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Certificate in e-Commerce

CEC-04

E-payment System and M-commerce

Block – 03

Mobile Commerce

Unit-1 Overview Of M-Commerce

Unit-2 Mobile Computing And Wap

UNIT-1 OVERVIEW OF M-COMMERCE

Learning Objectives

After reading this chapter, the students should be able to:

- Understand the meaning of mobile commerce
- Discuss the differences between m-commerce and e-commerce
- Enumerate the driving force for m-commerce
- Discuss the applications of m-commerce

Structure

- 1.1 Introduction to Mobile Commerce
- 1.2 M-Commerce Versus E-Commerce
- 1.3 Driving forces for M-Commerce
- 1.4 Limiting Factors for M-Commerce
- 1.5 Applications of M-Commerce
- 1.6 Benefits of M-commerce in India
- 1.7 Condition of M-Commerce in India
- 1.8 Let's sum-up
- 1.9 Key terms
- 1.10 Self-Assessment Questions
- 1.11 Further Readings
- 1.12 Model Questions

1.1 INTRODUCTION TO MOBILE COMMERCE

Mobile phones are central to the lives of most people in developed countries and are growing in importance in less developed countries.

Since their mainstream adoption in the 1990s, they have remained primarily communication devices. The internet and other technological advances have certainly changed the way. Even the most mundane things can now be accomplished through various ways and means, which have a lot to do with technology.

For a while, e-commerce has been a major catchphrase in business. E-commerce, also known as electronic commerce, was about trading products and services via the internet and other computer networks and electronic systems. These activities include, but are not limited to, banking, insurance, advertising and warehousing. Even transportation transactions were also completed using e-commerce. Basically, e-commerce was broadly referred to as conducting business on the internet. The increasing usage of mobile and telecommunication devices acted as another precursor to change, and that change led to the rise of mobile commerce, also known as m-commerce.

However, the situation is changing. Mobile phone manufacturers have developed mobile devices that can serve many functions beyond voice communication such as taking photos and listening to music. Mobile network operators are offering services that give greater value to subscribers, such as portable email for business users. Mobile phones are now equipped with cameras with the potential to turn them into portable bar code scanners. Handset manufacturers are developing Radio-frequency Identification (RFID) chips that can turn mobile phones into mobile wallets able to carry and exchange electronic money securely and engage in other transactions with RFID readers in the physical world.

The combination of more powerful mobile devices, more innovative mobile operators and change in the mobile network infrastructure (such as 3G networks able to carry large amounts of data at high speed as broadband connections do for computers) is setting the stage for an enormous change in a already fast-moving sector. Mobile devices are fast becoming the place where numerous technologies meet and create applications that are useful for both consumers and businesses across the globe. All these activities fall under M-commerce. The mobile phone of the future is a device that enables users to communicate, connect, transact and innovate.

The phrase mobile commerce was originally coined in 1997 by Kevin Duffey at the launch of the Global Mobile Commerce Forum, to mean "the delivery of electronic commerce capabilities directly into the consumer's hand, anywhere, via wireless technology." Many choose to think of Mobile Commerce as meaning "a retail outlet in your customer's pocket." M-commerce (mobile commerce) is the buying and selling of goods and services through wireless handheld devices such as cellular telephone and personal digital assistants (PDAs). Known as next-generation e-commerce, m-commerce enables users to access the Internet without needing to find a place to plug in. It is safe to say that m-commerce is an upgraded version of e-commerce. In fact, m-commerce has been defined as the conduct of e-commerce activities using mobile or cellular devices. If business transactions involve the use of wireless telecommunication networks, then it is highly likely to fall under m-commerce.

While terminologies such as internet banking, electronic money transfers and online shopping were very exciting and phenomenal in the past decade, what excites consumers now is mobile banking, money transfer via mobile and mobile bookings among many others.

1.1.1 Unique Features of M-Commerce

In order to fully understand what sets mobile commerce apart from e-commerce and m-business, it is a good idea to take a look at its unique features, which can be clearly seen in its advantages.

Mobility and ubiquity: Mobile commerce involves the use of portable mobile or cellular devices, such as mobile phones, smartphones and tablets. Portability results in closer proximity between businesses and their consumers, meaning it is now possible for businesses to reach their target audience faster. The parties are not restricted by physical or geographical locations when doing commerce, be it purchasing a product, completing a bank transaction, or even bidding on an auction. In addition, the

technology and devices that power mobile commerce are also available and readily accessible. As such, the probability of the businesses making a sale is also higher.

Electricity requirement: In e-commerce, a constant connection to an electric outlet is mandatory to power the devices. Thanks to the increased usage and flexibility of mobile devices which come with their own batteries, shopping via mobile devices is possible even without electricity.

Comfort, convenience and spontaneity: Many people prefer making their purchases over their desktop or laptop computers, in the comfort of their own homes or offices, instead of making that trip to the physical store or location of the goods or services that they want to buy.

However, there are even more people who find it more convenient to do their shopping on their mobile phones, and they can do this while sipping some latte at a coffee shop or even in a bus or train as they travel. There is no need to rush home or to the office to access the computer in order to buy something. All users have to do is whip out their tablets or phones and do their shopping from there.

1.2 M-COMMERCE VERSUS E-COMMERCE

Mobile Commerce, or m-Commerce, is about the explosion of applications and services that are becoming accessible from Internet-enabled mobile devices. It involves new technologies, services and business models. It is quite different from traditional e-Commerce. Mobile phones impose very different constraints than desktop computers. Between e-commerce and m-commerce, the latter is the newer concept, seeing as mobile technology had not exploded until about two decades after the internet was able to be used to conduct commercial transactions using electronic systems.

While e-commerce mainly makes use of computers, and requires internet connectivity, m-commerce uses mobile devices such as smartphones, PDAs, tablets

and it relies mainly on an internet connection provided by wireless telecommunication networks.

One of the major advantages of m-commerce over e-commerce is portability and flexibility. While internet connectivity is required in e-commerce, that is not the case in mobile commerce since these devices come with their own connection to the internet using telecommunication networks. Since the mobile devices are also smaller and more portable, users can literally conduct commercial activities anywhere, even in places with no electricity. This means, that usage of m-commerce is also broader, thanks to this portability feature.

The rise of m-commerce has certainly boosted e-commerce as a whole, since users are given more options on the platform and tools, and a majority of the limitations that they have encountered in e-commerce do not exist in m-commerce.

Both of these terms have different meanings though both aim at making consumer lives easier. To understand more the differences between E-commerce and M-commerce, please have a look at the following table

| <i>Criteria</i> | <i>E-commerce</i> | <i>M-commerce</i> |
|-----------------|---|---|
| Definition | Electronic Commerce (or also called E-commerce) refers to the activities of buying and selling products and services with the use of electronic systems such as the internet. | Mobile Commerce (or also called M-commerce) refers to the process of buying and selling products and services with the use of internet/cellular data. |
| History | 1970's | 1990's |
| Devices used | Computers, laptops... | Wireless handheld devices such as cell |

| | | |
|---------------------|---|--|
| | | phones, iPads, tablets... |
| The use of Internet | Mandatory | Not mandatory(allow the use of offline mode, might not work properly though) |
| Connectivity | Smaller | Larger owing to the bigger number of mobile users |
| Mobility | Limited | Less limited because of lighter weight and smaller size leading to easier to carry |
| Reach | Only at the places where the electricity and the internet are available | Broader due to its portability |
| Payment gateway | Credit cards | Caller's rate, mobile banking or user's credit card |
| Usage | Less simple because of more complicated user interface and more functions | Simple because all functions have been simplified |
| Platform used | Web stores | Web stores (mobile version/web app), hybrid app, native app |
| Cost | Less costly for the creation a web store and the use of internet | More costly for the creation of a mobile app and the use of cellular |

1.3 DRIVING FORCES FOR M-COMMERCE

The development of mobile computing and m-commerce is driven by the following factors.

- (i) ***Widespread Availability of Mobile Devices.*** According to Romow.com (2008), 50 percent of the world population will use mobile phones in 2008. It is estimated that within a few years, about 70 percent of cell phones will have Internet access (“smart-phones”). Thus, a potential mass market is available for conducting discovery, communication, collaboration, (e.g., see “Global Mobile,” a special report, Computer World, May 14, 2007), and m-commerce. Cell phones are spreading quickly even in developing countries.
- (ii) ***No Need for a PC.*** Today’s PDAs and some cell phones have as much processing power as personal computers did just a few years ago, and possess the range of software available to PC users. This suggests that the smart phone-not the PC-may soon become the foremost tool that connects people to the Internet.
- (iii) ***The Handset Culture.*** Another driver of m-commerce is the widespread use of cell phones, which is a social phenomenon, especially among the 15-to-25-year-old age group. These users will constitute a major force of online buyers once they begin to make and spend larger amounts of money. The use of SMS has been spreading like wildfire in several European and Asian countries. In the Philippines, for example SMS is a national phenomenon, especially in the youth market. As another example, Japanese send many more messages through mobile phones than do Americans, who prefer the desktop or laptop for e-mail.
- (iv) ***Declining Prices and Increased Functionalities.*** The price of wireless devices is declining, and the per-minute pricing of mobile services declined by 50 percent in recent years. At the same time, functionalities

are increasing. Also, a flat fee (e.g., monthly) encourages more use of mobile devices.

- (v) **Improvement of Bandwidth.** To properly conduct m-commerce, it is necessary to have sufficient bandwidth for transmitting text; however, bandwidth is also required for voice, video, and multimedia. The 3G (third-generation) and 4G technologies provide the necessary band width.
- (vi) **Networks.** A driving development of mobile computing is the introduction of the third- and fourth-generation wireless environments known as 3G and 4G, and the adoption of Wi-Fi as a wireless local area network (LAN), WiMax, and wide area networks.

1.4 LIMITING FACTORS FOR M-COMMERCE

The limiting factors of m-commerce are:

- (i) **Lack of Standards:** With a host of device operating systems and platforms, middleware solutions and networks, make application development for the wireless Internet a formidable task, versus the level operating environment of the wired Web. Even though efforts are underway to standardize the operating environment, companies will have to work within this scattered environment, at least in the short –term.
- (ii) **Device Constraints:** There are some constraints in the device such as (a) Weak processors; (b) Limited memory (c) Tiny screens, poor resolutions and (d) Poor data entry. While WAP has been a very important in the evolution of the wireless Internet and in turn m-commerce, there are problems/ difficulties with the standard, such as the lack of WAP-enabled devices and security issues.
- (iii) **Networks:** Current data speeds between 9.6-14.4 kbps are too slow and expensive.

1.5 APPLICATIONS OF M-COMMERCE

Aside from making purchases through apps on mobile devices, other m-commerce examples include purchase of ringtones, games and music online. Mobile ticket bookings and mobile parking meter payments are also m-commerce applications. While large purchases, such as purchase of real estate and automobiles, are still being worked on, there is no doubt that there will soon come a time when these major transactions may also be completed on mobile devices. The most common products and services on mobile commerce that are seen today are:

- (i) **Mobile banking.** Inquire about bank balance, manage bank accounts, remit money and transact with bank through mobile phone. The Digital user is fast, sharp and always on the move. They are always connected and ready to try new products on the shelf. As far as banking is concerned, they like it swift and convenient. In a Digital world that is constantly evolving, they are always willing to keep up with the latest trends that are making banking simpler. The same has happened with the onset of Internet Banking and Mobile Banking. It has made banking simpler, easier and extremely convenient.

What started with cashless transactions with Credit Cards and Debit cards, has now moved to an all new level with Mobile apps and Internet Banking. There used to be a time when swiping a card at a shop would mean a big leap of faith but now everything is on screen. Customer shops online, and pays online. Every minor transaction can happen without walking across to a vendor personally or actually exchanging cash. While some swear by Internet banking, there are some who prefer to use their mobile Apps for banking. The difference between Internet Banking and Mobile Banking are as follows:

It all started with Internet Banking. Mobile banking is a much latest entrant into the digital world of banking. When Internet Banking took off,

it felt like the go to thing for all transactions. Never before could a customer access his/her account balance and make transactions sitting on their sofa in the comfort of their home. All a customer requires is customer ID and the rest falls into place. Right from making credit card payments to setting up mutual fund and loan repayment debits, everything is a part of Internet banking. If customer needed to buy anything, he could immediately make a payment online and there that was, his transaction was done. There is no waiting time; there is no need to check if there was cash in wallet.

Mobile banking is just the thing a customer needs when he is on the move. In the absence of a laptop/computer, mobile app is the answer to all banking needs. Be it a phone recharge or a fund transfer, a mobile app takes care of all basic utility bill payments for which customer would, once upon a time make multiple trips. What mobile banking gives is the freedom to make a transaction irrespective of the place or time. Customer may be commuting or waiting at the airport, mobile app is always handy. Mobile Banking and Internet banking are two sides of the same coin. The screens have changes, the sizes have become smaller and banking has become simpler.

- (ii) ***Mobile browsing and purchase.*** The customer journey remains dynamic across devices. Mobile is showing a higher transaction rate with a higher average order size. Shopping can now be done on one's mobile device and if something catches eye, one can immediately purchase it while browsing. This is made faster and easier if the merchant has an app, instead of browsing their website on phone. Consumers are using mobile devices such as smartphones, tablets, connected devices (iPods, smartwatches) etc. to enhance their shopping experience. With technology that allows them to make purchase decisions on the go, shopping behaviors have altered indefinitely. Especially, mobile technology is gradually substituting human interactions.

In order to acquire long-term customers, it is important for the company/seller to understand this new purchase cycle and the role mobile plays in it. Here are the different stages of pre-purchase, during purchase and post-purchase along with the role played by mobile in influencing purchase decisions.

Awareness: *This* is the stage where customers are aware that something is amiss which needs fixing, without having complete knowledge of what is wrong or how it can be solved. SMS based awareness campaigns or mobile apps are used to drive awareness about value proposition.

Consideration: During this stage, customers are cognizant of a particular problem and are looking for solutions to fix it. During this phase, mobile search plays an important role in gaining awareness about a perceived need or issue. Ensuring that mobile site is optimized for keywords pertaining to industry/niche/value offerings will ensure that company's website is found when the prospect is searching for solutions for their problem.

Intent to purchase: This stage is the one where prospects have a decent idea of what they are looking for and are gauging how one can fix their problem or provide them with what they are looking for. Consumers with intent to purchase a product conduct extensive research, refer peer reviews and industry journals, before buying it online or in-store. A study has found that almost 31 percent of mobile shoppers research a product on their mobile device before buying it in-store, while 40 percent of them research a product from their smartphone before purchasing it online (Source: JiWire Mobile Audience Insights Report Q1 2011). Another trend that influences consumers with intent to purchase is coupons delivered to them in real-time. 73 percent of consumers find it useful to receive an instant coupon as they pass by an item in a store (Source: Accenture, reported by Internet Retailer, 2010).

Purchase: This is the stage where prospects purchase the product. With the help of mobile devices, consumers are now able to purchase items at any point of time, with utmost ease and convenience. Some retailers even utilize mobile to make the whole process of purchasing items more convenient, such as providing in-store browsing, giving instant coupons and offers available on mobile devices and more. Other mobile-centric activities include using store locator to find a store (78%), using mobile lists while shopping (40%), and using mobile devices for payment (26%) (Source: Nielson); 38% check the status of an order, and, while in store, 32% browse product reviews. (Source: 2010 IDC Survey).

Post-purchase: Post-purchase phases include activities starting from consumption of product to repurchase and finally gaining loyalty. Mobile users are increasingly using mobile devices which have social media apps installed on them to comment on purchases in real-time, write a review of purchases, provide feedback, share details of purchases with peer networks, join mailing lists and brand fan pages and more.

Mobile savvy consumers are now using the channel to efficiently manage their purchases and their shopping experiences. From awareness to post-purchase, brands need to be cognizant of these trends and design their consumer experience accordingly.

- (iii) **Mobile content purchase and delivery.** This is no longer a new concept, since this is one of the earliest forms of mobile commerce. Customer can purchase mobile content such as music, games, movies, ringtones, wallpapers and even apps, and they will be sent directly to his mobile phone. Mobile purchase allows customers to shop online at any time in any location. Customers can browse and order products while using a cheap, secure payment method. Instead of using paper catalogues, retailers can send customers a list of products that the customer would be interested in, directly to their mobile device or

consumers can visit a mobile version of a retailer's ecommerce site. Additionally, retailers will also be able to track customers at all times and notify them of discounts at local stores that the customer would be interested in.

- (iv) **Mobile money transfers.** Now, money can be transferred through the use of mobile devices.
- (v) **Information and location-based services.** Sometimes users may not necessarily want to purchase anything, but they would still be interested in receiving information, such as news, local weather, stock and financial quotes, movie and TV programming schedules, traffic reports and even sports scores. Unlike a home Personal Computer(PC), the location of the mobile phone user is an important piece of information used during mobile commerce transactions. Knowing the location of the user allows for location based services such as: local maps local offers local weather people tracking and monitoring.

A wide variety of information services can be delivered to mobile phone users in much the same way as it is delivered to PCs. These services include: news services, stock data, sports, results, financial records, traffic data and information. Particularly, more customized traffic information, based on users' travel patterns, will be multicast on a differentiated basis, instead of broadcasting the same news and data to all Users. This type of multicasting will be suited for more bandwidth- intensive mobile equipment.

- (vi) **Mobile marketing and advertising.** People check their mobile phones more often than they do their desktop computers, so marketers and advertisers believe that they will be able to catch the attention of their target consumers better if they send the promotional and marketing materials directly to them through their mobile devices. Mobile marketing is highly responsive sort of marketing campaign, especially from brands'

experience point of view. And almost all brands are getting higher campaign response rates. Corporations are now using m-commerce to expand everything from services to marketing and advertisement. Although there are currently very few regulations on the use and abuses of mobile commerce, this will change in the next few years. With the increased use of m-commerce comes increased security. Cell phone companies are now spending more money to protect their customers and their information from online intrusions and hackers.

The different types of ads on mobile are banner ads, video ads, rich media ads.

Banner Ads exist in mobile advertising, although there are more sizes offered than customer typically see on a website. They can run along the top of the screen like a typical banner ad, but they can also be designed as screen takeovers or as panel ads that will not take up the full screen.

Video Ads have also migrated from the web to mobile advertising. Like web ads, video ads take over the screen and automatically play their message for the user. After the ad is finished it offers the user to return to the app or visit the advertiser for more information.

Rich Media Ads try to engage with users the same way videos do. These ads tend to be interactive, many times in the form of games that showcase their sponsor as a part of the game. They offer the user a chance to play free game and then it will direct them toward the sponsor's site.

- (vii) **Mobile ticketing, vouchers and coupons.** Tickets, vouchers, coupons and even loyalty cards are now sent to users on their mobile phones. Since they are in digital form, all that is required would be to present these tickets, vouchers or cards, in order to get the service or benefits that they entail.

Tickets can be sent to mobile phones using a variety of technologies. Users are then able to use their tickets immediately by presenting their phones at the venue. Tickets can be booked and cancelled on the mobile with the help of simple application downloads or by accessing Wireless Application Protocol (WAP) portals of various Travel agents or direct service providers. Mobile ticketing for airports, ballparks, and train stations, or example, will not only streamline unexpected metropolitan traffic surges, but also help users remotely secure parking spots (even while in their vehicles) and greatly facilitate mass surveillance at transport hubs.

Mobile ticketing technology can also be used for the distribution of vouchers, coupons and loyalty cards. The voucher, coupon, or loyalty card is represented by a virtual token that is sent to the mobile phone. Presenting a mobile phone with one of these tokens at the point of sale allows the customer to receive the same benefits as another customer who has a loyalty card or other paper coupon/voucher. Mobile delivery enables economy of scale, quicker and easier delivery, effective target marketing, privacy

-friendly data mining on consumer behavior, environment

- friendly and resources-saving efficacy.

- (viii) **Mobile Wallet (mWallet).** An electronic wallet that is stored on a phone. GSMA provides the following more specific definition: “mWallet is a data repository that houses consumer data sufficient to facilitate a financial transaction from a mobile handset, and the applicable intelligence to translate an instruction from a consumer through a mobile handset/bearer/application into a message that a financial institution can use to debit or credit bank accounts or payment instruments.”
- (ix) **Mobile brokerage.** Stock market services offered via mobile devices have also become more popular and are known as Mobile Brokerage. They

allow the subscriber to react to market developments in a timely fashion and irrespective of their physical location.

- (x) **Auctions:** Over the past three years Mobile reverse auction solutions have grown in popularity. Unlike traditional auctions, the reverse auction (or low-bid auction) bills the consumer's phone each time they place a bid. Reverse auctions are high return applications as they allow the consumer to transact over a long period of time

1.7 BENEFITS OF M-COMMERCE IN INDIA

As it is known that M-commerce market grows rapidly now a days, the numbers of Smartphone users are increasing regularly. M-commerce helps to works easily and smoothly in life schedule. Its benefits are as follows:-

- (i) **User friendly:** - Now a days websites are being designed so much user friendly. Its predict search option helps consumers to find more easily and rapidly for a particular product. Different classification of products variety helps for consumers to choose more exclusively between products.
- (ii) **Easy to carry mobile device:** - Mobile device is easy to carry by user, It helps to avoid user to go physically to any particular shop as well as it also helps to user for avoid once of use of computer /laptops.
- (iii) **Low internet connectivity area:** - M-commerce is also efficiently used where the internet connectivity is less and website is taking more time to upload or hit. Through mobile devices less internet data will be used, so it is also economical with comparison of using internet via computer devices
- (iv) **Secure transactions:** - M-commerce also gives an assurance of secure transactions, for the transaction, confirmation code is sent on the e-mail and mobile phone. And after filling this code the transaction will be processed, So that chances of wrong transactions are very less and unsecure transitions can be eliminated. This increases the trustiness level for websites and increases the number of customers.
- (v) **Time Efficient:** Doing M-Commerce transactions do not require the user to plug anything like personal computer or wait for the laptop to load. Just

hit the on button of mobile device and ready to go. Despite the small screen, having something in pocket that can do so much via M-Commerce is really an amazing technology and a great help. E-Commerce businesses are also making applications for mobile phones which allow users to browse their online products and make payments with couple of buttons.

- (vi) **Personalization:** Each mobile device is usually dedicated to a specific user, it is personal. One can do whatever he wants to using his mobile device, modify the wallpaper, change view settings or modify contact information as one send emails or e-payments.

1.8 CONDITION OF M-COMMERCE IN INDIA

As it is known that mobile devices are becoming a part of our daily routine life, People use internet for various purposes which include: email, academic and financial information search, music and video on internet, chatting, online job search, gaming, booking tickets, hotel reservation, online news, internet telephony/video chat/voice chat, and online banking. E-commerce has touched every field of human life from information search to entertainment, job search & matrimonial site.

1.8.1 Drawback of E-commerce in India

Each coin has two sides; M-commerce also has some hurdles for growth in India. Drawbacks of M-commerce market in India are as follows:-

- (i) **Lack of Internet Connectivity:** - In India, still internet connectivity is under the dark room; still broadband connection is not accessible at many places in India. Also 3G networks are not available at so many states.
- (ii) **Language Barrier:** - In India, mostly people are not aware about the English language or not so good in English language. So that for the transaction over internet through mobile devices, language becomes one of the major factor to purchases, hire and sell a particular product or services.
- (iii) **Less Graphic Resolutions:** - In comparison to computer/laptop, mobile devices are still less graphic resolutions, for that reason consumers are

least interested to buy a particular product. In other words Product is not properly or exactly shown in mobile devices as compare to computers /laptops/notebooks.

- (iv) **Lack of Awareness:** - Still in India people do not aware about the term M-commerce, In India literacy rate grew by 74.04%, but the world's average literacy rate is 84% in 2011. People in India still afraid to adopt to purchase things online as well as they are feeling uncomfortable to buy a product through M-commerce.

1.8.2 Barriers to m-commerce

- (i) The existing technology is not best suited for mobile data transfer. The connections are unstable, the data transfer rate is limited, transfer duration is too long, And the costs involved are high.
- (ii) Acceptance of m-commerce is slow.
- (iii) M-commerce can have a profitable future only when it can offer new services or existing services in a new quality.
- (iv) After an initial enthusiasm there is some disillusionment with m-commerce. M-banking has made customers uncertain, and hence, slowed down mobile banking.
- (v) Many times, simple things are being ignored such as what kind of people are behind the billions of mobile services. Lack of infrastructure (wireless and business), competing standards, poor input and display capabilities in cell phones and customer indifference, piracy fear, human fear to learn new things are other constraints in the use of m-commerce.
- (vi) Security of m-commerce transactions needs to be ensured.
- (vii) There are problems of legal documentation, consumer protection and liability of service providers.

1.8.3 Reserve bank of India guidelines for mobile banking

In June 2008, the Reserve Bank of India, India's central bank issued a set of draft guidelines, 'the long term goal of mobile payment framework in India would be to enable funds transfer from an

account in one bank to any other account in the same or any other bank on a real time basis, irrespective of the mobile network a customer has subscribed to. Key provisions of the draft guidelines include the following:

- (i) Only banks that are licensed and supervised in India and have physical presence in India will be permitted to offer mobile payment services to the Indian residents. They would be expected to ensure compliance with the guidelines.
- (ii) Banks should offer mobile-based banking services only to their own customers.
- (iii) Banks should have their mobile payments scheme approved by their boards before offering it to their customers. Board approval must document the extent of operational and fraud risk assumed by the bank and the bank's processes and policies designed to mitigate such risk.
- (iv) The technology used for mobile payments must be secure and should ensure confidentiality, integrity, and authenticity. It should be interoperable across banks and mobile networks.
- (v) If sufficient safeguards are provided, SMS text messaging may be used for 'micro payment transactions' of up to INR 1500 (US \$35) and for 'repetitive utility bill payment transactions' of up to INR 2500 (US \$58).

1.9 LET'S SUM-UP

M-commerce (mobile commerce) is the buying and selling of goods and services through wireless handheld devices such as cellular telephone and personal digital assistants (PDAs). Known as next-generation e-commerce, m-commerce enables users to access the Internet without needing to find a place to plug in. The range of devices that are enabled for mobile commerce functionality is growing, having expanded in recent years to include smartphones and tablets. Mobile commerce has also accelerated through social media platforms, allowing users to purchase products and services. It is important that mobile web pages load quickly, as customers like to

make instant purchases, and pages that load promptly are likely to result in higher sale conversions. Mobile checkouts must be enhanced to allow customers to easily enter payment information. Ideally, the customer could add the payment information using a mobile wallet that avoids the use of manual entry, reducing human error and facilitating a smooth checkout experience. M-commerce has the potential to provide huge satisfaction to end-users, generate business opportunities, and provide quick access. There are a number of technologies that enable mobile commerce such as infrared, SMS, interactive voice response, mobile scan and contactless chips. These technologies are transforming the mobile phone into a replacement for petty cash, and debit and credit cards; here the payments are charged either through the mobile phone bill or to the bank account.

Despite all the hype, M-commerce has still not gained speed in the country. The overriding hype and expectation has kind of built a wall around M-commerce. The prevalent assumption is that this service is for the elite, which is not the case. Another area which needs to be dealt with is the issue of security and reliability. The Indian user is still not comfortable with the idea of giving away his debit or credit card number over the phone. Also, security is a major concern for M-commerce to flourish. There are a number of payment options for people such as cheque pick-up, cash on delivery, etc., so the number of people actually paying through cards is not very significant. Security is not a concern technologically; it is just a matter of the mindset that needs to be changed. There are ways such as tamper-proof digital certificates to authenticate the identity of users, for example PIN or passwords. Biometrics such as voice recognition is another area, which can be used to offer greater protection.

1.10 KEY TERMS

- Mobile Commerce
- Device Constraints
- Wireless Web-misleading

1.12 FURTHER READINGS

1. Adesh K Pandey, Concepts of E-Commerce, Katson Books, New Delhi
2. Rabindra Goel, E-commerce, New Age International Publishers, New Delhi

1.13 MODEL QUESTIONS

- (i) What is M-commerce and how it is different from e-commerce?
- (ii) How M-Commerce can help us to uplift our living standards?

UNIT-2 MOBILE COMPUTING AND WAP

Learning Objectives

After reading this chapter, the students should be able to:

- Understand the meaning of mobile computing
- Discuss the cellular Network Architecture
- Enumerate the CDPD Technology
- Discuss the different applications of Mobile computing
- Discuss the Wireless Application Protocol

Structure

- 2.1 Introduction to Mobile Computing
- 2.2 Classification of Mobile Computing
- 2.3 Cellular Network Architecture
- 2.4 Data Communications
- 2.5 CDPD Technology
- 2.6 Applications of Mobile Computing
- 2.7 Advantages of Mobile Computing
- 2.8 Mobile Computing: Current Trends
- 2.9 Introduction to WAP
- 2.10 Let's sum-up
- 2.11 Key terms
- 2.12 Self-Assessment Questions
- 2.13 Further Readings
- 2.14 Model Questions

2.1 INTRODUCTION TO MOBILE COMPUTING

In today's computing world, different technologies have emerged. These have grown to support the existing computer networks all over the world. With mobile computing, we find that the need to be confined within one physical location has been eradicated. We hear of terms such as telecommuting, which is being able to work from home or

the field but at the same time accessing resources as if one is in the office. The advent of portable computers and laptops, Personal Digital Assistants (PDA), PC tablets and smartphones, has in turn made mobile computing very convenient. The portability of these devices ensure and enable the users to access all services as if they were in the internal network of their company. For example, the use of Tablet PC and iPads. This new technology enables the users to update documents, surf the internet, send and receive e-mail, stream live video files, take photographs and also support video and voice conferencing.

The constant and ever increasing demand for superior and robust smart devices has been a catalyst for market share. Each manufacturer is trying to carve a niche for himself in the market. These devices are invented and innovated to provide state-of-the-art applications and services. For instance, different manufacturers of cellular phones have come up with unique smartphones that are capable of performing the same task as computers and at the same processing speed.

The need for better, portable, affordable, and robust technology has made these vendors to constantly be innovative. Market figure and statistics show an ever growing need to purchase and use such devices for either professional or personal use. It is in this light that services to suit long-term implementation are developed or innovated. It has also pushed other industry vendors to adopt services that will provide better services. For example, cellular service providers are forced to improve and be innovative to capture more subscribers. This can be in terms of superior services such as high speed internet and data access, voice and video service etc. Hence the adoption of different generations of networks like of 2G, 2.5G, 3G, 4G network services.

The essence of mobile computing is to be able to work from any location. The use of iPads, tablets, smartphones, and notebooks, have pushed the demand for these devices. Modern day workers have such devices that enable them to carry out their work from the confines of their own location. These devices are configured to access and store large amounts of vital data. Executive and top management can take

decisions based on ready information without going to the office. For example, sales reports and market forecasts can be accessed through these devices or a meeting can take place via video or audio conferencing through these devices. With such features being high in demand, manufacturers are constantly coming up with applications geared to support different services in terms of mobile computing.

Mobile Computing is a technology that allows transmission of data, voice and video via a computer or any other wireless enabled device without having to be connected to a fixed physical link. The main concept involves

- (a) Mobile communication
- (b) Mobile hardware
- (c) Mobile software

(a) Mobile communication:

The mobile communication in this case, refers to the infrastructure put in place to ensure that seamless and reliable communication goes on. These would include devices such as protocols, services, bandwidth, and portals necessary to facilitate and support the stated services. The data format is also defined at this stage. This ensures that there is no collision with other existing systems which offer the same service. Since the media is unguided/unbounded, the overlaying infrastructure is basically radio wave-oriented. That is, the signals are carried over the air to intended devices that are capable of receiving and sending similar kinds of signals.

(b) Mobile hardware:

Mobile hardware includes mobile devices or device components that receive or access the service of mobility. They would range from portable laptops, smartphones, tablet Pc's, Personal Digital Assistants. These devices will have a receptor medium that is capable of sensing and receiving signals. These devices are configured to operate in full- duplex, whereby they are capable of sending and receiving signals at the same time. They don't have to wait until one device has finished communicating for the other device to initiate communications. Above mentioned devices use an existing and established network to operate on. In most cases, it would be a wireless network.

(c) Mobile software:

Mobile software is the actual program that runs on the mobile hardware. It deals with the characteristics and requirements of mobile applications. This is the engine of the mobile device. In other terms, it is the operating system of the appliance. It's the essential component that operates the mobile device. Since portability is the main factor, this type of computing ensures that users are not tied or pinned to a single physical location, but are able to operate from anywhere. It incorporates all aspects of wireless communications.

2.2 CLASSIFICATION OF MOBILE COMPUTING

Mobile computing is not only limited to mobile phones, but there are various gadgets available in the market that are built on a platform to support mobile computing. They are usually classified in the following categories –

(a) Personal Digital Assistant (PDA)

The main purpose of this device is to act as an electronic organizer or day planner that is portable, easy to use and capable of sharing information with your computer systems. PDA is an extension of the PC, not a replacement. These systems are capable of sharing information with a computer system through a process or service known as synchronization. Both devices will access each other to check for changes or updates in the individual devices. The use of infrared and Bluetooth connections enables these devices to always be synchronized. With PDA devices, a user can browse the internet, listen to audio clips, watch video clips, edit and modify office documents, and many more services. The device has a stylus and a touch sensitive screen for input and output purposes.

(b) Smartphones

This kind of phone combines the features of a PDA with that of a mobile phone or camera phone. It has a superior edge over other kinds of mobile phones. Smartphones have the capability to run multiple programs concurrently. These phones include high-resolution touch screens, web browsers that can access and properly display standard web pages rather than just mobile-optimized sites, and high-speed data access via Wi-Fi and high speed cellular broadband. The most common mobile

Operating Systems (OS) used by modern smartphones include Google's Android, Apple's iOS, Nokia's Symbian, RIM's BlackBerry OS, Samsung's Bada, Microsoft's Windows Phone, and embedded Linux distributions such as Maemo and MeeGo. Such operating systems can be installed on different phone models, and typically each device can receive multiple OS software updates over its lifetime.

(c) **Tablet PC and iPads**

This mobile device is larger than a mobile phone or a PDA and integrates into a touch screen and is operated using touch sensitive motions on the screen. They are often controlled by a pen or by the touch of a finger. They are usually in slate form and are light in weight. Examples would include ipads, Galaxy Tabs, Blackberry Playbooks etc. They offer the same functionality as portable computers. They support mobile computing in a far superior way and have enormous processing horsepower. Users can edit and modify document files, access high speed internet, stream video and audio data, receive and send e-mails, attend/give lectures and presentations among its very many other functions. They have excellent screen resolution and clarity.

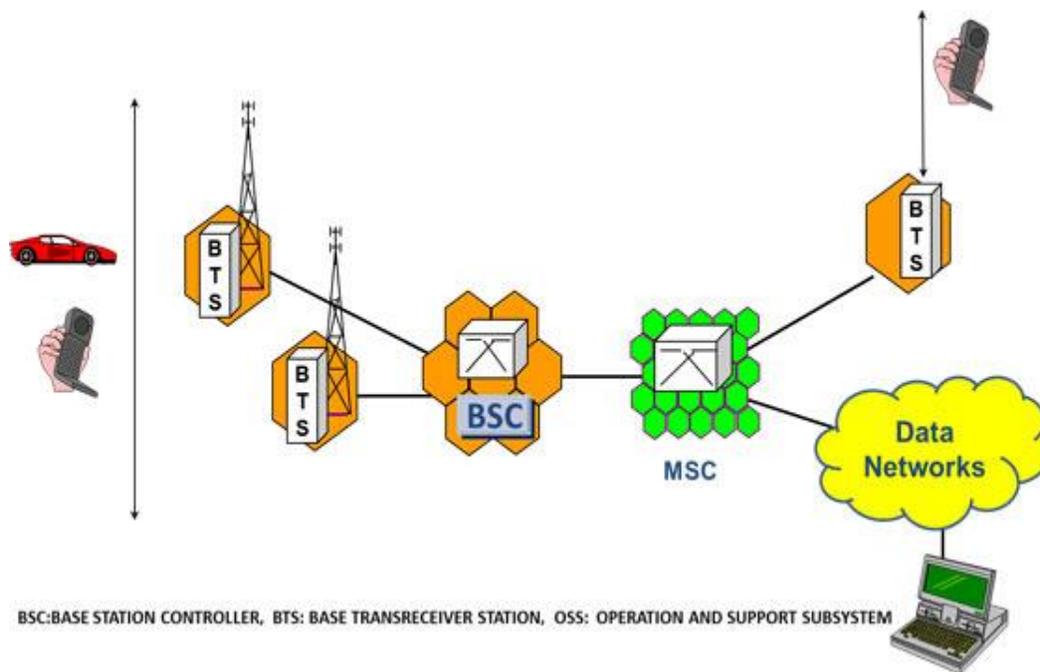
2.3 CELLULAR NETWORK ARCHITECTURE

A cell phone is nothing more than a radio. It is a complex radio, but still a radio. In order to really understand the way a cell phone works, we must discuss some of the cell phones history for just a moment. Back around the early 1950s', mobile-radio-phones were about as common as cruise control in post- World War II cars.

In select urban areas, there were large, central antennas that were specifically allocated for these radio-phones. Each car that had a radio-phone required a big antenna that could transmit at least 40 or 50 miles. Since radio technology itself was only in the building phase, only about 25 channels were available for private use. So basically only 25 people could be talking on their radio-phones at the same time. The solution to this problem was to divide each city up into small divisions, or "cells". The technology behind cells have changed dramatically over the years, just as cell phones have, but now most standard cells are about 10 square miles large. They are usually in the shape of a hexagon. Nowadays, every individual cell has its own base

station, rather than only one for an entire city. And now cell phones are made to be low-power transmitters (either 0.3 watts or 6 watts), which is much lower wattage than in past decades. This means that the same frequency can be used in the same city, at the same time, but in different cells.

Not much has changed since then and the basic cellular infrastructure / architecture remain the same. It is essentially a the areas which is divided into cells , services and connected to each other by collection of transceivers, controllers, switches, routers, and registers. Some of the main components and how it works is provided below;



- **Mobile Equipment (ME)** – This refers to the physical phone itself. The phone must be able to operate on a cellular network. Older phones operated on a single band only. Newer phones are dual-band, triple-band, and even quad-band capable. A quad-band phone has the technical capability to operate on any network worldwide.

Each phone is uniquely identified by the International Mobile Equipment Identity (IMEI) number. This number is burned into the phone by the manufacturer. The IMEI can usually be found by removing the battery of the phone and reading the panel in the battery well.

- **Base Transceiver Station (BTS)** – It is actually the antenna that you see installed on top of the tower. The BTS is the Mobile Phone's access point to the network. It is responsible for carrying out radio communications between the network and the Mobile Phone. It handles speech encoding, encryption, multiplexing (TDMA), and modulation/demodulation of the radio signals. One BTS usually covers a single 120 degree sector of an area. Usually a tower with 3 BTSs will accommodate all 360 degrees around the tower. However, depending on geography and user demand of an area, a cell may be divided up into one or two sectors, or a cell may be serviced by several BTSs with redundant sector coverage. A BTS is assigned a Cell Identity. The cell identity denotes a particular Location Area, which provides details of the cell which the BTS is covering.
- **What is a Cell** – A base station (transmitter) having a number of RF channels is called a cell. Each cell covers a limited number of mobile subscribers within the cell boundaries (Coverage area). Approximately a Cell Radius is 30 Km , (Start up), 1 KM (Mature) .
- **Cell Size and Capacity** – Cell size determines number of cells available to cover geographic area and (with frequency reuse) the total capacity available to all users. Capacity within cell limited by available bandwidth and operational requirements. Each network operator has to size cells to handle expected traffic demand
- **Base Station Controller (BSC)** – The BSC controls multiple BTSs. It handles allocation of radio channels, frequency administration, power and signal measurements from the MS, and handovers from one BTS to another (if both BTSs are controlled by the same BSC). A BSC also functions as a "funneler". It reduces the number of connections to the Mobile Switching Center (MSC) and allows for higher capacity connections to the MSC. A BSC may be collocated with a BTS or it may be geographically separate. It may even be collocated with the Mobile Switching Center (MSC)
- **Mobile Switching Center (MSC)** – The MSC is the heart of the GSM network. It handles call routing, call setup, and basic switching functions. An MSC handles multiple BSCs and also interfaces with other MSC's and registers. It also handles

inter-BSC handoffs as well as coordinates with other MSC's for inter-MSC handoffs.

2.4 DATA COMMUNICATIONS

Data communications (DC) is the process of using computing and communication technologies to transfer data from one place to another, and vice versa. It enables the movement of electronic or digital data between two or more nodes, regardless of geographical location, technological medium or data contents. Data communications incorporates several techniques and technologies with the primary objective of enabling any form of electronic communication. These technologies include telecommunications, computer networking and radio/satellite communication. Data communication usually requires existence of a transportation or communication medium between the nodes wanting to communicate with each other, such as copper wire, fiber optic cables or wireless signals. For example, a common example of data communications is a computer connected to the Internet via a Wi-Fi connection, which uses a wireless medium to send and receive data from one or more remote servers. Some devices/technologies used in data communications are known as data communication equipment (DCE) and data terminal equipment (DTE). DCE is used at the sending node, and DTE is used at the receiving node. Data communications have been achieved using a variety of networks such as PSTN, Leased Lines, and more recently ISDN and ATM.

The ***public switched telephone network (PSTN)*** refers to the international telephone system that uses copper wires to carry analog voice data. It consists of a collection of individual telephones that are hardwired to a public exchange.

A ***leased line*** is a telephone line that has been leased for private use. In some contexts, it's called a dedicated line. A leased line is usually contrasted with a switched line or dial-up line. Typically, large companies rent leased lines from the

telephone message carriers to interconnect different geographic locations in their company.

ISDN (Integrated Services Data Network) refers to the set of communication protocols proposed by the telephone companies to permit telephone networks to carry data, voice and other source material. ISDN involves the digitization of the telephone network, which permits voice, data, text, graphics, music, video, and other source material to be transmitted over existing telephone wires. ISDN applications include high-speed image applications additional telephone lines in homes to serve the telecommuting industry, high-speed file transfer, and videoconferencing. ISDN is generally viewed as an alternative to frame relay and T1 wide area telephone service (WATS).

The digital connectivity has many benefits including,

- 1- Provide access to all digital facilities for videos, packet switched data & telephone network services.
- 2- Much faster call setup using out of band channel signaling.
- 3- Much faster data rate of transmission using Bearer (B) channel services at 64kbps per channel.

Asynchronous transfer mode (ATM) is a switching technique used by telecommunication networks that uses asynchronous time-division multiplexing to encode data into small, fixed-sized cells. This is different from Ethernet or Internet, which use variable packet sizes for data or frames. ATM is the core protocol used over the synchronous optical network (SONET) backbone of the integrated digital services network (ISDN).

2.5 CDPD TECHNOLOGY

CDPD (Cellular Digital Packet Data) is a specification for supporting wireless access to the Internet and other public packet-switched networks. Cellular telephone and modem providers that offer CDPD support make it possible for mobile users to get access to the Internet at up to 19.2 Kbps . Because CDPD is an open specification that

adheres to the layered structure of the Open Systems Interconnection (OSI) model, it has the ability to be extended in the future. CDPD supports both the Internet's Internet Protocol protocol and the ISO Connectionless Network Protocol (CLNP). Cellular Digital Packet Data networks allow both mobile and fixed end user devices to be used. This means that the data can be transmitted from a portable device ie: portable computer, or a computer which has a fixed link to the CDPD computer network. In the case of a fixed end user system, a server or host computer has a fixed connection to the CDPD network. The system's advantages become clear when it is considered for a mobile end user device. The end user in this case can be moving around the cellular reception area. The existing Cellular Telephone Network is made up of a number of cells which cover the reception area. Each of these cells are used to pinpoint the position of the mobile device ie: the mobile phone, within the reception area and then calls to and from the particular mobile device can be routed appropriately.

CDPD uses a Packet Switched System, where data is split up into small packets, and then sent across the communication channel. This is available in both Virtual Circuit Switching and Datagram Switching form. The data packets are cleverly interleaved with the existing voice signals on momentarily unoccupied voice frequencies, during idle time in the voice signals. This detection of unoccupied frequencies and sending of packets is done by a Mobile Data Base station (MDBS). There is (at least) one of these in each cell of the cellular network. Multiple MDBS may be used to increase reliability of the system. CDPD networks can allow a mobile user to transmit data using either cellular channels or existing Circuit Switched telephone channels as shown above, which means that even outside the bounds of the cellular reception area, data transmission can be achieved. This data can then be sent to either another mobile end user or a fixed connection computer on the CDPD network. Below is a breakdown of the major components of the system in detail. The diagram shows how these components link together.

CDPD technology incorporates the following systems:

- (a) Mobile End System (M-ES) - a mobile computing device with a built-in or attached CDPD modem
- (b) Mobile Data Base Station (MDBS) - a manager of radio frequency.
- (c) Mobile Data Intermediate System (MDIS) - properly routes data packets between the CDPD network and M-ES
- (d) Intermediate System (IS) - the standard Internet Protocol (IP) router, which relays data packets
- (e) Fixed-End System (FES) - the final/end destination, which is a common host/server for receiving and processing data

During the 1990s CDPD was collaboratively developed by several leading mobile carriers as a networking protocol. Their developers no longer exist, due to mergers, buyouts and industry consolidation.

Today CDPD is a part of mobile history because AMPS' mobile telephony standard is obsolete. However, CDPD technology remains responsible for the unfolding of contemporary technologies utilizing data packet technology to transfer information through mobile networks.

2.6 APPLICATIONS OF MOBILE COMPUTING

Several devices such as palm computers, mobile phones and laptops make use of programs that are needed for internet connectivity and other computer related activities. This is called as mobile computing applications. Cited below are some of the mobile computing solutions that are offered for various industries.

(a) Airline and Railway Industries

The FCOM manuals in the cock pit can be entirely replaced with PDA's and Tablet PC's. Take the load and trim sheet to the tarmac on the tablet PC's. The PDA's or Tablet PC's can be used for grading in a simulator Training environment. It also helps

the user to keep access to flight schedule and ticket information. There is virtual check in for regular customers. It provides control of Cargo and Airline baggage. Using mobile computing applications, faster and quicker check in of baggage can be done by scanning the bar coded information from the baggage directly into a database. It is a pen based work order application that uses a wireless database network. It also aids the airport security and monitoring systems.

(b) Transporting Industry

The real time drop shipments or pickups can be achieved using Computer Aided Dispatch (CAD). Customer service can be enhanced with time tracking system for exact delivery. In mobile network system the two ways communication can be achieved, that is between the fleet drivers and the dispatch centers. The real time passenger information broadcasting can be done at Bus Stops, Kiosks and Bus stops. Vehicle fleets such as Airport Limo Service Vehicles and Cabs Service Vehicles can be controlled. The real time traffic control and monitoring can also achieved using mobile computing applications.

(c) Manufacturing and Mining Industries

The LAN extension problems can be resolved using broad spectrum networks. With the development of mobile computing applications, the portable computers find space in shop floors, vehicles and mines. They can be used for in- process monitoring. It can be used with real time asset management such as parts, tools and materials. Manufacturing and Mining industries also makes use of mobile computing application for order tracking, purchase verification and delivery confirmation. Thus it provides an over all control on the industrial unit as a whole.

(d) Banking and Financial Institutions

Wireless banking transactions such as funds transfer, checking of account balance and the payment of the bill can be fulfilled from a PDA or a smart phone. The handheld

devices are connected wirelessly to ATM's through Bluetooth. Professionals can respond to the customer queries on the spot through sales promotional automation system that makes use of mobile computing applications.

2.7 ADVANTAGES AND DISADVANTAGES OF MOBILE COMPUTING

The advantages of mobile computing are:

1- Increase in Productivity- Mobile devices can be used out in the field of various companies, therefore reducing the time and cost for clients and themselves.

2- Entertainment- Mobile devices can be used for entertainment purposes, for personal and even for presentations to people and clients.

3- Portability- this would be one of the main advantages of mobile computing, you are not restricted to one location in order for you to get jobs done or even access email on the go

4. Cloud Computing- This service is available for saving documents on a online server and being able to access them anytime and anywhere when you have a connection to the internet and can access these files on several mobile devices or even PCs at home.

5. Location Flexibility- This has enabled users to work from anywhere as long as there is a connection established. A user can work without being in a fixed position. Their mobility ensures that they are able to carry out numerous tasks at the same time and perform their stated jobs.

6. Saves Time- The time consumed or wasted while travelling from different locations or to the office and back, has been slashed. One can now access all the important documents and files over a secure channel or portal and work as if they were on their computer. It has enhanced telecommuting in many companies. It has also reduced unnecessary incurred expenses.

7. Streamlining of Business Processes- Business processes are now easily available through secured connections. Looking into security issues, adequate measures have been put in place to ensure authentication and authorization of the user accessing the services. Some business functions can be run over secure links and sharing of information between business partners can also take place.

Meetings, seminars and other informative services can be conducted using video and voice conferencing. Travel time and expenditure is also considerably reduced.

The disadvantages of mobile computing are:

1. **quality of connectivity**- as one of the disadvantages, mobile devices will need either WiFi connectivity or mobile network connectivity such as GPRS, 3G and in some countries even 4G connectivity that is why this is a disadvantage because if you are not near any of these connections your access to the internet is very limited.
2. **security concerns**- Mobile VPNs are unsafe to connect to, and also syncing devices might also lead to security concerns. accessing a WiFi network can also be risky because WPA and WEP security can be bypassed easily.
3. **Power Consumption**- due to the use of batteries in these devices, these do not tend to last long, if in a situation where there is no source of power for charging then that will certainly be a letdown.

2.8 MOBILE COMPUTING - SECURITY ISSUES

Mobile computing has its fair share of security concerns as any other technology. Due to its nomadic nature, it's not easy to monitor the proper usage. Users might have different intentions on how to utilize this privilege. Improper and unethical practices such as hacking, industrial espionage, pirating, online fraud and malicious destruction are some but few of the problems experienced by mobile computing.

Another big problem plaguing mobile computing is credential verification. As other users share username and passwords, it poses as a major threat to security. This being a very sensitive issue, most companies are very reluctant to implement mobile computing to the dangers of misrepresentation. The problem of identity theft is very difficult to contain or eradicate. Issues with unauthorized access to data and information by hackers, is also an enormous problem. Outsiders gain access to steal vital data from companies, which is a major hindrance in rolling out mobile computing services.

No company wants to lay open their secrets to hackers and other intruders, who will in turn sell the valuable information to their competitors. It's also important to take the necessary precautions to minimize these threats from taking place. Some of those measures include –

- (i) Hiring qualified personnel.
- (ii) Installing security hardware and software
- (iii) Educating the users on proper mobile computing ethics
- (iv) Auditing and developing sound, effective policies to govern mobile computing
- (v) Enforcing proper access rights and permissions

These are just but a few ways to help deter possible threats to any company planning to offer mobile computing. Since information is vital, all possible measures should be evaluated and implemented for safeguard purposes. In the absence of such measures, it's possible for exploits and other unknown threats to infiltrate and cause irrefutable harm. These may be in terms of reputation or financial penalties. In such cases, it's very easy to be misused in different unethical practices. If these factors aren't properly worked on, it might be an avenue for constant threat. Various threats still exist in implementing this kind of technology.

2.9 MOBILE COMPUTING - CURRENT TRENDS

The current trends in mobile computing include:

(a) 4G (fourth-generation wireless)

4G is the short name for fourth-generation wireless, the stage of broadband mobile communications that will supercede the third generation (3G). Carriers that use orthogonal frequency-division multiplexing (OFDM) instead of time division multiple access (TDMA) or code division multiple access (CDMA) are increasingly marketing their services as being 4G, even when their data speeds are not as fast as the International Telecommunication Union (ITU) specifies. According to the ITU, a

4G network requires a mobile device to be able to exchange data at 100 Mbit/sec. A 3G network, on the other hand, can offer data speeds as slow as 3.84 Mbit/sec.

(b) Global Positioning System (GPS)

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. The GPS program provides critical capabilities to military, civil and commercial users around the world. In addition, GPS is the backbone for modernizing the global air traffic system, weather, and location services.

(c) Long Term Evolution (LTE)

LTE is a standard for wireless communication of high-speed data for mobile phones and data terminals. It is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing the capacity and speed using new modulation techniques. It is related with the implementation of fourth Generation (4G) technology.

(d) WiMAX

WiMAX (Worldwide Interoperability for Microwave Access) is a wireless communications standard designed to provide 30 to 40 megabit-per-second data rates, with the latest update providing up to 1 Gbit/s for fixed stations. It is a part of a fourth generation or 4G wireless-communication technology. WiMAX far surpasses the 30-metre wireless range of a conventional Wi-Fi Local Area Network (LAN), offering a metropolitan area network with a signal radius of about 50 km. WiMAX offers data transfer rates that can be superior to conventional cable-modem and DSL connections, however, the bandwidth must be shared among multiple users and thus yields lower speed in practice.

(e) Near Field Communication

Near Field Communication (NFC) is a set of standards for smartphones and similar devices to establish radio communication with each other by touching them together or bringing them into close proximity, usually no more than a few centimeters. Present and anticipated applications include contactless transactions, data exchange, and simplified setup of more complex communications such as Wi-Fi.

Communication is also possible between an NFC device and an unpowered NFC chip, called a "tag".

2.10 INTRODUCTION TO WAP

Wireless Application Protocol) is a specification for a set of communication protocols to standardize the way that wireless devices, such as cellular telephones and radio transceivers, can be used for Internet access, including e-mail, the World Wide Web, newsgroups, and instant messaging. While Internet access has been possible in the past, different manufacturers have used different technologies. In the future, devices and service systems that use WAP will be able to interoperate.

2.10.1 WAP Forum

The Wireless Application Protocol is a standard developed by the WAP Forum, a group founded by Nokia, Ericsson, Phone.com (formerly Unwired Planet), and Motorola. The WAP Forum has now expanded to include more than 200 members, including operators, infrastructure suppliers, software developers and content providers.

The WAP forum is also working with many other standards organizations to develop or modify standards related to new technologies, which need modifications for wireless environment. The WAP forum has liaison relationships (or is in the process of having) with Cellular Telecommunications Industry Association (CTIA), World Wide Web Consortium (W3C), Telecommunications Industry Association (TIA) and Internet Engineering Task Force (IETF). This ensures that when new standards emerge, these standards remain compatible with the work of the WAP Forum. For example, the WAP Forum will be working with the W3C and IETF to ensure future convergence with HTML-NG (Next Generation) and HTTP-NG specifications, and to provide input to these groups regarding the requirements of future wireless network technologies.

The WAP Forum is the industry association that has developed the de-facto world standard for wireless information and telephony services on digital mobile phones and other wireless terminals. The primary goal of the WAP Forum is to bring together companies from all segments of the wireless industry to ensure product interoperability and growth of the wireless market. The objectives of the WAP Forum are:

- (ii) To bring Internet content and advanced data services to digital cellular phones and other wireless terminals.
- (iii) To create a global wireless protocol specification that will work across different wireless network technologies.
- (iv) To enable the creation of content and applications that scale across a very wide range of wireless bearer networks and wireless device types.
- (v) To embrace and extend existing standards and technology wherever appropriate.

2.10.2 Importance and Benefits of WAP

WAP allows wireless device users to access information from internet over wireless network, without spending a much time and cost. WAP allows mobile devices to communicate with application servers and information databases through the internet. Applications can be dynamically downloading, uploaded and run on WAP devices.

WAP is beneficial in several ways. Major benefits of WAP are as follows:

- (i) Benefits the developers that develop wireless application.
- (ii) Benefits the companies that manufacture wireless devices.
- (iii) Benefits the network operators or service providers.
- (iv) Benefits the end-users that use applications.

2.10.3 WAP Protocol Stack

The WAP protocol stack has undergone significant change from WAP 1.x to WAP 2.x. The basis for the change is the support for Internet Protocols (IPs) when IP connectivity is supported by the mobile device and network. As with other parts of WAP, the WAP 2.x protocol stack is backward-compatible. Support for the legacy WAP 1.x stack has been maintained for non-IP and low-bandwidth IP networks that can benefit from the optimizations in the WAP 1.x protocol stack.

We will take a look at both WAP 1.x and WAP 2.x, with a focus on the technologies used in each version of the specification.

WAP 1.x

The protocols in the WAP 1.x protocol stack have been optimized for low-bandwidth, high-latency networks, which are prevalent in pre-3G wireless networks. The protocols are as follows:

- ***Wireless Session Protocol (WSP)***. WSP provides capabilities similar to HTTP/1.1 while incorporating features designed for low-bandwidth, high-latency wireless networks such as long-lived sessions and session suspend/resume. This is particularly important, as it makes it possible to suspend a session while not in use, to free up network resources or preserve battery power. The communication from a WAP gateway to the microbrowser client is over WSP.
- ***Wireless Transaction Protocol (WTP)***. WTP provides a reliable transport mechanism for the WAP datagram service. It offers similar reliability as Transmission Control Protocol/Internet Protocol (TCP/IP), but it removes characteristics that make TCP/IP unsuitable for wireless communication, such as the extra handshakes and additional information for handling out-of-order packets. Since the communication is directly from a handset to a server, this information is not required. The result is that WTP requires less than half of the number of packets of a standard HTTP-TCP/IP request. In addition, using WTP means that a TCP stack is not required on the wireless device, reducing the processing power and memory required.
- ***Wireless Transport Layer Security (WTLS)***. WTLS is the wireless version of the Transport Security Layer (TLS), which was formerly known as Secure

Sockets Layer (SSL). It provides privacy, data integrity, and authentication between the client and the wireless server. Using WTLS, WAP gateways can automatically provide wireless security for Web applications that use TLS. In addition, like the other wireless protocols, WTLS incorporates features designed for wireless networks, such as datagram support, optimized handshakes, and dynamic key refreshing.

- ***Wireless Datagram Protocol (WDP)***. WDP is a datagram service that brings a common interface to wireless transportation bearers. It can provide this consistent layer by using a set of adapters designed for specific features of these bearers. It supports CDPD, GSM, CDMA, TDMA, SMS, FLEX (a wireless technology developed by Motorola), and Integrated Digital Enhanced Network (iDEN) protocols.

WAP 2.x

One of the main new features in WAP 2.x is the use of Internet protocols in the WAP protocol stack. This change was precipitated by the rollout of 2.5G and 3G networks that provide IP support directly to wireless devices. To accommodate this change, WAP 2.x has the following new protocol layers:

- ***Wireless Profiled HTTP (WP-HTTP)***. WP-HTTP is a profile of HTTP designed for the wireless environment. It is fully interoperable with HTTP/1.1 and allows the usage of the HTTP request/response model for interaction between the wireless device and the wireless server.
- ***Transport Layer Security (TLS)***. WAP 2.0 includes a wireless profile of TLS, which allows secure transactions. The TLS profile includes cipher suites, certificate formats, signing algorithms, and the use of session resume, providing robust wireless security. There is also support for TLS tunneling, providing end-to-end security at the transport level. The support for TLS removes the WAP security gap that was present in WAP 1.x.
- ***Wireless Profiled TCP (WP-TCP)***. WP-TCP is fully interoperable with standard Internet-based TCP implementations, while being optimized for

wireless environments. These optimizations result in lower overhead for the communication stream.

Note Wireless devices can support both the WAP 1.x and WAP 2.x protocol stacks. In this scenario, they would need to operate independently of each other, since WAP 2.x provides support for both stacks.

2.10.4 WAP Benefits

The WAP specification is continually changing to meet the growing demands of wireless applications. The majority of wireless carriers and handset manufacturers support WAP and continue to invest in the new capabilities it offers. Over the years WAP has evolved from using proprietary protocols in WAP 1.x to using standard Internet protocols in WAP 2.x, making it more approachable for Web developers. The following are some of the key benefits that WAP provides:

- WAP supports legacy WAP 1.x protocols that encode and optimize content for low-bandwidth, high-latency networks while communicating with the enterprise servers using HTTP.
- WAP supports wireless profiles of Internet protocols for interoperability with Internet applications. This allows WAP clients to communicate with enterprise servers, without requiring a WAP gateway.
- WAP allows end users to access a broad range of content over multiple wireless networks using a common user interface, the WAP browser. Because the WAP specification defines the markup language and microbrowser, users can be assured that wireless content will be suitable for their WAP-enabled device.
- WAP uses XML as the base language for both WML and WML2 (which uses XHTML), making it easy for application developers to learn and build wireless Internet applications. It also makes content transformation easier by incorporating support for XSL stylesheets to transform XML content. Once an application is developed using WML or WML2, any device that is WAP-compliant can access it.

- WAP has support for WTA. This allows applications to communicate with the device and network telephony functions. This permits the development of truly integrated voice and data applications.
- Using UAProf, the information delivered to each device can be highly customized. (Chapter 13 provides more details on how this information can be used to deliver user-specific content.)
- WAP works with all of the main wireless bearers, including CDPD, GSM, CDMA, TDMA, FLEX, and iDEN protocols. This interoperability allows developers to focus on creating their applications, without having to worry about the underlying network that will be used.

At present, all major wireless carriers support the WAP specification. This universal support is expected to continue as WAP evolves, providing a robust, intuitive way to extend Web content to wireless devices.

2.10.5 Technical Challenges of WAP

Of course every great protocol or specification out there for wireless technology will definitely have its drawbacks. With WAP, there are several problems that may or may never get addressed during its development:

- (i) Since WAP is designed for portable devices, important details matter: such as dealing with small screen sizes (a Palm Pilot or mobile phone). A small screen size does not allow high resolution or high pixel images to be seen clearly.
- (ii) Because WAP is designed for portable devices, there is limited device memory so that not a lot of data can be stored.
- (iii) WAP allows two devices to communicate only, and data transfers are usually done with Infrared, therefore the devices have limited range of data transfer.
- (iv) WAP also works on devices that have limited bandwidth.
- (v) There are no “cookies” available to hold the session together.

2.11 LET'S SUM-UP

Mobile computing is human–computer interaction by which a computer is expected to be transported during normal usage, which allows for transmission of data, voice and video. Mobile computing involves mobile communication, mobile hardware, and mobile software. In mobile computing, a set of distributed computing systems or service provider servers participate, connect, and synchronize through mobile communication protocols. Communication issues include ad hoc networks and infrastructure networks as well as communication properties, protocols, data formats and concrete technologies. Hardware includes mobile devices or device components. Mobile software deals with the characteristics and requirements of mobile applications.

1.12 KEY TERMS

- Mobile Computing
- Cellular Network Architecture
- Data Communications
- CDPD Technology
- Mobile data base station
- Mobile data intermediate systems
- Wireless Application Protocol
- Hybrid Pen Computers
- Personal Digital Assistance
- Palmtops

1.13 SELF-ASSESSMENT QUESTIONS

- (i) Write short note on WAP forum?

1.15 MODEL QUESTIONS

- (i) Now a days, almost everybody is using mobile phones. What kind of basic cellular network architecture exists to send and receive the phone calls.
- (ii) “Mobile data communication market is becoming dominated by a technology called CDPD”. Justify the statement by comparing CDPD with others.

UNIT-1

OVERVIEW OF M-COMMERCE

(ANSWERS)

(1) Narrate the limiting factors for M-Commerce.

The limiting factors of m-commerce are:

- (iv) **Lack of Standards:** With a host of device operating systems and platforms, middleware solutions and networks, make application development for the wireless Internet a formidable task, versus the level operating environment of the wired Web. Even though efforts are underway to standardize the operating environment, companies will have to work within this scattered environment, at least in the short –term.
- (v) **Device Constraints:** There are some constraints in the device such as (a) Weak processors; (b) Limited memory (c) Tiny screens, poor resolutions and (d) Poor data entry. While WAP has been a very important in the evolution of the wireless Internet and in turn m-commerce, there are problems/ difficulties with the standard, such as the lack of WAP-enabled devices and security issues.
- (vi) **Networks:** Current data speeds between 9.6-14.4 kbps are too slow and expensive.

(2) Discuss some driving force for M-Commerce.

The development of mobile computing and m-commerce is driven by the following factors.

- (vii) ***Widespread Availability of Mobile Devices.*** According to Romow.com (2008), 50 percent of the world population will use mobile phones in 2008. It is estimated that within a few years, about 70 percent of cell phones will have Internet access (“smart-phones”). Thus, a potential mass market is available for conducting discovery, communication, collaboration, (e.g., see “Global Mobile,” a special report, Computer World, May 14, 2007), and m-commerce. Cell phones are spreading quickly even in developing countries.
- (viii) ***No Need for a PC.*** Today’s PDAs and some cell phones have as much processing power as personal computers did just a few years ago, and possess the range of software available to PC users. This suggests that the smart phone-not the PC-may soon become the foremost tool that connects people to the Internet.
- (ix) ***The Handset Culture.*** Another driver of m-commerce is the widespread use of cell phones, which is a social phenomenon, especially among the 15-to-25-year-old age group. These users will constitute a major force of online buyers once they begin to make and spend larger amounts of money. The use of SMS has been spreading like wildfire in several European and Asian countries. In the Philippines, for example SMS is a national phenomenon, especially in the youth market. As another example, Japanese send many more messages through mobile phones than do Americans, who prefer the desktop or laptop for e-mail.
- (x) ***Declining Prices and Increased Functionalities.*** The price of wireless devices is declining, and the per-minute pricing of mobile services declined by 50 percent in recent years. At the same time, functionalities are increasing. Also, a flat fee (e.g., monthly) encourages more use of mobile devices.

- (xi) ***Improvement of Bandwidth.*** To properly conduct m-commerce, it is necessary to have sufficient bandwidth for transmitting text; however, bandwidth is also required for voice, video, and multimedia. The 3G (third-generation) and 4G technologies provide the necessary band width.
- (xii) ***Networks.*** A driving development of mobile computing is the introduction of the third- and fourth-generation wireless environments known as 3G and 4G, and the adoption of Wi-Fi as a wireless local area network (LAN), WiMax, and wide area networks.

UNIT-2

ONLINE SHARE TRADING

(iii) Write short note on WAP forum?

The Wireless Application Protocol is a standard developed by the WAP Forum, a group founded by Nokia, Ericsson, Phone.com (formerly Unwired Planet), and Motorola. The WAP Forum has now expanded to include more than 200 members, including operators, infrastructure suppliers, software developers and content providers.

The WAP forum is also working with many other standards organizations to develop or modify standards related to new technologies, which need modifications for wireless environment. The WAP forum has liaison relationships (or is in the process of having) with Cellular Telecommunications Industry Association (CTIA), World Wide Web Consortium (W3C), Telecommunications Industry Association (TIA) and Internet Engineering Task Force (IETF). This ensures that when new standards emerge, these standards remain compatible with the work of the WAP Forum. For example, the WAP Forum will be working with the W3C and IETF to ensure future convergence with HTML-NG (Next Generation) and HTTP-NG specifications, and to

provide input to these groups regarding the requirements of future wireless network technologies.

The WAP Forum is the industry association that has developed the de-facto world standard for wireless information and telephony services on digital mobile phones and other wireless terminals. The primary goal of the WAP Forum is to bring together companies from all segments of the wireless industry to ensure product interoperability and growth of the wireless market. The objectives of the WAP Forum are:

- (vi) To bring Internet content and advanced data services to digital cellular phones and other wireless terminals.
- (vii) To create a global wireless protocol specification that will work across different wireless network technologies.
- (viii) To enable the creation of content and applications that scale across a very wide range of wireless bearer networks and wireless device types.
- (ix) To embrace and extend existing standards and technology wherever appropriate.

(iv) What are the advantages of mobile computing?

The advantages of mobile computing are:

1- Increase in Productivity- Mobile devices can be used out in the field of various companies, therefore reducing the time and cost for clients and themselves.

2- Entertainment- Mobile devices can be used for entertainment purposes, for personal and even for presentations to people and clients.

3- Portability- this would be one of the main advantages of mobile computing, you are not restricted to one location in order for you to get jobs done or even access email on the go

4. Cloud Computing- This service is available for saving documents on a online server and being able to access them anytime and anywhere when you have a

connection to the internet and can access these files on several mobile devices or even PCs at home.

5. Location Flexibility- This has enabled users to work from anywhere as long as there is a connection established. A user can work without being in a fixed position. Their mobility ensures that they are able to carry out numerous tasks at the same time and perform their stated jobs.

6. Saves Time- The time consumed or wasted while travelling from different locations or to the office and back, has been slashed. One can now access all the important documents and files over a secure channel or portal and work as if they were on their computer. It has enhanced telecommuting in many companies. It has also reduced unnecessary incurred expenses.

7. Streamlining of Business Processes- Business processes are now easily available through secured connections. Looking into security issues, adequate measures have been put in place to ensure authentication and authorization of the user accessing the services. Some business functions can be run over secure links and sharing of information between business partners can also take place. Meetings, seminars and other informative services can be conducted using video and voice conferencing. Travel time and expenditure is also considerably reduced.