Mobile Commerce and the Internet of Things

6

Contents

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. Discuss m-commerce applications in banking and financial services.
4. Describe enterprise mobility applications.
5. Describe consumer and personal applications of m-commerce, including entertainment.
6. Define and describe ubiquitous computing and sensory networks.
7. Describe the Internet of Things and its major smart applications.
8. Describe wearables, Google Glass, smartwatches, and fitness trackers.
9. Describe the major implementation issues from security and privacy to barriers of m-commerce.

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.

Electronic supplementary material: The online version of this chapter (doi:10.1007/978-3-319-50091-1_6) contains supplementary material, which is available to authorized users.

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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).

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=hertzneverlostcompanion**). This app allows you to plan your trip on your smartphone and use the app to navigate selected cities such as Washington, DC 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).

  Hertz also installed inward-facing video cameras in an attempt to upgrade its NeverLost® service.

  For more 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. For more on customer service at Hertz, see Gingiss (2015).
- **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 the *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 (March 2016), 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 at the same site. 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?targetage=hertzmobilesite.jsp**. For recent mobile apps, see *PR Newswire* (2014).
- **Social media.** Hertz is active in social network applications.

  For details on the above, see Barris (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 Barris (2014), Gingiss (2015), and **hertz.com** (accessed April 2016).

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 6.3–6.7).

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. In addition, many enterprises are going multilocational and globally, and the need for mobile communication is increasing rapidly (see the closing case in Chapter 5). 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.

For definitions, topics, key issues, and so forth, see **mobileinfo.com/mcommerce**.

Mobile commerce has its own framework, attributes landscape, concepts, and terminology. These provide many benefits. For an overview, see the 2:45 min 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 an annual 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. Mobile computing topics are listed in the 2010–2016 reports.

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, (and soon G5). Finally, free Wi-Fi Internet access in many locations helps.

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 USA 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

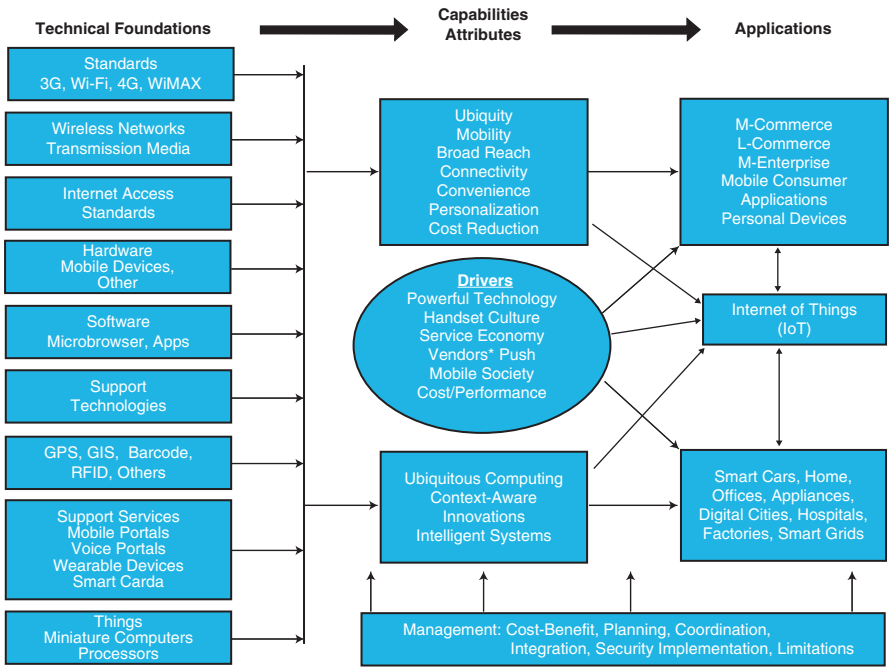

Figure 6.1 The landscape of mobile computing and m-commerce

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**.

For statistics on m-commerce, see **statista.com/topics/1185/mobile-commerce**. For more details, see **gartner.com/newsroom/id/3270418**.

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 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 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.

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 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.
- Ubiquitous computing—Section 6.6.
- Internet of Things (IoT) applications are covered in 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** and the closing case in this chapter. 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.

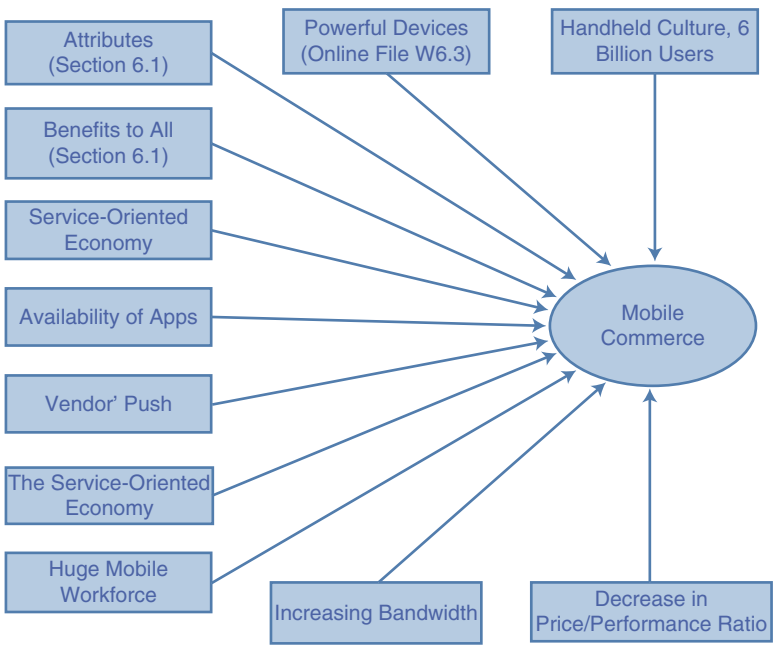

Figure 6.2 The drivers of m-commerce

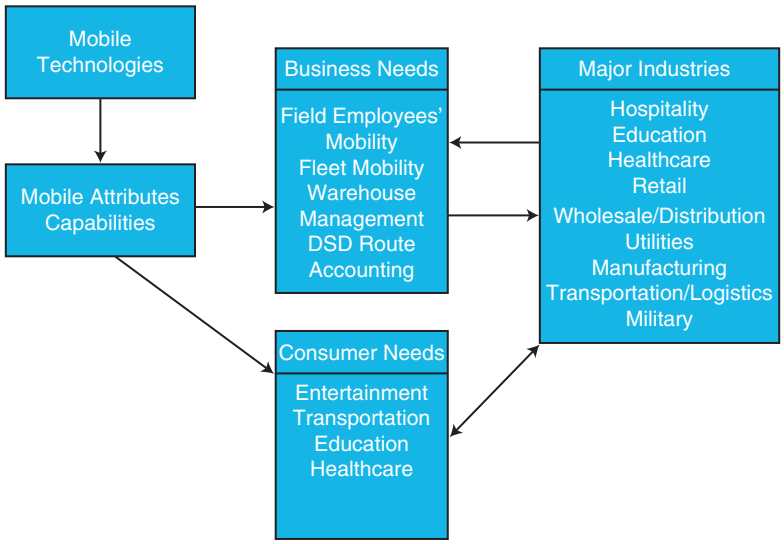

Figure 6.3 M-commerce applications and their classifications

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

This chapter discusses 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 6.6.

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 min 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.
- Increases collaboration, advertisement, customer service, and sales by using IoT (Section 6.7).
- 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.
- Allows "smart" applications.

Benefits to Society

There are many benefits to society. For example, self-driving cars can reduce accidents; smart cities can benefit the dwellers and visitors. 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 some limitations to m-commerce, which are discussed in Section 6.9.

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**).

This section briefly discusses the major technologies and application areas of mobile computing systems. For an extensive list of related terms, see **mobileinfo.com/Glossary** and **en.wikipedia.org/wiki/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 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 special handheld devices and 23″ laptops or mobile workstations are available (e.g., Dell, HP, and Lenovo). For an example, see Weiss (2015). Tablets are available in a 7″ or 13″ 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 11″ or larger. 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 **informationweek.com/mobile.asp** and **apple.com/ipad**. A major use of a tablet is to facilitate communication and collaboration.

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**). Fitbit Apple Watch is in production as of 2015. 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, 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 11. 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/rfid-blog/bid/52243/100-Uses-of-RFID**.

Mobile Computing Software and Services

Mobile devices offer some capabilities that desktops do not. These capabilities provide a foundation for new applications.

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 **mogreet.wordpress.com/2012/03/15/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.

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 improve.

Intelligent Personal Assistants

As described in Chapter 5, companies use AI to understand spoken natural languages. This application is used for **intelligent personal assistants**, which are offered today by major corporations. Well known are: Google Now, Microsoft's Cortana, Apple's Sire, and Amazon's Alexa. Other companies create competing products (e.g., SoundHound). Note that these products are integrated in smartwatches, smart TVs, and cars.

Of special interest is Amazon's Echo which is a screenless, voice-controlled device that operates with Amazon's Alexa and it excels in smart home applications. For details, see Rubin (2016), Manjoo (2016), and Mayo (2016).

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.

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 min) at **money.cnn.com/video/technology/2014/02/26/t-beaming-internet-from-space-outernet-cubesat.cnnmoney**). Also, note that there is an increase in mobile cloud computing (see **prezi.com/dpnifer-apgzh/examples-of-mobile-cloud-computing**).

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 6.4. 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.

6.3 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:

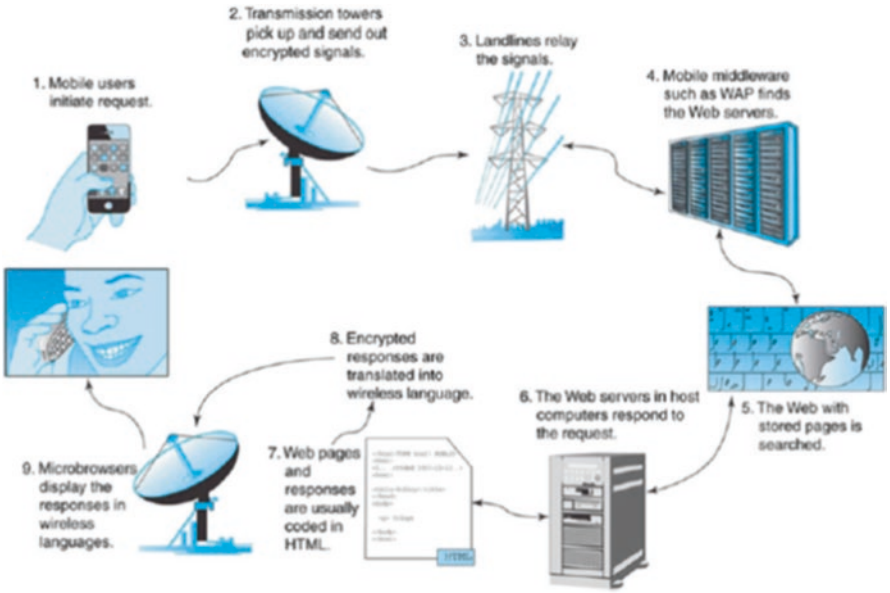

Figure 6.4 An m-commerce system at work

mobile banking and other mobile financial services. Mobile payments are described in Chapter 11. For an overview of mobile financial services, see **ericsson.com/m-commerce/node/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). A popular service is a mobile deposit of checks. You sign the front and back of the check, snap pictures of both sides, including the endorsement on the back, and submit it.

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

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**). American First Credit Union offers many mobile services, including location-based offers.

Banks 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 and Young (2013).

Finally, *mobile payments*, including payments withdrawn from bank accounts via mobile devices, and depositing checks via smartphone photos 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.

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 con-

stantly 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: Using Augmented Realty

Using augmented reality (see Chapter 2), some companies in Europe and the USA 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. 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.

Related to real estate, but used elsewhere, is electronic signature. A leading provider is DocuSign Inc.

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 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 ten items in Gartner's 2013 and 2014 strategic technology lists. Mobile enterprise apps are gaining momentum in 2016 (see Weiss 2015).

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.

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**. 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 Fonemine (2014).

The Framework and Content of Mobile Enterprise Applications

There are several proprietary frameworks for classifying mobile applications. For example, AT&T Enterprise Business provides categories such as vertical industry, healthcare, mobility, and mobile productivity. Also well known is Motorola's framework.

Mobile Workers

A **mobile worker** is usually defined as any employee who is away from his or her primary work space at least 10 h a week (or 25% of the time). According to a new forecast from International Data Corporation (IDC), the U.S. mobile worker population will grow at a steady rate over the next 5 years, increasing from 96.2 million in 2015 to 105.4 million mobile workers in 2020. By the end of the forecast period, IDC

expects mobile workers will account for nearly three-quarters (72.3%) of the total U.S. workforce. See **idc.com/getdoc.jsp?containerId=prUS25705415**.

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. Also, see the closing case in Chapter 5.

Mobile CRM

This is a growing application area. For an overview, benefits, and a case study, see **powershow.com/view/1497bd-M2JiN/Mobile-CRM-a_Case_Study_powerpoint_ppt_presentation**. Also see the 2015 slideshow: **slideshare.net/Sage_software_solutions/mobile-crm-ppt-from-sage-software-solutions**.

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-Hospitals-Goals60630**.

Transportation Management

Another popular mobile application area is that of transportation management (e.g., trucks, forklifts, buses, vans). 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).

For an example of the importance of enterprise and cars' mobility, see Ford's new division called Smart Mobility. It covers both enterprise and the car's applications (Austin 2016).

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**). The website describes the challenges and opportunities of enterprise mobility as well as providing 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 MARKETING

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 and mobile shopping.

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.

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. Other major Internet music providers are **spotify.com**, **youtube.com**, and **pandora.com**. Note that cell phones today can display analog TV (popular in developing countries). Smartphones can display any programs offered on the Internet. 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**. Finally, Amazon.com provides free access to their Prime member to a large collection of videos.

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 **www3.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. 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.onlinegaming.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 **pocketgamer.biz**.

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 quantity is also increasing.
- 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 availability of free games online.

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, lack of 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, ten 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 (**review-journal.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 be a fee to enjoy this.
- 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 USA and Canada, add friends, track progress). While the iPromises Recovery Companion does not generate revenue for the company, "it is aimed at bolstering Promises' reputation among patients and doctors."

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: Dolphin Fast Food

Dolphin Fast Food Inc. operates 19 Burger King franchises in Minnesota. 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 to improve security on the premises (e.g., video surveillance). The secure Internet access is protected by a VPN and it can block inappropriate content. The wireless system also operates the payment gateways and the POS terminals. For more recent material, see **dolphinfastfood.com**.

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.

Tablets and Other Mobile Devices in Restaurants

Several restaurants worldwide are introducing tablets or smartphones as a substitute to paper menus. For example, Au Bon Pain is using iPads in several of their locations. One option is to provide the customers with iPads with a built-in menu. This way they can submit the order directly to the kitchen. 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.

Example: Genki Sushi

This Japan-based company has restaurants in several Asian countries, as well as in California and Hawaii. If you love sushi, you should try Genki Sushi in any of their locations. When you sit at the counter, you are provided with a wireless tablet. Using the tablet, you can find the foods and drinks you like to order (listed by categories, photos are provided). Once you complete your selection on the tablet, a summary list is returned to you for final approval. Once you approve the list on the tablet, the order is delivered to you on a train-like tray. You pick up the food, push a button to send the tray back to the kitchen, and enjoy the meal! It is fast, clean, and error free. Several videos are available at **genkisushiusa.com**. For example, watch the 6:54 min video: "Bullet Train Sushi" at **youtube.com/watch?v=PkzBGjjNzPU** or **youtube.com/watch?v=C6ISPgtrqOo**.

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 applications 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 Marketing: Shopping and Advertising

Mobile marketing refers to all marketing communication activities conducted with wireless devices. Generally speaking, the use of mobile marketing is increasing exponentially. For statistics of the growth, see Strout (2015).

Mobile Shopping

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 (**omni-channeltechnologies.com**; acquired by Omni-channel Technologies), 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. Wishpond Technologies Ltd. (2014) shows how smartphone shoppers use their devices for different shopping-related activities (e.g., checking prices, searching for reviews).

A popular app in Facebook is its "stores." There are tens of thousands of stores on Facebook. In 2015, Facebook introduced a shopping section for retail (see **wired.com/2015/10/facebook-testing-shopping-section-app**).

For examples of mobile advertising and shopping, see CSS Author (2014).

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/onboard-experience/entertainment.html#wifi**. Other airlines offer similar capabilities.

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

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. For the 2016 mobile marketing guide, see **ebooks.localytics.com/2016-app-marketing-guide#new-page**.

Mobile Advertising

Mobile advertising is growing even faster than mobile shopping. This topic is covered in detail in Chapter 9.

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 UBIQUITOUS (PERVASIVE) COMPUTING

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. (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**). Here we present only the essentials that are related to EC.

Definitions and Basic Concepts

Ubiquitous computing (ubicom) 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*. 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 ten futuristic technologies, see **gartner.com/technology/research/top-10-technology-trends**.

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.

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.

From Theory to Practice

Ubiquitous computing is the basis for the Internet of Things, which is described in Section 6.7. Here we describe one topic: Smart Grids. In Section 6.7, we will describe more applications. Pervasive computing technology is the key to many smart applications. Some examples are presented next.

Smart Meters and Grids

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 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 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 the field and the network operations' center. The essentials of the grid are shown in Figure 6.5 and in the "Smart Grid Basics"infographicat**edf.org/energy/infographic-smart-grid-basics**.

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**.

CASE 6.1: EC APPLICATION BIG DATA ANALYSIS AT INRIX HELP PEOPLE AVOID TRAFFIC JAMS

INRIX (**inrix.com**) enables drivers to get real-time traffic information. Drivers can download INRIX-XD Traffic app for iOS and Android. A predictive analysis of massive data 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 min, the next few hours, and the next few days. This enables drivers to plan their optimal routes. As of 2016, INRIX offers global coverage in 41 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 2016, the company covered about 5,000,000 miles of highways worldwide, delivering the best recommended 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.

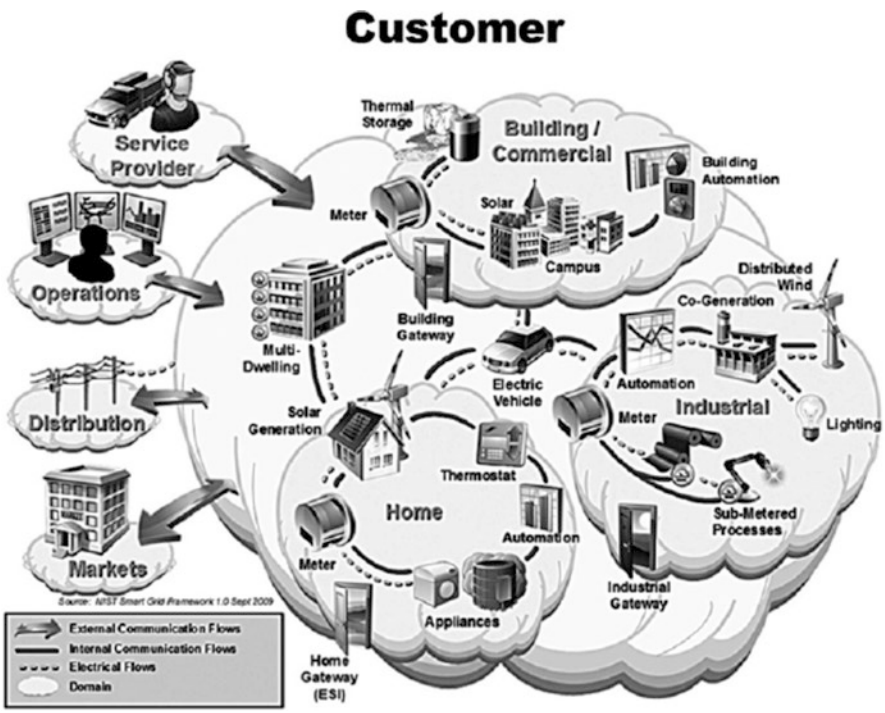

Figure 6.5 Smart grid environment (Source: National Institute of Standards and Technology, U.S. Department of Commerce, **nist.gov/smartgrid/upload/FinalSGDoc2010019-corr010411-2.pdf** accessed April 2016)

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 four countries. See **inrix.com/partners.asp** for more about INRIX's partners and their services.

The INRIX Traffic app (available for download at **inrix-traffic.com**) is available for all smartphones and supports ten languages, including English, French, Spanish, and Hungarian. For the INRIX Traffic free features, see **inrixtraffic.com/features**.

Sources: Based on **inrix.com**, **inrix.com/inrix-traffic-app**, and **inrix.com/why-inrix/customers-partners** (all accessed April 2016).

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.

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.

SECTION 6.6 REVIEW QUESTIONS

1. Define ubiquitous computing.
2. Describe the smart grid and the role of sensors there.
3. Describe a smart home.
4. In what ways can pervasive computing impinge on an individual's right to privacy?

6.7 THE INTERNET OF THINGS AND M-COMMERCE

The topic of the Internet of Things (IoT) has been receiving significant attention since 2014. While its applications are still emerging, it has a tremendous potential for creating value and innovations in many fields, including e-commerce (e.g., see Manyika et al. 2015). In this section, we present the essentials of IoT and its potential applications that are related to e-commerce. Most of these are in the area of m-commerce. For the impact of IoT on e-commerce, see Constantinou and Sellebraten (2015) and Mehra (2015).

The Essentials of 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 wirelessly 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).

Embedding mobile devices into items everywhere and connecting all devices to the Internet permits extensive communication between users and items. This kind of interaction opens the door for many applications. For business applications of the Internet of Things, see Jamthe (2015). In addition, check the "Internet of Things Consortium" (**iofthings.org**) and their annual conferences. For the technology, see Holler et al. (2014).

Definitions

There are many definitions of IoT. Wikipedia provides this definition:

"*The Internet of Things* (IoT) is the network of physical objects-devices, vehicles, buildings and other items embedded with electronics, software, sensors, and network connectivity—that enables these objects to collect and exchange data. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy, and economic benefit; when IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation, and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure."

According to Miller (2015), these are the characteristics of the Internet: IoT is a connected ecosystem in which:

- Large numbers of objects (things) can be connected
- Each thing has a unique definition (IP address)
- Ability to receive, send and store data, automatically
- Delivered over the wireless Internet
- Built upon machine-to-machine (M2M) communication

The Structure of IoT Applications

Things in IoT refer to a variety of objects and devices from cars and home appliances to medical devices, computers, fitness tracers, hardware, software, data, sensors, and much more. Connecting "things" and allowing them to communicate is a necessary portion of an IoT application; but for more sophisticated applications, we need other parts: A control system and a business model. The IoT enables the "things" to sense or be sensed wirelessly across the network. A non-Internet example will be a temperature control system in a room. Another non-Internet example is a traffic light at intersections of roads where cameras photograph the number of cars coming from each direction and a control system adjusts the time for changing the lights according to programmed rules. Later on, we will introduce some Internet-based applications. The major objective of IoT systems is to improve productivity, quality, speed, and quality of life.

The Major Benefits of IoT

According to Basu and Didyala (2014) and Miller (2015), the major benefits of IoT are:

- Create new revenue stream
- Optimize asset utilization
- Improve sustainability
- Improve workers' productivity
- The Internet of Things is changing and improving everything (McCafferty 2015)
- Systems will anticipate our needs
- People will make smarter decisions/purchases
- Greater accuracy
- Identify problems quickly (even before they occur)
- Reduce cost by automating processes
- Instant information availability
- Quick and inexpensive tracking
- Expedite problem resolution and recovery
- Support facility integration

The Drivers of IoT

The following are the major drivers of IoT:

- 50–75 billion "things"- may be connected (by 2020–2025)
- Connected autonomous "things"/systems (e.g., cars)
- Broadband Internet is more widely available
- Cost of connecting devices is decreasing
- More devices are created (via innovation) and they are connected (e.g., see Fenwick 2016)
- More sensors are built into devices
- Smartphones' penetration is sky-rocketing
- Wearable devices are all over
- Speed of moving data is increasing; 60 HTz
- Protocols are developing for IoT (e.g., WiGig)
- Customer expectations are on the rise

How the IoT Works

The following is a comprehensive process for IoT. In many cases, IoT follows only portions of this process.

The process is explained in Figure 6.6. The Internet ecosystem (top of the figure) includes a large number of things. Sensors and other devices collect information from the ecosystem. This information can be stored and/or processed (including data mining). This analysis converts the information into knowledge and/or intelligence. Machine learning may help in turning the knowledge into decision support (made by people and/or machines).

The decisions help in creating innovative applications, new business models, and improvements in business processes. These result in "actions," which may impact the original or other things.

Note that most of existing applications are in the upper part of the figure, which is called "sensor-to-insight," meaning opt to the creation of knowledge. However, now, the focus is moving to the entire cycle, i.e., sensor-to-action (see Ricktun 2016).

Illustrative Examples of Applications

We start with a well-known example. Your refrigerator can sense the levels of food and text you when inventory is low (sensor-to-insight). One day the fridge will be able to place an order, pay for it, and arrange delivery (sensor-to-action).

The following are a few examples of existing applications.

Existing Application of IoT

The following examples are related to e-commerce, based on Koufopoulos (2015):

- **Hilton Hotel**. Guests can check-in directly to their rooms with their smartphones (no check-in lobby is needed, no keys are needed). Other hotels will follow.

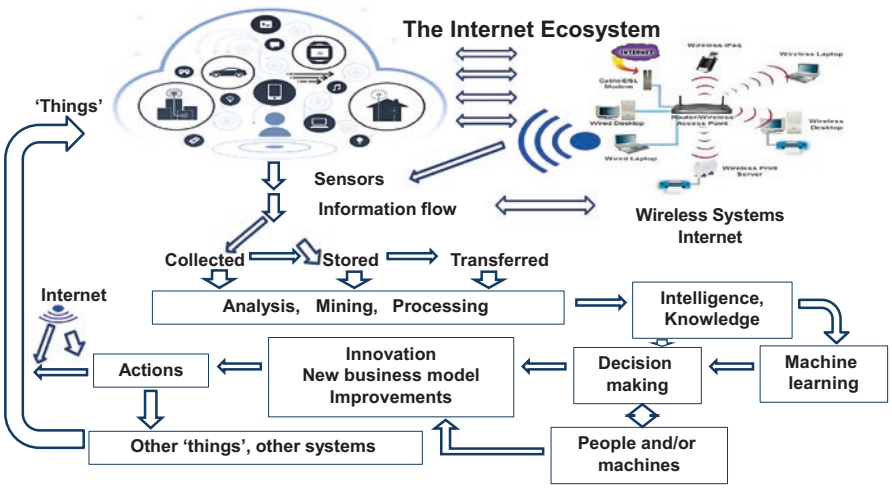

Figure 6.6 How the IoT works

- **Ford**. Users can connect to apps by voice. Coming up: autopay for gas and preorder at Starbucks.
- **Tesla**. Tesla's software autonomously schedules a valet to pick up a car and drives it to Tesla's facility when a need for repair arises.
- **Johnnie Walker**. The Whiskey company connected 100,000 whiskey bottles to the Internet for Brazil's Father's day. Using smart labeling, buyers can create a personalized video. Fathers can share the videos on social networks. Fathers get promotions to buy the whiskey if they like it.
- **Apple**. Enable users of iPhone, Apple watch, and Homekit with Apple Pay to streamline shopping.
- **Starbucks Clover Net in the Cloud**. This system connects coffee brewers to customers' preferences. The system also monitors employee's performance, improves recipes, tracks consumption patterns, and more.

A large number of consumer applications of IoT is reported by Jamthe (2015) and Miller (2015). Here are more applications:

Example: Nest-a Google Company

A leading manufacturer of IoT applications is Google's Nest. The company is a producer of programmable self-learning, sensor-driven, Wi-Fi-enabled products. In spring 2016, the company had three products:

- **The learning thermostat.** The device learns what temperature and humidity level people like and controls the air conditioner/heater accordingly. The company claims it has an average savings of 13% of energy, which is good enough to pay for the device in 2 years; see **nest.com/thermostat/meet-nest-thermostat/?alt=3**.
- **Smoke detector and alarm.** This device tests itself automatically and lasts for about a decade. It is controlled from a smartphone. For details, see **nest.com/smoke-co-alarm/meet-nest-protect**.
- **Nest.com.** It is a Webcam-based system that enables you to see what is going on in your home when you are away, from your smartphone or desktop computer. The system turns itself on automatically when nobody is at home. You can monitor your pets, babies, etc. There is a recorder that allows you to go back in time. For details, see **nest.com/camera/meet-nest-cam**.

Many companies are experimenting with IoT products for retailing (B2C), for B2B operations, for transportation, logistics, factory warehousing, and more. For details, see Miller (2015) and Jamthe (2015).

Of all the consumer-related products, three are of utmost importance: smart homes, smart cars, and smart cities.

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** and Miller (2015).

In the United States, thousands of homes are connected already 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 (e.g., Nest-a).
- **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.
- **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 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 city-wide 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." According to Editors (2015), smart cities will use 1.6 billion connected things in 2016 (Editors 2015).

In many countries, governments and others (e.g., Google) are developing smart city applications. For example, India is planning to develop 100 smart cities (see **enterpriseinnovation.net/article/india-eyes-development-100-smart-cities-1301232910**).

Note: For many case studies and examples of IoT, see **ptc.com/internet-of-things/customer-success**, **divante.co/blog/internet-e-commerce**, Greengard (2016), and Kuntz and Becker (2015).

Related to smart cities are smart factories (Libelium 2015). In smart cities, one will be able to find connected and self-driven cars (see Hamblen 2016 and our next section).

Smart Cars

Smart cars, also known as driverless cars, robot-driven cars, and autonomous cars are already on the roads in several places. The concept was initiated by Google (named Google Chauffeur), and it is becoming a reality, with several states in the USA getting ready to allow it on the road. These cars are electric, and they can create a revolution by their ability to reduce emissions, accidents, and traffic jams (e.g., see Neckermann 2015). Greenough (2015) estimated 10 million such cars to be on the road in the USA by 2020. Thus far these cars are being tested in several cities worldwide.

The cars possess sensor systems that may prevent collision and they can be completely autonomous. (Today, they still include a human safety driver.) Among the many implementation issues are legal issues, cost, privacy invasion, and more.

Despite these issues, several car manufacturers are ready to sell such cars soon (e.g., BMW, Mercedes, GM, Tesla, and of course—Google). For more information, see Bridges (2015).

SECTION 6.7 REVIEW QUESTIONS

1. Define Internet of Things.
2. Explain its major components.
3. What are its major benefits?
4. List the major drivers of IoT.
5. Explain how IoT works (see Figure 6.6).
6. Provide some consumer-related applications.
7. Describe smart homes and appliances.
8. Describe smart cities.
9. What is a self-driving car?

6.8 WEARABLE COMPUTING AND SMART GADGETS: WATCHES, FITNESS TRACKERS, AND GLASSES

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

Wearable Computing Applications and Devices

Wearable computing and devices received a major boost in 2015/2016 due to the expansion of the Internet of Things. For a comprehensive slide presentation, see Chamberlin (2014). 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 (smartwatch), and Apple released its Apple Watch in April 2015. Google has released a Nexus-like platform for wearables, called Android Wear.

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.

Vijayan (2014) stated, "Wearable computers, like fitness bands, digital glasses, medical devices, and smartphones 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"), smartwatches, smart clothing, and fitness bands/activity monitors. We describe some later in this section.

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.

Enterprise Wearables

The wearables described earlier are mostly used as consumer products. Some companies are using enterprise applications. There are a large number of wearables, which already have been used for a long time in enterprises. For a report on products, manufacturers case studies and applications, see the 2016 white paper titled: "Enterprise Wearable Technology Case Studies/Tractica." It includes 40 different applications. See **tractica.com/resources/white-paper/enterprise-wearable-technology-case-studies**.

According to the PWC report, **pwc.com/us/en/advisory/business-digital-technology-trends-wearables.html**: "Wearables hold so much promise because they provide a hands-free way for employees to engage in real time with context-specific business information, customers, or one another. For example, companies across industries can provide tailored, in-the-moment job training to workers equipped with smart badges or wearable displays. In industrial settings, goggles, lanyards, or sensor-embedded clothing could help workers who are performing repetitive or dangerous tasks increase productivity and reduce injuries."

Note: Wearable devices are subject to serious privacy and security problems. For a discussion, see Maddox (2016).

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."

For the state of the art in 2016, see McDowell (2016). For a slide show of wearable devices and their applications, see Khillare and Bobade (2016).

Three representative devices, smartwatch, fitness trackers, and smart glasses are presented next.

Smartwatches

A **smartwatch** is a computerized wrist watch with functionality that is enhanced beyond timekeeping. Today, smartwatches are wearable computers. Many run mobile apps, using a mobile operating system.

They can function as portable media players; others also feature full smartphone capabilities.

Like other computers, a smartwatch may collect information from internal or external sensors. It may control, or retrieve data from other instrument or computers. It may support wireless technologies like Bluetooth, Wi-Fi, GPS, and communication technologies.

For specific features, see the websites of smartwatches' manufacturers, such as Apple, Google, Pebble, Sony, Samsung, and several more. For a 2016 review, see Lamkin (2016a). For an overview, see **en.wikipedia.org/wiki/smartwatch**. For the capability to shop, see Arthur (2015). A special category of smartwatches is fitness (or activity) trackers. Some watches can be used as medical devices (e.g., Apple's Kardia, see Broussard 2016).

Fitness (Activity) Trackers

An activity tracker is a device or application for monitoring and tracking health and fitness-related metrics such as distance walked or run, calorie consumption, heartbeats, and even the quality of sleep. Today, many of these devices are wearable, which may be connected to a computer. For an overview, see **en.wikipedia.org/wiki/activity_tracker**. For the 2016 major manufacturers (e.g., Fitbit, Jawbone, Misfit, and Garmin), see Stables (2016).

Note that some trackers and regular smartwatches look very fashionable (e.g., Fibit Blaze). These are becoming more stylish with time. For the best fitness trackers for 2016, see **pcmag.com/article2/0, 2817,2404445,00.asp**. For how fitness trackers work, see Nield (2016).

Digital (Smart) Glasses

A digital glasses is an optical, head-mounted device that looks like regular eyeglasses. It was pioneered by Google (see **en.wikipedia.org/wiki/Google_Glass**). The device displays Internet information and it responds to voice commands. Smart glasses are closely related to virtual reality and augmented reality (see Chapter 2). The most well-known glasses are Google glass. For the best smart glasses for 2016, see Lamkin (2016b).

Google Glass

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 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. 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."

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**.

Other companies in the USA, Japan, and Korea have smart glasses (e.g., Sony). Note that Google Glass is getting more stylish by adopting the look of Ray-Ban and Oakley eye glasses' top brands.

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. Describe smartwatches.
5. Define fitness trackers.

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

Several issues need to be considered before applying mobile applications. Here, we discuss only a few of them.

Despite the vast potential benefits 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 wireline 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 min), available at **youtube.com/watch?v=aO--a5yhJCg**. Part 2 is titled "Mobile Commerce: Part 2, The Evolution" (8:51 min), available at **youtube.com/watch?v=fBlLxVeCouo**. Part 3 is titled "Mobile Commerce: Part 3, How to Make mCommerce Work" (8:23 min), 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 **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.

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. For securing the IoT, see Hu (2016).

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 10 for a discussion of privacy issues).

Related to this is the issue of security and especially combating fraud, see presentation in Chapter 10.

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 6.1. Note that with the passage of time the technological barriers are decreasing.

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.

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?

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.

Table 6.1 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. 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

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.

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.

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). 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.

There are many suggestions regarding the management and control 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 spring 2016, Apple had about 1.2 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 toward 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. Examples are: the issues of ROI measurement, determining the mobility platform, training, budget and cost control, and justification. Another issue is integration, collaboration, and communication. An interesting issue is the increased flow of data and how to handle it (see Knight 2015).

Conclusion

Despite the many obstacles, mobile commerce is growing rapidly, faster than EC in general. Wearables and IoT are growing the fastest. For mobile commerce trends for 2016, see Moovweb (2016).

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.

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/c/en/us/solutions/byod-smart-solution/overview.html** and Reisinger (2013).
4. **How to prepare for IoT?** It depends on the application. There will be several organizational and technological issues (e.g., see Deichmann et al. 2015 for suggestions). The transition to the new technology can be complex. Also, justification may be difficult.
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. **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.
4. **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.
5. **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 healthcare, hospitality, public safety, crime prevention, and homeland security.

6. **Ubiquitous computing.** 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.
7. **The Internet of Things.** It is an application of ubiquitous computing that may change the way we live and work. Basically, it is a system composed of sensors that collects information from devices attached to things in the cloud (e.g., cars, people, computers). The collected information is processed and results are communicated to people or to computers. In advanced systems, the processed information is translated automatically to actions. Implementation ranges from smart homes and appliances to smart cars, autonomous B2C and B2B, and much more. Being in its infancy, the technology has technical, legal, and organizational issues.
8. **Google Glass, smartwatches, and fitness trackers.** 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.
9. **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

Context-aware computing
Enterprise mobility
Intelligent personal assistants
Interactive voice response (IVR) system
Internet of Things (IoT)
Mobile app
Mobile banking (m-banking)
Mobile commerce (m-commerce; m-business)
Mobile enterprises
Mobile entertainment
Mobile portal
Mobile worker
Multimedia messaging service (MMS)
Pervasive computing
Radio frequency identification (RFID)
Short message service (SMS)
Smartphone
Smart grid
Smartwatch
Ubiquitous computing (ubicom)
Voice portal
Wireless mobile computing (mobile computing)

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. Discuss how the IoT can facilitate marketing.
7. Discuss the advantages of m-commerce over wired EC.
8. Discuss how to sell products on Facebook (e.g., view **shopify.com/facebook**).

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 either on 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.
7. Search the issue of m-commerce usability. Start with **baymard.com/mcommerce_usability**.
8. 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**.) Compare to competitors' products.
9. 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**.)
10. 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**.)
11. Find the latest applications of the "Internet of Things" and discuss their usability.
12. 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?
13. Join the discussion at **iotcommunity.net**. Write a report.

INTERNET EXERCISES

1. Research the status of 4G and 5G. You can find information 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 and 5G 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 **meetup.com** and review their mobile apps. Write a summary.
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 (**smartercities-challenge.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 Facebook and find all their features that facilitate mobile shopping. Also see **shopify.com/facebook**. Write a report.
9. Conduct a Google search for comparisons on tablets versus 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) Enter **neverlost.com** and identify recent services. View their companion. Write a report.

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 healthcare. Each team will present a report to the class based on their findings.
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. Each team investigates a major intelligent personal assistant and presents its capabilities and advantages to the class. Prepare a comparative analysis. Relate it to Echo from Amazon.
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 min 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. Check what is done in several countries (such as India where hundreds of cities are becoming "smart"). Also, see IBM's global activities (Taft 2014). Use this as a class project where different teams cover different topics and countries.
8. Watch the video titled "Technology Advances Fuelling M-Commerce Today" (7:43 min) 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

A large number of products and services are available. We present only some here.

The Major Enterprise Products

In 2015, 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: Motorola Enterprise was 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 Zebra Technologies, Inc. (**zebra.com/us/en/products/networks/wireless-lan.html**).

The Industries Services

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

This hospital, which is affiliated with the University of Toronto, is a three-site community teaching hospital with 5000 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 **motorola-latinamerica.hosted.jivesoftware.com/servlet/JiveServlet/download/2452-1-6216/MOT_North_York_General_Hospital_CaseStudy_EN_073012.pdf**. See also Motorola Solutions for healthcare (**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 March 2016.)

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 **ecommerce-introduction-textbook.com**

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

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