Intelligent Mobile Payment (IMP) System

by

Mr. Sukum Paitoonrajipipit

A Final Report of the Three-Credit Course
IC 6997 E-Commerce Practicum

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Internet and E-Commerce Technology
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The Graduate School of Assumption University has approved this final report of the three-credit course, IC 6997 E-Commerce Practicum, submitted in partial fulfillment of the requirements for the degree of Master of Science in Internet and E-Commerce Technology

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ABSTRACT

This project is concerned with the development of mobile payment system. The paper first evaluated what the key features of mobile payment systems are. Then it derives critical success factors from theoretical models and conducted studies in the mobile payment landscape. The mobile payment system refers to the new channel of buying products and services anytime, anywhere. With Mobile Payment, it is easy to use mobile phones that support SMS to buy products and services without using any cash or credit card. Intelligent Mobile Payment is suitable for everyone who has a trendy lifestyle. People can just sit at their homes and use their mobile phones to order their lunch from the magazine in a minute. All the payments will come with the mobile bill. Particularly, the analysis shows the function of each payment system and compares both pros and cons of using mobile phones instead of using cash or credit cards.

ACKNOWLEDGEMENTS

I am indebted to the following people and without them this project would not have been completed.

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I. INTRODUCTION

1.1 Background of the Project

With the growing of electronic commerce and the widespread use of mobile devices, a new type of channel is emerging, called mobile commerce. Furthermore, the pervasiveness of wireless networks is creating new opportunities to offer innovative mobile services. Since mobile operators are heavily in debt due to massive investments in 3G licenses, designing a killer application so as to generate substantial revenues rapidly is becoming a priority. It has already been predicted that mobile payment will become a successful mobile service.

The digitalization of the payment process is essential because of the success of e-commerce. Moreover, the recent emergence of m-commerce is likely to require real-time cashless wireless payments to buy physical and digital goods anywhere at anytime. Therefore, the development of mobile payment systems is becoming essential.

As already implied, the trend towards a cashless means of payment can be observed in the virtual realm as well as in the real world. The extensive use of credit and debit cards for proximity purchases has already demonstrated the possibility of considerably reducing the volume of cash-based transactions. This conversion from physical to virtual payment has already brought significant benefits to consumers and merchants alike.

We define mobile payments as wireless transactions of a monetary value from one party to another using a mobile device whose physical form can vary from a mobile phone to any wireless enabled device (e.g. PDA and laptop) which are capable of securely processing a financial transaction over a wireless network.

After seeing these huge benefits of M-Payment, many countries as well as organizations try to learn and adopt this new way of conducting business. Like the others, E-commerce business in Thailand was developing very fast. As the banks had credit cards for customer to buy products and services, I want to create the Intelligence Mobile Payment (IMP) system for customer to use in Thailand.

Mobile Phone is the trendy life style of every age in Thailand which is growing very fast. By just connecting to the Internet customers can shop online and payment will be show in their mobile phone bills at the end of each month.

1.2 Objectives

Develop an Intelligent Mobile Payment System

1.3 Scope

Analysis of Mobile Payment, and their market, network solution, investigative analysis and recommendation for business development.

1.4 Deliverables

(1) Intelligent Mobile Payment System

(2) A final report.

(3) A CD Rom contains the introduction and website that support IMP service, also includes the power point presentation.

II. LITERATURE REVIEW

2.1 Traditional Payment Method

Traditional payments have been around for decades and are widely accepted. They can be grouped into **basic payment procedures** and **card based products**.

Basic payment procedures encompass payment by cash, payment by check, direct transfer, and debit charge procedure. They are called basic payment procedures, because other payment systems are based on one of these payments and their settlement.

Depending on the time of payment, **card based products** can be differentiated into pay before, pay now and pay later cards. Cash cards belong to pay before cards and debit cards or EC-cards to pay now cards. Credit cards are typically pay later cards.

2.1.1 Payment by cash

Cash can be defined as coins and notes in circulation, a hand-to-hand currency from bearer to bearer without endorsement, normally having the status of legal tender. Coins and notes are seen as the most concrete manifestation of money.

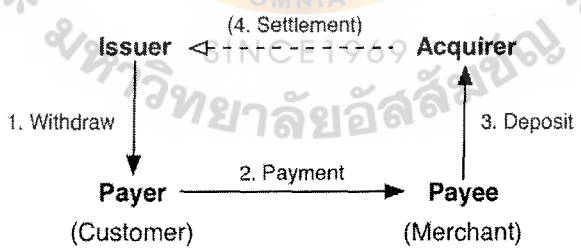

Figure 2.1. Cash payment.

Cash Payment Flow

Step 1 : Customer withdraws money from the Bank.

Step 2 : Customer paid money to merchant for products and services.

Step 3 : Merchant deposits money to the Bank

Step 4 : Bank settlement

Cash payment has several advantages. There are no transaction fees Cash payment is a legal tender. Legal tender money is recognized by law as acceptable payment for debts owed to creditors. That term means that cash money offered as payment must be accepted by the creditor unless a contract calls for another method of payment.

2.1.2 Payment by check

A check is defined as a written order drawn by a depositor, called drawer or maker upon his or her bank. The bank, called drawee, pays a sum of money with funds on deposit with the drawee to a designated party, which is called payee.

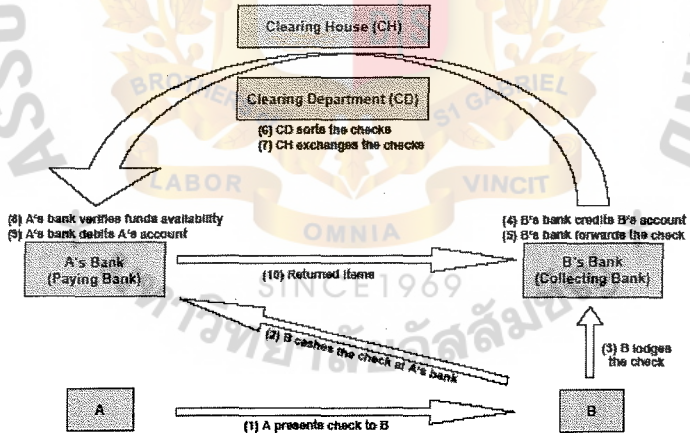

Figure 2.2. Check clearing.

The **check clearing process** is explained: due to an underlying trade person A (payer) owes person B (payee) money. They agree on payment per check. Person A originates a check in payment to person B and presents the check to B (1). Payee B can either collect the funds by cashing the check at the payer's bank A (2) or lodge the

check at his bank B (3). Bank B is referred to as collecting bank. Depending on the creditworthiness of A (A is known to the bank or A is a well known trusted company), a credit is made to B's account immediately on a provisional basis (4). The collecting bank then forwards the checks to a clearing department rather than sort all the checks and send each one to the paying bank for settlement (5). The clearing department sorts the checks according to the banks on which they are drawn (6). The next step involves the exchange of the checks between the banks at the clearing house (7). The following day, the check is presented to bank A, which will verify the check (8) and debit A's account, if the funds are available (9). In case of insufficient funding, wrong signature or any other problem, the check is returned to the collecting bank with a detailed error description (10). If funds are available banks calculate how much they owe or how much they are owed by the group of clearing banks as a whole. Finally, the difference is settled using a special account maintained by the central bank.

One advantage for the payer is that the check processing takes 2-3 days, giving the payer a short credit. Costs are a major drawback. Checks are expensive to issue and process and they generate substantial work for the banks. Another disadvantage are dishonored checks, which cause uncertainty for the payee.

2.1.3 Payment by Giro or credit transfer

A direct transfer automatically moves funds from the debtor's account to the creditor's account upon receipt of order from the debtor, avoiding the use of cash or checks. A standing order executes a direct transfer to a specific payee, thereby transferring a regular amount on periodical base.

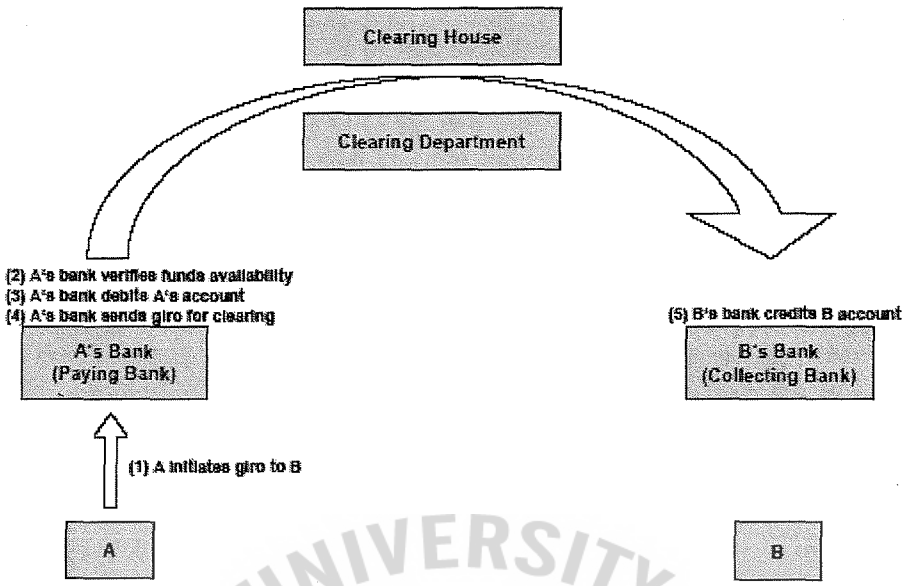

Figure 2.3. Giro transfer clearing.

A **giro transaction** can only be initiated by the Payer A, if funds are available (1). Compared to checks, the payment by giro takes the reverse way trough the clearing system. A's bank verifies funds availability (2), debits A's account (3) and sends the giro for clearing (4). The collecting bank is simply crediting B's account without the involvement of B(5).

Of advantage is that a direct transfer can not be initiated unless the funds are available on the payer's account. The electronically processing of the payment information is easier to conduct because there is no need to physically transfer a document like a check. Disadvantages could not be found in the related literature.

2.1.4 Payment by credit card

A credit card, usually made of plastic, establishes the privilege of the holder to charge purchases against a pre-approved line of credit. Credit cards are developed to fulfill consumer's needs for cashless payments in a retail situation.

There are four major parties involved in a payment by credit card: card companies, card holders, banks and merchants.

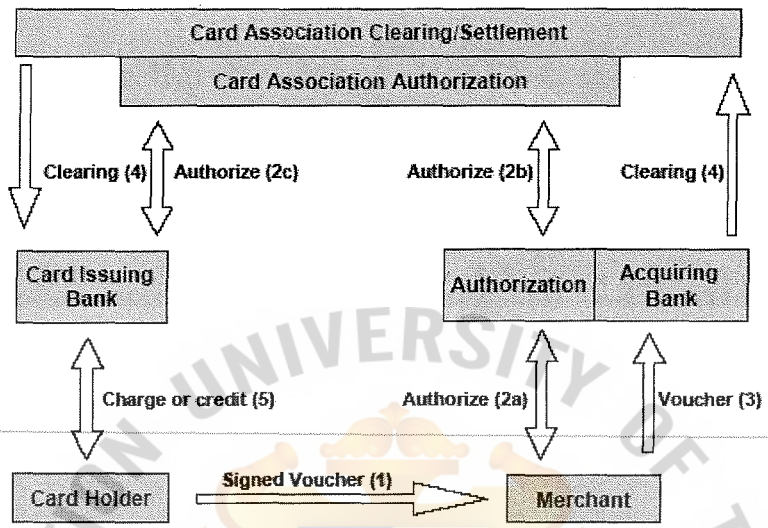

Figure 2.4. Credit card clearing.

Card companies themselves do not directly deal with the card holders or the merchants. They simply license other entities, usually card issuing or acquiring banks to do this for them. Card issuing banks roll out the cards to their customer base and operate a card account to which payments are charged. Merchants, who like to accept payments using credit cards, have to register at an acquiring bank. As shown in Exhibit 20 the sales voucher signed by the consumer (card holder) containing all relevant payment information like card number, date, amount, description of goods is given to the merchant (1). Regarding banks effort to eliminate paper based transactions; the payment information is exchanged almost solely electronically. The voucher comes into play only in case of a dispute. Depending on the policy, it may be necessary to accomplish an authorization of the payment (2a-2c). This usually involves verification of the credit card number and/or of solvency. The acquiring bank will clear the voucher using a

clearing system operated by or on behalf of the card associations (3-4). Finally the card holder is charged or credited (5).

Advantages are that there is no PIN involved and the already mentioned credit function. Some companies offer under certain circumstances zero liability in the event of unauthorized use of the credit card. This measure increases consumer protection enormously. A disadvantage is that credit cards are an easy target for fraud, e.g. to conduct a purchase at a virtual POS, only the information displayed on the card is necessary. An unauthorized person can get hold of this information by reading the card itself or related receipts. Another shortfall can be seen in the high fees of about 3% of total card based revenue for the merchants. It seems unfair that a merchant with a customer base bearing a low credit risk have to come up for the higher fraud rates of merchants with a significant less honorable customership.

2.1.5 Payment by debit card

Debit cards provide direct access to the cash in a holder's account or credit line. They are used as Automated Teller Machine (ATM) access cards to supply the holder with immediate cash or as POS cards to make transactions with automatic debiting to the customer's account. In Europe the debit cards are known as Electronic Cash (EC) cards. They evolved from the former eurocheque card backing eurocheque transactions. Today EC-cards in Germany and Switzerland originally designed to withdraw cash at national ATMs are almost entirely equipped with the international Maestro335 debit function. EC-cards equipped with Maestro enable worldwide payments at POSs336 as well as cash withdrawals at ATMs.

The system which enables **payment by debit card at the POS** is called **EC** and has been introduced in 1991. It is a PIN-based payment system which guarantees a

payment to the payee. All necessary transactions, validation of the card and check for the availability of funds are conducted online.

All these systems, except the EC system, have one similarity: the payment is not guaranteed, because of a lack of security. The main reason for the rise of these additional methods is that there are no fees by the card issuing bank involved. However, they are considered to put the trustworthiness and therefore the acceptance of the very secure EC system in danger, because they all can be easily abused.

The **debit card transaction** works as follows: the purchase amount is debited directly to the holders giro account. A Maestro transaction can only be conducted electronically. At the time of the transaction the merchant slides the card trough the authorization terminal and enters the purchase information. If offered, the buyer can request cash back. Cash-back enables the request of a total amount higher than the purchase. In the next step, the buyer verifies the amount by entering the PIN. Finally the terminal confirms the availability of the funds and the amount is deducted from the buyers account.

One **advantage** is that debit cards need no additional account to the already existing banking account. Other advantages can be seen in the immediate access of funds by the use of only one single card. The use of a debit card is very easy and convenient, although a PIN is necessary. On average, 80% of the card owners can remember their PIN. The use of a PIN reduces fraud, maintains privacy and makes it a more secure alternative to carry cash. There is no need to present personal identification. The complete transaction is very fast. Receiving a receipt for each purchase as well as the monthly account statement showing date, time, place and amount of purchase makes tracking easy. Debit Cards using Maestro are already worldwide accepted.

A **disadvantage** is the need of an online connection to the financial network to check the availability of funds. Compared to credit cards debit cards are not equipped with additional services like insurance services, flight or hotel reservation. Debit cards can never establish a new credit. Nevertheless, they can only use the line of credit of the giro account.

2.2 Introduction of Mobile Commerce

Payment has evolved from the physical exchange of notes and coins, to writing checks, through transferring payment card details either in person, over the phone or the Internet. This evolution has involved a shift from the physical transference of tangible tokens of value to an exchange of information between parties. In the case of payment cards, this exchange takes place between the consumer's bank and the merchant's bank over networks managed either by regional payment providers or global card organizations.

The emergence of e-commerce has further digitized the payment process, whereby payment details are sent over open networks with no physical contact between the buyer and the seller. 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.

The shift from physical to virtual payments has brought enormous benefits to consumers and merchants. However, it has put extra pressure on payment service providers, including banks and card companies, and mobile operators, to provide robust security and interoperability. The advent of mobile payments has added another layer of complexity through the use of constrained devices with different capabilities and network limitations.

Despite the differences, the success of mobile payments is contingent on the same factors that have fuelled the growth of physical world non-cash payments, namely: security, interoperability, privacy, global acceptance, and ease –of use.

In the meantime, high-speed data networks, such as 2.5 and 3G, with more sophisticated data-enabled wireless devices, have the potential to transform payment. Color screens, greater bandwidth, and more compelling content are converging to create an environment where consumers feel more comfortable transacting on the move. In addition, new wireless protocols, such as Bluetooth, infrared and radio frequency identification (RFID), are enabling short range wireless device-to-device payments. Although we are at an early stage in the development of mobile payments, a number of factors are threatening to arrest the development of this new medium, including the proliferation of competing network standards, as well as incompatible operating systems and devices. Another major factor is the lack of secure and interoperable standards for mobile payments. The following tables show the infrastructure of Mobile Commerce:

Table 2.1. M-Commerce Service and Application.

Type of M-Commerce Service	**Applications**
Information-based services	Instant messaging, e-mail, searching for a movie of restaurant using a cell phone or handheld PDA
Transaction-based services	Purchasing stocks, concert tickets, music, or games; searching for the best price of an item using a cell phone and buying it in a physical store or on the Web
Personalized services	Anticipate what you want based on your location or data profile, such as updated airline flight information or beaming coupons for restaurants

Table 2.2. M-Commerce Service and Application.

	Characteristics	Value-added attributes
M-Commerce	Mobility Reachability	Product and service localization Product personalization Ubiquity enhancement Instant connectivity Convenience

Table 2.3. Mobile Computing Infrastructure.

Requirement	Equipments
Hardware	Cellular (mobile) phones, Attachable keyboard, PDAs, Interactive pagers, Screenphones, E-mail solutions, Other devices (notebooks, mobile computers, etc.), convergence
- To conduct m-commerce, one needs devices for data entry and access to the Internet, applications, and other equipment.	
Software	Microbrowser, Mobile client operating system (OS), Mobile application user inteface, Back-end legacy application software, Application middleware, Wireless middleware
- Applications need to use customized software for each type of device with which the application may communicate.	
Networks and Access	Wireless transmission media (microwave, satellites, radio, infrared, cellular radio techonology), wireless systems
- Wireless networks provide true mobility. Mobile users may use a wireless network for occasional connections from hotels or airport VIP lounges.	

2.3 Mobile Payment

Mobile payment is a point-of-sale payment made through a mobile device, such as a cellular phone, a smartphone, or a personal digital assistant (PDA). Using mobile payment, a person with a wireless device could pay for items in a store or settle a restaurant bill without interacting with any staff member.

2.3.1 Market

The growth of the mobile payment market relies on the ongoing spread of mobile telephony and the related expansion of mobile commerce. At this early stage mobile commerce market forecasts and related mobile payment market forecasts are rather imprecise and therefore have to be interpreted carefully: the mobile commerce market is expected to reach 13 billion US Dollar (USD) in 2003, 50 billion USD in 2006 and approximately 270 billion USD in 2010. Forrester is predicting the mobile payment market in Europe to be 23,4 billion USD in 2005. According to Frost & Sullivan the mobile payment market in Europe is predicted to reach 25 billion USD in 2006.

2.3.2 Mobile hardware

Some mobile payment definitions have in common that they posit the mobile phone as the device to conduct payment. But there are payment solutions, which can also be considered as mobile and not using a mobile phone, but RFID key fobs. Additionally, PDAs are increasingly equipped with mobile phone technology and vice versa. Therefore it might be suggested to expand the circle of mobile payment devices. Next to mobile phones, smartphones, PDAs and RFID fobs can be considered as mobile payment devices according to the following criteria:

(1) Physical criteria: a mobile device should be highly portable.

(2) Connection criteria: a mobile device has to establish a wireless connection. The payment information can be exchanged by a local short range connection, as in the case of RFID, or by a cellular network connection or both.

(3) Acceptance criteria: a mobile device should qualify for every time and everywhere use. Points of acceptance should be widespread and not bound to a single location, e.g. a RFID technology based bridge toll payment system, which can only be used at one single bridge cannot be considered as a mobile payment system. However, if this toll collecting system could also be applied for another purpose, e.g. to purchase gas, it could be considered as a mobile payment system.

However, mobile phones are equipped with a combination of features and functionality, which gives them an outstanding position among other Mobile payment devices. Among the features are the ability to send and receive text and speech.

2.3.3 Connection technologies

The mobile payment device establishes a wireless connection. The communication can either be established by **cellular network technologies** or **proximity technologies**. Internet access by the mobile payment device based on cellular network or proximity technology requires **wireless Internet technologies.** Depending on the investigated connection communication bearers are of different nature.

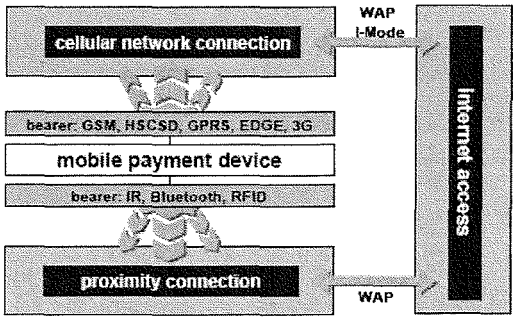

Figure 2.5. Mobile payment device connection overview.

(1) Cellular network technologies

Key cellular network technologies are: **Global System for Mobile Communication (GSM)**, **High Speed Circuit Switched Data (HSCSD)**, **General Packet Radio Service (GPRS)**, **Enhanced Data Rate for GSM Evolution (EDGE)**, **Universal Mobile Telecommunications System(UMTS)**. Additionally, **Short Message Service (SMS)**, which is based on GSM, is an important enabling service.

(a) GSM

GSM is a digital wireless network standard, also referred to as Second Generation (2G). In April 2002, approximately 70% of the totals of wireless subscribers are GSM subscribers. The number of GSM subscribers is 684.2 million worldwide. GSM is prevailing in Europe with 357.1 million subscribers and in most of the Asia-Pacific region with 249.9 million subscribers. In North America only 14.7 million subscribed to GSM. The North American mobile market is approximately 2 years behind the development in Europe, due to the "Called Party Pays" principle and the wide acceptance of other technologies, such as pagers. GSM operates in the 900 MHz and 1800 MHz frequency band. To enable data

transport, a circuit-switched connection is established. The data throughput is limited to 9.6 Kbps.

A main advantage is the widespread acceptance of GSM. A disadvantage is that the wire line circuit and the radio channel resources are reserved, even if data is not transferred. These resources could be used for other traffic. Alternatively they could be released if there is no data traffic and again reserved if necessary. However, GSM requires a long call set up time, which cannot be tolerated by many applications and each set-up call is producing extra traffic.

(b) HSCSD

The HSCSD protocol is based on GSM. The typical user scenario is the frequent business traveler accessing internet application while on the move. One advantage is the higher throughput. HSCSD enables a data throughput up to 57.6 Kbps, by making use of up to 8 Time Division Multiple Access (TDMA) time slots simultaneously instead of one time slot. Due to the higher throughput large file transfers and multimedia applications are possible. A disadvantage is the call set-up time of approximately 40 seconds. Additionally fewer users can share GSM services, because more resources are assigned to an individual consumer. HSCSD is expected to have a limited opportunity window and is seen as an interim technology to enhance existing GSM services.

(c) GPRS

GPRS is a packet switched wireless protocol defined in the GSM standard. GPRS is able to provide connections up to theoretically 115 Kbps, but it will initially only provide 43.2 Kbps downstream and 14.4 Kbps upstream. GPRS is considered as a step in the evolution towards UMTS, because both technologies are packet-switched based.

A major advantage of GPRS is the "always on" connection, improving end user experience. GPRS will enable any service, that currently runs on the fixed internet, such as web browsing, chat, e-mail or File Transfer Protocol (FTP) to work on the mobile network. The key idea is, that data are only transferred if necessary. Compared to HSCSD, spectrum efficiency is further increased: GPRS supports more users on one to eight channels. A disadvantage is the necessary investment in new infrastructure: GSM circuit-switched architecture needs to be expanded to enable packet switching.

(d) EDGE

EDGE is an enhanced GPRS version introduced under the same GSM infrastructure. One advantage is the introduction of user data rates up to three times higher and an up to six times higher spectrum efficiency than GPRS. Data transmission up to approximately 384 Kbps is realized. EDGE supports the migration channel from GPRS to UMTS, because for UMTS necessary modulation changes will be already in place. Compared to the GPRS/UMTS scenario a GPRS/EDGE/UMTS scenario is cutting operators' capital expenditure by half. A disadvantage is the little operators' commitment and the limited availability of triple-mode GPRS/EDGE/UMTS handsets. Thus, EDGE is considered as an interim technology with a short opportunity window.

(e) SMS

SMS enables to send and receive text messages up to 160 alphanumeric characters via mobile phone. There are two types of SMS services: cell broadcast service and point-to-point service. Cell broadcast service delivers SMS messages to all subscribers in an area, where as point-to point messages are delivered to a

specific user. Approximately 90% of SMS messages are voice mail notification or simple C2C messaging. 24 billion SMS messages were send in March 2002. Recent research revealed that the heavy SMS users are under age of 25. One advantage is that a SMS message can be received during conversation. A major disadvantage is the security issue. SMS messages cannot be blocked. Mobile phones can become subject of denial of service attacks, mail bombs and spamming through SMS. Also viruses are can be delivered via SMS. Additionally, SMS is considered to have a weak encryption. SMS messages are consuming memory in the mobile phone. Finally, the sending of SMS messages can become expensive if SMS messages are charged on per-message basis.

(2) Proximity technologies

The following technologies are applicable to establish a proximity or short range connection: **Bluetooth**, **Infrared** and **Radio Frequency Identification.**

(a) Bluetooth

Bluetooth is a computing and telecommunications industry specification describing how different devices can establish a wireless short-range connection to exchange data. Bluetooth technology was an internal Ericsson project on wireless connectivity developed in 1995. In 1998 the Home RF Working Group (HRFWG) and the Bluetooth Special Interest Group (SIG) started to develop industry standards for an integrated voice/data home wireless network. Bluetooth uses the Industrial Scientific and Medical spectrum (ISM). It provides 79 channels, operates at 2.45 GHz, and is almost globally available. Every Bluetooth device is equipped with a low cost chip transmitting and receiving at the 2.45 GHz band. To establish a network each device owns an unique 48-bit address from the IEEE 802 standard. The network throughput is 723.2 Kbps. Bluetooth utilizes fast-frequency hopping at

a rate of 1600 times per second with spread-spectrum techniques. This enables communication even in areas with heavy electromagnetic interference. Built-in encryption and verification is provided. One advantage is that Bluetooth does not require a line of sight to communicate. The connection can be point to point or multi-point at a range of 10 meters. Disadvantages are found in the field of security. There is the possibility to "datajack" a mobile phone via Bluetooth. This allows an unauthorized third party to make phone calls via someone else's phone. Another possibility is to record a communication between two Bluetooth devices, by recording all possible 79 channels. If the intruder finds out the hopping frequency he could repeat a transaction. It is also possible to conduct a denial of service attack by jamming transmission frequencies.

(b) IR

Infrared light can be used to connect devices to transfer data wireless. The Infrared Data Association (IrDA) recently launched Infrared Financial Messaging (IrFM) Point and Pay Profiles to standardize the way payments are made when using IR connections for proximity payment. IrFM is designed to enable users with IR equipped devices to pay for purchases by beaming their virtual financial instruments to a POS. Virtual financial instruments consists of so called soft cards (electronically stored credit cards, debit cards), stored value or other information to initiate a payment.

One advantage of IR is that the user is no longer required to swipe his physical credit card through a reader. The whole transaction is beamed and can be kept totally paperless. The backend processing is exactly the same as the backend processing triggered by a credit card swipe. IR has a very high throughput, up to 16Mbps and it is relatively cheap. The short range and the necessity of line of sight

limit the possibilities of attacks, such as data interception. Depending on the application this advantage can also become a disadvantage: e.g. the user is forced to point the device exactly to the other device or POS, which can lead to inconvenience.

(c) RFID

Radio Frequency Identification is a technology that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object. RFID is no bearer, such as Bluetooth or IR. It is rather a complete system based on the principle to send data via RF. A RFID system consists of three components: a tag, a reader and application components.

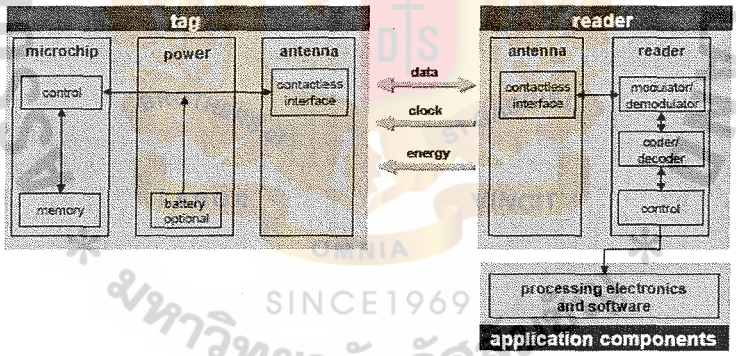

Figure 2.6. Radio frequency identification architecture.

The tag, also called transponder, is attached to the objects that shall be identified. It consists of a microchip and an antenna. The tag becomes active within the reader zone. Outside the reader zone the tag remains idle. There are passive tags without own energy supply and active tags powered by batteries. If a passive tag enters the reader zone, it is activated by electromagnetic induction resulting from

electromagnetic waves sent by the reader. The electromagnetic waves received by the tag's antenna give rise to an electromagnetic field that propagates through space transmitting information residing on the chip. Low frequency systems (30 KHz to 300 KHz) have a short range. High frequency systems (3 MHz to 30 MHz) and ultrahigh frequency (300 MHz to 3 GHz) possess a longer transmission range. The sizes of the antenna and, in case of active tags, the battery size determine the size of the tag. The antenna size increases with the range of the tag and decreases with frequency.

The reader, also called interrogator, produces the carrier signal for three purposes: first, to provide the energy for the chip on the tag: the closer the chip to the reader is, the higher is the induced voltage on the chip. Second, to provide a clock source for the tag: many RFID chips derive from the carrier signal clock functions, such as counters and the data transmission bit rate. The third purpose is to act as a data carrier.

Application components link the reader via standard interfaces to application systems, like Enterprise Resource Planning (ERP) systems or POS software.

One advantage of RFID systems is that direct contact or line-of-sight scanning becomes superfluous. RFID systems can interact with several tags in the reading range at the same time.

A disadvantage is that is allows only communications with a low amount of data, because passive tags are not designed to perform sophisticated computational tasks.

(3) Wireless Internet technologies

In the context of this paper, currently applied enabling wireless Internet technologies are the **Wireless Application Protocol (WAP)** and **I-Mode.**

(a) WAP

WAP is a global open standard designed to communicate information between wireless devices and the Internet. It originated from the WAP Forum, a joint development, of Ericsson, Nokia, Motorola, and Phone.com. Today numerous companies have joined the WAP forum. The Hypertext Transfer Protocol (HTTP) is not suitable for WAP applications, because it is consuming too much bandwidth. Therefore a WAP gateway is necessary. The WAP gateway transforms the encoded requests from the handset (1) to a standard Internet-based request (2). Then, the WAP gateway acts as an Internet client and sends the request to the content proving server. It retrieves the information (3) from the server, reformats and sends it back to the requesting handset as encoded Wireless Markup Language (WML) (4).

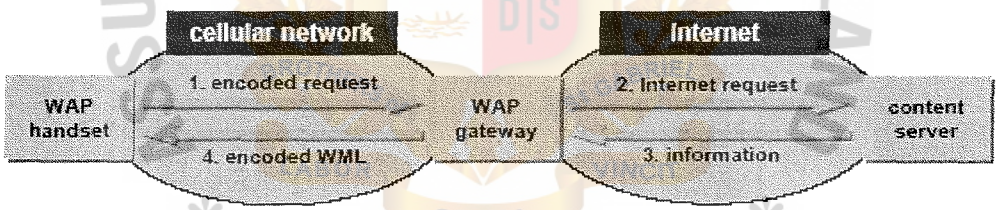

Figure 2.7. Wireless application protocol network mode.

One advantage of WAP is the easy and user friendly way to receive and react to information on the mobile phone. WAP copes with the constraints of the wireless devices, such as small display capabilities, low bandwidth, clumsy input devices, and reduced computational power and memory.

A disadvantage of WAP is that it was launched sooner than the technology suitable to leverage it. It was supposed to work in the slow GSM network, resulting

in long connection time and slow response time. Handsets need WAP browsers and should be provided with a larger screen. These aspects have led to a heavy user disappointment, which is hindering a fast adoption.

(b) I-Mode

NTT DoCoMo introduced I-Mode in February 1999. It is a mobile Internet access system. I-Mode started in Japan and is recently also offered in Germany by E-Plus. It allows users to view specially formatted Internet sites, access their e-mail, and receive financial information. It also offers travel and entertainment services via their mobile phone. I-Mode grew out of the need to prevent the collapse of the NTT DoCoMo network by 1997, suffering from dropped calls and poor call quality. The users had to be convinced to use more data traffic, than voice service, which would postpone the need for NTT DoCoMo to invest in a completely new infrastructure in order to cope with the rapid growth of mobile phones.

The main advantage of I-Mode is the "always on" feature, enabling an instant connection. Consumers are billed per data volume and not by a fixed or timed rate. Compared to its competitors, such as J-Phone with J-Sky service, I-Mode has a share of 60% of the Japanese wireless Internet market.

A disadvantage is that I-Mode runs on a slow packet switched network limiting the throughput to 9.6 Kbps. Another disadvantage is that I-Mode is only available to NTT DoCoMo subscribers.

2.4 Type of Mobile Payment

Several approaches have been taken to group mobile payments: one possibility is the distinction according the involved account, such as bank account or credit card account. Another option is to group mobile payments in three categories: in-band, out-of-band and proximity. Influenced by these options and led by the technical foundation

of chapter 2.2 three main groups were building: mobile payments applying cellular network technology, mobile payments applying mobile Internet technology and mobile payments applying proximity technologies.

2.4.1 Mobile payments applying cellular network technology

This type of mobile payment is based on the idea to initiate a payment by the use of a mobile phone and cellular network communication bearers, such as GSM. Depending on the solution the ability so send and receive SMS messages is necessary. Regarding the account for the final settlement, it can be further differed into mobile payments linked to a phone bill and mobile payments linked to a bank account.

(1) Mobile payment linked to phone bill

Telecommunication Companies have the necessary billing infrastructure and settlement agreements in place. Therefore they can accumulate purchases, include them in the phone bill and bill them on a monthly period. To conduct a payment the consumer has to call a premium rate number e.g. 0190 in Germany. The consumer is either charged on a per-time basis or on a per call basis. In the latter case, the charge is equivalent to the purchased item. The following **examples** have in common that they are rather micropayments than macropayments:

(a) The soft-drink vending machine by Sonera is a mobile payment linked to a phone bill on per-call basis. To "pay-by-GSM" the consumer dials a special number, which is displayed on the vending-machine. Sonera later bills the aggregated amounts. The same solution is realized to purchase other low-price products and services, such as passport photos, golf balls and car wash.

(b) NTT DoCoMo's I-Mode includes billing activities via phone bill on behalf of third party are. It offers to bill customers for their purchases at official partner sites.

(c) A per usage or per time model can consists of chargeable WAP services over GPRS. They are charged by the provider himself, or by a third party. Such services include news, videos or online games.

(2) Mobile payment linked to bank or credit card account

In this case the settlement information, such as card or account information is in the PSP. The link between account or card owner and the critical information is established by the mobile phone. In terms of final settlement the majority of currently operating solutions in Germany uses debit charge procedure or direct transfer. Two Mobile payments, which operate in Germany, are:

(a) Paybox: it has been the first mobile payment solution and is clearly the leading mobile payment system in Germany.

(b) Streetcash: its transactions are completely based on SMS messages, whereas Paybox uses an automatic voice system to call the user and ask for authentication.

2.4.2 Mobile payments applying mobile Internet technology

Technologies like WAP or I-Mode are a key foundation to enable Internet access with a mobile device. Thus, most former fixed-line online payment methods are potential mobile Internet payment methods. The fixed-line Internet content has to be adopted to be presented via WAP or I-Mode. The following chapters examine **personal online payments** and **micropayments**

(1) Personal online payments

Personal online payments are a successful example of a fixed-line Internet payment mechanism, which is mainly based on Internet and e-mail technology. The process of a personal online payment, as depicted by Exhibit 6, is as follows: the payer accesses his account at the payment provider. This can be done with a PC and fixed-line

Internet or with a WAP enabled mobile device wireless. Then he initiates (1) a payment to the payee by entering the payee's identification, usually his e-mail address, the amount and delivery instructions. The payee is notified (2) via e-mail of incoming funds. The payee's payment confirmation (3) via e-mail triggers (4) the internal book-entry transfer (5) in the provider's system.

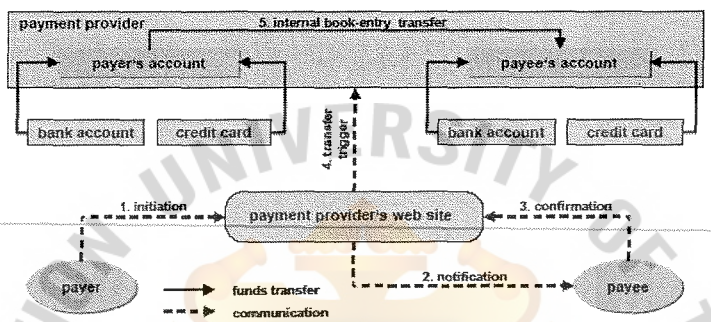

Figure 2.8. Personal online payment process.

The funds are transferred virtually instantaneously at low cost. However the payment has low potential for real POS applications: the current process is not qualifying for a fast checkout and there is no guaranty of payment. One **example** is **Paypal**

(2) Micropayments

Micropayments derived from the trade with intangible goods at low cost via Internet. The access of intangible goods is an important issue creating a strong demand for low-friction payments. Mobile micropayments bear a high potential, because this demand exists also in the mobile world.

Micropayment providers are aggregating low value payments to avoid unnecessary transaction costs for each single payment. The total can be billed on a

monthly period by the micropayment provider. Another option to charge the consumer is the use of premium rate numbers. Then, the consumer pays for the intangible goods by paying his phone bill.

scheme.

2.4.3 Mobile Payments applying proximity technology

Mobile proximity payments are predicted as the best medium term revenue opportunity.151 Bluetooth and IR are considered as promising drivers to develop vital mobile payment solutions at local POSs. An alternative to these approaches is the mobile payment based on RFID technology, which is presented by the example of Speedpass. Some mobile payment approaches in the retail environment are based on a combination of a proximity technology and implementation alternatives of the Security Element (SE) in the mobile phone.

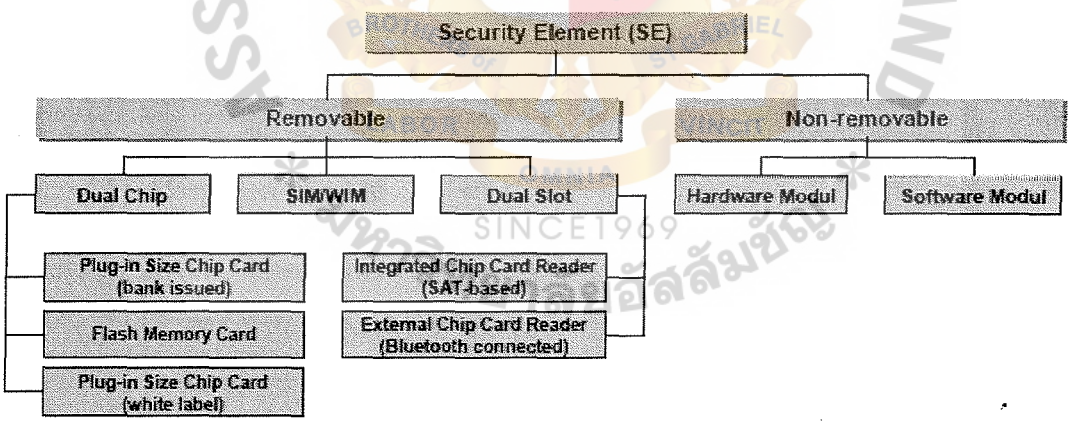

Figure 2.9. Implementation alternatives of security element.

SE is considered by the Mobey Forum as a key concept of the Preferred Payment Architecture (PPA). According to MeT SE is "[...] used to store of cryptographic keys and perform operations using these keys". As part of the mobile

phone it is involved in the following core functions: initialization, registration, secure session establishment, authentication, user authorization, key generation, key and user certificate storage. The focus will be on **removable** realizations of SE. Depending on the incorporation of WIM as part of the SE, three approaches are discussed: **single chip** , **dual chip** and **dual slot**.

(1) Single chip

The single chip, or SIM/WIM, approach is based on the storage of the bank credentials on the SIM card issued by the operator.

In terms of **advantages** the consumer experiences a high level of convenience. No additional device and no additional cards are necessary. The merchant benefits from a high level of security as well as strong authentication and non-repudiation. He has also access to a large customer base equipped with this identification mechanism. The bank is sure in the role of the trusted third party. Additionally, the banks rely on a technology, which is included in 3G standards. A major **drawback** is that the SIM/WIM approach is not applicable in a local environment with current standards, e.g. Eurocard Mastercard Visa (EMV) applications cannot be put on a non-bank issued SIM card. Thus, the payment application cannot be used anymore if the consumer replaces the SIM card. Additionally the operators' position would be strengthened as an irreplaceable institution for mobile services. In terms of customer service this approach causes irritation: e.g. which party is responsible for a lost PIN.

An **example** of the SIM/WIM approach is the payment system developed by the Danish operator Mobilix and the Danish clearing house PBS.

(2) Dual chip

The dual chip concept is based on a second chip at the size and shape of a GSM SIM chip additionally embedded in the mobile phone. This chip, which can host multiple applications from several providers, can be realized as:

(a) Bank issued plug-in size chip

(b) Flash memory card

(c) White label plug-in size chip from a trusted third party.

Major advantages of the **bank issued plug-in size chip** for the consumer are the high level of convenience. Additional devices or multiple cards become superfluous. Coherent with the consumers' expectations the bank is issuing the chip. The consumer can exchange the cards if required. For the merchant, there is no need to make new acquirer contracts. The investments in infrastructure remain low, because the major part is already in place. A faster check out could be achieved by an EMV based solution. The banks remain in control of the payment, because the solution is operator independent. The chip solution provides the opportunity to offer multiple applications defined by the banks, attracting new customers and foster existing customer relations. The volume of card transactions is increased resulting in less cash handling.

A major drawback arises with management of multiple applications from different providers on the same chip. Further, the new chip causes extra costs. The handset design has to be adapted to the second chip solution, which eventually affects size and production cost.

One advantage of a **flash memory card** is additional memory, which will be essential for 3G mobile phones. Another advantage is faster processing and the fact that flash memory slots could already be embedded. Major shortfalls of flash memory cards are the high costs and the fact, that they are not yet approved for bank use. The concept

of the **white label plug-in size chip from a trusted third party** shows similar advantages and disadvantages, but is highly questionable: banks would be out of control and the consumer has to trust a so far not defined third party. An example for a bank-issued dual chip solution is the Electronic Mobile Payment System (EMPS) mobile phone. EMPS is a joint project by Nokia, Visa and Merita-Nordbanken. The second plug-in sized card is a Visa credit card as well as a Merita debit card. The system can be applied to purchase goods via the Internet and at the local POS. The Internet purchases are conducted via SSL with the Visa credit card as payment instrument. Bluetooth has been applied to conduct payment at the local POS with Merita card. There are no examples available for the flash memory card or the concept of the white label chip.

(3) Dual slot

The dual slot concept is realized by an integrated SAT based full-size card reader or an external full-size card reader. Both approaches enable the consumer to make use of his physical cards. To conduct a payment the user chooses the preferred card from his physical wallet and inserts the card in the slot of the card reader in the mobile phone. Then he initiates the payment. After a complete transaction, he removes the card from the mobile phone. The whole transaction is similar to a card transaction at a real POS, except that the consumer brings his complete own infrastructure.

In terms of **advantages** this solution bears the highest familiarity for the consumer. He is not forced to accept new cards and can apply his existing payment instruments in a highly convenient manner. Moreover, he can use these payment instruments at multiple channels, e.g. ATM and POS. The bank is the trusted party and issues the cards. For the merchant this solution requires only small changes in the existing infrastructure e.g. an enhanced POS terminal, which communicates with the consumer's mobile phone. Acquirer agreements are already existent. Next to this, the

solution is very secure and has a strong support of authentication and no repudiation. The banks would be confirmed in their role as trusted party. There is no need to issue additional cards and thus the existing infrastructure can remain in place. Additionally, the volume of card payment would increase. Cards bear the potential to save additional applications.

Major **shortfalls** of this concept are the strong impacts on the design of the mobile phone. Size and cost would be significantly increased. The handling would become more difficult: both hands are needed. The solution would add complexity to the mobile phone architecture, to enable the use of different cards. Also critical is the lack of robustness. Manufacturers are not endorsing the production of dual slot phones. An external smart card reader brings up additional disadvantages. External readers are expensive and depending on the mobile phone design require connection by cable, IR or Bluetooth. Moreover, there is a major decrease of convenience: the user has to insert the card in the external reader, ensuring that the external reader is properly connected to the device, conduct the transaction and finally separate the physical card and the reader and store them in different locations, such as the purse and a box for the reader. An **example** for a dual-slot solution is the "Paiement Card Bancaire (CB) sur mobile". The service combines the use of a dual-slot phone with the ubiquitous CB issued by all French banks. The project hat been launched by France Telecom's Itineris mobile telephony services and is called "ItiAchat".

2.5 Mobile Payment Environment

Mobile telecommunications continue to be phenomenally successful, with an estimated one billion mobile subscribers by the end of 2002 (Source: The Universal Mobile Telecommunications Service (UMTS) Forum). The success of NTT DoCoMo's i-mode service in Japan, which currently has 34 million data subscribers, illustrates the

appetite for compelling mobile data services. In Europe, meanwhile, the viral uptake of short messaging (SMS) has demonstrated the huge demand for non-voice services in that market. According to the GSM Association, there were over 30 billion SMS messages sent in 2001. By 2004, there will be 60 million mobile payment users generating sales of $50 billion, according to Celent, a financial services research and Consulting firm. A joint survey by Visa International and Boston Consulting predicts that combined e-commerce and m-commerce volumes will grow from $38 billion in 2002 to $128 billion in 2004.

As more sophisticated devices are developed, new applications are emerging to take advantage of color screens, keyboards, and longer battery life. These new applications include enhanced messaging (EMS) and multimedia messaging (MMS), which enable the downloading of images, streaming video, and data files. Also, the proposed Federal Communication Commission's directive mandating the addition of global positioning (GPS) in mobile phones will enable location-based mobile commerce. These applications will help deliver to consumers new payment opportunities that harness the qualities of mobile devices in the U.S.

Meanwhile, there is considerable excitement surrounding proximity payments, a means of sending transaction data between devices within a certain range with no physical contact. There are a number of wireless technologies and standards that will enable consumers to send transaction data from a mobile device to a point of sale terminal without manually swiping a card through a reader. These include:

(1) Bluetooth

(2) 802.11

(3) infrared

(4) RFID and contactless chip

Mobile payments are many and varied, and are somewhat determined by regional differences and individual market dynamics. For example:

(1) In Japan, the success of mobile Internet services can be attributed to the high concentration of populations in urban areas, long commute times, consumer comfort with small electronic devices, and the lack of a ubiquitous fixed-line Internet infrastructure.

(2) In Europe, mobile top-up for prepaid phone services is popular.

(3) In individual markets in Asia-Pacific, Europe, and the U.S., there is a drive to implement proximity payments in environments such as road-tolling, fast-food drive-through, and service stations.

Despite the regional variations, there is a shared requirement for payment to be secure, interoperable, and easy to use. The efforts of the MPF are concentrated on ensuring that mobile payments meet current and future requirements for security and ease of use.

2.6 Barrier to the Adoption of Mobile Payment

Consumer concerns relating to security, privacy, and ease –of use are restricting the growth of mobile payments. Research from Forrester Research displayed in Table 2.3.1 shows that over half of surveyed consumers consider credit card security to be the major inhibitor to the growth of mobile commerce.

Table 2.4. Inhibitors to the Growth of M-Commerce.

OBSTACLE	PHONE	PDA
Credit card security	**52%**	**47%**
Fear of "Klunky" user experience	**35%**	**31%**
Don't understand how it works	**16%**	**16%**
Never heard of it before	**10%**	**12%**
Other	**11%**	**13%**

The challenge for the mobile and the payment industry is to convince the "conservative majority" of consumers to embrace mobile payments by addressing these concerns.

For example, Forrester also indicated that fewer than 15% of consumers feel completely comfortable sending their payment card details over mobile networks and over 65% claim to be "averse" to sending confidential information. If the industry therefore addresses this concern to ensure that both the actual security and perceived security are both strong, then the potential of mobile payments can start to be realized. There are also a number of other technical issues to be overcome. These include providing standards that are mutually developed, agreed upon, and supported by mobile operators, merchants, payment associations, and financial institutions.

Mobile payments, whether executed via a mobile network or a proximity-based protocol, must be subject to the same level of standardization that governs physical payment card use in order to be perceived as familiar and secure. Attempts to introduce

Proprietary payment schemes on top of the already confusing array of networks, devices, and operating systems, may therefore seriously hinder the growth of this new medium.

The four main parties involved in a mobile payment transaction — the user; the network operator; financial institution, and merchant — share many of the same concerns that need to be addressed by a mobile payment standards body. However, not all of these concerns are given equal weight by each party. For example:

(1) Consumers are mostly concerned with security, ease of use, and privacy. They also require any payment scheme to work across multiple devices, including mobile phones, PDAs, wireless tablets, and handheld computers.

(2) Mobile operators' principal concerns revolve around standardization and interoperability. Operators want payment to be seamless, allowing them to compete on services and applications.

(3) Financial institutions, meanwhile, are primarily concerned with ensuring the integrity of the payment system and reducing the risk of fraud.

(4) Merchants or content providers want the payment process to be transparent to the user, as this encourages greater usage and/or propensity to complete a purchase. They also want any payment scheme to facilitate swift and easy completion to ensure they get paid on time.

2.7 The Mobile Payment Lifecycle

In order to understand the scope of the Mobile Payment Forum's activities, it is worth using the example of a typical payment card transaction. In any given payment card transaction there are at least four parties involved: the user, merchant, issuer, and acquirer (see Table 2.4.1). In the mobile environment a network is also an integral part of the transaction flow. The issuer provides the user with the ability to make payments

by providing a credit link or a direct link to a checking or savings account. The validity of the user's payment credentials is contained on the piece of plastic in the form of an account number, hologram, and expiration date. Further payment credentials are encoded in the card's magnetic stripe or chip. Once the transaction is initiated, the merchant requires transaction credentials from the user in the form of a signature or PIN, and this is verified against information stored centrally at the user's issuer.

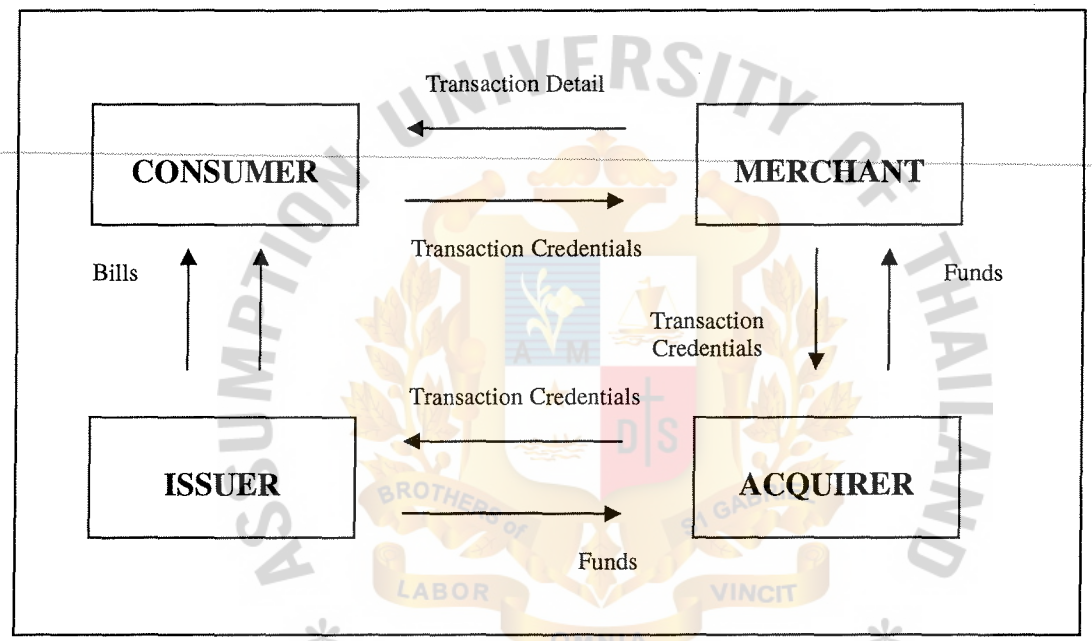

Figure 2.10. Typical Payment Transaction.

Once the transaction is complete, the funds are transferred from the issuer to the acquirer to the merchant, and the cardholder is billed for the goods purchased.

In the mobile environment, the transaction dynamics are similar, although the form factor that contains the transaction credentials is different. In addition, in the case of remote payments, the transport of payment details will involve a mobile network operator and use either a browser-based protocol, such as WAP or HTML, or a

messaging system, such as SMS or Unstructured Supplementary Service Data (USSD). Alternatively, the transport of payment details could be via Bluetooth, infrared, RFID or contactless chip in the case of proximity payments.

In order to understand the challenges facing mobile payments, it is important to explore the user experience within the card transaction flow described above. For the user, the card transaction contains four concurrent steps :

(1) Set-up and configuration of the payment mechanism

(2) The initiation of the payment

(3) Authentication of the user

(4) Completion of the payment

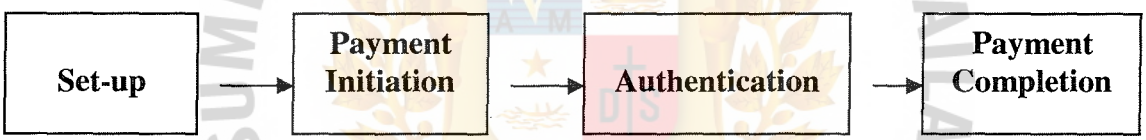

Table 2.7. Payment Lifecycle.

The first phase of the payment lifecycle is the configuration of the payment mechanism. In the mobile payment environment this could be the installation of an applet or application on a mobile device, such as a mobile wallet, or the issuance of a new mobile device and/or new SIM card. The set-up and configuration of the payment instrument usually takes place only once.

The four other stages mirror those described earlier and involve initiating the payment by the consumer, authenticating the user and completing the payment,

including generating a receipt. This payment lifecycle is applicable to any type of mobile payment, including remote, proximity, and micro-payment.

Beyond the payment transaction there are other phases involved in the completion of a payment, including bill presentment, clearing and settlement, and risk management. However, as none of these areas currently fall under the scope of the IMP, they are not discussed at length in this paper.

III. INTELLIGENT MOBILE PAYMENT (IMP)

3.1 Beginning of IMP system

IMP is one of the mobile payment services available via mobile phone. It allows you to shop and pay your bills through your mobile phone. You can make payments any time, anywhere via your mobile phone. Just key in the details into your mobile phone - you can immediately pay your bills without having to carry cash or credit card at the counter services.

The IMP defines mobile payment as the process of two parties exchanging financial value using a mobile device in return for goods or services. A mobile device for the purposes of this paper defines a wireless communication device, including mobile phones, PDAs, wireless tablets, and mobile computers.

	Micro m-payment	Macro m-payment
Electronic goods	E.g. news, seeking, alerts	E.g. stocks, movies
Physical goods	E.g. parking meters, ticket dispensers.	E.g. super market, retail

Figure 3.1. Micropayment & Macropayment.

Mobile payments can be divided into macro and micro payments:

· Micro-payment refers to a payment of approximately 100 Baht or less, and in the mobile environment this will often be for mobile digital content, such as information, Java gaming, Video clips, Wallpapers, Logos and Ring tones etc.

· Macro-payments refer to larger value payments such as online shopping or proximity-based payments. The distinction between the two types of payment is

important since the security required for each will be different. For example, authentication for every macro-payment transaction through a trusted financial entity is extremely important, whereas network authentication, such as SIM, may be sufficient for micro-payments that only use the operator's infrastructure. Macro-payment refers to a payment of Physical goods: CDs, DVDs, Book, etc.

The IMP also considers the type of transport used to deliver the payment transaction information. As discussed earlier, this can be divided into Over the Air (OTA) or wide-area network (WAN), which uses a wireless network and proximity payments that transfer details over shorter distances. OTA payments generally use a browser-based transport infrastructure or an SMS/MMS-based system. Although there are technical differences between IP and messaging-based communications, payment protocols can operate similarly across both. Proximity payments involve the use of short range messaging protocols such as Bluetooth, infrared, RFID, and contactless chip to pay for goods and services over short distances.

For example, Using IMP, a person with a wireless device could pay for items in a store or settle a restaurant bill without interacting with any staff member. So, for example, if a restaurant patron wanted to pay quickly and leave the restaurant on time to get to an appointment, the bill could be paid directly from the table - without waiting for a server to bring the check. The patron would simply connect to the cash register with a wireless device, punch in the table number and personal identification number (MO-PIN), and authorize payment. According to Mobile Operator (eg. AIS, DTAC, ORANGE) the entire transaction should take no more than 10 seconds.

3.2 IMP Transaction Process

The IMP Gateway consists of a mobile payment engine, the Consumer Preference Engine and the Merchant Configuration Engine. The engine can be easily customized for different payment services and to suit different business processes.

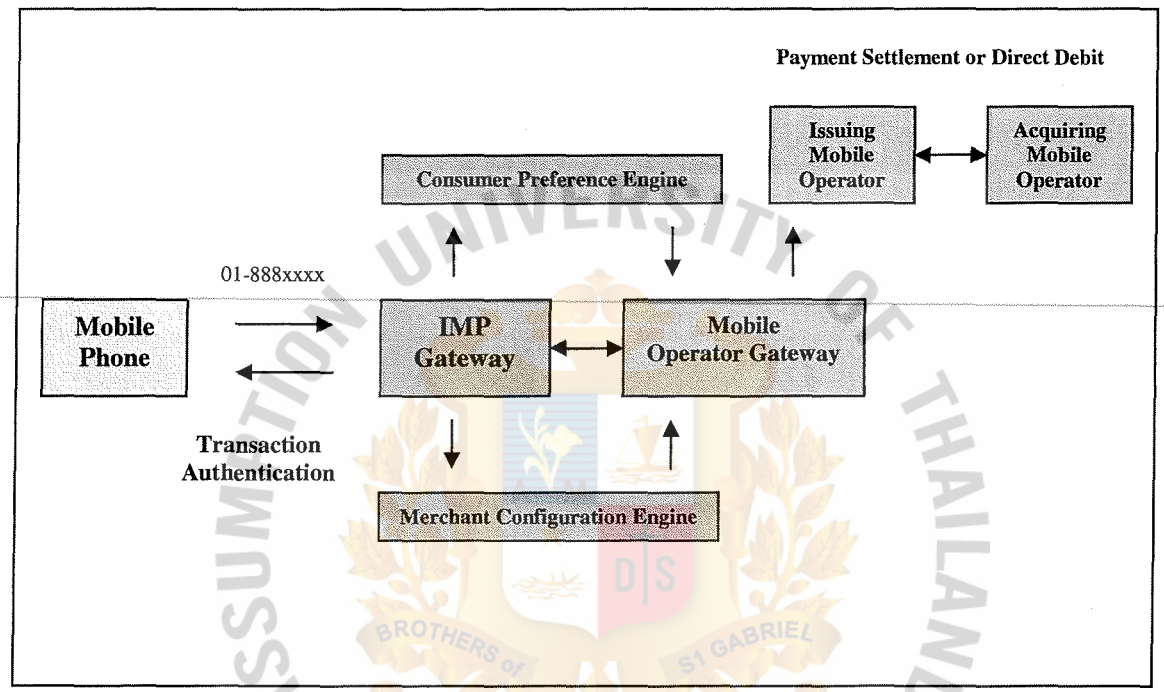

Figure 3.2. IMP Solution.

Merchant Configuration Engine

(1) Manages the merchants registered with the payment system.

(2) The merchant can sign up giving their mobile operator account and be assigned a merchant code and linked to his acquirer.

(3) The merchant can specify special offers, promotions and discounts for products and services which will be presented to the Consumer Preference

Engine and by SMS to the consumer phone if consumer pre-select to be notified at the Consumer Preference Engine.

(4) Interface with data miner module and statistics module in MMG to compute loyalty points for Consumer by number and value of mobile payment transactions to know consumer profile and buying preferences.

Consumer Preference Engine

(1) Consumer signed on mobile payment operator for using IMP service for both Pre-IMP and Post-IMP system.

(2) For bill payment merchants, consumer gives his mobile account/number to merchant to access to the IMP gateway for authentication.

(3) Consumer can select to be notified by SMS of merchant promotions and discounts.

The core of IMP's technology is the IMP Gateway. This Gateway is based around an intelligent engine that implements our mobile payment systems. IMP systems are in discussion with Mobile Operator and merchant partners in Thailand and targets to complete and deploy Pre-IMP and Post-IMP systems.

IMP Gateway includes the following mobile-payment products:

3.2.1 Pre-IMP System

Pre-IMP system enables a consumer to authorize and authenticate his instructions for payments and enable direct debit from his mobile account (pre-paid account/number) in a participating mobile operator to a participating merchant, and to deliver payment record to that merchant. Pre-IMP system is suited for direct debit payments for Micro-payment product (cheap) such as, BTS ticket, magazine, movie ticket, and snack, where a physical transaction is paid for by virtual means.

Pre-IMP system is a mobile direct debit account micro-payment solution. The consumer sends the same formatted instruction to a specified number at a hosted central server (IMP Gateway). The server interacts with the issuing Mobile operator's systems to effect the transaction. A mobile direct debit payment requires the consumer to underwrite his own risk in wrong or fraudulent payment to merchants and non recovery. The consumer is asked by the mobile operator which sends SMS back to confirm payment and to enter his Personal Identification Number (PIN) to authenticated payment. Direct debit from consumer's issuing mobile operator to merchant's acquiring mobile operator is undertaken by the payment infrastructure provider. The consumer gets a notification on his mobile phone or alternatively, by pre-selecting his choice via the Consumer Preference Engine, he can choose to receive a "payment made" notification by email or SMS.

3.2.2 Post-IMP System

Post-IMP System enables a consumer to authorize and authenticate his instructions for payments from his Post-paid mobile account/number in a participating Mobile operator (AIS, DTAC, Orange), to a participating merchant, and to deliver payment record to that merchant. Post-IMP system is suited for Macro-payment product, for example, Clothes, Electronic equipment, Furniture, etc.

The Post-IMP System is a virtual credit or charge card. The consumer gives his mobile phone number to the merchant rather than present his credit card. The merchant's system, through the IMP Gateway, will obtain information concerning the enrollment of the consumer. The merchant's system will then request payment authorization from the consumer's issuing mobile operator prior to executing a normal payment with the merchant's acquirer. This payment will be credit to the mobile bill at the end of each month.

3.3 Use of IMP service

After both consumer and merchant apply for IMP service, Consumer will have PIN code and merchant also get the merchant code and IMP software to access to the IMP gateway. The following step A, B and C show the IMP process:

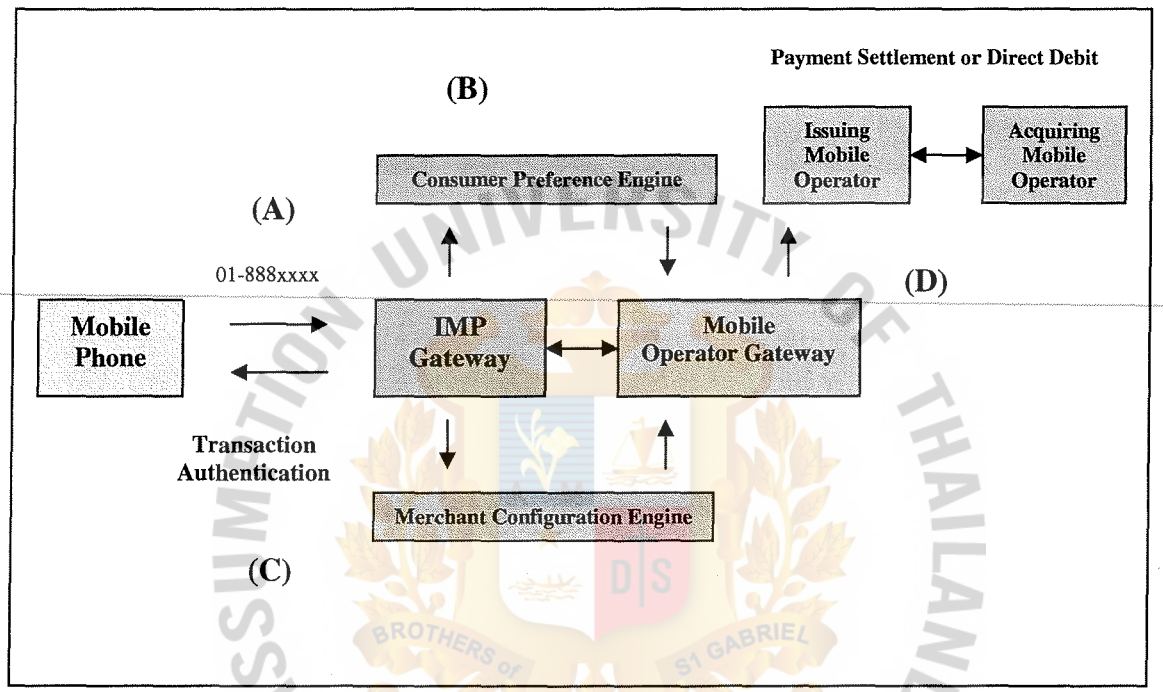

Figure 3.2. IMP Solution.

IMP Process

Step A: **Consumer** : Gives his mobile phone number(eg. 01-888xxxx) to merchant

Merchant : Key number into their IMP engine to access to the IMP Gateway

Step B: **IMP Gateway** : Checking both **Consumer Preference Engine** and **Merchant Configuration Engine** for authenticated

Step C: **Consumer** : Receive SMS asking to key PIN and reply back for

confirming the transaction

Merchant : If PIN reply to the IMP Gateway correctly, merchant will receive the "Transaction Complete" from IMP Gateway

Step D: **Mobile Operator :** Issuing and Acquiring will credit and debit to account

IV. INVESTIGATIVE ANALYSIS

4.1 Mobile Payment Method

4.1.1 Market Target

Our target market is emphasized on people who have a trendy lifestyle and use mobile not for only phone call. People who age between 14 to 40 years that always follow the trend of Mobile.

4.1.2 Market Strategy

Introducing Intelligent Mobile Payment to both consumer and merchant and make them understand the benefits of our new payment system. We will use some media both online and offline in order to advertise service.

4.1.3 SWOT analysis of Mobile Payment

Strengths

(1) High technology with trendy service

(2) Personal and always carrying

(3) Ubiquitous Infrastructure

Weakness

(1) Lack of standard (Cost-increasing)

(2) Few killer applications

(3) Low expertise in the mobile payment

(4) unfriendly user interfaces

(5) Limits of the amount of payment

Opportunities

(1) New services such as mobile Internet

(2) Various applications such as Mobile Life

(3) Personalized services

Threats

(1) consumers' trust in security

(2) other competing methods

(3) regulation of telecommunication company

(4) competing among the players

4.1.4 Mobile Payment Market Forecasting

Table 4.1 Mobile Payment Market Forecasting

(Mil. $)

	2000	2001	2002	2003	2004	2005
Worldwide	**35,500**	**151,600**	**378,700**	**825,800**	**1,402,000**	**2,107,800**
Domestic	**231**	**538**	**1,077**	**2,077**	**3,768**	**6,308**

Table 4.2 Factors for the Burst Increasing Markets

Demand Side	Supply Side
1. Convenience for payment 2. Increasing mobile commerce 3. Emerging various new services	1. Decreasing service charge 2. Benefits to supplier

4.1.5 Payment Service Power Comparison

As we can see in Table 4.3, the differences between each payment system are the features of each one. Mobile payment is not suitable for large payment, managing account and rink management but suit for bank and credit card.

Table 4.1. Payment Comparison.

Item	Mobile com.	Bank	Credit card com.
Mobile payment Platform	●	✖	✖
Billing system	●	△	●
Micro payment	●	△	△
Large payment	✖	●	●
Risk management	✖	●	●
Consumer Acquirement	●	△	△
Joining Partnership	✖	△	●
Managing accounts	✖	●	●
Connection with other financial services	✖	●	△
Confidence	△	●	●
●: Excellent, ▲: Common ✖: Insufficient			

4.1.6 Strategies for Mobile Payment

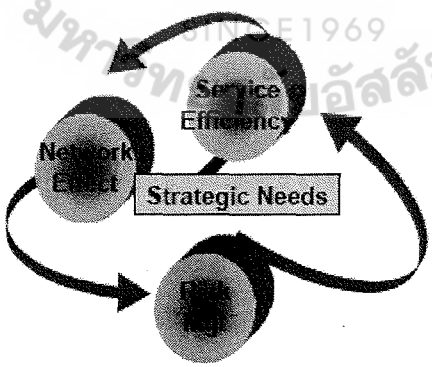

Figure 4.1. Mobile Payment Strategies.

Strategic needs

(1) Service efficiency – The services of mobile payment must give confidence to consumer.

(2) Network effect – The network provided must have enough security.

(3) Risk Management – Good management use to control risk.

(4) Government Regulation

(5) Various service providing

4.2 Values and Cost Analysis

4.2.1 Value Analysis

(1) Product Value

(a) New convenient channel for buying products and services.

(b) Various payment functions. For examples,

Micropayment – Download ringtones and wallpapers, paying for movie ticket, etc.

Macropayment – Buying digital product or electric product online and offline.

(c) Consumers only have mobile phones that support SMS service, do not need more technology.

(d) Safety. IMP system use End-to-End Encryption that needs consumer to type his PIN along with transaction processes to confirm the transaction. Consumers can be sure that transactions and accounts will be safe.

(e) Up-to-date service. Mobile technology is very popular nowadays. IMP is a payment system that is always developing and following the security technology.

(f) Easy-to-use transaction process. Consumers just give their telephone number to merchants or vending machines and wait a second to confirm PIN code. The transaction process will finish in a minute.

(g) Convenience. IMP requires only the mobile device and PIN codes.

(2) Service Value

(a) Free of charge to consumers.

(b) With short process, Consumers just requests through their mobile operator to use this service. The bill will debit and credit to their mobile account at the end of the month.

(c) Corporate service. The IMP team supports corporate service by co-operating with the big 3 mobile operators in Thailand which are AIS, DTAC and ORANGE and help them in promoting and providing information for every consumer.

(3) Personnel Value

(a) Collaboration with big 3 mobile operators in Thailand which are AIS, DTAC and ORANGE.

(4) Image Value

(b) Advertising. With the mobile operator, consumers will know of this service with in short period of time.

(c) Creating the event in order to creating awareness of IMP service

4.2.2 Cost Analysis

(1) Monetary Cost

(a) IMP system will charge 2% from each transaction from Merchants who wants to use this payment system.

(b) To use this system, consumers must have an Mobile phone.

(2) Time Cost

(a) It is not like consumers using cash. It takes time for do transactions because consumers need to press buttons or use joystick to move somewhere on a mobile phone screen.

(b) It takes time to apply this service because if consumer wants to use Post-IMP system, mobile operators have to check the profile of the consumer with the salary slip or bank account.

(3) Energy Cost

(a) Consumer needs to press a lot of buttons that costs energy.

(b) Consumer needs to remember their PIN.

(c) For merchant, they have to open an account with the mobile operator to use this service.

(4) Psychic Cost

(a) Generally, consumers are concerned about payment security and a privacy policy. They feel unsure whether his payment or order will be correct or not, or if another person will know his information, etc.

(b) Some consumers are afraid of new technology or do not want to try, because they think it may be risky.

(c) They may not be sure about the information shown on the mobile screen as to whether it will be right or wrong information.

V. THE PROPOSED SYSTEM

5.1 SYSTEM DESIGN

The design of the mobile payment system must begin with the important part which is IMP Gateway. Contact with mobile operator in order to make a network to support our service. The security system must be the most important. We also provide the telephone number and e-mail address for help when customers have some questions, they can contact us.

5.2 SYSTEM SPECIFICATION

In this section we cover the process of estimating the present and future workloads of a business network and the process involved in evaluating the ability of computer hardware and software to handle workloads adequately. The proposed system when integrated, every processing system will run on the Network. The requirements of the hardware and the software are shown below:

Hardware Specification

In the process of developing the project; a computer will be a server, gateway and client. This project implemented on Mobile Network with mobile operator. So this computer wants high performance to develop a proposed system.

Table 5.1. Hardware Specification.

HARDWARE	SPECIFICATION
Central Processor Unit (CPU)	Pentium 4 2.8 GHz
Memory (RAM)	DDR Ram 512 MB PC 3200 or higher
Cache Memory	L2 cache
Hard Drive	80 GB
Floppy Disk	3.5 inch (HD 1.44 MB)
Keyboard	Thai English key caps
Mouse	2 buttons (scroll option)
Monitor	15 " Super VGA Monitor or higher
Main Board	Support CPU, PCI slot, VGA on board
Power Supply	240 Watts line Automatic Switching

Software Specification

The development of a new website can require decisions about software as well as hardware. These decisions require careful about deemed suitable for part or all system.

Table 5.2. Software Specification.

SOFTWARE	**SPECIFICATION**
Operating System Software	Microsoft Window XP Professional
Network Server	Microsoft Window Network Solution
Database Server	Microsoft office XP Access

5.3 SECURITY AND CONTROL

Security is of paramount importance when deciding to participate in e-commerce over the Internet. Any business must have confidence in the safety and reliability of its "place of business" - because the information contained within its walls is what keeps the business alive. Just like a business owner locks his door when leaving each day, or verifies credit card signatures, a virtual company must ensure proper walls are in place to protect its data and legitimacy of transactions.

One of the most important considerations in the development of **IMP** is security. With the rapid growth of e-commerce, things have changed. Consumers use the Internet technology for purchasing goods and service online, million of individuals use their personal data to register for purchasing products and services. So our network must implement the security mechanism to protect both visitors and customers.

Table 5.3. Sale Forecast.

Year / Income	Year 2004	Year 2005	Year 2006	Year 2007
- Payment Charge 2%	100,000*12 months	300,000*12m onths	500,000*12 months	1,000,000*12 months
Total sales	**1,200,000**	**3,600,000**	**6,000,000**	**12,000,000**

5.4 Start-up Cost

Table 5.4. Start-up Cost.

(1) Investment cost Hardware specification	**Baht**
Computer Server/client/Gateway	10,000,000
Peripherals	100,000
Software specification	
Operation system	100,000
Network accessory	500,000
(2) Implementation Costs	
Registrations and Set up Network	80,000
Hosting/Client /Gateway Set up	50,000
(3) Annual Operating Costs	
Stationary	20,000
Maintenance Costs	20,000
Miscellaneous Costs	20,000
Total Start-up Cost	**10,890,000**

5.5 Estimated Income Statement

Income statement is a financial report summarizing revenues and expenses, and showing the net profit or loss in each year of the **IMP system**

Table 5.5. The Forecasted Income Statement for the Five-Year Operation.

	Year				
	1	**2**	**3**	**4**	**5**
Revenues :					
Charge 2%	1,200,000	3,600,000	6,000,000	12,000,000	18,000,000
Adv on Mobile	100,000	200,000	600,000	1,000,000	1,500,000
Net Sale	**1,300,000**	**3,800,000**	**6,600,000**	**13,000,000**	**19,500,000**
Mobile services	200,000	200,000	200,000	500,000	500,000
TotalGrossProfit	**1,100,000**	**3,600,000**	**6,400,000**	**12,500,000**	**19,000,000**
Expense :					
Implementation	100,000	300,000	500,000	1,000,000	2,500,000
OfficeEquipment	5,000	5,000	5,000	5,000	5,000
Salary	50,000	70,000	100,000	150,000	200,000
Operation Cost	3,000	5,000	8,000	10,000	15,000
Maintenance Cost	10,000	10,000	10,000	10,000	10,000
Depreciation Cost	12,000	12,000	12,000	12,000	12,000
Total Expense	**180,000**	**402,000**	**635,000**	**1,187,000**	**2,742,000**
Net Income	**920,000**	**3,198,000**	**5,765,000**	**11,313,000**	**16,258,000**
Cumulative Inc.	**920,000**	**4,118,000**	**9,883,000**	**21,196,000**	**37,454,000**

5.6 Break Even Analysis

The Break-even Analysis lets us determine when this service business will reach break even point. In the figure 5.1, it shows that we will get the fixed cost back within 3 years and 3 months. IMP system expects to be profitable in the third quarter of year 3 in operation of business online.

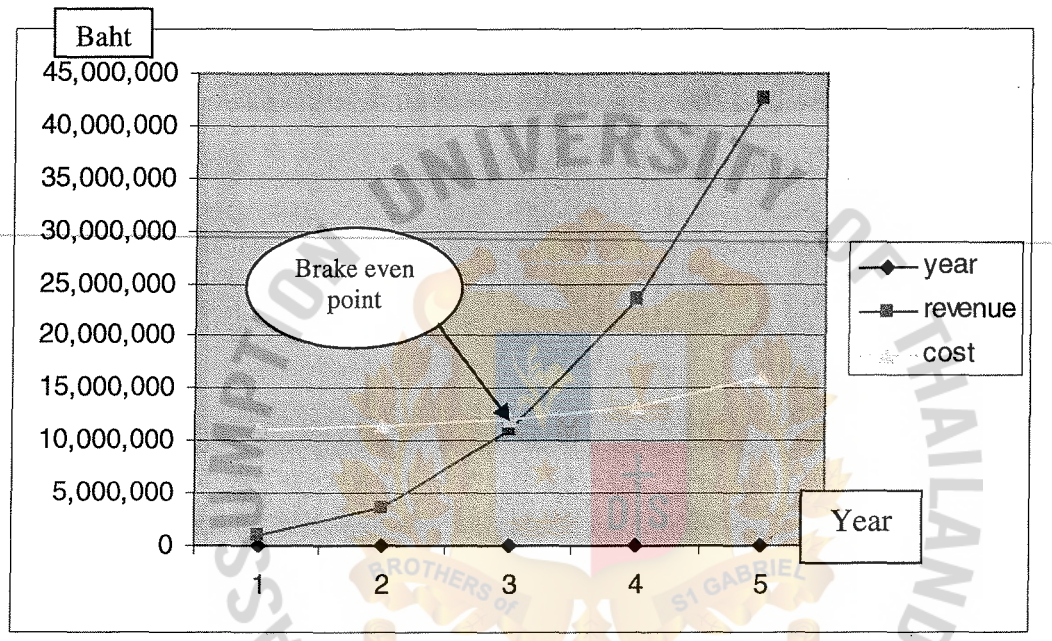

Figure 5.1. Break Even Analyses.

VI. CONCLUSION AND FUTURE PLAN

6.1 Conclusion

Mobile payment systems are not isolated systems, but systems with a strong interdependence of existing internet payment systems. Mobile payments are an extra option to existing payment methods and the mobile phone can be considered as another tool for carrying out payments. A lot of requirements need to be fulfilled if the new m-payment system shall be able to compete with the existing payment systems. This thesis has focused on the requirements for the client technology in the mobile phone. When using the mobile pone as a payment tool, the phone can act as a Personal Trust Device (PTD) or a terminal. In these situations the data handling and transmitting meets a lot of challenges. Many different initiatives and forums have been established to cope with these challenges, with the main focus of developing and distributing standards for mobile payments - standards, which all the interviewees also agreed on, has to live up to a set of critical success factors, to be a successful m-payment system. A bigger change for network externalities is present if all requirements from the critical success factors are met and accepted by the actors.

In Thailand, my paper indicates that mobile phones are widely used among university students and working people. There are some reasons for using mobile phones; the most popular ones are because it is useful anywhere, and in case of emergency. Mobile payment is a value added service which is not yet know and understood. The micropayment, such as taking photos, checking email, downloading wallpaper and ringtone are becoming popular.

The future trend of mobile phones in Thailand is indicating that they primarily use other features in their mobile phones than for making phone calls. With this

sustained interest in mobile phones, and advances in technologies, we expect that there will be a tight integration within PDA and mobile phones, which will make a mobile phones a true mobile computing device in the future.

6.2 Recommendation

After Intelligent Mobile Payment is launched, I believe that there'll be a problem of using IMP service for both consumers and merchants, so I recommend that:

(1) Establish the supporting department to take care of our services

(2) Developing the system to be an international payment system

(3) Increasing the payment security

(4) Improving the mobile payment system

(5) Creating the Informational website to promote and give information about IMP services

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