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. Explain what location-based commerce is.
7. Define and describe ubiquitous computing and sensory networks.
8. Describe wearables, Google Glass, smartwatches, and fitness trackers.
9. Describe the major implementation issues from security and privacy to barriers of m-commerce.

E. Turban et al., *Electronic Commerce 2018*, Springer Texts in Business and Economics, DOI 10.1007/978-3-319-58715-8_6

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 10,000 locations in 150 countries. The strong competition negatively impacted profits. For Hertz Global Holdings, Inc.'s business profile and statistics, see **hoovers.com/company-information/cs/company-profile.hertz_global_holdings_inc.a13218fdab48db66.html**. Hertz needs to constantly maintain a mobile presence. Customers can easily connect with the company through its mobile site. The Hertz mobile app is available for iPhone, iPad, Android, and Windows phone.

The Solution

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

Here are some of Hertz's mobile services:

- **Easy and quick rentals.** Reservations can be made by phone, e-mail, and on the website (via smartphone, tablet, or desktop). Confirmations are e-mailed (or texted) within seconds of making the reservation. Upon arrival in a city, the renter receives a text message pinpointing the car's location in Hertz's parking area. In many rental locations, the cars are equipped with an RFID system. In such a case, the renter sweeps the Hertz key fob/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 **www.neverlost.com/Products/ProductDetail?ProductName=hertzneverlostcompanion**). This app allows you to plan your trip on your smartphone and use the app to navigate over 40 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 5-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 th*e speed at which the* car is being driven. Although the company promises to keep the collected information secure, many view it as an *invasion of privacy.* However, some renters may feel safer knowing that they are being tracked at all times. Note: Currently (Marsh et al. 2016), Hertz is using the system only to track stolen cars and to find out when cars are returned.
- **Hertz On Demand.** According to their website, Hertz On Demand, available 24/7, 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.
- **PlatePass for toll payments.** Using this device, drivers can pay tolls for participating roads. Depending on the region, rented cars are equipped with a wireless transponder (an electric tag). If there is no such equipment on the car, the toll road will read automatically the auto plate number to bill the driver later. A daily service fee of $4.25 is paid to Hertz plus the fees for the toll road. For details, visit **platepass.com**.
- **Hertz mobile apps.** With the Hertz apps, which are available for iPhone, iPad, Windows, and Android, you can make reservations, search for store locations, enjoy special offers, and much more. See the Hertz mobile page at **hertz.com/rentacar/productservice/index.jsp?targetPage=hertzmobilesite.jsp**. For 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 2008–2014, 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 January 2017).

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 "The Enabling Infrastructure: Components and Services of Mobile Computing".) The mobile technology is based on a set of unique attributes (section "Mobile Commerce: Concepts, Landscape, Attributes, Drivers, Applications, and Benefits") that enable the use of many applications (sections "Mobile Banking and Financial Applications," "Mobile Enterprise Solutions: From Supporting the Workforce to Improving Internal Operations," "Mobile Entertainment, Gaming, Consumer Services, and Mobile Marketing," "Location-Based Commerce," "Ubiquitous (Pervasive) Computing," "Wearable Computing and Smart Gadgets: Watches, Fitness Trackers, and Smart Glasses," and "Implementation Issues in Mobile Commerce: From Security and Privacy toBarriers to M-Commerce").

The Hertz case is only one example of the impact of growing 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 emerging EC technologies.

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

As described in Chap. 1, businesses are becoming digital. In addition, many enterprises are going multi-locationally and globally, and the need for mobile communication is increasing rapidly (see the closing case in Chap. 7). According to GSMA (2016), the mobile industry is already a major contributor to the global economy. More than 75% of the world's population already own mobile phones, most 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/index.htm**.

Mobile commerce has its own framework, attributes, landscape, concepts, and terminology. These provide many benefits. For an overview, watch 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 all the 2010–2017 reports. Mobile commerce accounts now (2017) for about 40% of all EC transactions. Several countries are leapfrogging to mobile economy. One example is China (Ma 2016). In addition, see examples for mobile payments in Chap. 12. For mobile commerce in SMEs, see Diffly (2016).

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, CRM and m-learning transactions, as well as the transfer of information and money. Like regular EC applications, m-commerce involves 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 paying 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 4G networks (and soon 5G). 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 Swilley 2015 and **mobileinfo.com/mcommerce/differences.htm**). Mobile capabilities have resulted 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 United States will take place on mobile devices (reported by **mashable.com/2013/04/24/mcommerce-sales-forecast**). A 2014 InMobi report found that 83% of customers plan to conduct mobile commerce in 2014, a 15% increase from the previous year. Here are some more data to consider:

Mobile services contributed 4.2% of the GDP worldwide in 2015, forecasted to contribute close to 5% in 2020. By 2020, there could be close to 5.8 billion smartphones used by almost 90% of all Internet users. For more statistics, see **gsma.com/mobileeconomy/global/2016/**.

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. For the relationship, see **mobilepaymentstoday.com/blogs/social-media-becomes-more-of-a-mobile-commerce-tool-worldwide/**.

The Landscape of M-Commerce

The overall landscape of m-commerce is summarized in Fig. 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 "The Enabling Infrastructure: Components and Services of Mobile Computing", 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 Chaps. 7 and 8. This combination will shape the future of e-commerce and could be its major facilitator in the future.

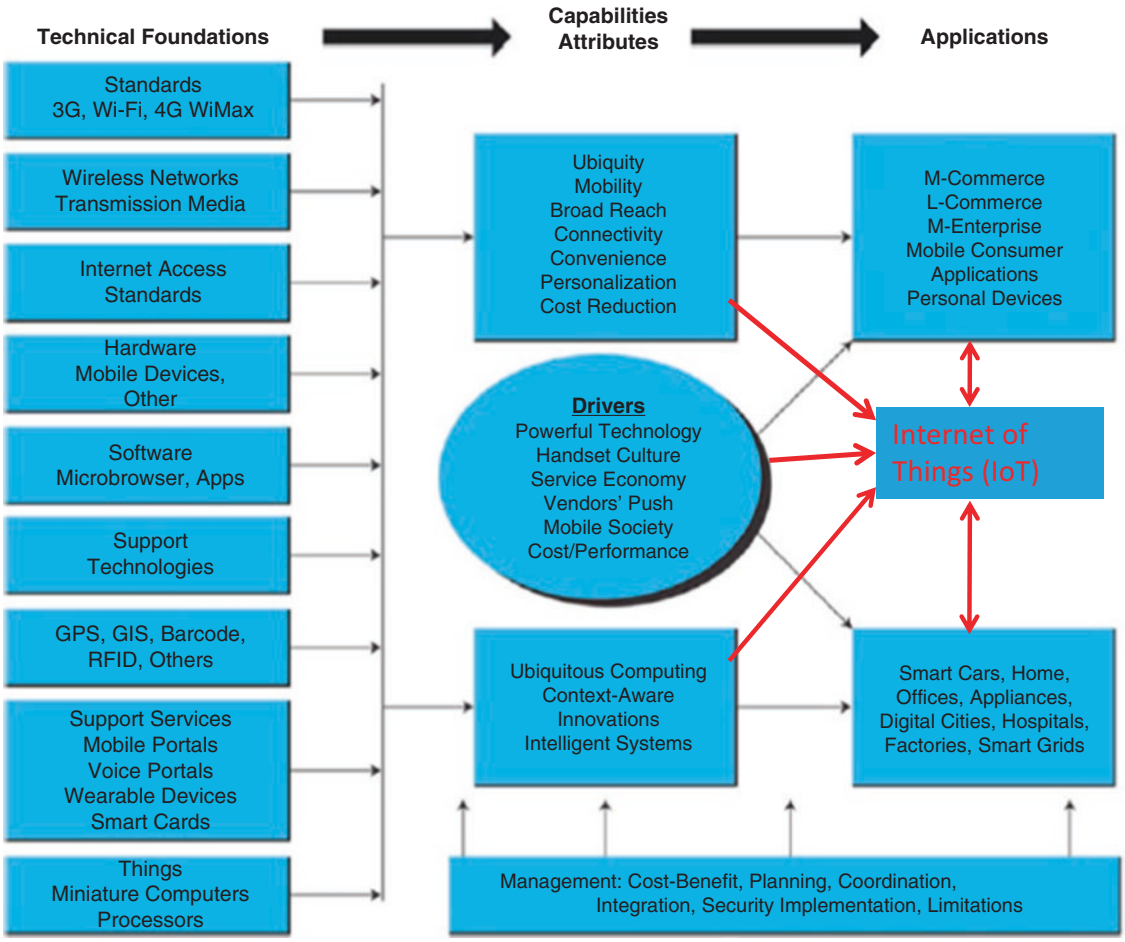

Fig. 6.1 The landscape of mobile computing and m-commerce

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 (Chap. 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 are 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.

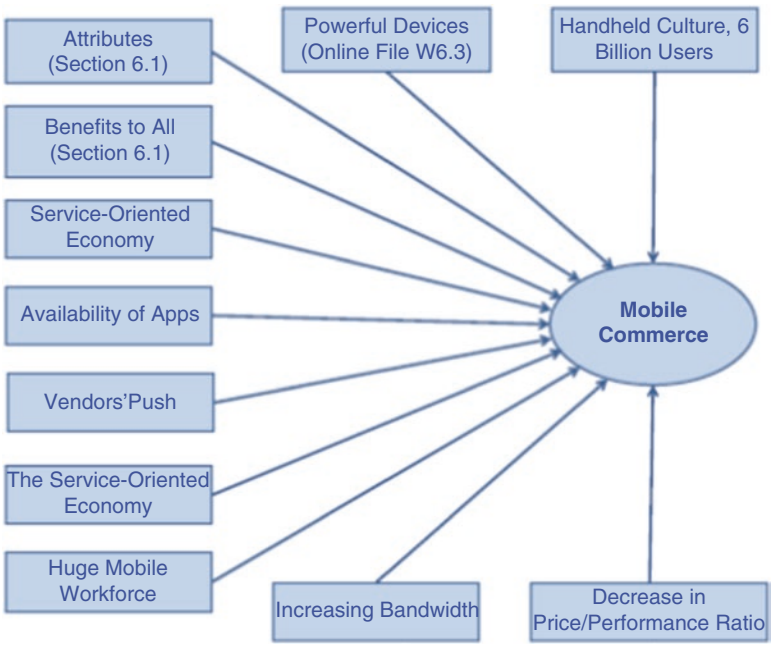

Fig. 6.2 The drivers of m-commerce

Mobile vendors differentiate themselves from wireline vendors by offering unique services based on the above attributes. These attributes are some of the drivers of m-commerce, which are illustrated in Fig. 6.2.

An Overview of the Applications of M-Commerce

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

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 "Mobile Banking and Financial Applications"
- Mobile enterprise applications—section "Mobile Enterprise Solutions: From Supporting the Workforce to Improving Internal Operations"
- Consumer services (including shopping and entertainment)—section "Mobile Entertainment, Gaming, Consumer Services, and Mobile Marketing"
- Ubiquitous computing—section "Ubiquitous (Pervasive) Computing"
- Emerging applications: wearables, Google Glass, smart grid, and driverless cars—section "Wearable Computing and Smart Gadgets: Watches, Fitness Trackers, and Smart Glasses"
- Internet of things (IoT) applications are covered in Chap. 7
- Mobile shopping is covered in Chap. 8
- Mobile marketing and advertising are covered in Chap. 10
- Mobile payment is introduced in Chap. 12
- Mobile ride-hailing (Uber, see closing case)

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

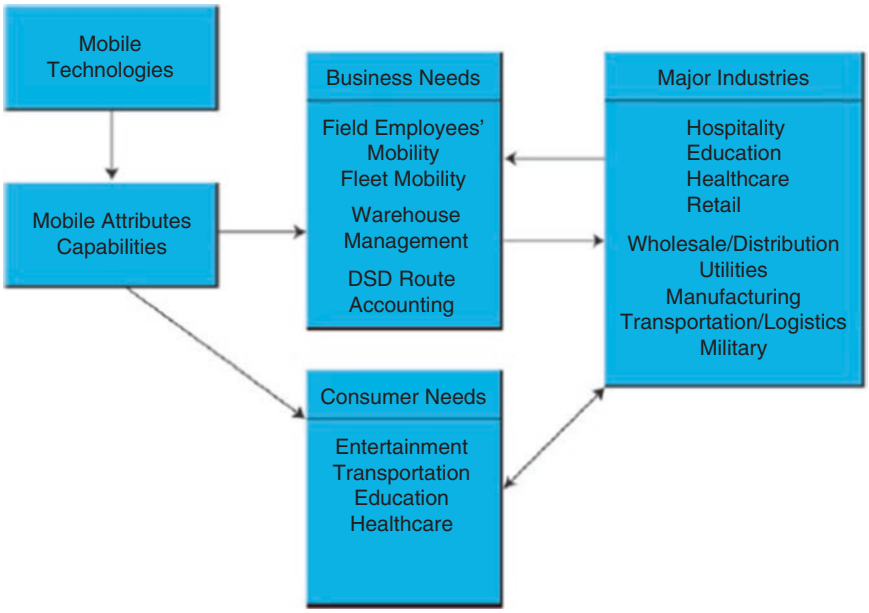

Fig. 6.3 M-commerce applications and their classifications

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 Fig. 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
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 "Ubiquitous (Pervasive) Computing".

Also of interest is the emerging field of *mobile intelligence* (see Saylor 2012 and Chap. 7).

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 "Location-Based Commerce")
- 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 (Chap. 7)
- Enables many enterprise applications (section "Mobile Enterprise Solutions: From Supporting the Workforce to Improving Internal Operations")

(continued)

- 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
- Ability to work at home and have flextime (Barry 2017)

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 and communication while traveling
- 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.

Mobile Commerce Trends

According to Moovweb (2016), the following are the major 2016 m-commerce trends:

1. Physical and online worlds will continue to converge.
2. Social commerce will remain hot, but will "buy" buttons deliver?
3. Over 85% of mobile time is spent in apps. However, only 25% sales come from apps.
4. Consumer expectations will drive retailers to focus on mobile services.
5. Loyalty will eclipse convenience in driving mobile payments.
6. IoT is still chasing full potential, but wearables are poised for growth.
7. The growth of mobile will force brands to optimize mobile checkouts.

Note: Figures for 2017 were not available at the time this chapter was written.

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 Fig. 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.
9. List five major mobility trends

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 wirelessly to networks. According to TechTarget Bitpipe, wireless mobile computing, also known as nomadic computing, is the use of portable computing devices (such as tablets and smartphones) in conjunction with mobile communications technologies to enable users' access to the Internet and to data from anywhere with Internet access (see **bitpipe.com/tlist/Wireless-Computing.html**).

For mobile statistics for 2016, see Steinberg (2016).

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/index.htm** and **en.wikipedia.org/wiki/Mobile_computing**. 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, wearables, 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 ultraportables.

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″ to 15″ screen. Smartphones also come in a variety of sizes.

Smartphones

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

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, Windows Mobile, Apple IOS and 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 many 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 Apple, 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). 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. However, they are increasingly used in entertainment, learning, and shopping.

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**). Both Fitbit and Apple Watch appeared in 2015. For more about wearable devices, see section "Ubiquitous (Pervasive) Computing".

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 Chap. 13. Also related to EC is the use of RFID to improve security and enable mobile payments (e.g., in paying for toll roads). For images of RFID applications, search Google Images 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 **www.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) is 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**.

The Internet of Things (IoT)

A most discussed topic in EC lately is the IoT. This ecosystem views billions of computing devices connected to the Internet. Most of the connections are wireless. In Chap. 7, we introduce IoT with many of its applications.

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 and coupons for products and services, in real time. GPS is also 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 and 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 (see Chap. 7).

Intelligent Personal Assistants and Robo-advisors

As described in Chap. 7, companies use AI to understand spoken natural languages. It is the basis for the development of chatbots and robots (Chap. 7). 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 Siri, and Amazon's Alexa. Other companies create competing products (e.g., SoundHound). Note that these products are integrated with 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 excels in smart home applications. For details, see Chap. 7, 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/partners/developers#BingSpeechApis**; 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/dpniferapgzh/examples-of-mobile-cloud-computing**).

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 at **pcmag.com/article/342695/the-best-mobile-device-management-mdm-software-of-2016**.

Mobile Apps

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 in use inside the enterprise. For example, as of spring 2016, Apple had about 1.2 million approved applications in its App Store.

Mobile apps can run on smartphones and tablets and on other devices such as smartwatches and glasses. Most devices are sold with many preinstalled apps, such as a Web browser. There are probably millions of mobile apps. Many can be downloaded for free, others for a small fee. PC Magazine and CNET provide up-to-date reviews. For a mobile app directory for government agencies categorized by platform and topic, see **usa.gov/mobile-apps**. According to Fox News (2016), the US Federal and Drug Administration launched a mobile app competition for crowdsourcing that will solicit public opinions about drug use.

Because their small size mobile apps are easy to develop and their cost is minimal, many companies provide such apps to their customers. Mobile apps have grown mostly in the areas of social networking, sports, business finance, shopping, health, and enterprise mobility applications.

A vivid example of a mobile app is ride-hailing. Companies such as Uber (see closing case) and Lyft are growing rapidly, disrupting the taxi industry.

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 Fig. 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).

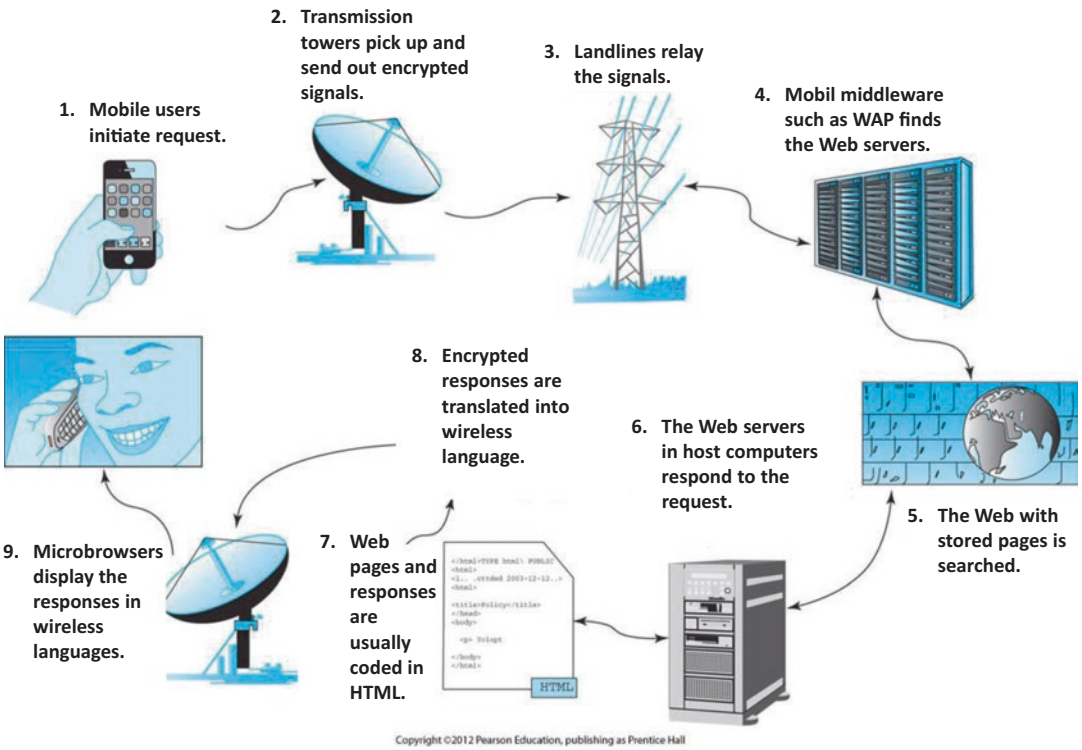

Fig. 6.4 An m-commerce system at work

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. Describe smartphone apps and list their advantages.

6.3 MOBILE BANKING AND FINANCIAL APPLICATIONS

Most mobile financial services are mobile versions of their wireline counterparts. However, they can be used anytime, anywhere. We divided these services into two broad categories: mobile banking and other mobile financial services. Mobile payments are described in Chap. 12. 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 has led to an increased utilization of mobile banking. For details, a conceptual model, and challenges for mobile banking solutions, see Krishnan (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 JPMorgan 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 their banking services, such as checking an account balance or 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 Knowledge@Wharton and Ernst & Young (2013).

Mobile Banking Apps

Mobile banking apps are increasingly becoming more important than physical branches. Actually, many banks (e.g., Bank of America) are closing branches. According to Clements (2016), customers are getting more satisfied with mobile apps. This writer also reports that Chase Bank has the best apps. These include fingerprint sign on, mobile check deposits, and the ability to view images of deposited checks.

Example

Citizens Bank lists the following smartphone apps (January 2017):

- Securely check balances quickly and easily with Fast Balance.
- Securely check balances with Fast Balance from the convenience of your Apple Watch, Android Wear, or widget.
- Pay bills and add billers.
- Deposit checks remotely.

- View check images.
- Transfer funds.
- Pay other people with Popmoney personal payment service.
- Review up to 18 months of account history.
- Locate ATMs and branches. Also available on Apple Watch and Android Wear.
- Use Touch ID or a PIN to log in.
- Receive alerts.

For details, see **citizensbank.com/online-and-mobile-banking/ap;ps.aspx**.

Finally, *mobile payments*, including payments withdrawn from bank accounts via mobile devices and depositing checks via smartphone photos, have become very popular (see Chap. 11).

Internet-Only Banks

Internet-only banks are virtual banks that have no physical branches. The more banks closing their physical branches, and the more people using mobile devices, the more people are getting used to transactions online.

Online-only banks' costs are substantially lower than that of conventional banks. Therefore, they can offer more free services, such as free checks or free bill paying. In addition, you do not need to worry about the closing of your branch. Online banks may give users more and/or quicker information, since all the data are digitized. Most Internet banks provide mobile access.

Internet-only banks have some disadvantages. When you need cash, you must go to an ATM, which may cost you money, if it is not maintained by your bank; or, when you cannot get cash from an ATM, you must use your debit card in the supermarket trying to get some extra change. In addition, you will need to mail deposits if you cannot transfer money online, not to mention getting cashier's checks or buying traveler's checks for your trips. Finally, when you have coins, you may need to pay 10% to change them to paper money.

Despite all the negatives, people may like the Internet-only banks.

Selecting a Bank

There are several banks to choose from. Well known are Ally Bank and the Bank of Internet USA. Others are Bank5 Connect, EverBank, Discover Bank, FNBO Direct, and State Farm Bank. To help you select one, you may use Gomez Internet Banker Scorecard. This service uses criteria such as services provided, interest paid to you, charges made, security measures, support provided, and reward programs.

Bank of Internet USA (BOFI)

This bank is one of the oldest Internet-only banks and the first to be listed on a stock exchange (NASDAQ). It is a nationwide bank that received a "Best Banks of 2017" award from **GOBankingRates.com** (GoBankingRate is similar to Gomez Internet Banker Scorecard). Being the oldest FDIC-insured Internet bank in the United States, the bank is the most trusted and is growing rapidly. For more information, see **bankofinternet.com**.

Using Cutting Edge Technologies in Mobile Banking

Since mobile banking requires that all data are digitized, it is easier to implement cutting edge technologies, such as AI and virtual and augmented reality. According to Oxagile (2016), cutting edge technologies will disrupt banking and financial services. Oxagile sees the following areas to be impacted: wealth management, trading, new channels for reaching millennials, and providing immersive experiences through data visualization.

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. For the best online brokers for stock trading (2017) and the services they offer and their fees, see Yochim (2017).

Real Estate Mobile Applications

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

Example: Using Augmented Realty

Using augmented reality (see Chap. 2), some companies in Europe and the United States 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. For an example, watch the 3:21 min video at **youtube.com/watch?v=LgBCkIDQjb0**.

Several other mobile real estate applications, combining Google Maps and Google Earth with mobile applications, are available or are being developed. 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 the 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. What is Internet-only banking?
4. What is a mobile banking app?
5. Describe mobile applications in real estate.
6. How is virtual reality and virtual augmented reality used 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*. Enterprise mobility includes the people and technology (e.g., devices and networks) that enable mobile computing applications within the enterprise. Enterprise mobility was one of the top 10 items in Gartner's strategic technology lists since 2013. Mobile enterprise apps are gaining momentum in 2016 (see Weiss 2015). For the top mobility trends for 2016, see Gordon (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 "Mobile Commerce: Concepts, Landscape, Attributes, Drivers, Applications, and Benefits", Fig. 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. The term is also known as *enterprise mobility*.

For a comprehensive description of mobile enterprise, including guidelines for implementation, best practices, and case studies, see Diogenes (2017).

For details, see **searchconsumerization.techtarget.com/definition/Enterprise-mobility**. For a large collection of enterprise mobility and enterprise mobility applications, conduct a Google search. 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 the 2017 trends in enterprise mobility, see Marsh et al. (2016).

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. For development and testing of apps, see Mobile Labs (2016).

Mobile Workers

A **mobile worker** is usually defined as any employee who is away from his or her primary workspace at least 10 h a week (or 25% of the time). According to a new forecast from International Data Corporation (IDC), the US 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 US workforce. See **businesswire.com/news/home/20150623005073/en/IDC-Forecasts-U.S.-Mobile-Worker-Population-Surpass**.

Examples of mobile workers include members of sales teams, traveling 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 in the office.

Mobile CRM

This is a growing application area. For definitions of CRM and CRM apps, see **ringdna.com/inside-sales-glossary/inside-sales-glossaryinside-sales-glossarywhat-is-mobile-crm** and **bitpipe.com/tlist/mobile-crm.html**. For an overview, benefits, and a case study, see **powershow.com/view/1497bd-M2JiN/Mobile-CRM-a_Case_Study_powerpoint_ppt_presentation**. In addition, see the 2015 slideshow: **slideshare.net/Sage_software_solutions/mobile-crm-ppt-from-sage-software-solutions**. For comprehensive coverage of mobile CRM, including a 2:59 min video, cases, etc., see **salesforce.com/eu/crm/mobile-crm**. For the strategic advantages of mobile CRM, see Maximizer (2015).

Using Messaging in CRM

Thouin (2016) lists the following help scenarios:

1. When someone needs help
2. When someone needs customer service
3. When a shopper needs help
4. When there is an urgency

Other Enterprise Mobile Applications

Hundreds of other mobile applications exist. For examples, see Motorola Solutions Enterprise Mobility (**motorolasolutions.com/US**; 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 **business.panasonic.com/industries-healthcarelifesciences-casestudies-frederickmemorial**.

Transportation Management

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

For examples 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 (search **infosys.com/mobility**). The website describes the challenges and opportunities of enterprise mobility and provides a large collection of mobility-related resources (e.g., case studies, white papers).

Enterprise Mobility 2017

For the trends of mobile enterprise in 2016, see Peng (2016). Peng explains that there is focus on knowledge workers by providing them with productivity mobile apps (e.g., Box, Evernote). Another area is *mobile workers,* by providing them with apps such as Invoice2go and PlanGrid, which can increase their productivity. For the near future, Peng sees utilization of all the functionalities of smartphones (e.g., real-time location data to collect real data in the field). For the 2017 trends, see Matteson (2017). For 2018–2023 outlook, see ICON Group (2017). For a pragmatic vision, see Beauduin et al. (2015).

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?

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

Mobile entertainment applications have been around for years, but they have only recently 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. For an overview of mobile entertainment in 2016, watch the 4:40 min video at **youtube.com/watch?v=9opLALHrFQ8**.

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 Chap. 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**. TallScreen (formerly imDown) provides a mobile entertainment network that focuses on 1-minute *vertical videos* (categorized by subjects); see details at Perez (2016).

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 carmaker 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 mobile game is a video game played on a mobile device. A wide range of mobile games has been developed for different types of players. The vast majority of players use smartphones and tablets. 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 on 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**. Venture Beat provides mobile game news very frequently; see **venturebeat.com/mobile-games**.

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 on 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 are 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 3G networks (at a minimum). 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.

A final note: Mobile games can be used for medical research. For example, Chester (2016) reports that data from mobile game players is being used to boost Alzheimer's research.

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 US states. In 2013, Delaware and Nevada were the first US 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 2016, many states legalized gambling or were considering legalizing or expanding online gambling (**washingtonpost.com/blogs/govbeat/wp/2014/02/05/at-least-10-states-expected-to-consider-allowing-online-gambling-this-year**). However, in March of 2014, a bill was introduced in Congress to outlaw any Internet gambling, including in the states where it is already legal (**reviewjournal.com/news/new-bill-would-prohibit-internet-gambling-including-where-already-legal**). As far as we know, the federal government in the United States is still considering the issue (January 2017).

Mobility and Sports

There are many sports mobile applications (e.g., see the closing case about the NFL in Chap. 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, 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's 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 United States and Canada, add friends, track progress, etc.). While the iPromises Recovery Companion does not generate revenue for the company, "it is aimed at bolstering Promises' reputation among patients and doctors."

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

Hospitality Management: Hotels, Resorts, and Restaurants

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**.

Example: Leading Hotels

All rooms and public areas are equipped with Wi-Fi. You do not need to stand in line to register. Just go to a room that its number is texted to your smartphone. No keys needed; your smartphone will help you to enter the room. An online guide will tell you about all facilities in the hotels and resorts, as well as information about nearby restaurants and attractions. All are supplemented by maps.

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 while 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.

Fig. 6.5 Genski Sushi's tablet-based system (Photo taken by Deborrah Turban)

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 at 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 would 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 (see Fig. 6.5). It is fast, clean, and error-free. Several videos are available at **genkisushiusa.com**. For example, watch the 6:54 min. video titled "Bullet Train Sushi" at **youtube.com/watch?v=PkzBGjjNzPU** or **youtube.com/watch?v=C6ISPgtrqOo**.

Many other mobile apps exist. For example, Taco Bell, Wendy's, Shake Shack, and others let you order from your smartphone, so you can skip the waiting line. You select from the menu, select location and time of arrival, and pay (of course). You get confirmation, go to the restaurant, and get seated immediately. Finally, in some Starbucks, you can order by voice on your smartphone instead of using the store's touchscreen menu.

Note: Such a system may not be available in your town, especially if it is a small one.

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 Chap. 5). The Department of Homeland Security applies many apps and 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). For BI mobile marketing statistics, see Sukhraj (2016). This discussion is a preview of the coverage of the topic in Chap. 10.

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 businesses, 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). Note that about 50% of all customers do mobile research before buying!

A popular app on 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 mobile shopping statistics and trends, see Meola (2016).

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.

Philippine Airlines provides extensive Wi-Fi services (named iN AiR-mobile services). Users can access the Internet (for a fee). Users can send or receive text messages, make or receive phone calls, send multi-mail messages, and use other mobile services. Users can download the PAL iN AiR Player app for many services. Once you connect to the airplane Wi-Fi hotspot, you can open the app to watch movies, TV shows, etc.

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 Tmall, 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 Chap. 7). 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 when the store was regular. 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 Chap. 10.

SECTION 6.5 REVIEW QUESTIONS

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

6.6 LOCATION-BASED COMMERCE

Location-based commerce (l-commerce), or LBC, refers to the use of location-finding systems such as GPS-enabled devices or similar technologies (e.g., triangulation of radio- or cell-based stations) to find where a customer with a mobile device or an object is located and provide relevant services, such as an advertisement or vehicle route optimization. LBC is also known as LBS (location-based systems). According to TechTarget, LBS is "a software application for a[n] IP-capable mobile device that requires knowledge about where the mobile device is located" (see **searchnetworking.techtarget.com/definition/location-based-service-LBS**). L-commerce involves *context-aware computing technology* (section "Ubiquitous (Pervasive) Computing"). For images, search Google Images for "location-based commerce." L-commerce offers convenient services to consumers such as connections with friends, the ability to receive relevant and timely sales information, safety features (e.g., emergency assistance), and convenience (a user can locate what facility needed is nearby without consulting a directory or a map). Sellers get the opportunity to advertise and provide or meet a customer's needs in real time. In essence, LBC is the delivery of m-commerce transactions to individuals who are in a known specific location, at a specific time. The location-based systems also are referred to location-aware systems. Today (2017), they include mainly smartphones and tablets with location tracking that allows various apps to use the information on the whereabouts of people for social commercial uses.

Basic Concepts in L-Commerce

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

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

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

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

L-Commerce Infrastructure

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

1. **Location finder (positioning) component.** A GPS (or other device) that finds the location of a person or a thing.
2. **Mobile Positioning Center.** This includes a server that manages the location information received from the location finder.
3. **User.** The user can be a person or thing (e.g., a vehicle).
4. **Mobile devices.** The user needs a mobile device (e.g., a smartphone) that includes a GPS or other feature that locates the location (position) of something or someone.
5. **Mobile communication network.** The network(s) that transfers user requests to the service providers and then transmits the reply to the user.
6. **Service or application providers.** Providers are responsible for servicing a user's request. They may use applications such as GIS.

(continued)

7. **Data or content provider.** Service providers usually need to acquire (e.g., geographic, financial, or other data) in order to provide a reply to requests. Data may include maps, coupons, and GIS information.
8. **Geographical information system (GIS).** This includes maps, location of businesses, and more.
9. **Opt-in application.** In the United States and some other countries, LBS can be used only with people's permission (opt-in). This requires an additional software app.

These components work together as illustrated in Fig. 6.6.
For additional components, see **www.gps.gov/technical/icwg**.
Here is how the LBS works (see Fig. 6.6):

1. The user expresses his or her wish by clicking on a function (e.g., "find me the nearest gas station").
2. The mobile network service finds where the user is located using satellite and GPS.
3. The request is transferred via a wireless network to the application service provider software that activates a search for the needed data.
4. The server goes to a database, to find, for example, the nearest requested business and check if it is open, what it serves, and so forth.
5. Using a GIS, the service delivers the reply to the user, including a map and driving directions if necessary.

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

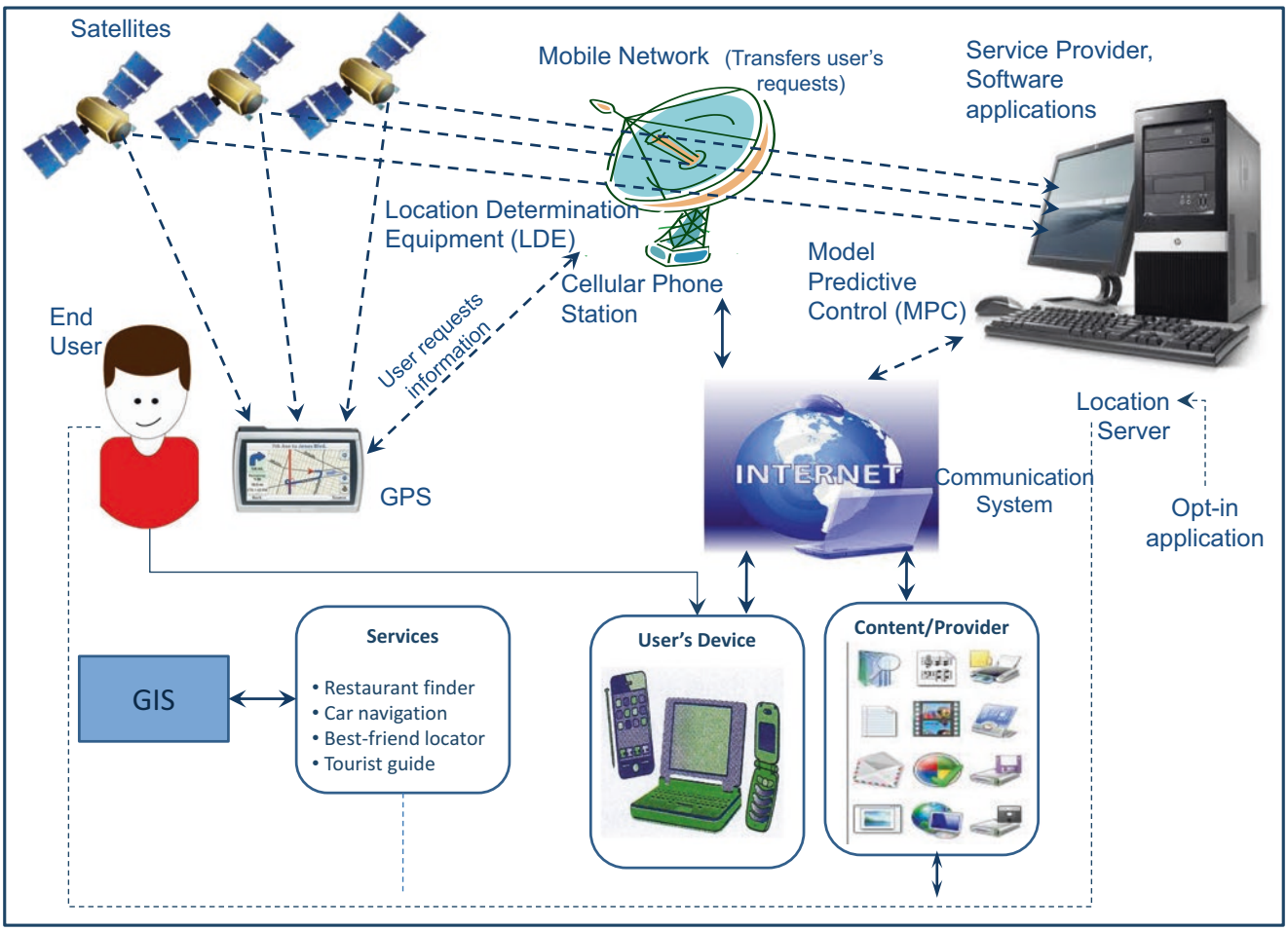

Fig. 6.6 Location-based commerce system

Geolocation

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

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

The GPS: Positioning Component

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

According to GPS.gov (2017), "the **Global positioning system (GPS)** is a U.S.-owned utility, satellite-based, that provides users with positioning, navigation, and timing (PNT) services. This system consists of three segments: the *space segment*, the *control segment*, and the *user segment*."

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

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

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

The US government describes these segments as follows:

In recent years, GPS locators have become a part of the consumer electronics market. They are available in many smartphones and today are used widely for business and recreation.

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

Location-Based Data

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

Using Data Collections

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

Locating Customers in Physical Stores

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

Geographical Information Systems

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

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

Example: Hailing Taxis from a Smartphone

Hailing taxis from smartphones is spreading slowly around the globe. ZabKab (now "ZabCab") (**zabcab.com**; "connecting taxicabs and passengers") provides an app by which a user with a GPS-enabled smartphone can push a button and GPS technology identifies their location. An icon with a map appears on the mobile devices of participating taxi drivers, letting the driver know the location of the passenger who needs to be picked up. Currently (2017), ZabCab is only available in certain cities in New York, Burlington, Vermont, and South Florida. The HAIL A CAB™ app (**hailacabapp.com**), a product of Yellow Cab, offers the taxi-hailing service in several cities in Texas (Austin, Houston, San Antonio, and Galveston), with more locations forthcoming. The Alibaba Group also offers a cab-hailing app in Beijing (see **online.wsj.com/news/articles/SB10001424052702303287804579442993327079748**.

Note: Taxi company Comfort Transportation, located in Singapore, offers a taxi-booking system in which the booking is done by SMS (see **cdgtaxi.com.sg/commuters_services_booking.mvn**). They also offer taxi-booking apps and online taxi booking. It is not location-based, but it solves the problem of busy telephone lines. Finally, GetTaxi (operating in New York as "Gett"; **gett.com**), available in New York and other major cities worldwide (e.g., Moscow, London, Tel Aviv), offers a free app that allows you to order taxis directly from your smartphone.

Location-Based Services and Applications

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

There are a large number of LBS applications. For a list of location-based services (applications), see **geoawesomeness.com/knowledge-base/location-based-services/location-based-services-applications**.

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

Other examples of location-based services are:

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

RFID technologies wirelessly track objects in warehouses (see Tutorial T2 and Chap. 13).

Four Labs, Inc. and Swarm

A pioneering LBC company is Foursquare. Today it is a local search-and-discovery mobile service app. The app provides personal recommendations. It provides a city guide and is a competitor of Yelp. The original LBC capabilities of Foursquare are available in its subsidiary—Swarm.

Personnel Tracking

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

Social Location-Based Marketing

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

Location-Based Applications 2016

Toms Guide **tomsguide.com/us/best-location-aware-apps,review-2405.html** provides the following list of the ten best location-based applications (per Corpuz 2016). Most applications are free.

Foursquare and Swarm

Foursquare is the pioneer of check-in location. (It is now two parts.) It helps the discovery of restaurants, events, etc., that are located near a user, in real time (based on users' preferences). In addition, you can meet with your friends when the system lets them know where you are.

GasBuddy

This mobile app helps users track down the cheapest gas stations which are near their present location. Prices are reported by users who receive points for reporting and updating prices. The points make users eligible to participate in regular raffles of prizes.

Waze

Similar to GasBuddy, Waze is based on user reporting. However, the contributions are more organized, so Waze may be considered a social network. In addition, the company is using the concept of *crowdsourcing* (Chap. 9). Waze lets drivers report traffic conditions and incidents, sharing them in real time on dynamically changing maps. Waze also provides optimal routings. The suggestions are based on users' reporting and data collected from other sources (including the cheapest fuel near users' locations). Waze, which is owned by Google, is an intelligent app that can learn users' commuting behaviors and preferred routes. Therefore, the app can make more personal recommendations. You can see which friends are driving to your destination and use Facebook to coordinate all arrival times.

Waze's community is the world's largest traffic and navigation social network. It originated in Israel and now is operational in dozens of countries. Waze works with all mobile devices that have Internet access and GPS support.

In some countries when you get Waze's maps and routing, you see paid advertisers' icons. This is why Google was willing to invest $1.3 billion for the company.

A final note: If you use Waze, you run the risk of being stalked by hackers (see Hill 2016).

Glympse

Glympse is a mobile app that allows you to share your location in real time with others. You can see those people who use Glympse, but who are not on time where they need to be (e.g., to meet you). The app is based on GPS. It can run on any Internet-enabled device. The app is fast and free. Your location is presented on a digital map.

Dark Sky

It is a local weather app that provides an accurate local forecast in real time. The predictions are based on radar mapping. It also can connect users to long-term forecasting (24 h and week ahead). The radar maps are similar to what you see on TV. Of course, the system needs to know your location.

Happn

This app allows you to share location data. This enables people to meet (e.g., for dating a new partner or meeting a potential employer). For example, let us say that you are jogging in the park, when you cross paths with another jogger, who is a Happn user, you can view her (his) profile. Then, you can communicate and possibly set something up.

Trigger
This app can automatically trigger a variety of phone actions based on NFC tags, Wi-Fi network connections, and Bluetooth. Users can set geofences.

Barriers to Location-Based M-Commerce

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

- **Lack of GPS in some mobile phones.** Without GPS, it is difficult to use LBS. However, GPS-enabled phones are increasing in availability. In addition, the use of cell phone towers helps.
- **Accuracy of devices.** Some of the location-finding tools are not too accurate. A good, but expensive, GPS provides accuracy of 10 ft. Less accurate locators provide accuracy of about 1500 ft.
- **The cost–benefit justification.** The benefits of location-based services may not justify the cost. For customers, it may be inconvenient to utilize the service. As you may recall from Chap. 1, Starbucks discontinued their LBS.
- **Limited network bandwidth.** Wireless bandwidth is still limited. As bandwidth improves with 4G and 5G, applications will expand, which will increase the use of the technology.
- **Invasion of privacy.** Many people are reluctant to disclose their whereabouts and have their movements tracked (see Chap. 15 for a discussion).

The Viability of LBC

During 2009–2013, the concept of LBC gained momentum due to Foursquare and its competitors. The major problem was lack of profitability. The objective of using LBC for advertising and marketing was not attainable. However, since 2016, there is a revival of the concepts due to advances in mobile apps. Companies such as Waze attract millions of visitors. Will LBC become profitable? We will have to wait for an answer (see Chap. 10 for marketing/advertising applications).

SECTION 6.6 REVIEW QUESTIONS

1. Describe the key elements of the l-commerce infrastructure.
2. What is GPS? How does it work?
3. What are some of the basic questions addressed by location-based services?
4. Define geographical information systems. How do they relate to LBS?
5. List the services enabled by LBS.
6. Describe social location-based marketing.
7. List some applications of LBC.
8. List the major barriers to LBC.

6.7 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.

The Internet of Things (IoT)

Ubiquitous computing is the basis for IoT. When the connections in a network are done via the Internet (e.g., using Cloud computing), the network is referred to as the Internet of things (IoT).

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

The IoT will include many everyday things, ranging from smart cars to smart homes, clothes, cities, and many others, all being networked.

The IoT applications are related to intelligent systems and are described in Chap. 7.

The field of pervasive computing has been developed rapidly since it provides the theoretical background for the IoT, wearable computing, and sensors. Google, Amazon, Facebook, and Apple are active in this area (see Ungureanu 2016).

Context-Aware Computing

Context-aware computing is a technology that is capable of 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.

From Theory to Practice

Here we describe one topic: Smart Grids. In Chap. 7, we describe more applications.

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 meters. In addition, electricity consumption can be optimized.

According to the US 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

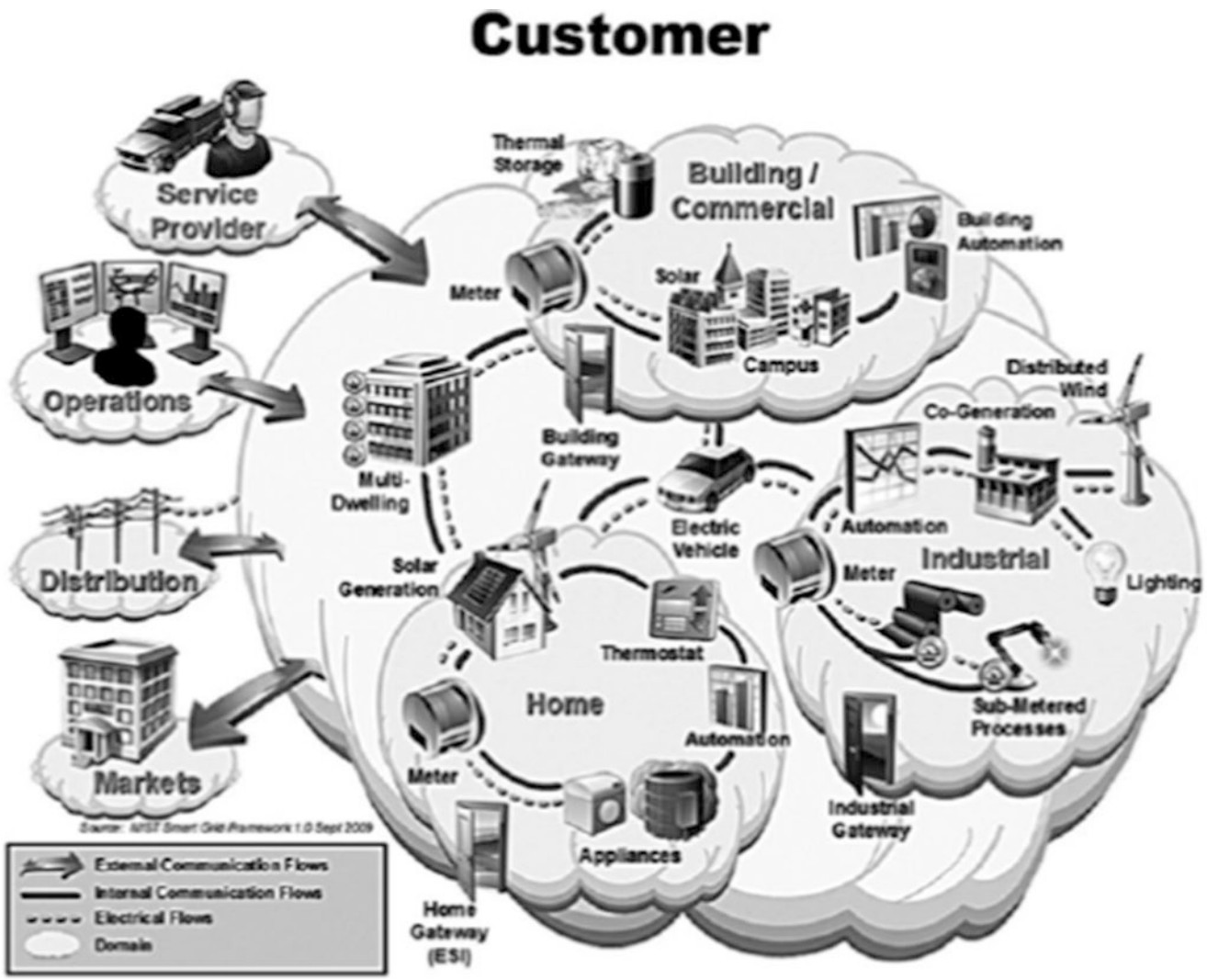

Fig. 6.7 Smart grid environment (Source: National Institute of Standards and Technology, US Department of Commerce, *nist.gov/smartgrid/upload/FinalSGDoc2010019-corr010411-2.pdf* accessed January 2017)

The US 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 utility's network operations center. The essentials of the grid are shown in Fig. 6.7 and in the "Smart Grid Basics" infographic at **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-brings-us-power-21st-century** and **smartgrid.gov**.

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 "Implementation Issues in Mobile Commerce: From Security and Privacy to Barriers to M-Commerce"), 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 6.7 REVIEW QUESTIONS

1. Define ubiquitous computing.
2. What is the Internet of things (IoT)?
3. Describe the smart grid and the role of sensors there.
4. In what ways can pervasive computing impinge on an individual's right to privacy?

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

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

Wearable Computing Applications and Devices

Wearable computing applications and devices have received a major boost since 2015 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. Wearable devices are an important part of the annual CES and computer electronics show in Las Vegas. For a list of wearables and other mobile accessories presented in the 2017 CES, see Diaz (2017). 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. For more on wearable technology, see Hunter (2015).

Sensors

Sensors are devices that collect information from the environment. The device can be a camera, a motion detector, a thermometer, or any of other hundreds of devices. Sensors can be a part of the wearables, or they can be stationary. They are an integral part of many mobile devices (e.g., in facial recognition) and the host of IoT applications. We cannot have self-driven cars or smart homes without sensors. For the use of sensors in mobile devices, see **mobiledevicesensors.com/sensor-applications/**. There, you will find categories of devices and their applications. For a handbook of modern sensors, see Fraden (2016). Wireless sensors and their networks are gaining attention and are used extensively in IoT (watch the 13:20 min video at **libelium.com/video-wsn-introduction**. For 50 sensor applications, see **libelium.com/resources/top_50_iot_sensor_applications_ranking**. Many of these relate to wearables.

Enterprise Wearables

Wearables are used extensively in consumer products. However, many companies are using wearables for 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-papers/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 and 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 (2015).

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 slideshow of wearable devices and their applications, see Khillare and Bobade (2015).

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

Smartwatches

A **smartwatch** is a computerized wristwatch with a 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 instruments 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). Large numbers of companies make smartwatches. Examples are Apple, Google, Samsung, Fossil, Casio, ZTE, and more. Nixon and Qualcomm make sports watches. Smartwatches are combined frequently with fitness and tracker gadgets.

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., Fitbit Blaze). These are becoming more stylish with time. For the best fitness trackers of 2016, see **pcmag.com/article2/0,2817,2404445,00.asp**. For how fitness trackers work, see Nield (2016). Fitness- and health-related gadgets can be on watches, headphones, shoes, and other wearables. For current apps, see Fuller (2017).

Digital (Smart) Glasses

A digital glass 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 Chap. 2). The most well-known glasses are Google Glass. For the best smart glasses of 2016, see Lamkin (2016b).

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 **newatlas.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**).

Google Glasses

According to Petroff (2013), Google Glass (and other "smart glasses") may save companies $1 billion a year by 2017 due to an increased productivity of employees, especially those who need to use both hands to perform complex tasks (e.g., by surgeons, technicians). In addition, the devices can be used, for example, by insurance agents to video damaged property while simultaneously checking on the costs of replacements. Several of the benefits of smart glasses are the same as those of other wearable devices.

Other companies in the United States, 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 eyeglasses' top brands.

Some people love smart 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 top 10 myths" about Google Glass.

Augmented Reality Glasses

Augmented reality is the basis for several wearables. Two types of glasses are on the market. HoloLens from Microsoft can help you to find your lost items in the house or workplace (e.g., your keys). Using a special camera, the device can make a special map of a room. Machine vision technology can then identify or track objects. For details, see Robertson (2016). Aira is a smart glasses-based service that helps people with visual impairment to navigate in the world. A camera that the blind person wears sends the relevant photos in front of the user to a live agent who can then navigate them. For details, see Bosniak (2017).

SECTION 6.8 REVIEW QUESTIONS

1. Describe wearable computing devices.
2. What are the benefits of wearable devices?
3. Describe sensors.
4. What are smart glasses? Why do some people have issues with them?
5. Describe smartwatches.
6. Define fitness trackers.
7. How can smart glasses help the blind?

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, it is not easy 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 attackers' programming malware difficult. However, as the capabilities of smartphones and tablets improve, the threat of malware attacks increases. The same applies to mobile apps and IoT applications. 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 Chap. 11), there are some differences between the two.

The basic security goals of confidentiality, authentication, authorization, and integrity (Chap. 11) 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 antitheft apps that can help you find your phone and keep your personal data safe from identity theft.

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 Chap. 15 for a discussion of privacy issues).

Related to this is the issue of combating fraud; see presentation in Chap. 11.

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.

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 a few more years for sufficient standards to be in place
Power consumption	The longer the life of a battery, the better the devices are (constantly improving)
Transmission interferences	Weather and terrain, including tall buildings, can limit reception. Microwave ovens, cordless phones, and other devices are free but crowded. A range of 2.4 GHz 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 on cell phones
Complexity	Many add-ons and features may make the device difficult to use

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? For an overview, see Diogenes et al. (2015).

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's movements. Finally, there is the issue of privacy infringement and protection while implementing some m-commerce applications. For a comprehensive guide to improving security in a BYOD in the enterprise, see Caspi (2016).

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. For the 2017 issues in MDM, see Matteson (2017).
- **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, etc.). They bring their devices to their workplace and use those devices to access the company's network. BYOD may save the company money. On the other hand, there are many implementation issues ranging from security to reimbursement policy to technical support.

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. For more BYOD for wearables and IoT, see **techproresearch.com/downloads/research-byod-wearables-and-iot**.

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).

Everything "On-Demand" via Mobile Apps

There are hundreds of thousands of apps to get things on demand. We can get food delivery, make reservations, make payments, and much more. This is becoming a culture. Soon, this phenomenon may make PCs and other devices obsolete. The issue of how to secure and manage these apps, some of which are developed by users, will be even more important in the future.

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. Other issues are integration, collaboration, and communication. An interesting issue is the increased flow of data traffic and how to handle it (see Knight 2015). For a comprehensive coverage of mobile technology trends for 2017 and some managerial implications, all presented in an infographic, see Gazdecki (2017).

Conclusion

Despite the many obstacles, mobile commerce is growing rapidly, faster than EC in general. Wearables and IoT are growing the fastest.

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 and 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. **Which applications should be implemented first?** Although there is little interest associated in 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. **Location-based commerce.** Knowing when people are in real time enables many social interactions. In addition, you can use this information to advertise businesses and products and to induce people to check into certain establishments. This technology can also be used to enhance customer service, to improve driving, to save on gasoline, and to engage people in different tasks.
7. **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.
8. **Wearable devices: 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 communication and collaboration. They free people's hands so business processes can be improved. They can be controlled by voice and even by the brain. Many benefits are derived when the wearables are connected to the Internet. Wearable devices that get a lot of publicity are 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. Both smartwatches and smart fitness trackers are some of the many mobile consumer-oriented gadgets that are improving every year and increasing our 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
Geographical information system (GIS)
Geolocation
Global positioning system (GPS)
Intelligent personal assistants
Interactive voice response (IVR) system
Location-based commerce (l-commerce; LBS)
Mobile app
Mobile banking (m-banking)
Mobile commerce (m-commerce; m-business)
Mobile enterprises
Mobile entertainment
Mobile portal
Mobile worker
Multimedia messaging service (MMS)
Pervasive computing
Radio-frequency identification (RFID)
Real-time location system
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 value of Internet-only banks. Check the mobile services of BOFI and compare them to that of the Bank of America.
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 the need to manage BYOD and BYOA.
7. Discuss the advantages of m-commerce over wired EC.

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-mails and voice communications, done on either their own or 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. Discuss the role of augmented reality in mobility and its relationship to smart glasses.
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. Discuss the value of Waze. What are its limitations?
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.com**. Write a report.
14. Is Uber's business part of the sharing economy or just B2C matching? Debate.

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**). Also read **pcmag.com/article/345387/what-is-5g?ipmat=345235&lpmtype=3**. 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 hotspots 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. In addition, 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 **waze.com** and other sources about Waze. Identify all the features of a social network. What is shared there?
8. Enter Facebook and find all their features that facilitate mobile shopping. In addition, see **shopify.com/facebook**. Write a report.
9. Enter meetup.com and find their mobile apps. Write a summary.

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? For example, compare the information sheet provided by Hertz on Hawaii on their website to one that you can get on a smartphone from TripAdvisor.
(b) Which one of Hertz's mobile applications can be considered a mobile enterprise and which one can be considered 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 app. Write a report.
(g) Find information about the NeverLost Companion app. What are its benefits?

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. Indiana University, with eight 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**.)
5. 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: CAN UBER CONTINUE TO GROW IN AN EVOLVING MARKET?

Uber, then called UberCab, began in 2009 in San Francisco, California. The company boasted the ability to hail a cab using a smartphone application. This initial idea has grown worldwide to 81 countries, with a combination of smart technologies and a large decentralized base of independent drivers (**uber.com/our-story**). The company relies on drivers to be available to transport customers on their own schedules. A suite of technology solutions, focused around a smartphone application, allows customers to match themselves with the driver nearest to them. The company's offering has grown and now includes several different classes of cars and even self-driving cars in limited markets (see **nextjuggernaut.com/blog/how-uber-**

works-business-model-revenue-uber-insights). All of this success has spread talks of an IPO in 2017. The company's current valuation is $68 billion (Vellanki 2016). Uber is now a global company operating in hundreds of cities.

Uber is considered a major disruptor (Chap. 5), but can the company be expected to grow in the future or at least grow at the current rate? While Uber has seen many successes in the past, there are several hurdles visible in its future. These challenges may affect the company's ability to remain competitive and profitable in the years ahead. Leaders at Uber will need to face issues with the company's overall business model, growing regulatory burdens, and competition from similar providers.

Business Model

One issue that Uber has always faced is the fundamental soundness of its business model. While the company is growing quickly, so are its losses (Solomon 2016). Company leaders see these losses as a prelude to future growth and a sign that the company is aggressively expanding and maintaining its market dominance. Others are concerned that these losses may never cross over into profits, as the company is faced with competition and legal issues. While an exact description of the businesses profit and loss is not completely available since the company is private. However, leaked information has allowed analysts to make some estimates. It is estimated that the company lost $570 million in Q1 2016 and $750 million in Q2 2016 (Vellanki 2016 and Kolodny 2016).

Part of the business model is collaboration with auto manufacturers and with Hertz and Enterprise Rent-A-Car (for short-term car rental programs). The company also collaborates with Sears.

Regulation

In addition to financial issues, the company faces a wide variety of regulatory challenges. The first set of challenges strike directly at the company's business model and the ability to use independent drivers. A number of legal issues around this model have sprung up. The first issue is that Uber is acting as a taxi service, but is not paying the appropriate licensing fees for that service. Cities argue that Uber must pay the same licensing fees as taxis and that, by not, they are defrauding the city of revenue and competing unfairly (Posen 2015). Plaintiffs in another case contend that Uber's drivers are not truly independent but are acting as employees. In this role, employees would be eligible for benefits as well as overtime, which Uber does not provide (Ross 2015). The final issue is in direct relation to Uber's new driverless car service. In California, the state has held that driverless cars are illegal, and Uber has recently canceled its pilot project in San Francisco, largely due to this complaint (see **nytimes.com/2016/12/21/technology/san-francisco-california-uber-driverless-car-.html**).

Competition

As Uber has continued to grow, others have noticed their success, and that success has brought about competition that did not initially exist. This competition can take the form of a direct competitor, such as Lyft, or changes in the business models from existing companies like Yellow Cab. Lyft has a business model that is very similar to Uber, using independent drivers and a smartphone app to connect them (**lyft.com**). Lyft has a smaller domestic footprint but sees its potential in international markets where firm business boundary is not yet established (see **cnbc.com/2017/01/13/lyft-to-go-global-take-on-uber-outside-the-us.html**). Companies with a history in the taxi business, such as Yellow Cab, are changing their business models to meet some of the same demands of Uber's customers. This includes smartphone applications and lower prices in some markets (see **theverge.com/2016/9/26/13035642/nyc-taxi-cab-android-touchscreen-tablet-verifone**).

Future Plans

Uber started to test driverless cars (Griffith 2016). They already encounter difficulties in testing as discussed earlier. Self-driving car may kill jobs (McFarland 2016). Therefore, there could be political oppositions.

Note: Walton's history has been one of fast growth and many successes. The changes in competitive landscape and lingering issues about the business may cause concern for its future.

Sources: Compiled from Griffith (2016), Kolodny (2016), Posen (2015), Ross (2015), McFarland (2016), and **uber.com** (accessed February 2017)

Questions

1. What is the reason for Uber's rapid growth in both users and revenue?
2. Why is Uber valued at $68 billion, at the time that it is not profitable?
3. Should Uber drivers be treated as employees or independent contractors?
4. Should cities and states be allowed to charge Uber license fees like taxi companies?
5. What can Uber do to remain competitive against companies like Lyft?
6. Are self-driving cars the future of Uber's success? Why or why not?
7. Comment on Uber's partnership with car manufacturers and car rental companies.

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