FEASIBILITY STUDY AND IMPLEMENTATION OF MOBILE CREDIT CARD FOR RELIANCE CDMA NETWORK

Thesis report submitted towards the partial fulfillment of requirements for the award of the degree of

Master of Engineering (Electronics and Communication)

Submitted by

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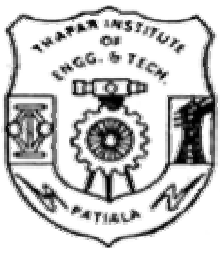

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CERTIFICATE

I hereby declare that the thesis report entitled "Feasibility Study and Implementation of Mobile Credit Card for Reliance CDMA Network" is an authentic record of my own work carried out as requirements for the award of degree of M.E. (Electronics and Communication) at Thapar Institute of Engineering & Technology (Deemed University), Patiala, under the guidance of Mr, Rajesh Khanna, Astt. Professor, ECED and Mr. Kulbir Singh, Senior Lecturer, ECED during January to June 2006.

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ABSTRACT

The emergence of wireless and mobile networks has made possible the introduction of Electronic Commerce to a new application and research subject: Mobile Commerce. Mobile Commerce has undergone massive growth with the maturation of mobile content delivery on 2.5G mobile networks. Due to its inherent characteristics such as ubiquity, reachability, flexibility, and localization, mobile commerce promises business unprecedented market potential, greater productivity and higher profitability. With this in mind, it is perhaps not surprising that mobile commerce is growing much faster than its fixed counterpart. Unlike Electronic Commerce, Mobile Commerce is more personalized and there is a need for a novel approach to evaluating Mobile Commerce applications.

Herein an application is presented, which changes the way credit transaction happens at present. This replaces the usual credit cards with mobile cards. Two Mobile Commerce application scenarios are implemented by making use of the Reliance CDMA Network, SMS services and the data services. First, when both customer and the merchant use Short Message Service (SMS) and second, when merchant uses the data services (IP) and customer uses SMS services for the credit transaction using mobile phones. This thesis examines the feasibility analysis of both the technologies for various parameters like security, transaction duration, etc. Comparisons have been made with the present credit card scenario and the mobile card. A secure transaction environment is an obligatory part in mobile commerce environment while a customer considers making payment. This thesis discusses the objectives of network integrity and over all network security

Finally, conclusions are drawn on the future directions in wireless and mobile Internet service provision. Future applications of mobile commerce like mobile ticketing, mobile telematics, mobile broking, mobile medical records, mobile banking etc. are discussed in this thesis.

LIST OF FIGURES

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LIST OF ABBREVIATIONS

AAA	: Authentication, Authorization and Accounting
AC	: Authentication Network
ACM	: Address Complete Message
AES	: Advanced Encryption Standard
AH	: Authentication Header
AKA	: Authentication and Key Agreement
ATM	: Asynchronous Transfer Mode
BSC	: Base Station Controller
BTS	: Base Transceiver System
CA	: Certification Authority
CAVE	: Cellular Authentication and Voice Encryption
CCP	: Compression Control Protocol
CDMA	: Code Division Multiple Access
CHAP	: Challenge Handshake Application Protocol
CMEA	: Cellular Message Encryption Algorithm
DES	: Data Encryption Standard
EDI	: Electronic Data Interchange
EMS	: Enhanced Message Service
ESME	: External Short Message Entity
ESN	: Electronic Serial Number
ESP	: Encapsulating Security Payload
FTP	: File Transfer Protocol
GMSC	: Gateway Mobile Switching center
GSM	: Global System for Mobile Communication
HLR	: Home Location Register
HTTP	: Hyper Text Transport Protocol
IAM	: Initial Address Message
IKE	: Internet Key Exchange

IMSI	: International Mobile Subscriber Identity
IP	: Internet Protocol
ISAKMP	: Internet Security Association and Key Management Proto
ISUP	: Integrated Services Digital Network User Part
L2TP	: Layer Two Tunneling Protocol
LAI	: Location Area Identity
LCP	: Link Control Protocol
MC	: Message Center
MDN	: Mobile Directory Number
MMS	: Multimedia Message Service
MS	: Mobile Station
MSC	: Mobile Switching Center
MTP	: Message Transfer Part
OSI	: Open System Interface
OTAF	: Over the Air Function
PAP	: Password Authentication Protocol
PC	: Personal Computer
PCF	: Packet Control Function
PDSN	: Packet Data Switching Network
PN	: Pseudo Random Noise
PPP	: Point to Point Protocol
PSTN	: Public Switch Telephone Network
REL	: Release
RLC	: Release Complete
SA	: Security Association
SCCP	: Signaling Connection Control Part
SCP	: Signal Control Point
SHA-1	: Secure Hashing Algorithm-1
SMDP	: Short Message Delivery Point to Point
SMPP	: Short Message Peer to Peer

SMS	: Short Message Service
SMSC	: Short Message Service Center
SMSC	: Short Message Service Center
SMSNOT	: SMS Notification
SMSREQ	: SMS Request
SMTP	: Short Message Transport Protocol
SS7	: Signaling System #7
SSD	: Shared Secret Data
SSD	: Shared Secret Data
SSL	: Secure Socket Layer
STP	: Signal Transfer Point
TCAP	: Transactions Capabilities Application Part
TCP	: Transfer Control Protocol
TLS	: Transport Layer Security
TMSI	: Temporary Mobile Subscriber Identity
UDP	: User Datagram Protocol
VLR	: Visitor Location Register
VPN	: Virtual Private Networks
WWW	: World Wide Web

CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Introduction

The origin of commerce by exchanging goods occurred before recorded history, now commerce is a basic activity of goods trading and buying in everyday life. In the electronic era, the way individuals and organizations do business and undertake commercial transactions have been changed. During the 1990s, the rapid expansion of the World Wide Web (WWW) network; Electronic Commerce (E-Commerce) software; and the peer business competitions, large number of Internet starts-ups appeared. Integrated with the commercialization of the internet, web invention, and Personal Computer (PC) networks these three important factors made electronic commerce possible and successful [1]. There are many advantages and disadvantages for customers, business and non-profit organisations to apply E-Commerce. Through the Internet, different levels of product information can be accessed online globally, which makes it easy for customers to compare and evaluate. Business can provide wide range of choices to extend markets and opportunities. With contribution to digital goods and services through credit card or debit card, customers could save delivery time; business could reduce operating cost and increase profit. The biggest disadvantage is the privacy and security issues of customers' credit card detail [2].

The advent of wireless and mobile technology has created both new opportunities and new challenges for the business community [3]. It makes possible the concept of delivering value to the customer at all times, irrespective of his or her location, as long as he/she is within connection range. It also thereby provides value to information itself; although it may be readily accessible in households or offices (the traditional contact points for E-Commerce) through other media such as the internet or television, a person on the move would not be able to access it as readily. Mobile Commerce (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 a subset of E-Commerce that deals with electronic transactions using mobile communication equipment [3], the only difference with E-Commerce being that the medium is wireless rather than wire line. It can expedite the interaction between the store and the consumer and bridge the associated gaps of E-Commerce.

E-Commerce consists primarily of the distributing, buying, selling, marketing, and servicing of products or services over electronic systems such as the Internet and other computer networks [1].

Various benefits of M-Commerce over E-Commerce are:

- Customer satisfaction, cost savings, and new business opportunities.
- Use M-Commerce anytime, anywhere with the light-weighted device
- Mobile device can be highly personalized [3].
- It can bring the buyer and seller together more easily and facilitate greater profits and a closer customer relationship [4].
- Users sharing a common location or interest can be instantly connected via text messaging and mobile chat capabilities.
- Advertisers can use it for promoting products and make special offers with the expectation that subscribers will answer and listen to their messages.
- With the deployment of positioning technologies, companies can know users' where about and will be able to offer goods and services specific to their location [3].
- Users can store profiles of products, company addresses, information about restaurants and hotels, banking details, payment and credit card details, security information and access these when needed for purchases all from their mobile handsets [2].

M-Commerce refers to transactions using a wireless device and data connection that result in the transfer of value in exchange for information, services, or goods. M-Commerce, facilitated generally by mobile phones, includes services such as banking, payment, and ticketing. Mobile content can include stock quotes, weather forecasts,

driving directions, and other information; it can also include interactive services such as polling, chat lines, and games. It offers the ability to purchase physical goods and services that are delivered or performed off-line. The recent development of high-speed mobile data networks has created a new channel for commerce, while more sophisticated mobile devices are enabling the virtual exchange of payment information known as proximity payments.

1.2 Objectives of the Thesis

The objectives of this dissertation are:

- To understand the basics of Code Division Multiple Access (CDMA) network and various call flows.
- To study various applications of mobile commerce and their importance in today's world.
- To study possible technologies to develop the mobile commerce applications.
- To design an application for credit transaction in which both the parties use Short Mobile Service (SMS) flow.
- To design an application for credit transaction in which customer uses SMS and merchant uses data flow.
- Feasibility analysis of SMS-SMS and SMS-Internet protocol (IP) technologies.
- To analyze the various factors like security, transaction duration etc. that can make the application commercial.
- To compare the present credit card transaction scenario with the designed mobile card.
- To analyze the security offered by the CDMA network, of both over-the-air and fixed network, with special emphasis on SMS and IP messages.

The methodology to meet these objectives is to practically make the implementation of the different technologies and study their feasibility for commercial point of view. Investigation of the available cryptographic applications provided by the mobile technologies was done and the best suitable technology was chosen. Java based program was made for M-Commerce application server and the client and credit transaction was actually done at prototype level using SMS-SMS and also for SMS-IP. Various factors were studied in details, which can make the mobile card application to be developed in commercial sector. Experimental results

of both the designs were analysed and time duration of the transaction was considered an important factor. Any information, or transaction data flowing through IP network is assumed to be secure as well known mechanisms are there for securing of data traversing IP networks like IP Security (IP Sec) and Secure Socket Layer (SSL). The backbone networks of financial institutions are also assumed to be secure.

1.3 Outline

The dissertation follows a logical flow. It covers the following topics:

Chapter 2 discusses the emergence of E-Commerce in the market, what factors drive the popularity of M-Commerce and the present and future applications of M-Commerce.

Chapter 3 looks at the basics of the CDMA network architecture. All network elements of CDMA architecture; their interfaces and protocols with other entities are discussed in detail, following with the discussion of the Telephony and Data Call flows.

Chapter 4 covers the introduction to M-Commerce; SMS-SMS and SMS-IP implementation details to facilitate M-Commerce transactions are also discussed here.

Chapter 5 deals with the network security aspects.

In Chapter 6, an analysis of the two proposed solutions takes place and comparison of both the solution is shown. It also discusses M-Commerce application server and client architecture.

In Chapter 7, author ties all the strings together in the conclusion and discusses the future scope of the implemented application.

CHAPTER 2
LITERATURE SURVEY

2.1 Introduction

E-Commerce began before PC's were prevalent and has grown into a multi-billion dollar industry. In 1984, electronic data interchange (EDI), was standardized [2]. This guaranteed that companies would be able to complete transactions with one another reliably. In 1992, Compuserve offered online retail products to its customers [2]. People got first chance to buy things off their computer. The technology of today is vastly innovative and beneficial to those who know how to manipulate it. The Internet era is unfolding, anybody can now log on to their computers and take care of their financial business, online in the comfort of their own homes. Within the past few years, companies have been excited with the idea of online shopping and connecting with customer's worldwide. This is mainly because of over exaggerated headlines, outrageous market appraisals and so-called "instant billionaires". The hype began in 1994, when the Internet and the WWW gained popularity [5]; companies competed to be the first ones out with convenient online shopping sites, for busy, tech savvy individuals. Online shopping was seen as the future and technology stocks were benefiting from all the positive media that was being reported [5].

As we progress into the future E-Commerce is becoming an important part of all businesses as they try to capture and enter new markets all over the world. However, there is reluctance by many to embrace this technology simply because of the unknown and the main issue of security when trading over the internet or other computer networks. In 2003, there was an article [6], which told that a computer hacker gained access to more than 5 million Visa and MasterCard credit card accounts in the US. Visa and MasterCard said the hacker breached the security system of a company that processes credit card transactions on behalf of merchants [6]. Although fraud is at an all time low, criminals will always target government agencies, high profile companies, internet programs and

websites. There have been many cases of hackers obtaining huge quantities of credit card information from company databases. Unfortunately, there are intruders who are aware that many companies web-site security is not up to par, and they are exploiting flaws faster than system administrators can protect themselves. A report published by Gartner states that 75 percent of cyber attacks occur at the application layer [7]. Many people are hesitant to shop online, reason being the insecurity in E-Commerce. Due to rapid expansion in wireless technology, M-Commerce is the new up-coming field. Figure-2.1 shows the transition from traditional commerce to E-Commerce and then to M-Commerce [8].

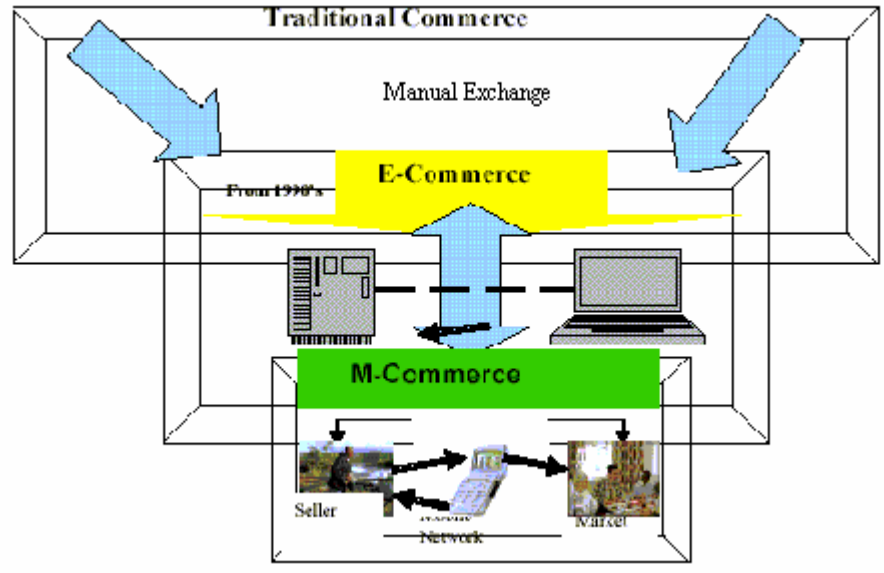

Figure-2.1: Transition from Traditional Commerce to M-Commerce

2.2 Mobile Commerce

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 refers to transactions using a wireless device and data connection that result in the transfer of value in exchange for information, services, or goods. In addition to providing users with mobility and the ability to be tracked, M-Commerce applications have the ability to achieve a high (detailed and accurate) level of personalization of the interaction with the customer. It could translate well into the

promotion of goods and services [3]. Mobile phone users have increased multifold in these days.

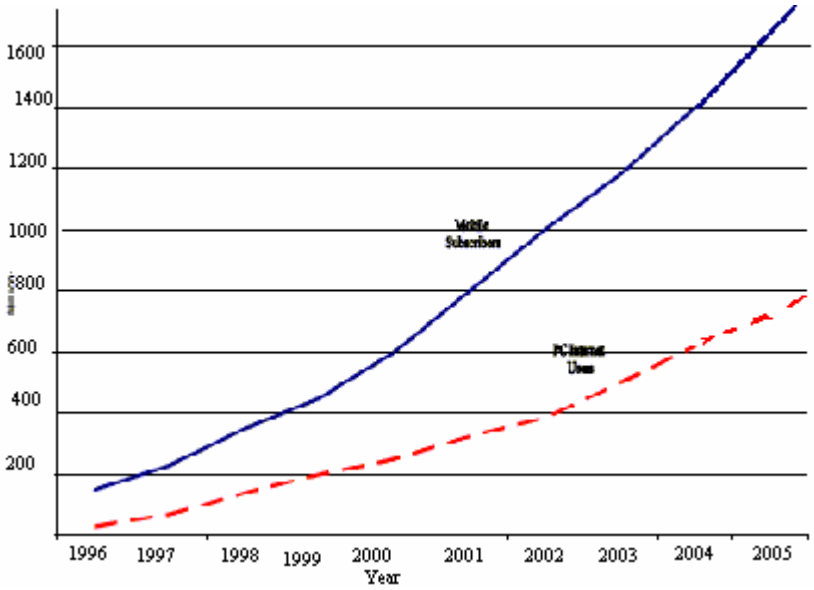

Figure-2.2: Number of Mobile Subscribers and PC Internet Users

India has close to 85 million mobile users and is adding three million and more every month. The mobile subscriber base is expected to touch 300 million by 2010 [4]. But the same kind of penetration is still awaited in credit card business. With the help of this new application, where a mobile phone (mobile card) can serve as credit card, it will be possible to fill the gap. Any person having a mobile phone will be able to do a transaction through his mobile phone.

2.3 What Drives Mobile Commerce?

With the coming of advanced and sophisticated services, mobile communications combined with E-Commerce propositions are heightening the attractiveness of M-Commerce [9]. The key drivers of this are:

- **Ubiquity**: The 'anytime anywhere' advantage of M-Commerce [10]. Smart phones may fulfill the need for both real-time information and communications, independent of the user's physical location [9].

- **Reachability**: Using a mobile terminal, a user can be contacted anywhere anytime. Mobile handsets also provide users the ability to restrict their reachability to certain people.
- **Personalization**: Handsets are affective personal accessories that are capable of holding data and enabling access to information and services tailored to the needs of each individual [10].
- **Localization**: Noting where the user is and providing information related to that location adds a unique value to mobile services.
- **Convenience**: Mobile subscribers have become accustomed to their devices that store data and are always at hand [9]. More advanced applications are driven by technology further enabling the mobile subscriber.
- **Convergence**: Technological applications can be deployed on the move. This is blurring the divide between mobile phones and PCs [10]. Ever increasing sophistication and functionality sustains further handset development.

2.4 Advantages: Mobile Card Over Present Credit Transaction Scenario

Mobile Card has many advantages in comparison to the credit card. These are as follows:

- Using the present credit card for transaction, a separate bill statement is generated at the end of the month of all the transactions, which took place in a month. Whereas, using mobile card for credit transactions, a unified bill can be generated showing the mobile bill and the credit transactions. It becomes easy for the customer to pay for a single bill rather than going to two different places for depositing the bill.
- In credit card scenario, if by mistake the merchant enters the wrong amount for transaction. Wrong amount will be transacted and the customer has to go to the respective bank to get the extra amount credited in his account. Whereas in mobile card the confirmation message stating the amount is sent to both the merchant and customer. If wrong amount is entered, customer can abort the transaction and the merchant in a new transaction can again enter the correct amount.

- With the advancement in the field of wireless communication and digital electronics, mobile handsets have become part of everybody's life. It would be convenient for a common man to do a transaction with his mobile card. For using credit card, one needs to open account in a bank, which is time consuming.
- In case the credit card is lost, wrong hands can misuse it, as no pin code is required at the time of transaction. Only signature of the customer are required which any body can copy from the credit card. Whereas in case of mobile card, if mobile is lost, nobody else can make the transaction except the mobile owner because before starting the transaction merchant asks for the 4-digit pin code which is known to the owner only. Transaction cannot be started if that 4-digit pin code is not entered in the merchant's software.

2.5 Applications of M-Commerce

M-Commerce has wide range of applications from consumer point of view to business point of view. Some of the present applications of M-Commerce are entertainment such as mobile gaming, mobile music, music video, etc., mobile information provisioning such as general news, sports news, entertainment news, financial news [10] and so on. The other future applications of mobile commerce are:

2.5.1 Mobile Financial Services

Financial services are a key commercial driver for the mobile commerce market in Europe and beyond [10]. Retail banking and stock broking markets are in the midst of major industrial restructuring [12].

- **Mobile Banking**: The services mainly considered for offering through mobile banking are:
  - Public Information
    - Check exchange rates
    - Check interest rates
  - Private Information

- Check account and credit card balances
- Administer credit lines
- Check interest earned on deposits
- Check last transactions
- Transfer funds
- Pay invoices
- Apply for credit line

- **Mobile Broking**: Mobile broking is a killer application for mobile commerce. Location independent, real-time information about a share price reaching a particular stop mark and the possibility to act on it provides a very high value to many stock traders, private or professional [10]. Shares exceeding certain price points could trigger messages asking whether to buy or sell.

Mobile broking provides the following key functionalities:

- Receive alerts about price-movements
- Receive message when order is executed
- Check quotes
- Manage portfolio
- Buy and sell stocks, options, mutual funds, other financial instruments [12]
- Browse and delete existing orders

- **Mobile e-bill**: In this, one can receive electronic bills to an e-mail address or to a mobile phone, e.g. from your telephone company, which can be paid via semi-direct debit from the handheld terminal [12]. Thus, no paper invoice is sent any longer. This will cut costs significantly for the bill issuer saving in both production costs and postage. For the user, mobile e-bill will significantly reduce the effort required to pay bills to trusted parties.

2.5.2 Mobile Shopping

Mobile extends your ability to make transactions across time and location and creates new transaction opportunities. It is only a part of the purchasing process is conducted with the mobile terminal.

- **Mobile Ticketing:** Mobile electronic purchase or reservation of tickets is one of the most compelling proposed services, because ticket reservation/purchasing is hardly a pleasant expertise today [11]. It is clearly more convenient to select and book tickets for movies, theatres, opera and concerts directly from the mobile device, because often the decision to purchase is made while outside or on the move among friends. The tickets will be downloaded onto the mobile device and the device will communicate with the check-in counter at the movie theatre or at the airport via Bluetooth or infrared.
- **Mobile Reservations:** Mobile reservations for restaurants and hotels has been one of the most featured applications in mobile commerce, since the prospect of easily finding a restaurant or hotel that suits personal taste and fits the relevant criteria at least is intuitively very appealing. Especially as a location based service, mobile reservations become a valuable application for the business or leisure traveler.

2.5.3 Mobile Dynamic Information Management

The area of what we call dynamic information management is actually related to the mobile device as a secure storage tool for important information,

- **Mobile Membership:** Instead of using as a membership card a magnetic stripe or smartcard, club memberships could be stored on the mobile device, e.g. on the SIM card. Using Bluetooth in the phone and at the point of sale (POS), you could be automatically checked in at your sports club, without having to carry the card with you [10].
- **Mobile Loyalty Programs:** Loyalty or affinity programs, such as airline frequent flyer programs, require a card as well, which could just as easily be substituted by the smart phone or communicator. The device can also store the user's latest point levels for instant reference.
- **Mobile Medical Records:** The mobile terminal would be ideally suited to store a patient's entire medical records or to identify the patient enabling the records to be accessed via the web, so that they would be available whenever needed at a

physician's office [10]. This would not only add convenience, but it could significantly reduce costs to health insurance providers and patients alike.

2.5.4 Mobile Telematics

Driving directions provisioning is a very useful m-commerce application, since only relatively few luxury cars are equipped with a global positioning system (GPS)-based in-car navigation system. In-car navigation has been realized so far mostly with GPS technology and CD-ROMs, which are inserted into the system inside the car [11].

2.6 Summary

The emergence of wireless and mobile networks has made possible the introduction of E-Commerce to a new application and research subject: M-Commerce. Ubiquity, localization, personalization, convenience, convergence and reachability factors drive M-Commerce. M-Commerce application will be implemented on CDMA network. In next chapter, CDMA network architecture is explained.

Equation 1