

## Mobile Commerce from the view of its Technical Prerequisites and Few Potential Areas of Uses in Bangladeshi Businesses

MD. ZAHIR UDDIN ARIF<sup>1</sup>  
MIR SEMON HAIDER

### Abstract

*Electronic commerce continues to enjoy phenomenal growth, but so far most E-Commerce development demands wired infrastructure, such as a browser on a PC connected to the Internet using phone lines or a Local Area Network (LAN). The limited use and accessibility of internet and compatible devices in Bangladesh did not support E-Commerce up to its potential. The authors envision many new e-commerce applications that will benefit from emerging wireless and mobile networks. The authors term these applications “Wireless E-Commerce” or “Mobile Commerce” or “M-Commerce”.*

*Wireless and mobile networks have experienced exponential growth in terms of capabilities of mobile devices, middleware development, standards, and network implementation, and user acceptance in Bangladesh. Countries with a lack of regular telecom infrastructure are likely to adopt wireless and mobile communications to serve both urban and rural areas. The Wireless Application Protocol (WAP) plays an important role in bridging the gap between the Internet and the mobile world.*

*In this article, the authors examine how new M-commerce applications can be designed and supported by wireless and mobile networks and mobile middleware in the Bangladesh. How a business will adopt these applications will depend on how fast these applications can be developed, acceptance of*

<sup>1</sup> Md. Zahir Uddin Arif is an Assistant Professor, Marketing Department, Jagannath University, Dhaka, and Mir Semon Haider is a Senior Lecturer in Marketing, School of Business, North South University, Dhaka,

*new technologies by users and businesses based on “easy to use” and uniform interfaces, and building of trust/security concern necessary to conduct M-Commerce transactions while on the move. The study advocates widespread deployment of wireless and mobile E-Commerce all over the world, including Bangladesh.*

**KEY WORDS:** *Mobile commerce, m-commerce services, privacy, security, trust, wireless technologies, WAP, network middle-wire*

### **1. Background and Motivation**

Advancements in e-commerce have resulted in significant progress towards strategies, requirements, and development of e-commerce applications. However, nearly all e-commerce applications envisioned and developed so far assume fixed or stationary users with wired infrastructure. The authors of the present papers envision many new e-commerce applications that will be possible and significantly benefit from available and emerging wireless and mobile networks or service providers in Bangladesh. To allow designers, developers, and researchers to strategize and create mobile commerce applications, the authors propose four attempts to identify several important classes of applications such as mobile financial applications, mobile inventory management, proactive service management, product location and search, and wireless re-engineering.

### **2. Methodology**

No systematic study has been done so far in this new important sector of Bangladesh. The present paper is a modest attempt to fill this gap. The paper is prepared on the basis of secondary information, reviewing and analyzing the existing international literature published in relevant books, magazines, reports, and relevant websites.

### **3. Mobile-Commerce Defined**

Mobile commerce – the conduct of business transactions over the internet enabled wireless devices – is gradually becoming a dominant force in business and society. The push for advancing technology and the pull of public demand for low-cost, high-speed, communications and ubiquitous access to information anytime anywhere have truly revolutionized the telecommunications industry over the past two decades. Nevertheless, the wireless web market is still in the womb in Bangladesh, and Mobile Commerce (M-Commerce) is expected to evolve significantly in future; this study looks forward to locate some potentials.

Mobile Electronics Commerce (M-Commerce) is defined as any type of

transaction of an economic value having at least one mobile terminal at one end and thus using the mobile communication network. E-Commerce transactions performed by a mobile customer via a fixed terminal (e.g. from a cyber cafe) or via a portable computer that is connected to the internet via a modem and wired network are not included in his definition. The same applies for personal SMS communication sent by one person to another.

M-Commerce is the product of interaction among business transactions, Internet applications, and mobile communications. It is a highly evolved version of t-commerce (commerce via telephony) of the 1980s and E-Commerce (commerce via the Internet) of the 1990s.

Figure 1 shows the revolutionary changes in the cellular mobile communication facilities in almost every decade. The first generation (1G) system, introduced in the early 1980s, provided analog voice-only communications, and the second generation (2G) system, introduced in the early 1990s provided digital voice applications and circuit switched low speed data services (Mehrotra, 1994). The introduction of the third generation (3G) systems resumed in the 21<sup>st</sup> century, with the focus shifting to packet instead of just void data ([www.umts-forum.org](http://www.umts-forum.org)). The fourth generation (4G) system was foreseen to provide broadband IP-based multimedia services around the year 2010 ([www.docomo.com](http://www.docomo.com) and Tachikawa, 2003).

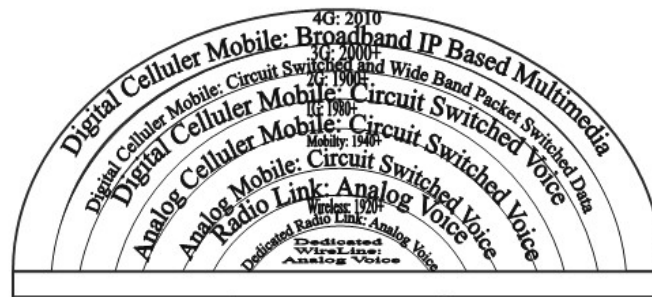


Figure 2: Evalalution in Mobile Evolution in Recent Decades

### 3.1 Mobile Advertising

Mobile advertising is also a very important class of m-commerce applications. Using demographic information collected by wireless service providers and information on the current location of mobile users, much targeted advertising can be done. The advertising message can be personalized based on information

provided by consulting the user at an earlier stage or by the history of the user's purchasing habits. Advertisements sent to a user can also be location sensitive and can inform a user about various on-going specials (shops, malls, and restaurants) in surrounding areas. The type of advertising can be performed using short messaging service (SMS) or by using short passing message to mobile users. The message can be sent to all users located in a certain area (the geographic region can be identified by advertisers or even by users in advance). A user specific message can be sent independent of the user's current location.

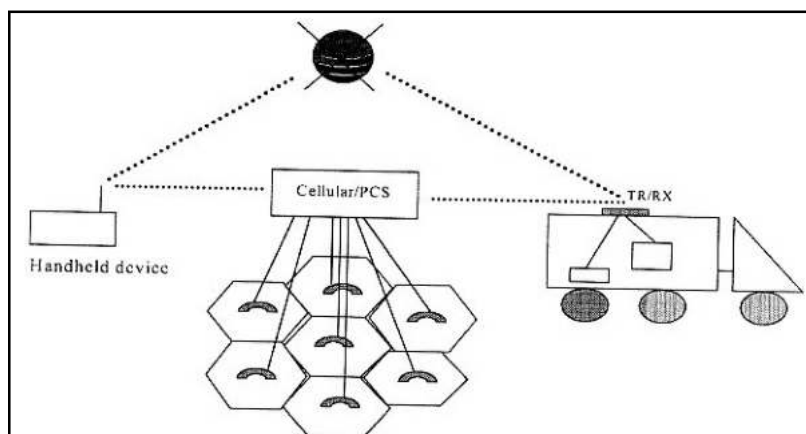
Also, depending on interests and the personality type of individual mobile users, a network provider may consider using a "push" or "pull" method of mobile advertising based on a per-user basis or a class of users.

Wireless networks may consider such advertising lower priority traffic if network load crosses a certain threshold. Since these services need the current location information of a user, a third party may be needed to provide location service. However this may require a sharing of revenues between the network service provider and location service provider.

### 3.2 Mobile Inventory Management

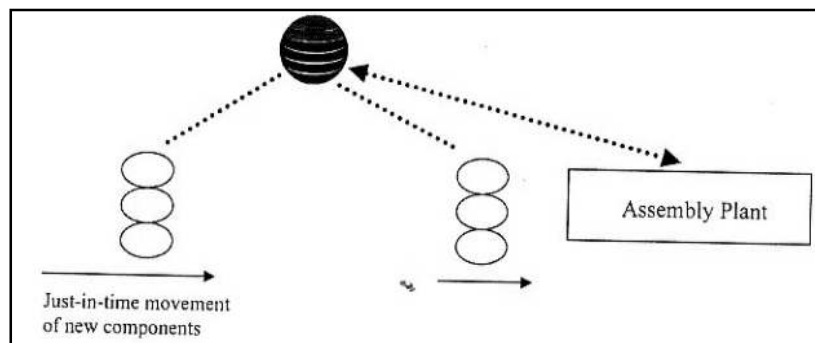
This class of applications involves location tracking of goods, services, and possibly even people. The tracking of goods may help service providers in determining the time of delivery to customer service and obtaining a competitive edge over other businesses. One very interesting application is "rolling inventory", which may involve multiple trucks and just-in-time delivery of goods

**Figure 2: Authors' idea in Locating and Tracking of Goods with M-Commerce.**



can be performed. The rolling inventory and delivery application can reduce the amount of inventory space and cost for both vendors and stores and may also reduce the time between when an order and when placed on the goods are delivered (Figure 2). Rolling inventory is a B2B m-commerce application while location tracking can be considered a B2C application. Using expensive embedded radio/microwave devices (chips), a wireless network can track goods and services. Since satellite signals may not work well inside a truck, a separate wireless LAN can be provided on-board for intra-truck communication and tracking.

**Figure 3 : Authors' idea in Location Tracking and just-in-time movement of components using M-Commerce**



Another example of MIM is just-in-time delivery/movement of components in an assembly plant based on the rate of consumption of existing components (Figure 3). A variety of new components can be moved at a certain speed after receiving a wireless signal from the components reaching the assembly line or from a device on the assembly line itself. This will allow just-in-time delivery leading to a reduced inventory and assembling cost. If the new components are delayed for some reason, then signals can be sent to the assembly line for possible adjustment of the assembly speed to match the arrival time of new components. Such an application would reduce the inventory cost while increasing productivity by matching the speed of new component arrival to the rate of assembly.

### 3.3 Mobile Entertainment and Other Services

With an increasingly mobile society, more and more people are on the move. While mobile, people may prefer to be involved in some business or entertainment activities. Many of these services can be offered to people through mobile devices and wireless meters. These include mobile auction/reverse

auction, video-on demand service, and other entertainment-oriented services. The technologies needed include mobile devices with capabilities to match desired applications, suitable mobile middleware, and wireless networks with high bandwidth (such as emerging LEO satellites or third generation wireless networks).

#### **4. Wireless User Infrastructure and Middleware Issues**

To make the applications described previously a reality, several functional components are necessary. One important area includes mobile devices with sufficient power in terms of memory, display and communication functionalities. The hand-held device is really the entry point for most mobile commerce systems. The capabilities or limitation of these devices will impact the type and frequency of which mobile commerce applications will be used.

The devices available today (Oliphant, 1999) can be characterized as either communication-centric or computing-centric. However, in near future such differences may cease to exist as these devices converge to a single intelligent mobile device. Many hand-held devices now support a variety of network interfaces and access ranges, from short range Bluetooth, to wireless LAN to wireless WAN access. Location support, video streaming, barcode readers and other features are also being implemented in many of the devices.

Although it is possible to do some simple mobile commerce transactions using a simple hand-held device, many sophisticated mobile commerce applications require other capabilities. For example-

- Dynamic, adaptable and smart user interface with multi-lingual support,
- Ability to accept user input in many forms, including voice,
- Ability to display rich and usable contents,
- Location awareness and ability to track users, products and devices,
- Multi network interfaces for increased and reliable wireless access,
- Basic security features to handle malicious code, support for authenticating user, servers, and applications,
- Ability to work with and adapt to mobile commerce applications with diverse requirements (such as the types of transaction both push and pull, transaction rates, duration, and multicast),
- Possible support for context awareness,
- Ability to discover and download upgraded applications and software proactively,

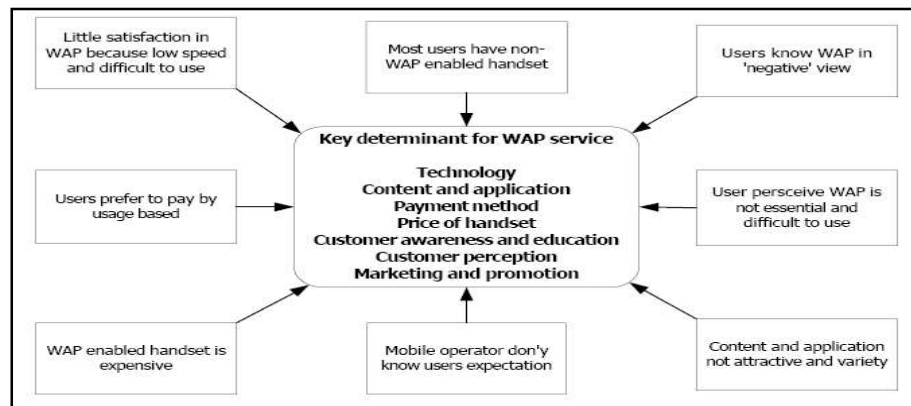
- An operating system that can manage resources to support many of these functions.

Some of these features are already available in hand-held devices. For example, iMode devices using I-appli can use software applications downloaded from sites by employing an automatic transmission mode. These devices are also capable of receiving area specific (location-dependent) information and currently support a bi-lingual (Japanese and English) interface ([www.nttdocomo.com](http://www.nttdocomo.com)).

### 5. Primary Problems of Introducing WAP in Bangladesh

WAP success depends on rapidly expanding the installed base of WAP terminals. Operators are in a strong position to do this, but they must put pressure on the handset vendors to provide WAP terminals on time and at the right price. An upgrade strategy is required with a carefully constructed marketing message, as further upgrades will be required for 2G+. The key determinants for WAP service and m-commerce in Thailand are summarized in Figure 4.

**Figure 4: Possible Key Determinants for WAP service (The authors' finding).**



Information and telecommunication services on mobile terminals. It was developed by the WAP forum, an industry association founded by Nokia, Ericsson, Motorola and Unwired Planet in June 1997 with the goal to open internet for wireless mobile access by creating a 2G+ network technology. Today, WAP forum comprises over 200 members from all segments of wireless industry value chain, including Hewlett Packard, Microsoft, IBM etc. aiming to ensure product interoperability and growth of wireless market.

Internet standard such as HTML, HTTP, TLS, TCP are inefficient over mobile networks as they require large amounts of mainly text-based data to be

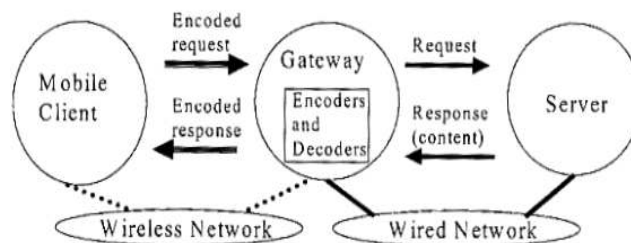
transferred. Standard HTML content can not be effectively displayed on the small-sized screens of packet sized mobile wireless terminals or pagers. WAP optimizes these standards for low band-with, high latency and unstable connection.

The WAP specifications define a lightweight protocol to minimize band-with requirements and to guarantee that a variety of wireless networks can deliver WAP service. The lightweight protocol stack is designed to minimize the required brand with and minimize the number of wireless network types that can deliver WAP content. Multiple networks can be targeted, which include GSM900, 1800, 1900 MHz, DECT, TDMA, PCS, FLEX and CDMA. All network technologies and bearers will also be supported, including SMS, USSD, CSD, CPDD and GPRS.

The interface between the operator's network and the internet is realized by the WAP gateway, which includes HTML to WML fitters. The HTTPS interface to an on-line web server as well as interface to the WAP from the mobile devices/terminal are sent as a URR through the operator's network to the WAP gateway (Figure 5). Responses are sent from the web server to the WAP Gateway in HTML, which are then translated in WML and sent back to the mobile terminal over WST/WST.

**WAP** (Wireless Application Protocols) appears to be the key to future IP-based m-commerce applications. WAP, an industry-initiated world standard, has emerged as a common communications technology and uniform interface standard for presenting and delivering wireless services on wireless devices (Varshney and Vetter, 2002). WAP specifications include a micro-browser, access functions, and layered communication specifications for sessions, transport, and security. The WAP gateway is used to translate the WAP protocols (protocols that have been optimized for low bandwidth, low power consumption, limited screen size, and low storage) into the traditional Internet protocols (TCP/IP). These specifications

**Figure 5 : The Role of WAP Gateway for Bangladesh according to the author**





enable bearer-independent and interoperable applications. In short, future trends clearly indicate that the device manufacturers as well as service and infrastructure providers will keep adopting the WAP standard ([www.openmobilealliance.org](http://www.openmobilealliance.org)).

In this process WAP established the mobile terminal as a trusted, personalized delivery channel for many kinds of services – new financial services, travel services, information services, news alerts, relating services, entertainment services and so on. The penetration of the market by WAP is quite hard for Bangladeshi context but not at all an impossible task. Moreover, it will generate possibilities and create challenges and competition and network operators for service providers in providing new services for the clients.

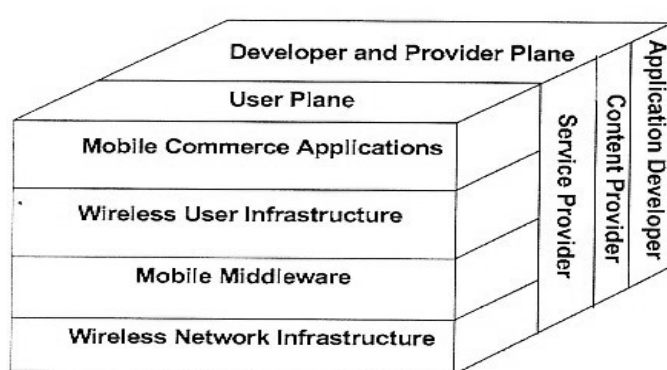
### 6. Possible Mobile Commerce Framework

To help future developers and M-Commerce service providers to strategize and effectively implement M-Commerce applications, a framework is shown in Figure 6.

The framework tries to define multiple functional layers, simplifying the design and possible future development in the current mobile service infrastructure, so that different parties (service providers, vendors, sellers, suppliers, developers, and designers etc.) can focus on individual layers. This framework has *four levels*:

- Mobile Commerce Application,
- User/client infrastructure,
- Mobile middleware, and
- Network infrastructure.

**Figure 6: From the viewpoint of the authors, A Possible Framework for M-Commerce**



The framework shows that M-Commerce applications should take into consideration the general capabilities of user infrastructure (Mobile/Wireless Devices), and not the individual devices. With its ability to hide details of understanding wireless and mobile networks from applications while at the same time providing a uniform and easy to use interface, mobile networks middleware distinctively is an extremely important component in developing new mobile commerce applications. The network infrastructure also plays an important part in M-Commerce, as the user-perceived service quality depends on available resources and capabilities of wireless and mobile networks.

The framework also shows a developer and service provider plane to indicate the different needs and roles of application developers, content providers and service providers. Each of these could build its products and services using the functionalities provided by others.

A content provider can offer its service using applications from multiple application developers. They can also aggregate content from other content providers and can supply the aggregate content to a network operator or service provider.

Service providers can also play the role of content aggregators, but are unlikely to act as either an application or content provider due to their focus on the networking and service aspects of M-Commerce. A service provider can also be a clearing house for content and application providers in advertising and distributing their products to its targeted customers/clients.

Wireless carriers can play a very active and important role in M-Commerce application and services due to the fact that a mobile user is going through their network to perform all commercial transactions. In addition, a mobile user is likely to perform one common bill (bundled services) for voice, data and M-Commerce services. However, there are many technical and non-technical hurdles (i.e. pricing for mobile commerce transaction) that need to be solved. Before carriers can become major players in this emerging business field. The key advantage of M-Commerce is its ability to support a wide variety of attractive and innovative applications, and that will be the “killer” characteristic of M-Commerce. It is worth highlighting that the highly-personalized, context-aware, location-sensitive, time-critical applications, conducted in a very secure environment are the most promising M-Commerce applications. There are indications that the next generation of wireless communications services based on 4G systems will not be limited to human (as it has been before) but rather to

anything that very small wireless chips can be attached to (i.e., machine-to-machine communications).

Table-1 Highlights the M-Commerce service categories encompassing sets of attractive applications.

M-Commerce services with compelling contents are provided by tight business and strategic partnership arrangements and by involving a large number of companies, each influencing other parties in the value chain. While no two value chains are the same, a company can assume multiple roles in the value chain for m-commerce, or a single role for a multiplicity of services, such as M-Commerce, E-Commerce and, iTV. Table-2 identifies the main categories of players in the m-commerce value chain.

**Table 1 : M-Commerce Value Chain**

<i>Players</i>	<i>Roles</i>
Telecom Infrastructure Providers	provide the communications networks.
Infrastructure Equipment Vendors	manufacture the mobile base stations and switching systems.
Mobile Network Operators	provide wireless access to mobile users.
Mobile Device Manufacturers	manufacture wireless devices (e.g., phones, pagers, PDAs).
Mobile ISPs	provide mobile users with anytime, anywhere access to the Internet.
Mobile Content Providers	develop new content to deliver information and services.
Mobile Portal Providers	provide mobile users with access to all Internet needs.
Content Aggregators	focus on value creation by assembling content from multiple sources.
Mobile Location Brokers	supply info about user's position to everyone across the value chain.
Software Vendors	supply operating systems, databases, and micro-browsers.
Third-Party Billing Providers	make it possible for users to make payments.
Server Wallet Providers	store both payment information and other valuable personal data.
Security Providers	ensure secure payments through digital signatures and biometrics.
Push/Pull Advertisers	furnish users with messages to influence them.
Voice Portals	provides users with audio interfaces
Mobile Technology	provide technologies to introduce new applications.
Online Retailers	sell product and services to mobile users over the Internet.
Financial Organizations	allow all users to pay using debits/credit cards.
Wireless Applications Providers	develop, maintain, and/or host applications.

Figure 7 presents a generic payment model for mobile commerce ([www.openmobilealliance.org](http://www.openmobilealliance.org)). This model provides an abstract view of what information is passed between various parties to conclude a transaction and does

not depict any particular ordering of the information flow. In the selection phase, the customer indicates what goods and services are desired, and he/she negotiates the price of the goods and services and the terms of conditions. The transaction details highlight the description of goods or services, the customer's name, and

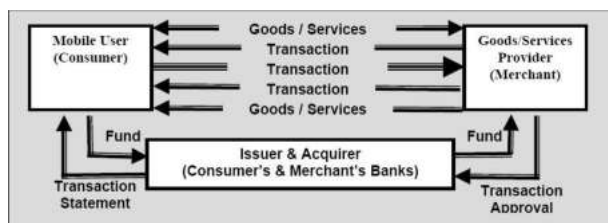
**Table 2 : M-Commerce Services and Applications**

Service Categories	Applications Types
<i>Portal Services:</i>	SMS, E-mail/voice-mail/video-mail, interactive voice, instant messaging, soft fax, Web browsing, synching with PC, video-conferencing, file transfers, MMS
<i>Entertainment Services:</i>	Interactive games, downloading music (MP3 files) and comics (jokes/cartoons/horoscope), uploading photos, streaming music/video on-demand, gambling
<i>Financial Services:</i>	Banking, stock trading, paying fees, bills, tolls, and e-cash
<i>E-Tailing Services:</i>	Shopping, booking, ticketing, advertising (user-specific/time-dependant/location-sensitive)
<i>Directory Services:</i>	Finding the nearest "X" (on-the-move yellow pages) and shortest route (driving directions)
<i>Information Services:</i>	News (e.g., sports, business, weather, traffic), crisis alert
<i>Distribution Services:</i>	Fleet tracking/dispatching of goods/people, broadcasting/multicasting, audio/video streaming
<i>Monitoring Services:</i>	Metering, trouble shooting, inventory control & management, tracing & tracking moveable/wearable objects, telemetry services, tracking assets, tracking stolen/lost cars/pets
<i>Social Services:</i>	Medical query/consultation, distance learning
<i>Security Services:</i>	Security and surveillance of people, locations, and things
<i>Emergency Services:</i>	911 & enhanced 911, taxi, roadside
<i>Micropayment Services:</i>	Wireless access to vending machines, parking meters, gas pumps
<i>Access Services:</i>	Wireless access to doors and toll booths

other required details. The customer then responds with transaction credentials (which may contain the payment credentials), the transaction details, and some authentication of the customer. Upon authentication, the payment is approved, the funds are transferred, and the goods will be delivered, or services will be provided.

In mobile payment, although confidentiality (making sure that information is not visible to eavesdroppers), integrity (finding out the content has not been tampered with), and non-repudiation (proving that the transaction has taken place) are primary concerns, authentication (ensuring that communicating parties are certain of each other's identity) is of paramount importance. As a result, public key

**Figure 7: M-Commerce transaction model**



cryptography, which is slower but more powerful than symmetric key cryptography, will be used for authentication and the exchange of symmetric session keys. In order to prevent a false (cracker's) public key as a legitimate public key, a certificate authority issues a public key certificate that would contain the name, the public key, and the expiration date. In view of the fact that the emerging wireless devices will have more throughputs, processing power, and memory, more complex encryption techniques—such as longer keys and/or more sophisticated multi-level algorithms—will be employed to enhance mobile payment security (Sklar, 2001).

### **7. Privacy, Security and Trust in M-Commerce**

Even though wireless communications have numerous merits, privacy is not one of them. M-Commerce possesses, in addition to all privacy issues related to E-Commerce, another major privacy threat: the sharing of knowledge about a user's location with others. There are basically three solutions to this positioning problem: i) the network-based solution, where the calculations are carried out by the cellular network and the positioning information may then be passed to the user; ii) the device-based solution, where the wireless device computes its own position; and iii) a hybrid solution. The pitfall associated with the network-based positioning is that the information about the user's whereabouts can be collected but not necessarily passed to the user. Instead, the information may be exploited by other entities, all without the user's knowledge, let alone his/her consent. Also, there are some privacy implications about the requirement that wireless devices need to be embedded with a location tracking technology to provide location-based services, such as targeted advertising and finding the nearest "X." For instance, if location records were kept over time, an in-depth profile could be compiled for other, perhaps unwarranted, purposes.

### **8. Conclusion**

The potentials of M-Commerce are enormous for all over the world, including Bangladesh. Mobile terminals seem to be the ideal channel for offering personalized and location-based services as well as for *one-to-one* marketing. Other very popular applications are mobile advertising, mobile financial services (stock exchange, bank payments, and insurance services), mobile entertainment, e-mails based on SMS and alert services, to mention a few.

Regarding the m-terminals, PDAs and smart phones, including a WAP micro-browser for wireless Internet access, are becoming very popular. We will soon

have a wide range of mobile terminals from simple voice terminals to multi-purpose terminals incorporating MP-3 player or video player that can handle in parallel voice, data and video services, depending on customer demand.

The mobile network operators have a competitive advantage in the M-Commerce market due to the fact that they possess information about customers, they have an established billing relationship with them, and they can easily locate the subscriber's geographical location. Thus, location-based services such as advertising, shopping, reservations and information provisioning can be easily offered. Also, they can be strategically positioned between content/service providers and subscribers and have an upgraded role in the M-Commerce value chain by acting as mobile portals or information brokerage. They can also play the role of Internet service provider and even acquire a bank or a banking license and play the role of a Trusted Third Party. It is very likely that operators will keep only mobile voice services and set up subsidiary companies for mobile portal services in order to comply with existing legislation and also because of the different business models required for serving respective demands. In this paper we have investigated some of the roles that the mobile network operator can play and discussed associated issues. A more extensive discussion on the associated business, legal and technical issues as well as on transactional aspects may be found in (Tsalgatidou and Veijalainen, 2000).

At the moment there is still only a small number of applications and contents available. The WAP phones are not widely available and the call set-up time is too long. But, there is a lot of work going on by many industries, network operators and software providers. It is expected that, as GPRS10, which started in 2002, will become more widespread, m-commerce will begin to take off on a larger scale (Durlacher Research Ltd.: Mobile Commerce Report, 2000). However, in order for m-commerce to flourish, related business and legal issues should also be resolved.

Future research should focus on studies involving implemented technology. Because our study is based on hypothetical services, the findings do not necessarily reflect users' behaviors in a real setting. Longitudinal studies could be conducted to assess if the use level is consistent or is just due to initial excitement. Finally, research focusing on implementing technology to ensure privacy, should consider looking into what level of privacy is actually needed and desired by users.

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Your Wap. [www.yourwap.com](http://www.yourwap.com)

**Appendix: List of Selected Acronyms**

CDMA	=	Code Division Multiple Access
FCC	=	Federal Communications Commission
GPS	=	Global Positioning System
GSM	=	Global Systems for Mobile communications
ISDN	=	Integrated Services Digital Network
ISP	=	Internet Service Provider
ITU	=	International telecommunications Union
MIMO	=	Multiple Input Multiple Output
MMS	=	Multimedia Messaging Services
OFDM	=	Orthogonal Frequency Division Multiplexing
PIPEDA	=	Personal Information Protection & Electronics Document Act
PSTN	=	Packet-Switched Telephone Network
RFID	=	Radio Frequency Identification
SDR	=	Software Define Radio
SMS	=	Short Messaging Services
UWB	=	Ultra Wide-Band
WAP	=	Wireless Application Protocols
WBAN	=	Wireless Body Area Network
WEP	=	Wired Equivalent Privacy
WLAN	=	Wireless Local Area Network
WPAN	=	Wireless Personal Area Network
WMAN	=	Wireless Metropolitan Network
WRC	=	World Radio Conference