restaurants worldwide are introducing tablets or smartphones as a substitute to paper menus. For example, as mentioned earlier, Au Bon Pain is using iPads in several of their locations. One option is to provide the servers with an iPad with a built-in menu. This way they can submit the order directly to the kitchen. Another one is to loan tablets to those customers that do not have one while dining in the restaurant. Using the tablets, customers can order food by themselves and provide their credit card information. It seems that the use of tablets also facilitates customer relationships since self-ordering expedites the service and reduces errors in ordering. The tablets can supplement or replace paper menus. Some restaurants provide portable devices for playing games or ordering movie tickets while waiting for the food. For details, see Nassauer (2012).

Public Safety and Crime Prevention

There are many mobile devices and methods for improving public safety. For example, in Vietnam and in Australia, mobile cameras identify unregistered cars by reading license plate numbers from a distance, and then comparing these numbers to those in a database. Another example is using digital cameras in Vietnam and Australia to find illegal taxi operators, and in Singapore to photograph speeding vehicles. (For information about new "average speed" cameras implemented in Singapore, see **therealsingapore.com/content/singapore-trialling-new-average-speed-speed-cameras**.)

Other Industries

Mobile systems and applications can be found in almost all industries. For example, extensive applications can be found in m-government and m-learning (see Chapter 5). Two interesting application are provided in the Motorola closing case to this chapter (hospitals and manufacturing). The Department of Homeland Security applies many devices, as do the transportation industry and the military. In agriculture, wireless devices can even guide tractors to work at night.

Mobile Shopping and Advertising

Online shopping can be easier when done from your smartphone or tablet. For shopping, one needs a mobile shopping platform such as the one provided by ADCentricity Corporation (**adcentricity.com**; acquired by Bee Media Inc.), or by adMobile Corp. (**admobile.com**). Many apps for iPhones facilitate advertising and shopping. For example, you can download the Costco Mobile App for easy coupon redemption (see **costco.com/costco-app.html**). For a list of smartphone applications for business, see the iPhone apps and Del Rey (2010). Wishpond Technologies Ltd. (2014) shows how smartphone shoppers use their devices for different shopping-related activities (e.g., checking prices, searching for reviews).

Example: Delta Airlines

Delta offers in-flight Wi-Fi connection on many of its flights (called *Delta Connect*). With Delta Connect, there is free access to many shopping and entertainment sites, including eBay. For a nominal fee, you can purchase a Wi-Fi Mobile Pass and be able to connect to the Internet via your smartphone, and send and receive mobile messages, check your e-mail, and browse the Web. For more about Delta Connect and Wi-Fi Mobile Pass, see **delta.com/content/www/en_US/traveling-with-us/in-flight-services/amenities-information/in-flight-wi-fi.html#**. Other airlines offer similar capabilities.

In addition, consumers use mobile devices to locate stores, compare prices, and place orders.

For more, see 'mobile marketing' in Chapter 9. For example, Chinese consumers can make purchases from inside WeChat (Millward 2014). China's largest e-tailers, Taobao and T.mall offered special discounts in 2014, in order to encourage shoppers to buy from their smart phones. Finally, using text messages greatly facilitates recommendations and advice for shoppers, especially in social networks (see Chapter 7 and Butcher 2011). To see how mobile shopping is done, visit Amazon.com, JCPenney, Target, REI, and Crate & Barrel to download their shopping apps.

Example

METRO Group (AG) is offering an application for high-capacity mobile phones to use in its Future Store in Rheinberg, Germany. According to their site, the Mobile Shopping Assistant (MSA) "is a software package which allows customers to scan items independently, receive current pricing information and a quick overview of the value of their goods." An MSA provides online access to product descriptions and pictures, pricing information, and store maps. It also enables scanning items before they are placed in the cart, calculating the total cost of the items. At checkout, the MSA allows a shopper to "pay in passing" by using the MSA to pass scanned data to a payment terminal. For more about METRO's Future Store Initiative and functionalities of the MSA, see **future-store.org/internet/site/ts_fsi/node/25216/Len/index.html**. METRO has measured the reactions and satisfaction of the Future Store shoppers. The results indicate that customers are more satisfied and visit the store more often than before. In addition, the percentage of new customers has increased, and customers spend 45 more euros per month. Metro AG, like Food Lion and other grocers, are experimenting with RFID, which can be used for supply chain logistics and more.

SECTION 6.5 REVIEW QUESTIONS

1. Briefly describe the growth patterns of the various segments of mobile entertainment.
2. Discuss the basic components of the mobile music market.
3. What are some of the key barriers to the growth of the mobile games market?
4. Discuss some of the key legal issues impeding the growth of mobile gambling.
5. Describe the use of mobility in sports and in restaurants.
6. Describe some hospitality management mobile applications.
7. Describe mobile shopping and advertising.

6.6 LOCATION-BASED MOBILE COMMERCE AND MOBILE SOCIAL NETWORKS

Location-based m-commerce (l-commerce) (or LBC), refers to the use of location finding systems such as GPS-enabled devices or similar technologies (e.g., triangulation of radio- or cell-based stations) to find where a customer with a mobile device, or an object, are located and provide them with relevant services, such as an advertisement or vehicle route optimization. According to TechTarget, LBS is "a software application for a IP-capable mobile device that requires knowledge about where the mobile device is located" (see **searchnetworking.techtarget.com/definition/location-based-service-LBS**). L-commerce them with involves context-aware computing technology (Section 6.7). For images, search Google for 'images of location-based commerce.' L–commerce offers convenient services to consumers such as connections with friends, the ability to receive relevant and timely sales information, safety features (e.g., emergency assistance), and convenience (a user can locate what facility needed is nearby without consulting a directory or a map). Sellers get the opportunity to advertise and provide or meet a customer's needs in real time. In essence, LBC is the delivery of m-commerce transactions to individuals who are in a known specific location, at a specific time. Foursquare (**foursquare.com**) is a company that makes LBC apps (see Chapter 7).

Basic Concepts in L–Commerce

Location-based m-commerce mainly includes five possible activities, all done in real time:

1. **Location.** Finding where a person (with a smartphone) or a thing (e.g., a truck) are located.
2. **Navigation.** Finding and illustrating a route from one location to another (e.g., as done by Google maps)
3. **Tracking.** Monitoring the movements and whereabouts of people or objects (e.g., a truck, airplane)
4. **Mapping.** Creating maps of certain geographical locations with super-imposed data if needed (e.g., GIS, Google maps)
5. **Timing.** Determining arrival or departure time of something at a specific location (e.g., arrival of a bus to a specific bus stop, or an airplane to an airport).

For example, WeatherBug (**weather.weatherbug.com**) and Send Word Now (**sendwordnow.com**) have combined some of these five services to ensure the safety of customers, employees, and stores during severe weather and other emergencies.

A recent development of l-commerce is known as **real-time location systems (RTLS)**, which are used to track and identify the location of objects in real time (see Malik 2009). For an overview, see **searchmobilecomputing.techtarget.com/definition/real-time-location-system-RTLS** and **computerlearningcentre.blogspot.com/2014/04/l-commerce.html**.

L-Commerce Infrastructure

L-commerce is based on an infrastructure. The components depend on the applications. However, the following usually exist:

1. **Location finder (positioning) component.** A GPS (or other device) that finds the location of a person or a thing.
2. **Mobile Positioning Center.** This includes a server that manages the location information received from the location finder.
3. **User.** The user can be a person or thing (e.g., a vehicle).
4. **Mobile devices.** The user needs a mobile device (e.g., a smartphone) that includes a GPS or other feature that locates the position of something or someone.
5. **Mobile communication network.** The network(s) that transfers user requests to the service providers, and then transmits the reply to the user.
6. **Service or application providers.** Providers are responsible for servicing a user's request. They may use applications such as GIS.
7. **Data or content provider.** Service providers usually need to acquire (e.g., buy) geographic, financial, or other data in order to provide a reply to requests. Data may include maps and GIS information.
8. **Geographical Information System (GIS).** This includes maps, location of businesses, and more (described later).
9. **Opt-in application.** In the U.S. and some other countries, LBC can be used only with people's permission (opt-in). This requires an additional software app.

These components work together as illustrated in Figure 6.6.

For additional components, see **gps.gov/technical/icwg** and TeleCommunication Systems, Inc. (2010).

Here is how the LBS system works (see Figure 6.6):

1. The user expresses his or her wish by clicking on a function (e.g., "find me the nearest gas station").

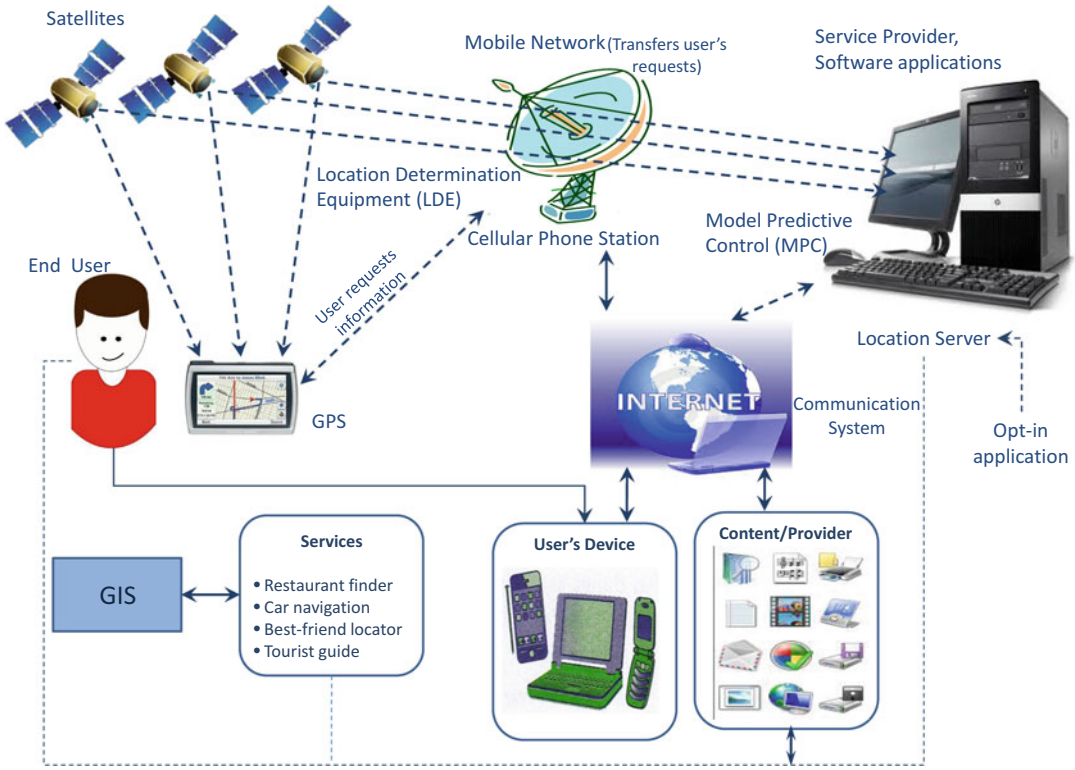

Figure 6.6 LBS components creating a system

2. The mobile network service finds where the user is located using satellite and GPS.
3. The request is transferred via a wireless network to the service provider software application that activates a search for the needed data.
4. The server goes to a database, to find for example, the nearest requested business and check if it is open, what it serves, and so forth.
5. Using a GIS, the service delivers the reply to the user, including a map and driving directions if necessary.

A similar system can be used for vehicle or asset location. A GPS is then attached to the object.

Musil (2013) reported that by combining conventional GPS signals with data from sensors, one can pinpoint the location of a car within six feet of its location.

Geolocation

LBS is related to the concept of *geolocation*. **Geolocation** refers to the ability to find the location of a user who is connected to the Web via a mobile device. Geolocation works with all Web browsers.

L-commerce is distinguished from general m-commerce by the *positioning component*, the compulsory opt-in, and the mash up with GIS or other data sources.

The GPS: Positioning Component

The major device in l–commerce is a global positioning system (GPS). Here is how it works:

According to GPS.gov (2014), "the **Global Positioning System (GPS)** is a U.S.-owned utility that provides users with positioning, navigation, and timing (PNT) services. This system consists of three segments: the space segment, the control segment, and the user segment."

The U.S. government describes these segments as follows:

Space Segment. The space segment consists of 24 satellites that transmit signals. The signals designate the satellites' positions at any given time (using an atomic clock). Each satellite orbits the earth once every 12 hours at an altitude of 10,900 miles.

Control Segment. The control segment includes a global monitoring system and control station to monitor the satellites.

User Segment. The user's equipment, which is the GPS receiver, receives information from the satellites and calculates the user's position at the given time.

In recent years, GPS locators have become a part of the consumer electronics market. They are available in many smartphones, and today are used widely for business and recreation. Online File W6.4 provides an example of the use of GPS for tracking buses. See Garmin Ltd. (**garmin.com**) for examples of GPS devices, and Trimble Navigation Limited (**trimble.com/gps_tutorial/whatgps.aspx**) for tutorials on different GPS-related topics.

Note: The European Union (EU) and the European Space Agency are constructing an alternative global navigation satellite system called *Galileo*, which will be under civilian control. Galileo, which will consist of 30 orbiting satellites, has been given a budget of €7 billion to fund the system from 2014 to 2020. Four operational satellites were dispatched in 2011 and 2012. For more information about Galileo (history, benefits, application, etc.), see the European Global Navigation Satellite Systems Agency (**gsa.europa.eu/galileo-0**) and **ec.europa.eu/enterprise/policies/satnav/galileo/index_en.htm**. For further details, see **navipedia.net/index.php/Galileo** and **navipedia.net/index.php/Galileo_General_Introduction**, respectively.

Note: GPS dating applications let you sort through lists of people you may want to date based on their location at any given time (see applications such as Skout (**skout.com**; "the global network for meeting new people"). For an example of a success story, see Sutter (2010).

Location-Based Data

Location-based services (LBS) and l-commerce are based on a series of location-based questions or queries.

Using Data Collections

GPS-enabled smartphones and other devices help in collecting large amounts of data, which can be used in decision making to save millions of dollars (see Feldman 2010).

Locating Customers in Physical Stores

When shoppers equipped with smartphones are in physical stores, it is possible to track their movements in specific stores and malls. The information collected may give retailers ideas about the customers' shopping habits. The companies that collect the information say that it is anonymous. The tracking is done via the smartphone's MAC address (the smartphone's unique identifier code). Any smartphone that is connected to Wi-Fi sends signals with the MAC address, which a store can capture. Smartphone users can opt-out of the use of their MAC address by going to the Smart Store Privacy website at **smartstoreprivacy.org**. For a discussion, see Kerr (2014). For more information on what happens to the information collected on your smartphone and disabling "geotagging" (locating geographic information), see **bctnv.com/what-happens-to-the-gps-location-information-collected-on-your-smartphone.html**.

Geographical Information Systems

Some data, information, and processes that are needed to answer location-based queries are usually handled by a *geographical information system (GIS)*. According to USGS (2007), a **geographical information system (GIS)** is a computer-based system whose function is to capture, store, analyze, and display geographically-related data. For example, suppose a person is using his or her mobile phone to ask an online directory service to provide a list of Italian restaurants that are close by. In order to service this query, the directory service would need access to a GIS containing information about local restaurants by geographical coordinates and type. For more on GIS, see **en.wikipedia.org/wiki/Geographic_information_**

system, USGS (2007), Heywood et al. (2012), and esri.com/what-is-gis/overview.

Geographical information systems are frequently combined with GPS, as shown next.

Example: Hailing Taxis from a Smartphone

As discussed in Chapter 1, hailing taxis from smartphones is spreading slowly around the globe. ZabCab (zabcab.com; "connecting taxicabs and passengers") provides an app by which a user with a GPS-enabled smartphone can push a button and GPS technology identifies their location. An icon with a map appears on the mobile devices of participating taxi drivers, letting the driver know the location of the passenger who needs to be picked up. Currently (2014), ZabCab is only available in certain cities in New York. The HAIL A CAB™ app (hailacabapp.com), a product of Yellow Cab, offers the taxi-hailing service in several cities in Texas (Austin, Houston, San Antonio, and Galveston), with more locations forthcoming. The Alibaba Group also offers a cab-hailing app in Beijing (see online.wsj.com/news/articles/SB10001424052702303287804579442993327079748).

Note: Taxi company Comfort Transportation, located in Singapore, offers a taxi-booking system in which the booking is done by SMS (see cdgtaxi.com.sg/commuters_services_booking.mvn). They also offer taxi-booking apps and online taxi booking. It is not location–based, but it solves the problem of busy telephone lines. Finally, GetTaxi (gett.com), available in New York and other major cities worldwide (e.g., Moscow, London, Tel Aviv), offers a free app that allows you to order taxis directly from your smartphone. What differentiates GetTaxi is that they are the only taxi company that has: game-changing technology, unbelievable customer service, and transparent and attractive practices (see gett.com/about.html).

Location-Based Services and Applications

A **location-based service (LBS)** is a mobile device–based computerized service, which utilizes information about the geographical position of a user's mobile device (e.g., mobile phone tracking) for delivering a service (e.g., advertisers can target ads to specific location), to the user.

Table 6.1 Location-based applications and services

Category	Examples
Advertising	Banners, advertising alerts (e.g., promotions, coupons)
Billing and payments	Road tolling, location-sensitive billing
Emergency	Emergency calls, automotive assistance
Games	Mobile games, geocaching
Information	Entertainment services, mobile yellow pages, shopping guides
Leisure and travel	Buddy finder, instant messaging, social networking, travel guides, travel planner
Management	Facility, infrastructure, fleet, security, environmental
Navigation	Directions, indoor routing, car park guidance, traffic management
Tracking	People/vehicle tracking, product tracking

Sources: Based on Steiniger et al. (2006), geoawesomeness.com/knowledge-base/location-based-services (accessed May 2014), and the authors' experiences.

There are a large number of LBS applications. The major categories of these are shown in Table 6.1. For a list of location-based services (applications), see geoawesomeness.com/knowledge-base/location-based-services/location-based-services-applications.

Location-based services can be used in marketing, operations, services, finance, and so forth. LBS technologies determine the location of a person (or an object), and act upon this information. LBS also work in asset tracking (e.g., of parcels at USPS or FedEx) and in vehicle tracking (see Online File W6.4 and the Tracking section at geoawesomeness.com/knowledge-base/location-based-services/location-based-services-applications). LBS also include location-based games.

Other examples of location-based services are:

- Recommending public events in a city to tourists and residents.
- Asset recovery, for example, finding stolen cars.
- Pointing a user to the nearest business (e.g., a gas station) to his (her) location.
- Providing detailed navigation from any place to any address (sometimes with voice prompts).
- Locating things (such as trucks) and displaying them on the mobile devices' map.
- Inventory tracking in warehouses.
- Delivering alerts, such as notification of a real time sale in a specific store.

RFID technologies wirelessly track objects in warehouses (see Tutorial T2).

Personnel Tracking

Different technologies are used by managers and employees for tracking personnel on the company premises and while they are off premises.

Social Location-Based Marketing

Social location-based marketing occurs when users share their location with vendors in real time (opt–in), usually within social media environments. The vendors then deliver targeted ads, coupons, or rebates to the users. In addition, the vendors may conduct market research about the user's preferences and collect feedback about product quality. For more information, see the video titled "The Future of M-Commerce - Did You Know?" (4:30 minutes) at **youtube.com/watch?v=F58q6yUAsHE**.

The major LBS 'check in' services in 2014 were Foursquare, Facebook Places, and Plyce (in France). Technology vendors include AT&T, IBM and Telecomsys. Retailers that use such systems include Best Buy ("check-in" app).

Barriers to Location-Based M-commerce

The following are some factors that are slowing down the widespread use of location-based m-commerce:

- **Lack of GPS in some mobile phones.** In 2014, only about 35% of regular mobile phones were sold with GPS. Without GPS, it is difficult to use LBS. However, GPS-enabled phones are increasing in popularity. Also, the use of cellphone towers helps.
- **Accuracy of devices.** Some of the location-finding tools are not too accurate. A good, but expensive, GPS provides accuracy of 10 feet. Less accurate locators provide accuracy of about 1,500 feet.
- **The cost–benefit justification.** The benefits of location-based services may not justify the cost. For customers, it may be inconvenient to utilize the service. As you may recall from Chapter 1, Starbucks discontinued LBS.
- **Limited network bandwidth.** Wireless bandwidth is still limited. As bandwidth improves with 4G and 5G, applications will expand, which will increase the use of the technology.
- **Invasion of privacy.** Many people are reluctant to disclose their whereabouts and have their movements tracked (see Yun et al. 2013 and Chapter 15 for a discussion).

SECTION 6.6 REVIEW QUESTIONS

1. Describe the key elements of the l-commerce infrastructure.
2. What is GPS? How does it work?
3. What are some of the basic questions addressed by location-based services?
4. Define geographical information systems. How do they relate to LBS?

5. List the services enabled by LBS.
6. Describe social location-based marketing.
7. List the major barriers to LBS.

6.7 UBIQUITOUS (PERVASIVE) COMPUTING AND SENSORY NETWORKS

Many experts believe that the next major step in the evolution of computing will be *ubiquitous computing (ubicom)*. In a ubiquitous computing environment, almost every object in the system has a processing power (i.e., microprocessor) and a wireless or wireline connection to a network (usually the Internet or intranets). This way the objects can both communicate and process information. This section provides an overview of ubiquitous computing and briefly examines a number of related applications in the areas of sensor network technologies. (Note: The words *ubiquitous* and *pervasive* mean "existing everywhere.")

Overview of Ubiquitous Computing

Ubiquitous computing is a comprehensive field that includes many topics (e.g., see **en.wikipedia.org/wiki/Ubiquitous_computing** and Krumm 2009). Here we present only the essentials that are related to EC.

Definitions and Basic Concepts

Ubiquitous computing (ubicom), also known as *pervasive computing*, has computing capabilities embedded into a relevant system, usually not visible, which may be mobile or stationary. It is a form of human-computer interaction. In contrast, mobile computing is usually represented by visible devices (e.g., smartphones) possessed by users. Ubiquitous computing is also called *embedded computing*, *augmented computing*, or *pervasive computing*. Sometimes a distinction is made between pervasive and ubiquitous computing. The distinction revolves around the notion of mobility. **Pervasive computing** is embedded in the environment but typically is not mobile. In contrast, ubiquitous computing possesses a high degree of mobility. Therefore, for example, most smart appliances in a smart home represent wired, *pervasive computing*, while mobile objects with embedded computing, such as in clothes, cars, and personal communication systems, represent *ubiquitous computing*. In this chapter, however, we treat pervasive and ubiquitous as equivalent terms, and we use them interchangeably.

Context-Aware Computing

Context-aware computing is a technology that is capable in predicting people's needs and providing fulfillment options (sometimes even before a request by the end user is made). The system is fed with data about the person, such as location and preferences. Regardless of the types of the end user, the system can sense the nature of personalized data needed for different environments. In its 2014 predictions, cited earlier, Gartner, Inc. cited context-awareness as one of the top 10 futuristic technologies. Context awareness technologies are related to LBS, but the technology can also be used without LBS.

In general, the technology is expected to increase productivity and result in many new applications. Carnegie Mellon University is a leader in the research of business applications in this technology.

Internet of Things (IoT)

The **Internet of Things (IoT)** is an evolving term with several definitions. In general, The IoT refers to a situation where many objects (people, animals, items) with embedded microprocessors are connected mostly wirelessely to the Internet. That is, it uses ubiquitous computing. Analysts predict that by the year 2020, there will be more than 50 billion devices connected to the Internet, creating the backbone of the IoT. The challenges and opportunities of this disruptive technology are discussed in an interview with Peter Utzschneider, vice-president of product management for Java at Oracle (see Kvita 2014). Note that the more 'things' are connected to the Internet the more security issues are anticipated (Vogel 2014).

Embedding mobile devices into items everywhere and connecting all devices to the Internet permits extensive communication between users and items. This kind of interaction adds a unique

perspective to collaboration. For business applications of the Internet of Things, see Nazarov (2009). In addition, check the "Internet of Things Consortium" (**iofthings.org**) and their annual conference. For the technology see Holler et al. (2014).

Machine-to-Machine Technology.
An integral part of IoT is machine-to-machine (M2M) communication. According to **whatis.techtarget.com**, M2M is a "technology that supports wired or wireless communication between machines. An example of M2M technology might be a set of devices that monitor traffic in a city and communicate the information to the city's traffic lights in order to regulate the flow of traffic. M2M is used in telemetry, data collection, remote control, robotics, remote monitoring, status tracking, road traffic control, offsite diagnostics and maintenance, security systems, logistics services, fleet management, and telemedicine." For more see Holler et al. (2014).

For more on the IoT (e.g., definition, history), see **whatis.techtarget.com/definition/Internet-of-Things**.

The IoT will include many everyday things, ranging from smart grids to smart homes, clothes, cities and many others, all being networked. For more about the Internet of Things (smart cities, smart cars, and so forth), see the 2013 presentation from van Geest at **wired.com/2013/04/the-internet-of-things-quantified-self-iot-smart-cities-smart-cars-smart-clothes**.

Smart Application: Grid, Homes, Cars, and More

An example of a simple application of pervasive computing is the use of smart meters for measuring electricity use. With smart meters there is no need to go from house to house to read the meter. Also, electricity consumption can be optimized. According to the Pacific Gas and Electric (PG&E) 'SmartMeter' Web page, current benefits include: more reliable service (two-way communication between PG&E and the grid, thus eliminating the need for workers to go to houses to read the meter); tracking energy use online in real time; getting alerts about usage; and much more. Future benefits include better usage of renewable power – using energy from solar and wind sources. For more details on PG&E's SmartMeter see **pge.com/en/myhome/customerservice/smartmeter/index.page**.

Pervasive computing technology is the key to many smart applications. Some examples are presented next.

According to the U.S. Department of Energy, a **smart grid** (**smartgrid.gov**) is an electricity network managed by utilizing digital technology. Like the Internet, the Smart Grid consists of controls, computers, automation, and new technologies and equipment working together, but in this case, these technologies work with the electrical grid to improve usage by responding to the quickly changing electric demand.

The Smart Grid represents an unprecedented opportunity to move the energy industry into a new era of reliability, availability, and efficiency that will contribute to our economic and environmental health. The benefits associated with the Smart Grid include:

- More efficient transmission of electricity
- Quicker restoration of electricity after power disturbances
- Reduced operations and management costs for utilities, and ultimately lower power costs for consumers
- Reduced peak demand, which will also help lower electric rates
- Increased integration of large-scale renewable energy systems
- Better integration of customer-owner power generation systems, including improved security of renewable energy systems
- Goal of zero carbon emissions

The U.S. Department of Energy (DOE) Office of Electricity Delivery and Energy Reliability provides substantial information about the smart grid (see **energy.gov/oe/technology-development/smart-grid**). According to the DOE, the smart grid devices have sensors to gather data and two-way digital communication between the device in

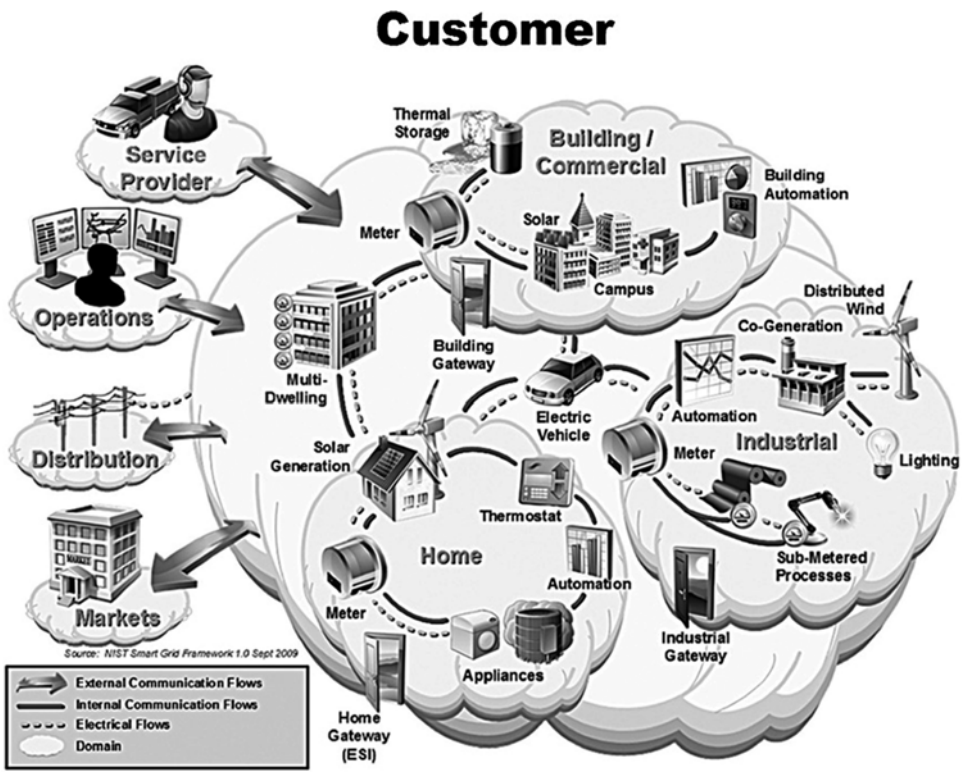

Figure 6.7 Smart grid environment (Source: National Institute of Standards and Technology, U.S. Department of Commerce *nist.gov/smartgrid/upload/FinalSGDoc2010019-corr010411-2.pdf* accessed July 2014)

the field and the network operations' center. The essentials of the grid are shown in Figure 6.7 and in the "Smart Grid Basics" infographic at **edf.org/energy/infographic-smart-grid-basics**.

The U.S. Department of Energy proposes that the following four types of technologies will drive the advancement of smart grids:

1. Integrated, automated communication between components of the electric grid.
2. Sensing and measurement technologies.
3. Automated controls for distribution and repairs.
4. Improved management dashboards and decision support software.

The major features of the grid include: smart meters for measuring electricity usage, self-healing ability from power malfunction incidents, and engagement by consumers. The meter reading is used for pricing strategy aimed at reducing consumption during peak demand. For more information, see **en.wikipedia.org/wiki/Smart_grid**. Smart grids enable the use of smart homes and appliances. For more see **edf.org/climate/smart-grid-overview** and **smartgrid.gov**.

Smart Homes and Appliances

In a smart home, the home appliances such as computers, refrigerators, washers, dryers, televisions, and security systems are interconnected and can be controlled remotely by smartphone or via the Internet. For an overview see **smarthomeenergy.co.uk/what-smart-home**.

In the United States, thousands of homes are connected to such systems and other countries are warming to the idea. Currently, smart home systems support a number of different tasks:

- **Lighting.** Users can manage their home lighting from wherever they are.
- **Energy management.** A remote home heating and cooling system can be controlled via remote to adjust the thermostat in the house.

- **Water control.** WaterCop (**watercop.com**) is a system that reduces water damage by monitoring leaking water via a sensor, which sends a signal to the valve, causing the valve to close.
- **Home and senior communities security and safety.** Home security and safety systems can be programmed to alert you to a security related event on your property. Home security can also be supported by cameras, so you can remotely view your property in real time. Sensors can be used at home to detect intruders, keep an eye on working appliances and much more.
- Security measures are common in assisted living facilities and in senior communities, and for seniors who live independently. For example, the iHealthHome Touchscreen system collects data and communicates with the company's software. According to their website, it is a comprehensive monitoring and communication system for professional caregivers and independent living communities. Family caregivers and physicians are given remote access to the patient's health data. Using this technology, the iHealthHome program reminds seniors of their daily appointments, makes the Internet useful, keeps their mind occupied, and much more. iHealthHome also reminds seniors to take their medicine, monitor their blood pressure, and stay in touch with their caregiver. See **ihealthhome.net** for more information.
- **Home entertainment.** Audio and video equipment can be programmed to respond to a remote control device. For instance, the remote control for a stereo system located in the family room can command the system to play on speakers installed anywhere else in the house. Home automation performs for the user all from one remote and all from one button.
- **Smart appliances.** According to **smartgrid.gov**, a smart appliance is "an appliance that includes the intelligence and communications to be automatic or remote-controlled based on user preferences or external signals from a utility or third party energy service provider. A *smart appliance* may utilize a *Home Area Network* to communicate with other devices in the customer's premise, or other channels to communicate with utility systems."

For more about home automation, see **smarthome.com/sh-learning-center-what-can-i-control.html**. To see the various apps used for home control, see **smarthome.com/android_apps.html**.

Smart and Driverless Cars

The average automobile today already contains 30–50 invisible microprocessors that control many functions such as the air conditioning. This is only the beginning of this revolution. In Section 6.8, we describe smart cars in more detail.

Smart Cities

Smart grids, homes, cars, and other things lead to smart cities (see Section 6.8).

Wireless Sensor Networks

A question facing many companies that are interested in becoming more efficient is "How can we sense the important or changing events in the real world and quickly respond more effectively?" *Real-world awareness* is a concept used to describe the ability of a company to access real-time information, allowing them to respond more effectively. For how RFID devices can be used for this purpose, see the SAP Press Release at **global.sap.com/press.epx?pressID=4143**.

Sensor Network Basics

A **sensor network** is a group of sensors distributed throughout a particular space (e.g., a manufacturing plant or an orange grove) that monitors and records environmental conditions and analyzes the collected data. Each individual sensor is called a "node." Most sensor networks are wireless. Each node consists of (1) a sensor that monitors and records environmental conditions (e.g., temperature), (2) a microprocessor that collects and processes information, and (3) a device that receives and sends data. For an overview of wireless sensor networks, see **intechopen.com/books/wireless-sensor-networks-technology-and-protocols/overview-of-wireless-sensor-net-**

work.When nodes with embedded intelligence are inserted into physical items, the items are called *smart items* or *smart objects*. RFIDs that are combined with a sensing device can be used as nodes in a sensor network; however, most sensor networks use other technologies. Advanced sensor systems can measure almost anything. For a video titled "This Sensor Measures Almost Anything" (2:06 minutes) on advanced sensor systems see (**money.cnn.com/video/technology/2013/01/15/t-ces-node-sensor.cnnmoney/index.html**).

Smart Sensor Applications

Connected World magazine (**connectedworldmag.com**) covers machine-to-machine communication. It has constructed a list of more than 180 applications of sensor networks. In addition to this list, *M2M Magazine* (**machinetomachinemagazine.com**) also provides a listing of the major sensor network vendors, as well as key resources for sensor networking. For an application in traffic flow, see Case 6.1. For an example of how sensors are used in Amtrak's high-speed trains, see Rash (2014).

CASE 6.1: EC APPLICATION: SENSORS AT INRIX HELP PEOPLE AVOID TRAFFIC JAMS

INRIX (**inrix.com**) provides a free app called INRIX Traffic, which enables drivers to get real-time traffic information (they also offer a premium service for a fee). The predictive analysis used is based on a large amount of data obtained from consumers, the environment (e.g., road construction, accidents), and government sources. Such sources include:

- Real-time traffic flow and accident information collected in real time by driver services (e.g., radar)
- Flow of traffic collected by participating delivery companies and by over 100 million anonymous volunteer drivers that have GPS–enabled smartphones, reporting in real time
- Road weather conditions and forecasts
- Traffic congestion (e.g., road maintenance).

INRIX processes the collected information with proprietary analytical tools and formulas. The processed information is used to make traffic predictions. For example, it creates a picture of anticipated traffic flows and delays for the next 15–20 minutes, the next few hours, and the next few days. This enables drivers to plan their optimal routes. As of 2014, INRIX offers global coverage in 37 countries and in major cities, and they analyze traffic information from over 100 sources. This service is combined with digital maps. In Seattle, traffic information is disseminated via smartphones and color codes on the freeways. Smartphones also display estimated times for the roads to be either clear or become jammed. By 2014, the company covered 4,000,000 miles of highways in 37 countries, delivering the best routes to drivers in real-time.

The Inrix system provides recommendations for decisions such as:

- Optional route for delivery vehicles
- Best time to go to work or other places
- How to reroute a trip to avoid an incident that just occurred
- Fees to be paid on highways, which are based on traffic conditions

The technologies used are:

- Magnetic sensing detectors embedded under the road surface
- Closed-circuit TV cameras and radar monitoring traffic conditions
- Public safety and traffic information
- Information about free access and departure flows
- Toll collection queues.

According to their website, INRIX has partnered with Clear Channel Radio to broadcast real-time traffic data directly to vehicles via in-car or portable navigation systems, broadcast media, and wireless and Internet-based services. Clear Channel's Total Traffic Network is available in more than 125 metropolitan areas in 4 countries. See **inrix.com/partners.asp** for more about INRIX's partners and their services.

The INRIX Traffic app (available for download at **inrixtraffic.com**) is available for all smartphones and supports 10 languages, including English, French, Spanish, and Hungarian.

For the INRIX Traffic free features, see **inrix-traffic.com/features**.

Sources: Based on Jonietz (2005/2006), **inrix.com**, **inrix.com/inrix-traffic-app**, and **inrix.com/why-inrix/customers-partners** (all accessed May 2014).

Questions

1. Why is this service considered m-commerce?
2. What role do sensors play in the systems?
3. What is the revenue model of the company?
4. Enter the company's website and find additional services provided.

Implementation Issues in Ubiquitous Computing

For ubiquitous systems to be widely deployed, it is necessary to overcome many of the technical, ethical, and legal barriers associated with mobile computing (Section 6.9), as well as a few barriers unique to ubiquitous, invisible computing. Poslad (2009) provides a comprehensive list of technical and nontechnical issues.

Among the nontechnical issues, the possible loss of individual privacy seems to be at the forefront. There is a concern about "Big Brother" watching. In some cases, privacy groups have expressed a concern that the tags and sensors embedded in items, especially retail items, make it possible to track the owners or buyers of those items. A larger problem is that the information processed by tags, sensors, and other devices may be misused or mishandled.

With ubiquitous computing, the privacy issue is sometimes complex, since in many cases the data are collected in an invisible fashion. When no opt out is possible, individual privacy could be in jeopardy. However, using sensors can be very beneficial. For example, equipping the elderly or impaired people with wearable devices for monitoring movement, vital signs, usage of facilities and equipment, etc., and transmitting this information regularly over a sensor network can help people to live with minimal assistance.

SECTION 6.7 REVIEW QUESTIONS

1. Define pervasive computing.
2. What is the Internet of Things (IoT)?
3. Describe the smart grid and the role of sensors there.
4. Describe a smart home.
5. Describe machine-to-machine (M2M) technology.
6. Describe sensor networks. What are some of their benefits?
7. In what ways can pervasive computing impinge on an individual's right to privacy?

6.8 EMERGING TOPICS: FROM WEARABLES AND GOOGLE GLASS TO SMART CITIES

In this section, we will briefly describe several emerging issues related to wireless computing.

Wearable Computing Devices

Wearable computing devices have been used in industry since the mid 1990s. Typical devices were wireless computers tied to people's wrists, digital cameras mounted on the head, mobile devices attached to a belt, and much more. These became popular in the consumer market when Samsung came out with a computer mounted on a watch (smart watch), and Apple planned to released its Apple Watch in April 2015. In March 2014, Google decided to enter the smart watch market. In 2014, Google is planning to release a Nexus-like platform for wearables, called Android Wear (see **cnet.com/news/google-unveils-android-wear-its-modified-os-for-wearables** and for a developer preview, see **developer.android.com/wear/index.html?utm_source=ausdroid.net**).

Wearables are getting popular. For example, medical tracking of patients with chronic diseases is on the increase, and for $130 you can place a device on your dog's collar to track its movements.

Albanesius (2013) reported on Meeker's Internet trend assessment of the forthcoming trend of wearable technology. Also see Toh (2013). Regarding "Wearable Worries," Vijayan (2014) stated, "Wearable computers, like fitness bands, digital glasses, medical devices, and smart phones promise to radically transform the manner in which information is collected, delivered, and used by, and about, people. Many of the emerging technologies promise significant, and potentially revolutionary, user benefits. But as with most Internet-connected devices, the growing proliferation of wearables has spawned both privacy and security concerns." Vijayan presents seven devices and their hidden dangers. These devices are: digital glasses (e.g., eyewear like Google Glass), wearable/embedded medical devices, police cameras (wearable "cop cams"), smart watches, smart clothing, and fitness bands/activity monitors.

Dale (2014) describes a wearable headband that can read the brain's activity. The Canadian company Interaxon developed the device, called Muse (see **interaxon.ca/muse**). In 2014, Amazon opened a special store for wearable devices (Morphy 2014).

State of the Art

Japan is one of the leaders in developing wearable devices. For example, Patrizio (2014) reports the following: "A Japanese university has shown off a tiny personal computer that is worn on the ear and isn't much larger than many Bluetooth headsets, but it can be controlled with the blink of an eye or the click of a tongue."

The 17 gram device, creatively called 'Earclip-type Wearable PC,' is the creation of Kazuhiro Taniguchi of Hiroshima City University and made by NS West, a machinery company. "The device has Bluetooth and comes with a GPS, compass, gyrosensor, battery, barometer, speaker, and microphone. It can be connected to a smartphone or other gadget and allows the user to navigate through software programs using facial expressions, such as a raised eyebrow, tongue, nose, or mouth movement."

This device is expected to compete with Google Glass.

Google Glass

Of all the wearable devices, the one that has attracted much attention and debates in 2013/2014 is Google Glass. **Google Glass** is a wearable Android-powered mobile device controlled by voice and built like a pair of glasses. According to Petroff (2013), Google Glass (and other "smart glasses") may save companies $1 billion a year by 2017 due to increased productivity of employees, especially those who need to use both hands to perform complex tasks (e.g., by surgeons, technicians). Also known as smart glasses, the devices can be used, for example, by insurance agents to video damaged property while simultaneously checking on the costs of replacement. Several of the benefits of smart glasses are the same as those of all wearable devices.

Some people love the glasses; others hate them. In February 2014, a woman was attacked in San Francisco for wearing the device in a bar. A similar attack was reported in a McDonald's in Paris in April 2013. Several bars in San Francisco and a café in Seattle have placed a ban on Google Glass. Other cities are following suit, with Google Glass being banned in strip clubs and casinos in Las Vegas, and they are banned in most movie theatres (see **huffingtonpost.com/2013/04/10/google-glass-banned_n_3039935.html#slide=2314456**). A 2014 poll, conducted by the research firm Toluna, found that 72% of Americans did not want to wear Google Glass due to privacy and security issues (see **mashable.com/2014/04/07/google-glass-privacy**). Google is trying to counter what they call 'the 10 myths about Google glass.'

The renowned tech blogger Robert Scoble likes it so much that he said he "he's never taken them off." However, he complained about the price of $1,500 and suggested a fair price of $200. For details and resources of Google Glasses, see Rosenblatt (2013).

Other companies in the U.S., Japan, and Korea are also experimenting or coming up with smart glasses. Note that Google Glass is getting more stylish by adopting the look of Ray-Ban and Oakley eye glasses' top brands.

Smart Cities

The idea of smart cities took off around 2007 when IBM launched their Smart Planet project and Cisco began its Smart Cities and Communities program. The idea is that in smart cities, digital technologies (mostly mobile-based) facilitate better public services for citizens, better utilization of resources, and less negative environmental impact. For resources, see **ec.europa.eu/digital-agenda/en/about-smart-cities**. Townsend (2013) provides a broad historical look and current coverage of the technologies. In an overview of his book, he provides the following examples: "In Zaragosa, Spain, a 'citizen card' can get you on the free citywide Wi-Fi network, unlock a bike share, check a book out of the library, and pay for your bus ride home. In New York, a guerrilla group of citizen-scientists installed sensors in local sewers to alert you when storm water runoff overwhelms the system, dumping waste into local waterways." Campbell (2012) looks at smart cities from the point of view of learning and innovation.

SECTION 6.8 REVIEW QUESTIONS

1. Describe wearable computing devices.
2. What are the benefits of wearable devices?
3. What are smart glasses? Why do some people have issues with them?
4. Define smart cities. What are their major objectives?

6.9 IMPLEMENTATION ISSUES IN MOBILE COMMERCE: FROM SECURITY AND PRIVACY TO BARRIERS TO M-COMMERCE

Many issues need to be considered before applying mobile applications (for a list, see Finneran 2011a). Here, we discuss only a few of them.

Despite the vast potential for mobile commerce to change the way many companies do business, several barriers are slowing down the deployment of m-commerce applications. The major barriers to m-commerce are security, performance, availability, cost–benefit, lack of clear strategy, difficulty in integrating with in-house IT, and difficulty in customizing applications. In this section, we examine only some of these barriers, starting with the issue of security. For more on implementation issues, see the three-part video series on Mobile Commerce. Part 1 is titled "Mobile Commerce: Part 1: Where Are We Now?" (8:03 minutes), available at **youtube.com/watch?v=a--5yhJCg**. Part 2 is titled "Mobile Commerce: Part 2, The Evolution" (8:51 minutes), available at **youtube.com/watch?v=fBlLxVeCouo**. Part 3 is titled "Mobile Commerce: Part 3, How to Make mCommerce Work" (8:23 minutes), available at **youtube.com/watch?v=DsDGNLjYPxQ**.

M-commerce Security and Privacy Issues

In 2004, Cabir became the first known wireless worm that infects mobile phones. It spreads through Bluetooth devices. Since then, attacks on phones, including smartphones, have increased rapidly. For more on the Cabir worm, see **technewsworld.com/story/34542.html** and **f-secure.com/v-descs/cabir.shtml**.

Most Internet-enabled cell phones in operation today have basic software embedded in the hardware. This makes programming malware difficult. However, as the capabilities of smartphones and tablets improve, the threat of malware attacks increases. The widespread use of smartphones opens up the possibility of viruses coming from Internet downloads. Although m-commerce shares some of the same security issues as general e-commerce (see Chapter 10), there are some differences between the two.

The basic security goals of confidentiality, authentication, authorization, and integrity (Chapter 10) are just as important for m-commerce as they are for e-commerce, but they are more difficult to ensure. Specifically, m-commerce transactions usually pass through several networks, both wireless and wired. An appropriate level of security must be maintained on each network, despite the fact that interoperability among the various networks is difficult. For

details, see Currier (2009). According to Finneran (2012), an *InformationWeek* 2012 security survey shows that mobile security problems are increasing, and there is gap in the measures used to combat the problem. Finneran (2012) provides some recommendations for increasing security.

Another area is that of identity fraud. A 2011 Javelin Strategy and Research Study showed that smartphone users (as well as social media users) could easily become victims of identity fraud (reported by Rashid 2012). See discussion in Chapter 10. The research study also found that people who use social networks (mainly Facebook and Twitter) were more likely to become victims of identity fraud.

In general, many of the defense mechanisms used in IT and e-commerce security are also used in m-commerce. However, given the unique nature of mobile security, additional defense methods may be needed. For example, there are many anti-theft apps that can help you find your phone and keep your personal data safe from identity theft.

Technological Barriers to M-commerce

The navigation systems for mobile applications have to be fast in order to enable rapid and easy search and shopping. Similarly, the information content needs to meet the user's needs. Other technical barriers related to mobile computing technology include limited battery life and transmission interference with home appliances. These barriers and others are listed in Table 6.2. Note that with the passage of time the technological barriers are decreasing.

Table 6.2 Technical limitations of mobile computing

Limitation	Description
Insufficient bandwidth	Sufficient bandwidth is necessary for widespread mobile computing, and it must be inexpensive. It will take a few years until 4G and LTE are the norm in many places. Wi-Fi solves some of the problems for short-range connections
Security standards	Universal standards are still under development. It may take few more years for sufficient standards to be in place
Power consumption	The longer the life of a battery, the better the devices are (constantly improving)
Transmission interferences	Weather and terrain, including tall buildings, can limit reception. Microwave ovens, cordless phones, and other devices are free, but crowded. 2.4 GHz range may interfere with Bluetooth and Wi-Fi 802.11b transmissions
GPS accuracy	Tall buildings may limit the use of location-based m-commerce
Potential health hazards	Potential health damages (e.g., cancer) from cellular radio frequency emission are under investigation. Known health hazards include cell phone addiction, thumb-overuse syndrome, and accidents caused by people using cell phones (e.g., texting) while driving
Human-computer interface	Some people, especially the elderly or those with vision problems, may have difficulty using a small monitor and keypad in cell phones
Complexity	Many add-ons and features may make the device difficult to use

Failures in Mobile Computing and M-commerce

As with many new technologies, there have been many failures of m-commerce initiatives as there are entire m-commerce companies that collapse. It is important to anticipate and plan for possible failures and to learn from those failures.

For mistakes that CIOs can avoid while encouraging enterprise mobility, see Goldschlag (2008).

Ethical, Legal, Privacy, and Health Issues in M-commerce

The increasing use of mobile devices in business and society raises new ethical, legal, and health issues that individuals, organizations, and society will have to resolve.

One workplace issue is the isolation that mobile devices can impose on a workforce. Some workers have had difficulty adjusting to the m-commerce environment since there is less need for face-to-face interactions that some people prefer.

The personal nature of mobile devices also raises ethical and legal issues. Most employees have desktop computers both at home and at work, and they can easily separate business and personal work accordingly. However, it is not so easy to separate work and personal life on a cell phone, unless one carries two phones. The concept of "bring your own device" (BYOD) is spreading rapidly, introducing issues of management, monitoring, and security. For example, if an organization has the right to monitor e-mail communications on its own network, does it also have the right to monitor voice communications on a company-owned or on a BYOD smartphone? BYOD will be discussed later.

A widely publicized but unproven potential risk is the potential health problems (e.g., cancer) from cellular radio frequency emissions. Cell phone addiction also is a problem.

Other ethical, legal, and health issues include the ethics of monitoring staff movements. Finally, there is the issue of privacy infringement and protection while implementing some m- commerce applications.

Privacy

Invasion of privacy is one of the major issues related to the use of mobile computing technologies, especially LBS, tracking, RFID, and context aware applications (see Chapter 15 for a discussion of privacy issues).

For three suggested steps for developing a strategic plan for mobility, see AT&T (2010).

Enterprise Mobility Management

According to TechTarget, *enterprise mobility management* (EMM) is "an all-encompassing approach to securing and enabling business workers' use of smartphones and tablets." It includes data and access security, physical device tracking and configuration, and application management (see **i.zdnet.com/whitepapers/SAP_Enterprise_Mobility_for_Dummies_Guide.pdf**). Since more workers are bringing smartphones and tablets and using them in the enterprise, it is necessary to support these devices. This is where enterprise mobility management enters the picture. With an increasing number of people using mobile devices for many applications, mobility management has become a significant and challenging task. For example, Greengard (2011) suggests organizing mobility management under the security and control of IT, concentrating on data rather than on devices and employees. For guidelines on device management strategy, see Dreger and Moerschel (2010).

Mobility management can be divided into the following areas:

- **Mobile Device Management (MDM)**. Some companies allow their IT department to have full control over all mobile devices. Others allow users to maintain their devices mostly on their own (see a discussion on BYOD later in this section). Special software can help companies with their MDM.
- **Mobile Application Management (MAM)**. Similar to MDM, MAM attempts to control all applications in a company.
- **Mobile Information Management (MIM)**. This is a newer area that deals with cloud computing.

For details on these types of mobile management, see Madden (2012). Related to these are two specific areas: Bring your own device ("BYOD") and mobile apps. These are briefly described next.

The BYOD Issue

The proliferation of mobile devices in the enterprise raises the issue of "Bring Your Own Device" (BYOD). Many employees like to use their personal devices for work-related activities (e.g., their iPhones for corporate mail, travel reservations, etc.). They bring their devices to their workplace and use those devices to access the company's network. BYOD may save the company money. On the other hand, there are

many implementation issues ranging from security to reimbursement policy to technical support (for a discussion, see Reisinger 2013; Finneran 2011b). Also see Cisco's 'BYOD Smart Solution' (**cisco.com/web/solutions/trends/byod_smart_solution/index.html**).

There are many suggestions regarding the management and control of BYOD. See Fiberlink (2012) for the "Ten Commandments of BYOD." Major consulting companies such as Gartner, Inc. (**gartner.com**) and Forrester Research, Inc. (**forrester.com**) provide free white papers, webinars, and reports on BYOD.

Mobile Apps and their Management

According to WhatIs.com, a **mobile app** "is a software application developed specifically for use on small, wireless computing devices, such as smartphones and tablets, rather than desktop or laptop computers. Mobile apps are designed with consideration for the demands and constraints of the devices and also to take advantage of any specialized capabilities they have. A gaming app, for example, might take advantage of the iPhone's accelerometer" (**whatis.techtarget.com/definition/mobile-app**).

Mobile applications are very popular for both consumers and use inside the enterprise. For example, as of 2013, Apple had about 1 million approved applications in its app store. McKendrick (2014) proposes six ways to bring more mobile apps into the enterprise.

Build (or Bring) Your Own App (BYOA)

BYOA is an increasing trend towards the creation of applications by users rather than by software developers. Unfortunately, BYOA creates security challenges. For a practical guide to affordable mobile app development, see Salz and Moranz (2013).

Other Managerial Issues

Several other issues are related to mobility management. For example, Currier (2009) cites the issues of ROI measurement, determining the mobility platform, training, budget and cost control, and justification. Other issues are integration, collaboration, and communication (Finneran 2011a), tablet management (Murphy 2012), data management (Greengard 2011), and mobility strategy (AT&T 2010).

SECTION 6.9 REVIEW QUESTIONS

1. How is m-commerce security similar to e-commerce security? How is it different?
2. Discuss a few of the technical limitations of m-commerce.
3. Describe the potential impact of mobile devices on organizational, health, and privacy issues.
4. Describe mobility management.
5. Define BYOD and its challenges.
6. Describe mobile apps. Why are they so popular?

MANAGERIAL ISSUES

Some managerial issues related to this chapter are as follows.

1. **What is your m-commerce strategy?** M-commerce is composed of these elements: support for internal business processes; an extension of existing e-business customer services, availability of suppliers and other business partners; and an extension of Web-based services to smartphone and tablet users. The key to success in the m-commerce world is to define your overall e-commerce and m-commerce business strategy, determine which segments are critical to the strategy and the order in which they need to be addressed, and which of the available mobile technologies will support the strategy and the critical segments (consult AT&T 2010).
2. **Are there any clear technical winners?** Among mobile devices, the answer is yes. Many like the all-in-one devices, such as smartphones or tablets. There still is a confusing multiplicity of standards, devices, and supporting hardware. The key is to select a suitable platform and infrastructure that can support the existing needs of most users. While m–commerce is becoming very popular in marketing, payments, manufacturing, and services, l–commerce applications are still in their infancy.

3. **How should BYOD be managed?** Device management becomes a complex issue since employees started to bring and use their mobile devices at work. Mobile devices are made by different manufacturers and use different operating systems. Add to this the thousands of apps and you need a good system and policies to manage BYOD. For a comprehensive strategy for managing BYOD, see **cisco.com**: search for Cisco's "BYOD Smart Solutions" and Reisinger (2013).
4. **Is it wise to embark on l–commerce?** While l-commerce is still emerging and there is not much evidence of mega success, it is wise to at least experiment with the technology. Given that several of its driving factors are growing rapidly and so are its potential benefits, users need to conduct a preliminary feasibility study to find the most promising applications and then go ahead with small scale experimentation.
5. **Which applications should be implemented first**? Although there is little interest associated with various m–commerce applications, especially location–based services, mobile applications must be judged like any other business technology – by ROI, cost-benefit analysis, potential cost reductions, and improved efficiency. Enterprise applications such as supporting the mobile workforce, fleets, and warehouses have resulted in the highest returns. Implementers need to remember that the m–commerce platform is the platform most preferred by younger generations. It is also important to understand why Japan and Korea have a much higher penetration rate in m–commerce while other countries with the same level of mobile telecommunication infrastructure do not have a similar level of penetration. Implementation includes the topic of mobile device management (see Oliver 2008).

SUMMARY

In this chapter, you learned about the following EC issues as they relate to the chapter's learning objectives.

1. **What is m-commerce, its value-added attributes, and fundamental drivers?** M-commerce is any e-commerce activity conducted with mobile devices over a wireless telecommunications network. M-commerce complements e-commerce. M-commerce can help a business improve its value proposition to customers by utilizing its unique attributes: ubiquity, convenience, interactivity, personalization, and localization. Currently, m-commerce is driven by the large number of users of mobile devices; a developing "smartphone culture" among youth; demands from service-oriented customers; vendor marketing; declining prices; an increase in size of the mobile workforce; improved ratio of performance to price; and the increasing bandwidth.
2. **What is the mobile computing environment that supports m-commerce?** The mobile computing environment consists of three key elements: mobile devices, wireless networks, and services. Although mobile computing devices vary in size and functionality, they are rapidly moving toward an all-in-one device that is overcoming some of the limitations associated with poor usability, such as small screen size, limited bandwidth, and restricted input capabilities. Even with their limitations, mobile devices offer a series of support services, principally SMS, voice, and location-based services, which differentiate m-commerce from e-commerce.
3. **Which types of networks support mobile devices?** Mobile devices connect wirelessly to networks or other devices at personal, local, metropolitan, or wide area levels. Bluetooth (personal), cellular phone networks (WWAN), and wireless LANs (like Wi-Fi) are well-known technologies that are well established in the wireless marketplace. In contrast, municipal and WiMAX (metropolitan) are less well-known.
4. **Financial and banking applications.** Many EC applications in the financial services industries (such as e-banking) can be conducted with wireless devices. Most mobile

financial applications are simply wireless versions of their wireline counterparts, and they are conducted via SMS or the mobile Web system. Mobile banking and mobile payments are examples of this activity. More and more, banks throughout the world are enabling their customers to use mobile devices to make payments, view paid checks, compare bank services, transfer funds, and locate branches.

5. **Enterprise mobility applications.** The major application is that of supporting the various types of workforce (e.g., salespeople, repair people, and field force). Other areas are mobile CRM, inventory management, and wireless job dispatch. These applications offer high return on investment, even in the short run. Additional areas are fleet and transportation management and applications in warehouses.
6. **Consumer and personal applications and mobile entertainment.** One of the fastest growing markets in m-commerce is mobile entertainment. Mobile entertainment encompasses mobile music, games, gambling, adult entertainment, and specialized user-generated content. Among these, mobile music is the largest segment, but mobile video is the fastest growing. Mobile gambling is also growing rapidly despite the legal restrictions by various government bodies. Also growing are mobile sports applications. Service industries using mobile applications include health care, hospitality, public safety, crime prevention, and homeland security.
7. **Location-based commerce.** Location-based commerce (l-commerce) refers to the use of positioning devices, mostly GPS, to find a customer's location and deliver products and services based on the user's location. The services provided by companies using l-commerce tend to focus on one or more of the: location, navigation, tracking, mapping, and timing. These services include five basic components: mobile devices, communication networks, positioning components, service and application providers, and data or content providers. Among these, the position and data components, especially geographical information systems (GIS), are critical. Even though l-commerce has a large potential, several factors impede its widespread use, including the accuracy of the location finding devices, the cost of many applications in relation to the benefits, the limited network bandwidth, and potential invasion of privacy.
8. **Ubiquitous computing and sensory systems.** The *Internet of Things (IoT)* is upon us, and so are cutting-edge and futuristic systems that involve many embedded and invisible processors. These systems appear in several formats, notably those that are context aware, and they enable intelligent and useful applications. They are interrelated with sensory systems and provide for smart applications such as smart electric grids, smart homes, smart buildings, smart cars, and much more.
9. **Google Glass, driverless cars, and mobile apps.** Wearables are getting more important as they relate to the Internet of Things and to improved productivity in the enterprise. Wearables improve business processes and communication. They free people's hands so business processes can be improved. They can be controlled by voice and even by the brain. Most benefits are derived when the wearables are connected to the Internet. A wearable device that gets lots of publicity is Google Glass (and similar smart glasses). On one hand these can increase productivity, but on the other hand many fear the potential of invasion of privacy. Wearables and other mobile devices are important components in smart cities. Designers of smart cities aim to improve both government services to citizens and the dwellers quality of life.
10. **Security and other implementation issues.** Even though the potential benefits of m-commerce applications may be substantial, their implementation faces a number of challenges, including technical interruptions and gaps in network coverage; performance problems created by slow mobile networks and applications; managing and securing mobile devices; and managing mobile network bandwidth. The mobile computing

environment offers special challenges for security, including the need to secure transmission over the open air and through multiple connecting networks. The biggest technological challenges relate to the usability and technological changes of mobile devices. Finally, privacy concerns, such as legal, ethical, and health issues, that can arise from the use of m-commerce, especially in the workplace, need to be considered.

KEY TERMS

Bluetooth
Context-aware computing
Enterprise mobility
Geographical information system (GIS)
Geolocation
Global positioning system (GPS)
Google Glass
Interactive voice response (IVR) system
Internet of Things (IoT)
Location-based m-commerce (l-commerce)
Location-based services (LBS)
Mobile app
Mobile banking (m-banking)
Mobile commerce (m-commerce; m-business)
Mobile enterprises
Mobile entertainment
Mobile portal
Mobile worker
Multimedia messaging service (MMS)
Personal area network (PAN)
Personal digital assistant (PDA)
Pervasive computing
Radio Frequency identification (RFID)
Real-time location systems (RTLS)
Sensor network
Short message service (SMS)
Smart Grid
Smartphone
Social location-based marketing
Ubiquitous computing (ubicom)
Voice portal
Wi-Fi (wireless fidelity)
WiMAX
Wireless local area network (WLAN)
Wireless mobile computing (mobile computing)
Wireless wide area network (WWAN)

DISCUSSION QUESTIONS

1. Discuss how m-commerce can expand the reach of EC.
2. Which of the m-commerce limitations listed in this chapter do you think will have the biggest near-term negative impact on the growth of m-commence? Which ones will be minimized within 5 years? Which ones will not?
3. Discuss the advantages and limitations of self–driven cars.
4. Discuss the factors that are critical to the overall growth of mobile banking.
5. Why are many of the more popular mobile gambling sites located in small island countries?
6. How are GPS and GIS related?
7. Discuss the advantages of m-commerce over wired EC.
8. Why must location-based services, by law, be permission-based?

TOPICS FOR CLASS DISCUSSION AND DEBATES

1. Discuss the potential benefits and drawbacks of conducting m-commerce on social networks.
2. Discuss the strategic advantage of m-commerce.
3. Google acquired AdMob (**google.com/ads/admob**) partly to compete with Apple's iAd. Discuss the strategic implications of AdMob versus iAd.
4. Debate the issue of tracking the whereabouts of employees. Related to this is the privacy issue of tracking people and cars. Discuss the pros and cons.
5. Debate the issue of a company's right to check all employee's e-mail and voice communications, done on either their own, or on the company's devices during work hours.
6. Examine the use of mobile devices in restaurants and debate the possibility of the elimination of paper menus. (Start by reading Nassauer 2012.)

7. Read Sutter (2010). Discuss the advantages and risks of GPS-based dating.
8. Find information about EcoRebate's incentive programs (see **ecorebates.com**). Explain their relationship to LBS. Write a report.
9. Research the evolvement of Google Glass. Write a report. Start with the evolution of Google Glass at **redmondpie.com/the-evolution-of-google-glass-in-two-years-since-its-inception-image**. What will be the benefits of the device to users? (See **golocalworcester.com/business/smart-benefits-vision-coverage-for-google-glass-is-clear**.)
10. Find information on IBM's "smarter cities." What are the benefits of the initiative to the residents of such cities? (See **ibm.com/smarterplanet/us/en/smarter_cities/overview**.)
11. Find information about Cisco's "BYOD smart solution." Examine the benefits and discuss the possibility of using this solution in medium or small companies. (See **cisco.com/web/solutions/trends/byod_smart_solution/index.html**.)
12. Find the latest applications of the "Internet of Things" and discuss their usability.
13. In-store mobile tracking of shoppers in brick-and-mortar retailers is increasing. Examine the benefits and the necessary protection of the customers (e.g., choice to opt-out). Under what circumstances would you allow customer tracking?

INTERNET EXERCISES

1. Research the status of 4G. You can find information on 4G by conducting a Google search and by going to Verizon Wireless (see **verizonwireless.com/wcms/consumer/4g-lte.html**). Prepare a report on the status of 4G based on your findings.
2. You have been asked to assemble a directory of Wi-Fi hotspots in your local area. There are a number of sites, such as **hotspot-locations.com** that offer search capabilities for finding hotpots in a specific area. Make a list of locations that offer this feature.
3. Juniper Research has created a variety of white papers dealing with different segments of the mobile entertainment market (e.g., mobile games). Go to Juniper Research (**juniperresearch.com**) and download a white paper regarding one of these market segments. Use the white paper as a guide to write a summary of the market segment you selected – the size of the market, the major vendors, the factors encouraging and impeding its growth, and the future of the market segment.
4. Enter **gpshopper.com**. Find the products/services they provide for LBS. Then enter **jiwire.com/advertisers/ad-solutions/compass-audience**. Compare the products and services it provides with those offered by GPShopper. Write a report.
5. Find information about Google Maps for mobile devices. Also review the capabilities of Google SMS and other related Google applications. Write a report on your findings.
6. Enter **mobile.fandango.com** and find the services they offer to mobile customers. Write a report.
7. Enter IBM's Smarter Cities Challenge (**smartercitieschallenge.org**). Find the recent activities related to IBM's initiatives about smarter cities. Then check MIT Media Lab Initiative City Science (**cities.media.mit.edu**) and find their latest smart cities projects. Finally, enter European Smart Cities (**smart-cities.eu**). Write a report on the major current projects related to smart cities.
8. Enter **ehow.com** and find information on "how to locate a cell phone with GPS." Why does a mobile device need to have this capability?
9. Conduct a Google search for comparisons on tablets vs. PCs. Write a report.

TEAM ASSIGNMENTS AND PROJECTS

1. **Assignment for the Opening Case**
   Read the opening case and answer the following questions.
   (a) Do you really need the NeverLost GPS (fee of $13.99/day) when you can get almost the same information with a smartphone like the iPhone (or iPad) and a portable GPS? Why or why not?

(b) Which one of Hertz's mobile applications can be considered a mobile enterprise and which one can be considered a mobile customer service?
(c) Identify finance and marketing-oriented applications in this case.
(d) What are the benefits of offering mobile apps to Hertz?
(e) As a customer, how do you feel about Hertz knowing where you are at all times?
(f) Find information about the competition between Hertz Fleet with Eileo and Zipcar. Provide a summary. Start by reading **trefis.com/stock/zip/articles/112405/is-hertz-fleet-with-eileo-a-big-trouble-for-zipcar/2012-06-29**.

2. Each team should examine a major vendor of enterprise-oriented mobile devices (Nokia, Kyocera, Motorola; a Google company, BlackBerry, etc.). Each team will research the capabilities of the devices offered by each company and then present the findings to the class. The objective of the presentation is to convince the rest of the class to buy that company's products.
3. Each team should explore the commercial applications of m-commerce in one of the following areas: financial services (including banking); stocks; insurance; marketing and advertising; travel and transportation; human resources management; public services; restaurants; and health care. Each team will present a report to the class based on their findings. (Start with **sociomine.eu**).
4. Each team should choose one of the following areas – homes, cars, appliances, or other consumer goods, such as clothing – and investigate how embedded microprocessors are currently being used. How will they be used in the future to support consumer-centric services? Each team will present a report to the class based on its findings.
5. There are many applications of tablets in the enterprise. Investigate the major applications as well as the IT requirements, support, necessary security, development efforts, and so forth. Begin by reading Carr (2010).
6. Indiana University, with 8 campuses, has over 110,000 students and over 18,000 employees, including faculty and support staff. The information systems include the use of many BYOD mobile devices. Enter **citrix.com/products/enterprise-mobility.html** and read the story about Indiana University. Watch the 2:28 minute video titled "Indiana University Customer Story" and conduct an additional search regarding how the university controls mobile device security. Write a report. (Start with the university's IT services at **uits.iu.edu/page/bcnh**.)
7. Wireless cities and communities can improve people's lives and even reduce the digital divide. Find information on the research and applications of wireless (or smart) cities. Use this as a class project where different teams cover different topics.
8. Watch the video titled "Technology Advances Fuelling M-Commerce Today" (7:43 minutes) at **youtube.com/watch?v=398EztRwPiY** and answer the following questions:
(a) What EC services are provided by m-commerce?
(b) Discuss the role of m-commerce in retailing.
(c) Discuss the lack of m-commerce strategy vs. its wide acceptance.
(d) Why is m-commerce such a fragmented market?
(e) Why do retailers spend much of their IT budget on m-commerce?
(f) Discuss the impact of m-commerce on competition among retailers.
(g) What are the difficulties in managing mobile technology?
(h) What are the advantages of mobile payments?
(i) Research the major methods and vendors of m-payments.

CLOSING CASE: MOTOROLA ENTERPRISE: WIRELESS SOLUTIONS FOR A HOSPITAL AND A MANUFACTURER

Motorola (**motorola.com**) is one of the world's largest enterprise mobility companies. The company's diverse operations are classified next.

Products and Services

The Major Enterprise Products

In 2014 Motorola's major enterprise products included: barcode scanners, interactive kiosks, mobile computers, tablets, RFID products, original equipment manufacturer (OEM) products, two-way radios and pagers, enterprise voice and data services, and wireless LAN (described next).

For details, benefits, and case studies, see Motorola Solutions Enterprise (**motorolasolutions.com/US-EN/Enterprise+Mobility**; Note: acquired by Zebra.com).

The Major Wireless Solutions

In 2014, the major wireless solutions offered by Motorola were: indoor location, remote access, voice over wireless, mobile application services, BYOD, cloud wireless, video over wireless, and mobile data offload.

The wireless LAN products are: access, management, and security.

For details, benefits, and case studies, see Motorola Solutions Wireless LAN (**motorolasolutions.com/US-EN/Business+Product+and+Services/Wireless+LAN**).

The Industries Services

Motorola serves many major industries, including: manufacturing, retail, hospitality, health care, education, utilities, petrochemical, transportation and logistics, and wholesale distribution.

A Health Care Example: North York General Hospital of Toronto, Canada

This hospital, which is affiliated with the University of Toronto, is a three-site community teaching hospital with 5,000 staff, physicians, and volunteers. To improve quality of care (e.g., ensuring that patients receive the correct medication), the hospital introduced an electronic health system which includes significant wireless subsystems.

The system, known as eCare, is based on wireless network and advanced electronic mobile points of care. For example, it includes a computerized provider of order entries, a high speed electronic medication administration system, communication, and secured network access features. All these have increased patient safety and quality of care. The system facilitated teamwork of the staff in the hospital. To read the case study, see **motorolasolutions.com/web/Business/Solutions/Industry%20Solutions/Healthcare/documents/static_files/MOT_North_York_General_Hospital_CaseStudy_EN_073012.pdf**. See also Motorola Solutions for health care (**motorolasolutions.com/US-EN/Business+Solutions/Industry+Solutions/Healthcare**).

A Supply Chain Example: Yodobashi Camera of Japan

The company is one of Japan's largest retailers of electronic goods. It has 19 stores with more than 850,000 items and new products arriving almost every day. The products are supplied by hundreds of manufacturers and distributors. Inventory levels must be sufficient to meet customer demands and avoid lost sales. The effective management of the supply chain, the warehouse, and the inventory is a critical success factor.

The company is using Motorola's RFID-based warehouse management solution, which operates in real time. RFID tags are pasted on all product boxes arriving from the suppliers. They are detected at the entry gate by the RFID readers and the information is transmitted automatically to the warehouse management system. The result is reduced cost of warehousing operation, flow of real-time information, minimization of inventory-related problems, and increased customer satisfaction and sales.

Sources: Extracted from Motorola's website. The cases are condensed versions of:

"Electronic TLC: Toronto Hospital Increases Patient Safety with eCare Project" and "Yodobashi Camera Deploys RFID Warehouse Management." (All materials accessed May 2014.)

Questions

1. Enter **motorolasolutions.com** and **zebra.com** and find case studies similar to the above that are related to restaurants, cruise ships, salesforce automation, and education. Relate the wireless system to the benefits for each case.

2. Yodobashi Camera uses tags attached to boxes and containers. Conduct a Google search to find other companies that tag individual items.
3. In what ways has patient safety increased in Toronto's North York General Hospital?
4. Find any enterprise applications that are provided by Motorola's competitors. Write a report.

ONLINE FILES
available at **affordable-ecommerce-textbook.com/turban**

W6.1 Drivers of M-Commerce
W6.2 Representative List of Mobile Devices
W6.3 Mobile Workforce and M-Commerce Support
W6.4 Application Case: NextBus – Superb Customer Service

COMPREHENSIVE EDUCATIONAL WEBSITES

bitpipe.com: A collection of white papers, videos, and case studies on information technology and m-commerce.
bmcgee.com: Brandon McGee's blog on m-banking and e-payment systems.
ecommercetimes.com/perl/section/m-commerce: A vast collection of articles on m-commerce.
iab.net: Interactive Advertising Bureau – standards, guidelines, and standards and practices of interactive advertising.
ipso-alliance.org: Technical information, resource library, news, and events on enabling the Internet of Things.
juniperresearch.com/mobile_commerce: A collection of reports, white papers, and data on m-commerce.
theemf.org: Enterprise Mobility Foundation—Mobility success stories, latest research, news and events, and much more.
mobilecommercepress.com: Comprehensive site dedicated to many m-commerce topics.
mobilemarketer.com: News, resources, and articles on mobile marketing, media, and commerce.
mobilemarketingwatch.com: "The Pulse of the Mobile Marketing Community"—Best practices and industry guidelines on mobile computing.
searchmobilecomputing.techtarget.com/resources: News, articles, white papers, blogs, and tutorials on mobile computing.
trimble.com/gps_tutorial: A tutorial on GPS technology designed to give a basic understanding of the principles behind GPS.
wimaxforum.org: An industry-led organization that represents the entire mobile Internet ecosystem, committed to the global adoption of 4G mobile broadband.
wsnmagazine.com: *Wireless Sensor Networks Magazine*--All about wireless sensor networks, including technical articles, news, and events.

GLOSSARY

Bluetooth A set of wireless technology standards for exchanging data between devices over a short range.
Context-aware computing A technology that is capable in predicting people's needs and providing fulfillment options (sometimes even before a request by the end user is made).
Enterprise mobility The people and technology (e.g., devices and networks) that enable mobile computing applications within the enterprise.
Geographical information system (GIS) A computer-based system whose function is to capture, store, analyze, and display geographically-related data.
Geolocation The ability to find the location of a user who is connected to the Web via a mobile device.
Global positioning system (GPS) "A U.S.-owned utility that provides users with positioning, navigation, and timing (PNT) services. This system consists of three segments: the space segment, the control segment, and the user segment." (Per GPS.gov; last modified February 2014)

Google Glass A wearable Android-powered mobile device controlled by voice and built like a pair of glasses.

Interactive voice response (IVR) A voice support application system that enables users to interact by telephone (of any kind) with a computerized system to request and receive information.

Internet of Things (IoT) A situation where many objects (people, animals, items) with embedded microprocessors are connected mostly wirelessely to the Internet.

Location-based m-commerce (l-commerce) The use of location finding systems such as GPS-enabled devices or similar technologies (e.g., triangulation of radio- or cell-based stations) to find where a customer or an object is located and provide relevant services, such as an advertisement or vehicle route optimization.

Location-based service (LBS) A mobile device–based computerized service, which utilizes information about the geographical position of a user's mobile device (e.g., mobile phone tracking) for delivering a service (e.g., advertisers can target ads to specific location), to the user.

Mobile app A software application developed specifically for use on small, wireless computing devices, such as smartphones and tablets, rather than desktop or laptop computers.

Mobile banking (m-banking) A term used to describe the conducting of banking activities via a mobile device (mostly by texting, or via mobile website).

Mobile commerce (m-commerce; m-business) Conducting e-commerce by using mobile devices and wireless networks.

Mobile enterprise Mobile applications conducted by enterprises to improve the operations of the employees, facilities, and relevant supply chains, within the enterprise and with its business partners.

Mobile entertainment Any entertainment delivered on mobile devices over wireless networks or that interacts with mobile service providers.

Mobile portal A gateway to the Internet from mobile devices.

Mobile worker Any employee who is away from his or her primary work space at least 10 hours a week (or 25% of the time).

Multimedia messaging service (MMS) The new type of wireless messaging, delivering rich media content, such as video, images, and audio to mobile devices. MMS is an extension of SMS (no extra charge with an SMS "bundle"). It allows for longer messages than with SMS.

Personal area network (PAN) A network that provides very short-range device-to-device wireless connections (a distance up to 60 feet).

Personal digital assistant (PDA) A stand-alone handheld computer that provides access to a user's address book and calendar and supports calculations and some desktop applications, such as word processing and spreadsheets. New versions of the PDA also provide multimedia support for audio and video.

Pervasive computing Computing capabilities that are embedded in the environment but typically are not mobile.

Radio frequency identification (RFID) A short-range radio frequency communication technology for wirelessly identifying and tracking tags attached to objects.

Real-time location systems (RTLS) Systems used to track and identify the location of objects in real time.

Sensor network A group of sensors distributed throughout a particular space (e.g., a manufacturing plant or an orange grove) that monitors and records environmental conditions and analyze the collected data.

Short message service (SMS) A service that supports the transmittal of short text messages (up to 140 to 160 characters) between wireless devices.

Smartphone A mobile phone with Internet access and PC-like functionality.

Smart grid An electricity network managed by utilizing digital technology.

Social location-based marketing Marketing that occurs when users share their location with vendors (opt–in) in real time, usually within social media environments.

Ubiquitous computing (ubicom) Computing capabilities embedded into a relevant system, usually not visible, which may be mobile or stationary.

Voice portal A website with an audio interface that can be accessed through a telephone call.

Wi-Fi The common name used to describe a wireless networking technology known as IEEE 802.11 (e.g., 802.11g).

WiMAX Worldwide Interoperability for Microwave Access is a wireless communications standard that provides relatively fast (e.g., 75 Mbps to several GHz) broadband access over a medium-sized area of up to 31 miles (50 kilometers).

Wireless Application Protocol (WAP) The technology protocol that enables Internet browsing using mobile devices.

Wireless local area network (WLAN) A telecommunications network that acts wirelessly, similar to a wired LAN.

Wireless mobile computing (mobile computing) A computing solution where computing is done using mobile devices at any place connected to a wireless network.

Wireless wide area network (WWAN) A telecommunications network that offers the broadest wireless coverage. WWANs rely on the same network technologies as cell phones.

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