Contemporary Issues in the Interdisciplinary Research: Smartphone Computing Research

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ABSTRACT

Smartphones have become extremely popular in these days. People use smartphones to perform their daily activities like making phone calls, sending short messages, connecting with others, and browsing the mobile Internet. Although smartphones are indispensable devices, people are not familiar with how they are made of, how they function, and how capable they could be. It is because smartphones are intrinsically complicated and smartphone computing is related to several separate subjects such as mobile computing, mobile data management, and mobile payment and security. This article tries to fill the gap by giving an insight on smartphones including four themes: (i) smartphone status, which gives the current status of smartphones, (ii) smartphone anatomy, which shows the internal structures of smartphones, (iii) smartphone computing, which introduces smartphone app development, and (iv) current issues of smartphone computing research. Finally, further information for more smartphone-computing research will also be given.

Keywords: Smartphones, Smartphone Computing, Smartphone Computing Research, Smartphone Systems, Smartphone Technologies, Mobile Computing, Mobile Systems and Mobile Technologies.

1. INTRODUCTION

Personal computing devices are convenient and they become an essential part of our lives. People use them to perform their daily activities like making phone calls, checking short messages, browsing the Internet, playing mobile games, watching video, listening to music, making payments, etc. The devices started from PCs in 1980s. Gradually, they become smaller and more powerful, and some like smartphones turn out to be very popular and some such as PDAs fades away eventually. They include PDAs (personal digital assistants), feature phones, tablets, and smartphones. Table 1 shows the numbers of units of the four devices (feature phones, smartphones, PCs, and tablets) shipped in the years from 2015 to 2019 based on reports from market researchers [1] [2] [3] [5] [6] [7]. At this moment (2020), smartphones are the winner since they have the highest number of sales. Smartphones are indispensable devices in these days, and people keep asking more functions from smartphones. Though people use smartphones at all times, most of them have no idea how they work. This article tries to fill the gap by introducing smartphone computing to readers and help readers who are interested in developing apps to be familiar with smartphone computing research.

Table 1. Mobile phones, smartphones, PCs, and tables shipped from 2015 to 2019 [1] [2] [3] [5] [6] [7].

	Feature Phones	**Smartphones**	**PCs**	**Tablets**
Number of Units Shipped in 2015 (million)	486	1,424	288	196
Number of Units Shipped in 2016 (million)	396	1,495	270	169
Number of Units Shipped in 2017 (million)	—	1,537	263	160
Number of Units Shipped in 2018 (million)	—	1,556	259	146
Number of Units Shipped in 2019 (million)	—	1,540	261	140

Topics of Smartphone Computing Research

Desktop computing research has been extensively studied, but smartphone computing research is fairly new and is unfamiliar territory for most people. It involves a wide variety of subjects including

- Android systems, computing, applications, and programming
- Client-side mobile-commerce computing, applications, and programming
- Context-based services, computing, and applications
- Embedded systems, computing, and applications
- Energy saving
- iPhone systems, computing, applications, and programming
- Location-based services, computing, and applications
- Mobile advertising and sales
- Mobile and wireless networks
- Mobile commerce applications and systems
- Mobile commerce, business, and banking
- Mobile instructions and classrooms
- Mobile inventory management and resource planning
- Mobile messaging, emailing, broadcasting, and blogging
- Mobile offices, management, and services
- Mobile semantic and intelligent web applications
- Mobile social networks and virtual communities
- Mobile traffic, travel, and weather reports
- Mobile Web 2.0 and further developments
- Mobile Web and data mining

- Mobile Web and Internet access
- Mobile/smartphone algorithms and methodologies
- Mobile/smartphone data management
- Mobile/smartphone entertainment and gaming
- Mobile/smartphone human computer interface and user interface design and implementation
- Mobile/smartphone operating systems and platforms
- Mobile/smartphone programming languages and environments
- Mobile/smartphone security and payment methods
- Mobile/smartphone/embedded database systems
- Remote intranet access
- Server-side mobile-commerce computing, applications, and programming
- Smartphone components such as mobile browsers, cameras and scanners; data synchronization such as infrared and Bluetooth wireless communication; and batteries
- Smartphone hardware and software integration
- Smartphone input and output methods, components and peripherals
- Smartphone specifications, standards, guidelines, software, and tools
- Smartphones, architecture, and systems

Organization of This Paper

Various smartphone topics are given in the previous section, and the technologies used by one function (like mobile payments) may be very different from the ones used by another function (such as mobile advertising). Therefore, smartphone computing research is actual interdisciplinary research including several disciplines like mobile computing, mobile security and privacy, and mobile commerce. This article introduces contemporary issues in smartphone computing research to readers new to the field and provides an overview of current research for those interested in studying smartphones. The remainder of this paper is organized in terms of three main themes:

1. *Smartphones*: A smartphone is a small computer that can be held in one hand. It includes six major components: (i) a mobile operating system, (ii) a mobile central processing unit, (iii) a mobile browser, (iv) input and output components and methods, (v) data storage capability, and (vi) batteries.
2. *Smartphone computing*: Smartphone computing is the use of smartphones to perform wireless, mobile, smartphone operations such as making phone calls, sending short messages, connecting with others, and browsing the mobile Internet. It includes two kinds of computing, namely client- and server- side computing and programming.
3. *Topics in smartphone computing research and applications*: Smartphone research topics cover not only conventional computer research topics but also new ones that arise as a result of the inherently high mobility of smartphones compared to relatively static desktop and laptop computers. Five popular research topics, namely (i) location-based services, (ii) mobile commerce systems and technologies, (iii) mobile and wireless networks, and (iv) mobile security and payment methods, are explained in this section.

This article cannot cover all smartphone issues but instead aims to provide an overview of the field. For those seeking further information useful sources are listed in the final section, including relevant smartphone research publications.

2. SMARTPHONES

Desktop, laptop, and tablet computers make up the client-side of electronic commerce systems, while smartphones serve the same purpose for mobile commerce systems. A smartphone is defined as follows:

> *A smartphone is a small, general-purpose, programmable, battery-powered computer that can be operated comfortably while being held in one hand and enables mobile users to interact directly with mobile applications like mobile banking and making phone calls.*

The major differences among these different types of client machines are listed in Table 2. The market shares achieved by the major smartphone manufacturers for the years 2018 and 2019 [3] are shown in Table 3.

Table 2. Differences between computers and smartphones.

	Desktop Computers	**Laptop and Tablet Computers**	**Smartphones**
Browser	Desktop browsers	Desktop browsers	Mobile browsers
Functions	Full	Full	Limited
Major Input Methods	Keyboards and mice	Keyboards and touchpads/mice	soft keyboards/ writing areas
Major Output Methods	Screens and printers	Screens	Screens
Mobility	No	Low	High
Networking	Wired	Wired/wireless	Wireless and mobile
Transmission Bandwidth	High	High/low	Low
Power Supply	Electrical outlets	Electrical outlets/ batteries	Batteries
Screen	Normal	Intermediate	Small
Size	Desktop	Portable	Handheld
Weight	Heavy	Intermediate	Light

Table 3. The market share achieved by smartphone companies in 2018 and 2019 [3].

	Market Share in 2019 (millions)	*Market Share in 2018 (millions)*
Samsung	1st: 296 (19.2%)	1st: 295 (19.0%)
Huawei	2nd: 241 (15.6%)	3rd: 203 (13.0%)
Apple	3rd: 193 (12.6%)	2nd: 209 (13.4%)
Xiaomi	4th: 126 (8.2%)	4th: 122 (7.9%)
OPPO	5th: 118 (7.7%)	5th: 118 (7.6%)
Others	566 (36.7%)	607 (39.0%)
Total	1,540 (100%)	1,556 (100%)

System Structure of Smartphones
Smartphones are small general-purpose, programmable, battery-powered computers that differ from desktop PCs or notebooks in the following important respects:

- limited network bandwidth,
- small screen/body size, and
- high mobility.

The limited network bandwidth prevents the display of most multimedia on a mobile browser. Though Wi-Fi and 5G networks go some way toward addressing this problem, the wireless bandwidth is always far below the bandwidth of wired networks. The small screen/body size is an issue as it restricts most smartphones to using a stylus for input. Short battery life and limited memory, processing power, and functionality also impede operations to some extent, but these problems are gradually being solved as the technologies improve and new methods are constantly being introduced.

Figure 1 shows a typical system structure for smartphones, which includes the following six major components, (i) a mobile operating system, (ii) a mobile central processor unit, (iii) a mobile browser, (iv) input and output devices and methods, (v) data storage, and (vi) batteries [9]. Synchronization connects smartphones to desktop computers, notebooks, or peripherals to transfer or synchronize data. Many smartphones no longer require serial cables to perform this function as they utilize either an infrared (IR) port or Bluetooth technology to send information to other devices.

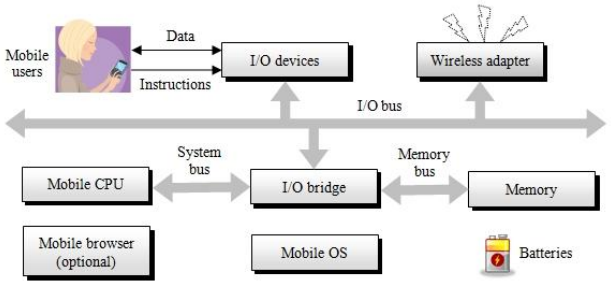

Figure 1. A typical system structure of smartphones.

Mobile operating systems are the most important of the above six components because it usually determines the features of a smartphone. There used to have several mobile OSs available, but only two of them, Android and iOS, survive and dominate the market now. Table 4 shows the market shares of Android and iOS from 2016 to 2019 [4] [11], and some of their major features are shown in Table 5.

Table 4. Market shares of smartphone mobile operating systems, Android and iOS, from 2016 to 2019 [4] [11].

Smartphone Operating System	Android	iOS
Market Share in 2016	84.8%	14.4%
Market Share in 2017	85.9%	14.0%
Market Share in 2018	85.1%	14.9%
Market Share in 2019	86.1%	13.9%

Table 5. Some major features of Android and iOS.

Smartphone Operating System	Android	iOS
Sponsor	Open Handset Alliance and Google	Apple
Development Language	Java	Objective C/C++
Kernel Type	Linux	Hybrid
IDEs, Libraries, Frameworks	Android SDK; Android Studio	iPhone SDK
Source Model	Open	Closed (open for the core)
Initial Release	2008	2007

3. SMARTPHONE COMPUTING

This section will introduce crucial smartphone terms and definitions, including smartphones, client- and server- side smartphone computing. As smartphone computing is a fairly new computing area there is as yet no generally accepted formal definition, but for the purposes of this paper it will be defined as follows:

> *Smartphone computing is the use of smartphones to perform wireless or mobile operations such as browsing the mobile Web or finding the nearest gas station.*

Smartphone computing can take one of two forms, namely client- or server- side smartphone computing. These will be defined next.

Client-Side Smartphone Computing and Programming
The term "client-side" means the computing and programming are completed on the smartphone and there is no need to use a server. Client-side smartphone computing is defined as follows:

> *Client-side smartphone computing refers to the use of smartphones to perform smartphone operations that do not need the support of a server. Examples of these applications include: (a) address books, (b) standalone video games, (c) note pads, and (d) photo-editing.*

The terms "computing" and "programming" are sometimes confusing and often misused. It is important to remember that "smartphone programming," defined as programming for smartphones, is different from "smartphone computing" and is made up of two kinds of programming, client- and server-programming, where the client-side programming is defined as follows:

> *Client-side smartphone programming refers to the design and development of smartphone software such as Java programs that reside on the smartphones themselves.*

Two environments, Android and iOS, are available for client-side smartphone computing and programming. Java and Objective C/C++ languages are used for development by Android and iOS, respectively. These apply different approaches to accomplishing the development of mobile applications. Figure 2 shows a generic development cycle.

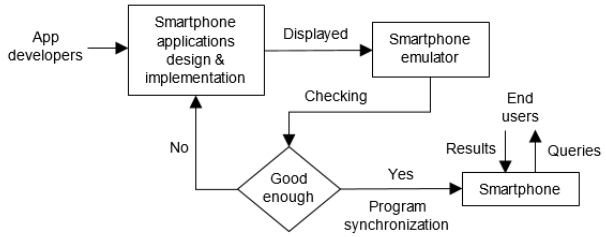

Figure 2. A generic client-side smartphone computing development cycle.

Server-Side Smartphone Computing and Programming

Although the term "server-side" is used, this usually also involves some client-side computing and programming. For example, a mobile web site may require the server-side programs to validate customer information. It may also be necessary for the server to create a client-side interface to enable customers to enter their information. Server-side smartphone computing is defined as follows:

> *For server-side smartphone computing, smartphones are used to perform wireless or mobile operations that require the support of a server. Examples of such applications include: (a) online video games, (b) mobile payments, (c) short message services, and (d) wireless telephony.*

Server-side smartphone programming is defined as follows:

> *Server-side smartphone programming includes the design and development of smartphone software such as PHP programs that reside on servers.*

Server-side smartphone computing and programming may involve complicated procedures and advanced programming such as TCP/IP network programming. However, many smartphone applications involving both server- and client- side computing and programming can be implemented by using mobile development environment such as Android Studio. A database-driven mobile site is often implemented using a client-server architecture consisting of the three layers shown in Figure 3: (i) user interface, (ii) functional modules, and (iii) database management systems. This three-tier design has many advantages over traditional two-tier or single-tier design, the chief one being that the added modularity makes it easier to modify or replace one tier without affecting the others.

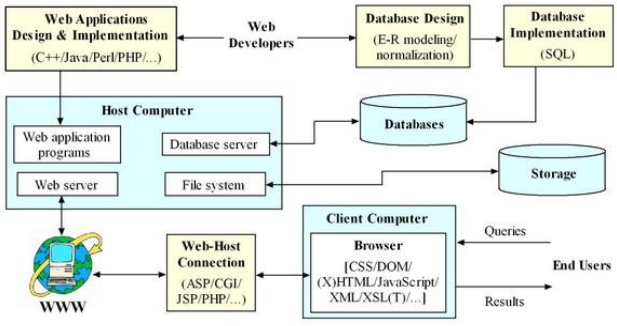

Figure 3. A generic system structure of a database-driven mobile web site.

4. TOPICS IN SMARTPHONE COMPUTING RESEARCH/APPLICATIONS

Smartphones are essential to many people because they regularly use smartphone applications such as short message services and mobile emails in the course of their daily lives. This section introduces five of the most popular topics: (i) location-based services, (ii) mobile commerce systems and technologies, (iii) mobile and wireless networks, and (iv) mobile security and payment methods. Sources of further information about other topics will given in the final section.

Location-Based Services (LBSs)

A location-based service is a service based on the geographical position of a smartphone. An LBS system, which is made up of five major components, is similar to a mobile-commerce system but includes a special component for dealing with location information [10]:

- *Smartphones*: In addition to their regular smartphone capabilities, the devices must also be capable of providing positional information.
- *Mobile and wireless networks*: The networks relay commands/data from the devices to the service providers and return results from the service providers to the devices.
- *Positioning systems*: This component consists of the systems, for example mobile/wireless networks and global positioning systems (GPSs), that make it possible to determine the current positions of the devices.
- *Service/application providers*: Numerous location-based services and applications are now available, and these are generally offered through the Internet.
- *Geographical data providers*: Service providers normally do not maintain geographical information themselves because of the huge size of the associated databases. Instead, the geographical data is usually maintained by data providers such as mapping agencies or yellow-page directories.

Figure 4 shows the five components of an LBS system and the data flows among the components. Introduction to LBSs can be found from the articles [12] [13].

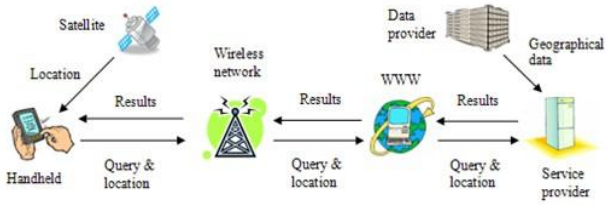

Figure 4. Flowchart showing how a user query is processed in an LBS system.

Mobile Commerce Systems and Technologies

Mobile commerce is the exchange or buying and selling of commodities, services, or information or the transfer of funds on the Internet (wired or wireless) through the use of Internet-enabled smartphones. Although it is the most popular smartphone application, most people are not familiar with its system structures and technologies because the many

technologies and methodologies involved are complex and new technologies are constantly being created.

As with e-commerce, mobile commerce is conducted 100% electronically through computer networks but the two differ in that m-commerce refers to the buying and selling of goods and services via wireless networks using a smartphone. Compared to an electronic commerce system, a mobile commerce system is much more complicated because components related to mobile computing have to be included. To facilitate understanding and constructing mobile commerce systems, here we will use a modular approach to analyze the system. Figure 5 shows the structure of a mobile commerce system and a typical example of such a system [7]. The system structure includes six components: (i) mobile commerce applications, (ii) smartphones, (iii) mobile middleware, (iv) wireless networks, (v) wired networks, and (vi) host computers. The network infrastructure for mobile commerce systems consists of both wired and wireless networks.

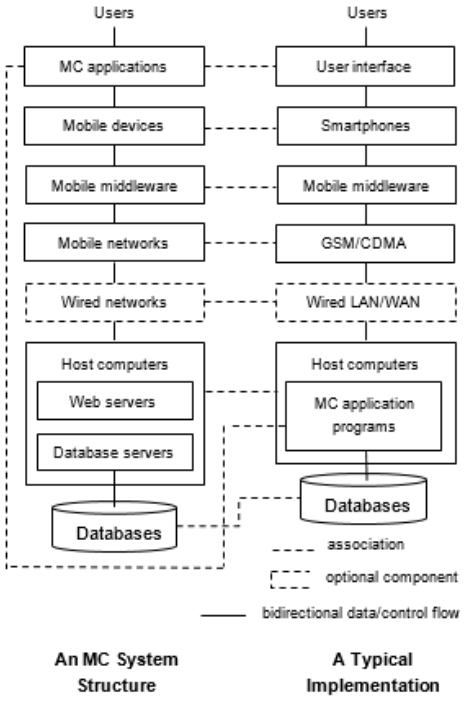

Figure 5. A mobile commerce system structure.

Mobile commerce transaction processing is complicated. To explain how the mobile-commerce components work together for a transaction, Figure 6 shows a flowchart of how a user request is processed by the system, along with brief descriptions of how each component deals with the request:

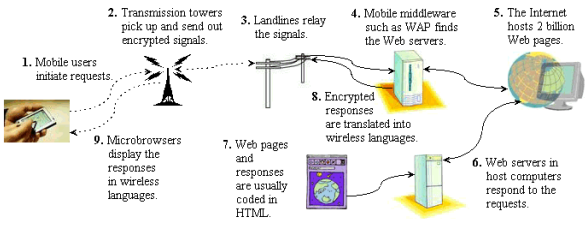

Figure 6. Flowchart of a user request processed in a mobile commerce system.

1. *Mobile commerce applications*: A content provider implements an application by providing two sets of programs: client-side programs such as user interfaces on mobile browsers, and server-side programs such as database access and updating.
2. *Smartphones*: Smartphones present user interfaces to the mobile end users, who specify their requests on the interfaces. The devices then relay the user requests to the other components and later display the processing results using the interfaces.
3. *Mobile middleware*: The major purpose of mobile middleware is to seamlessly and transparently map Internet contents to smartphones that support a wide variety of operating systems, markup languages, mobile browsers, and protocols. Most mobile middleware also encrypts the communication in order to provide some level of security for transactions.
4. *Mobile/wireless networks*: Mobile commerce is possible mainly because of the availability of mobile networks. User requests are delivered to either the closest wireless access point (in a wireless local area network environment) or a base station (in a cellular network environment).
5. *Wired networks*: This component is optional for a mobile commerce system. However, most computers (servers) reside on wired networks such as the Internet, so user requests are routed to these servers using transport and/or security mechanisms provided at least partially by wired networks.
6. *Host computers*: Host computers process and store all the information needed for mobile commerce applications, and most application programs can be found here. They include three major components: Web servers, database servers, and application programs and support software.

Mobile and Wireless Networks

Mobile and wireless communication capability supports mobility for end users in mobile commerce systems. Wireless LAN, MAN, and WAN are the major components used to provide radio communication channels so that mobile service is possible. In the WLAN category, the Wi-Fi standard with 11 Mbps throughput dominates the current market. However, it is expected that standards with much higher transmission speeds, such as IEEE 802.11a and 802.11g, will replace Wi-Fi in the near future. Compared to WLANs, cellular systems can provide longer transmission distances and greater radio coverage, but suffer from the drawback of much lower bandwidth (less than 1 Mbps). More recently, 5G standards supporting mobile multimedia and high-bandwidth services have begun to be deployed in cellular systems. The mobile telephony technology includes several generations as follows:

- *0G (1945 - 1973)* refers to mobile radio telephone systems.
- *1G (since early 1980s)*: the analog cellphone standards, including NMT and AMPS.
- *2G (since early 1990s)*: the digital cellphone standards, which are divided into TDMA-based and CDMA-based standards depending on the type of multiplexing used.
- *2.5G (since late 1990s)* implements a packet switched domain in addition to the circuit switched domain.
- *3G (since early 2000s)* includes wide-area wireless voice telephony and broadband wireless data, all in a mobile environment.

- *4G (since late 2000s)* provides end-to-end IP solutions where voice, data and multimedia streaming can be served at higher data rates to support the anytime-anywhere concept.
- *5G (since 2019)* provides faster speeds. In addition, the 5G networks will provide extra features such as meeting the needs of new use-cases, broadcast-like services, and lifeline communications.

A variety of technologies and standards for mobile/wireless telephony are available. Some of the important ones are as follows:

- *CDMA (Code Division Multiple Access)* is based on a spread spectrum method. The method transmits a signal by "spreading" it over a broad range of frequencies. This reduces interference and can thus increase the number of simultaneous users within a radio frequency band. With CDMA, each conversation is digitized and then tagged with a code.
- *GSM (Global System for Mobile communications)* is one of the most popular standards for mobile telephony and was specifically developed to provide system compatibility across country boundaries, especially in Europe. It is based on TDMA (Time Division Multiple Access) technology, which works by dividing a radio frequency into time slots and then allocating slots to multiple calls. GSM allows eight simultaneous calls on the same radio frequency.
- *IEEE 802.11* includes an encryption method, the Wired Equivalent Privacy algorithm. WLAN (Wireless Local Area Network), based on 802.11, allows a mobile user to connect to a local area network (LAN) through a wireless (radio) connection. The wireless data transmission speed of WLAN is up to 54 Mbps.

Mobile and Wireless Security

No matter how useful smartphone applications are, they are unusable unless users feel safe using them. For example, people will not finish their mobile transactions if they do not trust the payment methods. This section introduces two security issues of particular importance in smartphone computing: mobile security and mobile payment methods.

A secure mobile system must have the following properties: (i) confidentiality, (ii) authentication, (iii) integrity, (iv) authorization, (v) availability, and (vi) non-repudiation. Wireless LAN and WAN are the two major systems used to provide the radio communication channels that make mobile services possible. Security issues specific to WLANs can be dealt with in two ways:

- *Wi-Fi security*. The security provisions in the IEEE 802.11 WLAN standard are based on the use of a data link level protocol called Wired Equivalent Privacy (WEP). When it is enabled, each mobile host has a secret key that is shared with the base station. The encryption algorithm used in WEP is a stream cipher based on RC4. The ciphertext is generated by XORing the plaintext with a RC4 generated keystream.
- *Bluetooth security*. Bluetooth provides security by using frequency hopping in the physical layer, sharing secret keys between the slave and the master, encrypting communication channels, and controlling integrity.

The most important technology in WWANs is the cellular wireless network. GSM and UTMS systems use different approaches to deal with security issues:

- *GSM security*. The Subscriber Identity Module (SIM) in the GSM contains the subscriber's authentication information, such as cryptographic keys, and a unique identifier called international mobile subscriber identity (IMSI). The SIM is usually implemented as a smart card consisting of microprocessors and memory chips. The same authentication key and IMSI are stored on GSM's network side in the authentication center (AuC) and home location register (HLR), respectively. In GSM, short messages are stored in the SIM and calls are directed to the SIM rather than the mobile terminal. This feature allows GSM subscribers to share a terminal with different SIM cards.
- *UMTS security*. UMTS is designed to reuse and evolve from existing core network components of the GSM/GPRS, in the process fixing known GSM security weaknesses such as the one-way authentication scheme and optional encryption. Authentication in UMTS is mutual and encryption is mandatory (unless specified otherwise) in order to prevent message replay and modification. In addition, UMTS employs longer cryptographic keys and newer cipher algorithms, which make it inherently more secure than GSM/GPRS.

Mobile Payment Methods

Among the many issues that arise with mobile security, mobile payment methods are probably the most crucial. These are the methods used to pay for goods or services with a smartphone. Two common kinds of mobile payment methods are

- *Macropayments*: This kind of payment is commonly used by traditional electronic commerce and involves significant amounts of money, for example more than US $10.00. Payments by credit cards are the most common method for macropayments.
- *Micropayments*: These usually involve small amounts of below about US $10.00, which are too small to be economically processed by credit cards. The amounts are usually charged to users' phone bills or accounts.

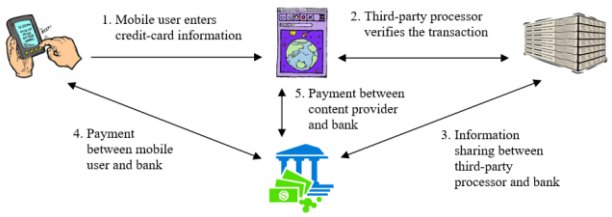

Figure 7. A typical macropayment scenario.

Typical macropayment/micropayment scenarios proceed as follows, as illustrated in Figures 7 and 8 for macro and micro payments, respectively [9]. In the figures, the number indicates the sequence of events.

1. A mobile user submits his/her credit-card or personal information to the mobile content via a smartphone.
2. A third-party processor verifies and authorizes the transaction.

3. The third-party processor routes verification and authorization requests to the card issuing bank or mobile carrier.
4. The user pays his/her monthly credit-card or phone bill.
5. The bank pays the mobile content provider or the mobile carrier pays the mobile content provider directly or through a bank after deducting a transaction fee.

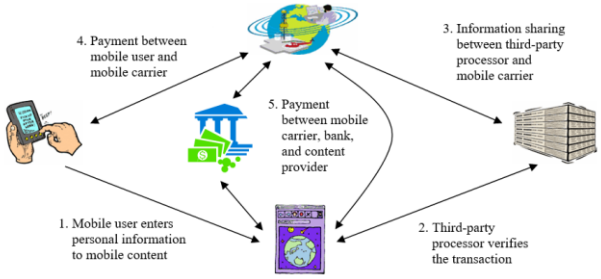

Figure 8. A typical micropayment scenario.

5. SUMMARY

Every milestone in computer history radically changes the human lives, and creates many opportunities and positions for people. For example, the WWW (World Wide Web) helped the dotcom boom, which has created millions of jobs and numerous business and research opportunities. The creation of smartphones and smartphone computing is one of the milestones.

Milestones of Computer History
The milestones of computer history are divided into two sets: software/infrastructure and hardware, where the former set includes the following milestones and the years when they started flourishing:

1. (1957) FORTRAN, the first commercially available high-level programming language,
2. (1969) UNIX, a multi-user and multi-tasking operating system,
3. (1981) DOS (Disk Operating System), a common operating system for personal computers,
4. (1989) WWW, a system connecting countless objects on the Internet, and
5. (2007) iOS, one of the two dominant mobile operating systems currently.

Moreover, the five milestones and their start years of computer hardware history are given next:

1. (1945) ENIVAC, the first electronic computer,
2. (1964) IBM System/360, a widely-accepted mainframe computer,
3. (1977) Apple II, a well-received personal computer,
4. (1996) feature phones, primitive-function smartphones like Nokia and BlackBerry, and
5. (2007) iPhone, the first full-function smartphones.

The milestone of full-function smartphones happened in 2007 when iPhones were released. Before that, many kinds of feature phones like BlackBerry and Palm were available, but they did not function well compared to today's smartphones. It was until Apple launched the iPhone that revolutionized the smartphones.

Related Mobile Publications
There are many other important topics of smartphone computing research such as mobile human computer interaction (HCI), mobile data management (MDM), and mobile multimedia, which are not covered here because of the limited page number of this article. For those interested in pursuing further studies, Table 5 lists some major smartphone-related publications and their themes. Note that many mobile and wireless networks publications are not listed because they would dominate the table if all were included. Smartphones continue to improve rapidly and there is a constant flow of smartphone innovations from many research centers, both academic and for-profit.

Table 5. Some major smartphone-related publications and conferences.

Title	Publisher/Sponsor	Type
Pervasive Computing	IEEE	Journal
Transactions on Mobile Computing	IEEE	Journal
Pervasive and Mobile Computing	Elsevier	Journal
Mobile Networks and Applications	Springer	Journal
MDM (Mobile Data Management)	IEEE	Conference
Mobile HCI (Human-Computer Interaction)	ACM SIGCHI	Conference
Mobile Learning	IADIS	Conference
MobiCom (Mobile Computing and Networking)	ACM SIGMOBILE	Conference
MobiHealth	EAI (European Alliance for Innovation)	Conference
MobiMedia	EAI	Conference
MobiQuitous (Mobile and Ubiquitous Systems)	EAI	Conference
MobiSys	ACM SIGMOBILE	Conference
PerCom (Pervasive Computing)	IEEE	Conference
UbiComp (Pervasive and Ubiquitous Computing)	ACM	Conference

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