A Study of Trend in Global Mobile Commerce

by

Mr. Duangruedee Arj-harnwongs

A Final Report of the Three-Credit Course
CE 6998 Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
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The Graduate School of Assumption University has approved this final report of the three-credit course, CE 6998 PROJECT, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer and Engineering Management

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ABSTRACT

Mobile commerce is the first report of its kind to examine and analyze the enormous potential mobile commerce in the international business community. It focuses on how the market expects to provide the crucial infrastructure for mobile commerce.

Mobile commerce is the way to change business to the Internet, E-Mail and the World Wide Web. Everything can be commercialized electronically and can interact electronically as a typical business using mobile phone and consumers will be able to use their mobile phones (or other devices) to carry out their business wherever they are, whenever they want. The idea of delivering services and information directly into the hands of consumer, wherever they may be, is the most important in mobile commerce. The service includes banking, the purchase and redemption of tickets and reward schemes, travel, shares, weather, and other information, and the formation of contracts on the move, e.g. to arrange insurance. Customers will benefit from the increased scope and ease of access to information, products and services. However, several factors would relate to the development of Mobile Commerce, such as communication infrastructure, security issue, law, cost and tax issue etc.

This research discusses the possibilities of Global Mobile Commerce by focusing on the applications of the mobile phone. It can determine the future trend of Mobile Commerce by using SWOT analysis, which shows a number of mobile services that will also increase in the near future. Customer's demands will increase in terms of both usability of mobile end-devices and number of applications. In addition, mobile commerce market has a large potential for the new ventures to come in.

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1.1 Introduction of the Telephone System

With the exponential increase of worldwide web users, telephone companies have a big chance of making large profits, since many data communications are transmitted by using the analogue public switched telephone networks. However, the structure of the existent telephone networks could not meet the ever-increasing web users' demand for high speed so the traditional telephone networks also face a big challenge.

1.2 Limitation of Traditional Telephone Network

First, it is necessary to give a brief introduction on what the telecommunication industry calls copper-access that is communications into your home or office based on a twisted copper loop. Copper-access has been used since some geezer called Bell invented something we currently call a phone. When this Scotsman started inventing his telephone, people did not really need it, they definitely did not need high bandwidth data, fax, video or multimedia. Because the phone was only used for speech, the bandwidth of 3.1 kHz was more than sufficient. After about one hundred years, people started becoming more mobile and needed data communication. Phone lines suddenly had a new function. Data would be sent at speeds between 75bps and 300bps, most phone lines exchanges started to become fully automatic, speeds got higher and higher. By using compression, speeds of up to 2400bps and 9600bps could be reached on normal PSTN lines. This way the phone companies could keep using their cherished investments of copper in the ground without having to dig every year. In 1989, the first 14400bps modems entered the markets and yet again, the phone companies could keep using existing technologies. Somewhere in the beginning of 1990 there were changes that effected the phone companies infrastructure, people started using the Internet.

Internet had been around for almost 30 years but did not really draw much attention that was until the CERN labs in Switzerland invented what you are looking at now: the World Wide Web. The web turned to the otherwise old and boring Internet into a multi-media amusement park full of drawings, music and video. However, all this requires a much higher bandwidth than the existing telephone network can offer. (http://www.mobilemcommerce.com, 2003.)

1.3 History of Digital Mobile Phone

During the early 1980s, analog cellular telephone systems were experiencing rapid growth in Europe, particularly in Scandinavia and the United Kingdom, but also in France and Germany. Each country developed its own system, which was incompatible with everyone else's in equipment and operation. This was an undesirable situation. Because not only was the mobile equipment limited to operations within national boundaries, which in a unified Europe were increasingly unimportant, but there was also a very limited market for each type of equipment, so economies of scale and the subsequent savings could not be realized.

The Europeans realized this early on, and in 1982, the Conference of European Posts and Telegraphs (CEPT) formed a study group called the Group Special Mobile (GSM) to study and develop a pan-European public land mobile system. The proposed system had to meet certain criteria:

(1) Good subjective speech quality.

(2) Low terminal and service cost.

(3) Support for international roaming.

(4) Ability to support handheld terminals.

(5) Support for range of new services and facilities.

(6) Spectral efficiency.

(7) ISDN compatibility.

In 1989, GSM responsibility was transferred to the European Telecommunication Standards Institute (ETSI), and phase I of the GSM specifications was published in 1990. Commercial service started in mid-1991, and by 1993, there were 36 GSM networks in 22 countries. Although standardized in Europe, GSM is not only a European standard. Over 200 GSM networks (including DCS 1800 and PCS1900) are operational in 110 countries around the world. In the beginning of 1994, there were 1.3 million subscribers worldwide, which had grown to more than 55 million by October 1997. With North America, making a delayed entry into the GSM field with a derivative of GSM called PCS1900, GSM exists on every continent, and the acronym GSM now aptly stands for Global System for Mobile communications. (Mobile Communication International Magazine, March 1999 — Feb 2000.)

The developers of GSM chose an unproven (at the time) digital system, as opposed to the then-standard analog cellular systems like AMPS in the United States and TACS in the United Kingdom. They had faith that advancements in compression algorithms and digital signal processors would allow the fulfillment of the original criteria and the continual improvement of the system in terms of quality and cost. The over 800 pages of GSM recommendations try to allow flexibility and competitive innovation among suppliers, but provide enough standardization to guarantee proper interworking between the components of the system. This is accomplished by providing functional and interface descriptions for each of the functional entities defined in the system.

1.4 Services provide by Digital Mobile Phone

From the beginning, the planners of GSM wanted ISDN compatibility in terms of the services offered and the control signaling used. However, radio transmission

limitations, in terms of bandwidth and cost, do not allow the standard ISDN B-channel bit rate of 64 kbps to achieve.

Using the ITU-T definitions, telecommunication services is divided into bearer services, teleservices, and supplementary services. The most basic teleservice supported by GSM is telephony. As with all other communications, speech is digitally encoded and transmitted through the GSM network as a digital stream. There is an also an emergency service, where the nearest emergency-service provider is notified by dialing three digits.

Varieties of data services offered. GSM users can send and receive data, at rates up to 960 bps, to users on POTS (Plain Old Telephone Service), ISDN, Packet Switched Public Data Networks, and Circuit Switched Public Data Networks using a variety of access methods and protocols, such as X.25 or X.32. Since GSM is a digital network, a modem is not required between the user and GSM network, although an audio modem is required inside the GSM network to interwork with POTS.

Other data services include Group 3 facsimile, as described in ITU-T recommendation T.30, which supported by use of an appropriate fax adaptor. A unique feature of GSM not found in older analog systems, is the Short Message Service (SMS). SMS is a bi-directional service for short alphanumeric (up to 160 bytes) messages. Messages can be sent to another subscriber in the service, and an acknowledgement of receipt provided to the sender. SMS can also be used in a cell-broadcast mode, for sending messages such as traffic updates or news updates. Messages can also be stored in the SIM card for later retrieval.

Supplementary services are provided on the top of teleservices or bearer services. In the current Phase I specifications, they include several forms of call forward, such as call forwarding when the mobile subscriber is unreachable by the network and call

barring of outgoing or incoming calls, for example when roaming in another country. Many additional supplementary services will be provided in the Phase 2 specifications, such as caller identification, call waiting, multi-party conversations. (Mobile Communication International Magazine, March 1999 — Feb 2000.)

1.5 Architecture of the Digital Mobile Phone Network

A GSM network is composed of several functional entities, whose functions and interfaces are specified. The GSM network is divided into three broad parts. The subscriber carries the Mobile Station. The Base Station Subsystem controls the radio link with the Mobile Station. The Network Subsystem, the main part of which is the Mobile services Switching Center (MSC), performs the switching of calls between the mobile users, and between mobile and fixed network users. The MSC also handles the mobility management operations. Not shown is the Operations and Maintenance Center, which oversees the proper operation and setup of the network. The Mobile Station and the Base Station Subsystem communicate across the Urn interface, also known as the air interface or radio link. The Base Station Subsystem communicates with the Mobile services Switching Center across the A interface. (Mobile Communication Asia, October 1999 — Feb 2000.)

1.6 Research objectives

The objectives of the project on study of trend of mobile commerce are as follows:

(1) To study the mobile phone technology and to analyze its usefulness in the near future.

(2) To study the consumer demand on mobile phone technology.

(3) To study the future wireless data market.

(4) To analyze the mobile value added services.

1.7 Research scope

The scopes of the project development are as follows:

(1) Study the general mobile phone services.

(2) Study GSM mobile phone technology for e-commerce.

(3) Study the mobile phone business and its development in the near future.

(4) Study the advantages and disadvantages of mobile commerce.

II. LITERATURE REVIEW

Mobile Commerce is the first report of its kind to examine and analyze the enormous potential mobile commerce has for the international business community. It focuses on how the market expected to grow; who the main players are; and looks at what alliances are formed to provide the crucial infrastructure for mobile commerce.

Mobile Commerce will deliver significant opportunities to those working in the banking, transport, and retail and communication industries.

By December 1998, some European consumers enjoy the convenience and efficiency of electronic commerce delivered directly into their hands, wherever they are. The banks and retailers, as well as mobile phone operators, who deliver these services, stand to benefit enormously. (http://www.thaitoracom.com, Thailand, 2003.)

The development of a new "mobile commerce" paradigm will let consumers send and receive electronic cash, electronic tickets, and electronic keys from their mobile phone. For example, commuters will be able to request a ticket for public transport, and have it delivered electronically into their phone, without the need to join a queue. The ticket will be a piece of electronic code, stored on a smart card in the 'flip' of the handset. By simply waving the phone at the ticket barrier, customers will be able to access the platform.

Cellnet (UK) launched a mobile phone in collaboration with the leading UK bank and credit card distributor, Barclays. Cellnet sold 20,000 of the phones within six weeks of launch (equal to over 30% of all its GSM sales in that period.) According to Tom Alexander of Cellnet, both the take up rate and the press coverage of "the Cellnet Barclaycard Phone" are "phenomenal". Development of the "mobile wallet" driven by several factors. Most importantly, the first steps forward are highly lucrative to GSM

operators. "The customer that Cellnet has won through its partnership with Barclaycard are more loyal, have higher usage rates and cost us less to acquire than the average consumer" according to Alexander.

The second catalyst is that so many mobile phone users, especially in Europe and then in South East Asia, will find them using smart cards in year 1999. In 1998, at least a quarter of West Europeans used smart cards to make phone calls, to hold loyalty points, travel tickets, identification, medical records, or electronic cash, or even access Intranet sites, pay-TV channels, or physical buildings. If mobile phone operators can add functionality or convenience to these smart cards applications, they are able to create powerful new distribution channels, enhance customer loyalty, and generate additional traffic.

A wide range of companies, such as banks, retailers and transport companies is promoting smart cards. Many such companies are already working with mobile operators: in the UK, at least three major banks will have over 80,000 customers using a mobile phone branded or promoted by their bank. Schemes offered that pays the monthly subscription for a mobile phone as part of the monthly fee for banking services. Petrol and supermarket retailers are likely to be among the early followers. These companies already have serious plans for smart cards and they are starting to appreciate how Mobile Commerce will make those plans much more powerful.

A smart card is a piece of plastic containing an integrated circuit (a chip) that is capable of reading, writing, storing and processing information. The size and shape of the plastic, the positioning of the chip and its resilience to attack defined by international standards. Smart cards cost between $2 and $20 in large quantities, depending upon their capabilities. "Memory and power to multiple application smart cards" have sufficient support several applications. "Send and receive information to a

card reader without Contactless smart cards" can touch them: the card reader emits a radio signal that resonates in the circuit, causing it to reply in a pre-programmed manner. Contactless cards work at distances of about 15cm, making the ticket turnstile experience friendlier, and up to two times faster. Multiple application cards let consumers hold several items that would normally be in the wallet on a single card.

According to Dataquest, the number of smart cards that include a microprocessor is growing at about 55% per year. However, consumers have already demonstrated their desire for three enhancements to the basic smart card concept.

(1) Consumers want a device that displays the value held on their smart card: this requires a keyboard ("an electronic wallet").

(2) Consumers want the cards and the display devices to be free: this implies that the card should hold several applications (to share the costs) and that the display device should be subsidized.

(3) Consumers want smart card services to work "every where": neither an ATM installed in a wall nor a wire-line phone with smart card reader can hope to deliver that.

2.1 Growing Demand

Demand for better smart card solutions is quiet now, because the number of smart card transactions is relatively small. Within four years however, Schlumberger predict over 100 billion smart card transactions annually. As most such transactions will be in Europe, the typical European will conduct one transaction per day, while many French, Finnish, and other early adopters may use a smart card dozens of times daily.

Smart cards have won the theoretical battle between alternative value containers (such as magnetic-strip cards) because of their security, reliability, capability, and lifetime cost. For example, although the unit cost of a paper-based magnetic-stripe card

is only $0.10, a contactless smart card ticketing solution is much cheaper in the end. According to Gemplus, capital investment can be 90% lower, revenues can increase by 5% to 10% through lower fraud, and maintenance can be 30 times lower with a contactless smart card system.

Despite the investment lead times that public transport systems work to, smart cards are already used for public transport and parking services in cities such as Paris, Dusseldolf, Dortmund, Hong Kong, and even Canton. One of the most innovative public uses of smart cards is in Salzburg, where the main tourist attractions, museums, restaurants and transport facilities can be accessed using a contactless smart card held in a Swatch watch. (Skiers may have noticed that some Swatch watch are being used to access ski lifts at many resorts this year.)

The most important advantages of smart cards are not in their cost however, but in the capability and security that they offer. Smart cards can hold significant amounts of data, and do so securely. That is what the reason that the Subscriber Identity Module of the GSM standard is; loyalty schemes that try to encourage repeat purchases through personalized service and special offer. Smart cards can easily accommodate enough information to hold important medical records, which is why they are now being widely deployed in France, Germany and Spain. (http://www.schlumberger.com, 2003.)

2.2 Commerce Depends On Standard

Having demonstrated their theoretical superiority as a foundation for loyalty, ticketing, authentication and commerce, the main inhibitor to the adoption of smart cards in 1996 was a lack of standards. This was not such an issue in the payphone market, because most run the SIM application used in GSM have also sold several tens of million, because a single international standard has been agreed. In other market segments, standardization is only now completed. The wireless industry-from cell

phone providers to pager networks-celebrated perhaps it is most important milestone: the 20% market penetration mark. Twenty per cent is more than a regular milestone on the way up and it is a magical moment when technologies begin taking off exponentially.

The fax machine — actually old technology, it was invented more than 20 years ago. It was not, until the fax started showing up in offices seemingly everywhere that people realized they needed one. Suddenly, everyone had one. This "sudden visibility" seems to occur around the 20% penetration mark. Once a technology becomes visible in day-to-day life, we consumer learning pounce on it. History supports the numbers — it was at the 20% mark that wireless adoption in the U.S. and Europe really started moving. Today, more than half of the population in Finland has a cell phone — and 95% of those aged 18-21 wired.

Understandably, Canadian wireless firms are salivating. Every hour, more than 150 Canadians become new cells phone customers. In addition, within a decade, two in five Canadians will have a cell phone, according to the Canadian Wireless Telecommunications Association. While that is certainly great regular revenue for the airtime and service providers, the real opportunity here is yet to come. Residing in one quiet, nascent corner is the giant in waiting: Mobile Commerce. To explain how the life will change, here is what the day will look like in 2009:

All the technologies are in development today. They will be part of our lives within the next decade.

(1) Smart Products: Researchers have already developed a cheap, small microchip that can wirelessly transmit information about the product to which it is attached. If used to replace the UPC bar code symbol that adorns nearly everything today, you will simply wheel your cart through a checkout

and a receiver will total your cart's contents. On the other hand, it will add things to your shopping list when you throw them in a container equipped with a receiver.

(2) Wireless coupons: since cell phones can target your location reasonably precisely, you can tell your device to keep its ears open for stores transmitting information you are interested. You will only receive the news when you are nearby and it is a product you are interested in buying.

(3) Beaming money: This software already exists, though in prototype. The "PayPal" software, by Confinity, will start on Palm Pilots, then likely make its way to cell phones and other devices.

(4) Buddy finding: Soon, phone will be able to match your device's phone quick list with a list of people in the area (using the same locating technologies as the wireless coupons) and, with the permission of both parties, alert you when a friend or colleague is in the same block. AirFlash.com is using this location technology to help you find the nearest ATM or restaurant.

The opportunity is obvious: by taking a small percentage fee to enable these technologies, service providers from the wireless network end to content provider to the relationship brokers who will manage our info-laden lives on our behalf, will just watch the cash beamed in. In addition, it will make the web-based e-commerce we have all gone glossy-eyed over look like pocket change.

Mobile Commerce or M-Commerce, as this phenomenon is called, is already starting to change the rules of the game in the e-Commerce arena such as in the United Kingdom, German. Mobile Commerce is the effective delivery of electronic commerce into the consumer's hand, anywhere, using wireless technology. This advance has the

power to transform the mobile phone into a 'mobile wallet'. Already, major companies have begun to establish partnerships with banks, ticket agencies and top brands to take advantage of the retail outlet in the consumer's hand. The buzz phrase, "have mobile, will transact", sums up the prevailing sentiment over a growing sector that is fast gaining currency with customers, telecoms operators and content providers.

In the wireless utopia, you can kiss goodbye to long queues as public transport tickets delivered electronically into your mobile on request. Once in the phone, "smart card" ticket barriers will read your e-ticket. Simply swipe your hand phone across a card reader. Mobile commerce is already twining its vines tightly into Asia where we appear to value our mobile as much as we do our wallets. In addition, the twain shall surely meet in the coming m-commerce revolution.

Mobile commerce applications involve using a mobile phone to carry out financial transactions. This usually means making a payment for goods or transferring funds electronically. Transferring money between accounts and paying for purchases are electronic commerce applications. An emerging application, electronic commerce has facilitated by developments in other areas in the mobile world- such as dual slot phones and other smarter terminals and more standardized protocols, which allow greater interactivity and therefore more sophisticated services. (Mobile Communication International Magazine, 1999.)

2.3 Development of Mobile Commerce Application

There are several issues relating to the development of mobile commerce applications:

(1) Delivering mobile commerce applications necessitates dealing with issues such as security.

(2) Integration with the retail and banking hardware and systems.

(3) Non-standardized mobile infrastructure and competing e-commerce standards.

Additionally, there is a lack of standards relating to the mobile phone to network interface, the interfaces between host and mobile platforms and between different mobile platforms. As such, the scalability of e-commerce is questionable-initiatives that link wireless and IT systems tend to be custom developments on a project-by-project basis. There are also questions about the appropriateness of using a mobile phone as the interface to e-commerce applications. The man machine interface on mobile phones is currently sub-optimal and difficult for mass-market users to manipulate a smart card on its own. It could be a better platform for non-cash payment.

However, this area of electronic commerce applications is expected to contribute to grow significantly in the future, as mobile phone penetration delivers a critical mass of potential customers for such services. Indeed, it is in countries such as Scandinavia where mobile penetration is highest that e-commerce applications pioneered.

2.4 Data Market Evolution

Mobile voice services now are well established around the world, and the number of subscribers continues to grow healthily, however, the history of mobile data so far makes rather less cheerful reading. Mobile Internet and intranets are important because they represent two of the fastest growing markets in telecommunications and may provide the impetus, which will lift mobile data out of its specialist niche.

A number of trends in telecommunications and computing are causing fundamental change, for example, the increasing need of processing power in smaller portable devices. However, the rapid uptake of both mobile communications and data communications on the Internet creates step changes in the telecommunications

environment. At the same time, developments in terminals are providing users with portable computing devices of ever-increasing power and decreasing size.

The combination of Internet technology with mobile connectivity has the prospect of the marriage between two of the biggest and fastest growing markets in telecommunications. Meeting the problems, this combination poses, and developing packages of services, terminals and applications, which will delight users, will be one of the key challenges to the mobile supply community over the next decade.

2.5 User Expectations of Network Performance will continue to rise

Users expect big growth in the use of third party applications, particularly electronic commerce and location dependent services.

Operators have the opportunity now to put the relationship in place to offer commerce and location-based services. In a similar way to content owners, operators should be talking to transaction specialists and to location-based information specialist Operator and Motorola should work intensively with early adopters of both transaction and location technologies in order to produce the marketing collateral to stimulate broader demand.

2.6 Tariffing

At present, tariffing is based upon the duration of the cell. However, for data applications, users will expect tariffing to be volume dependent not time dependent. The users are thinking this way at pr esent. If marketing efforts are concentrated in the right directions, and if data applications become more and more attractive to the users, tariffing will still be an issue.

2.7 Targeting the Early Adopters (The Business Company)

It is expected that the early adopters of advanced data technology are managerial and professional workers. In order to capture this market, Operator and Supplier will need to:

(1) Target promotional campaigns at high interest professional groups.

(2) Provide solid benefits message, such as strong messages on coverage, roaming and cost effectiveness.

(3) Make it easy for individuals to trial data services.

(4) Provide applications packages matched to the capabilities of the GSM network.

(5) End users will expect a high degree of integration with their existing applications.

2.8 The Mass Market

For the mass-market end users, the future vision of the data usage is predicted to be the following:

(1) Mobile Internet/ interact will become part of daily life for users.

(2) Usage expected to grow strongly in terms of both frequency of access and total access time.

For the mass market, the operator and its data solution partner (e.g. Motorola) should ensure that: applications are scalable across a number of users and usage volumes in terms of both performance and management. It will be imperative to ensure that service packages are flexible enough to accommodate rapid rises in usage without creating a barrier to further growth. (Mobile Communication International Magazine, June 1999.)

(1) By 2005, more mobiles will connect to the web than PCs.

(2) Thirty percent of all Internet traffic will access by mobile by 2005.

(http://www.nationmultimedia.com, 2003.)

III. RESEARCH METHODOLOGY

3.1 Project Methodology

The methodology of this project is based on study of mobile commerce and the analysis of mobile commerce. This study will examine mobile commerce standards and applications by gathering information from different sources. The analysis and results will use the existing technology management knowledge and technology management tools such as SWOT analysis on mobile commerce, competitive strategy of each mobile company. The analysis benefits mobile commerce to operators and users and technical feasibility study of mobile commerce for improving the reliability and consistency of this project by using the linear regression method to study the trend of global mobile market in the near future.

3.2 Project Design

The first part is the introduction of the study, giving the study boundaries and objectives. Part 2 describes the study of mobile commerce applications. Part 3 describes the methodology and design of project. Part 4 describes the analysis and comparison of mobile commerce applications such as SWOT analysis, and the benefits of mobile commerce to operators and users. It includes the analysis of mobile commerce in Asia Pacific focusing in Thailand and the analysis of global digital mobile market that indicates the number of digital mobile subscribers and users, also the result forecast in the next few years by linear regression analysis. Part 5 are conclusions and recommendations of the project.

3.3 Project Research Process

This research process is divided into seven elements. However, the variety of approaches to research suggests that not all research projects will follow precisely the same sequence of procedures. Each of the elements is discussed in turn below.

(1) Select the topic

The topic arises from source of personal interest as well as the trends of mobile commerce that are booming and are being interested by many business sectors such as banking, retailing, transportation, entertainment and so forth.

(2) Review Literature

The process of reviewing the existing literature is sufficiently important for this project. Researcher identified and engaged with previously published research relevant to the topic.

(3) Devise conceptual framework

A conceptual framework indicates how the researcher views the concepts involved in a study — especially the relationships between concepts. In addition, the framework within which they are set, determine the whole course of the study. Thus, the development of this research uses the conceptual framework that involves four elements as identification of concepts, definition of concepts, exploration of relationship between concepts and operation of the concepts.

(4) List information needs

The research objectives gave rise to a list of information needs. At this stage, the information expressed is in general terms.

(5) Decide research strategy

Development of a research strategy involves making decisions on a number of aspects of the research process. This research, uses the informative-gathering methods. For each item of information listed in element 4 of the research process, a range of sources is applied. This research utilizes existing information; that includes published and unpublished research and secondary data. In addition, data analysis method of this research follows logically from the type of information collection. Details of analysis results will be discussed further in Part 4.

(6) Conduct research

There is a broad range of research approaches and criteria for their uses. The use of methods that are appropriate to the research issues addressed is vital for successful research. This research method applied using the existing literature and secondary data for the results.

(7) Report finding

The results of the research demonstrate the analysis of trends of mobile commerce and it reveals the market trend of mobile commerce in the near future.

IV. PRESENTATION & CRITICAL DISCUSSION OF RESULTS

4.1 WAP Technology

With the evolution of higher data rates for mobile subscribers, through bearer technologies such as GPRS and ultimately 3G (UMTS), operators are able to offer new value added services to their customers. One such area attracting a great deal of attention is the convergence of mobile and Internet technologies. A major enabler for this convergence will be the introduction of a common open interface for use within the mobile environment. The Wireless Application Protocol (WAP) is one such protocol gaining support.

With a unified standard like WAP, a much greater variety of services will become available and wireless data will begin to penetrate the mass market. WAP will provide operators, infrastructure and terminal manufactures and content developers with a common environment for the development of Internet access and other Value Added Services for mobile phones and wireless data devices. Motorola will provide flexible access to services via a wide range of WAP enabled terminals.

The establishment of this commonly accepted industry wide protocol (WAP) promises very substantial benefits for wireless network operators, end users and content developers of exciting new applications. This is because one programming model and programming language for developing applications decreases the risk of fragmentation. The strategy will expand the scope of the mobile industry by building a bridge from the mobile world to the Internet and other information sources, allowing easier access for standard mobile terminals. The fact that within a relatively short matter of time there will be more mobile devices attached to the Internet than desktop PCs, is fundamentally changing access criteria to the Internet.

With the introduction of WAP into a wireless network an operator is able to open up new revenue streams and both horizontal and vertical markets through added services and functionality. Four parties initially formed the WAP forum; Motorola, Ericsson, Nokia and software house Unwired Planet. These four member companies developed the core idea of an open interface specifically designed to allow www type functionality over the air interface for use by mobile phones and new concept products such as personal digital assistants (PDA's). The WAP forum has now grown to incorporate over 70 members from a diverse number of companies who hold an interest in the mobile industry. Participants in WAP forum are as follows:

(1) Terminal infrastructure manufacturers

(2) Operators

(3) Carriers

(4) Service Providers

(5) Software Houses

(6) Content Providers

(7) Companies developing services and applications for mobile devices

The proposal from the WAP forum is to develop an open protocol allowing Internet content and data services to cellular phones and other wireless devices. The creation of a global wireless protocol that will work across different wireless technologies and device types will enable operations to offer new and enhanced content and applications to their customers.

WAP is not bound by technological constraints but is developed to run over a number of current industries standard systems such as:

(1) GSM (900, 1800 and 1900)

(2) PDC and PHS (for Japan)

(3) CDMA (IS-95 or IS-707)

(4) D-AMPS (IS-136)

(5) DECT

(6) CPDP (the packet data over analogue standard)

(7) Mobitex (i.e. RAM Mobile data)

(8) FLEX and REFLEX (Motorola paging standards)

(9) DataTAC

(10) IDEN (ESMR)

The WAP forum has taken the World Wide Web as the architecture model to base its new standard. This has lead to a great deal of overlap with areas that W3C are involved. Hence working groups from both consortiums have been set-up to see where common solutions that will address the mobile requirements. This will ultimately achieve the seamless integration of mobile devices into the web. (Mobile Communication Asia, 1999.)

4.1.1 Benefits of WAPS

For the operators

Operators can enhance their existing service offerings to subscribers with the addition of WAP enabled terminals. Enabling terminals to gain access to web based content is only the beginning. As subscribers start to realize the benefits of WAP based applications; the feature usage will increase opening up new revenue streams for operators while decreasing their operating costs. The operators will be able to communicate an influence their subscriber base in a new way through visual interfaces enabling them to market new features and services.

By implementing origin servers within their own networks, operators are able to position their selves within the value chain to the subscriber. With control of the servers

within an operator's network, it becomes an easy step for an operator to enable new services with application upgrades and changes, to the server. These new services are instantly available network wide to all its customers. Teleservices such as prepaid recharge, call control and online customer care are all easy to deploy through out the network.

Due to WAP's open standards, network operators will be able to choose or commission a variety of applications from software houses and developers. Either these may be off the shelf products or tailor made to enhance a network operators' featuring offering. As more and more vendors join, the WAP Forum network operators will face with a varied choice of infrastructure being able to choose a gateway from one vendor and an origin server from another. The operator will also face with a wealth of options regarding different types of terminals available for use within the WAP enabled network. All this should provide an environment for competitive pricing and ensure future feature development.

As stated earlier WAP is technology independent. This allows an operator to migrate his feature offers from one generation of equipment to the next, for example GSM to UMTS migration. This has obvious benefits for the operator by way of reduced WAP infrastructure costs and minimal disruption to his subscriber services allowing high levels of customer satisfaction to maintain.

For the subscribers

Ultimately, the end user is the one who will benefit the most from the introduction of WAP into the wireless network. WAP written with the subscriber in mind, as a result the subscriber could expect to see significant value from this new technology by way of features and new standards.

WAP enabled pagers are able to provide subscribers with fast efficient access to information provided by the operator's network and external Internet based content material. WAP is specifically designed to meet the needs of the wireless subscriber, allowing both browsing of specific network operator information and features to external www sites. WAP will filter the information sent to and displayed by the wireless terminal for ease of use by the subscriber.

Subscribers will be able to access their own personal content areas using WAP browsers. This will give them a uniform look and feel wherever they are roaming.

As WAP, terminals become more common in addition to the voice centric handsets available, there will be a greater variety of terminals with different factors and features, such as PDA's Smart Phone and pagers, aimed at specific markets within the operator's customer base.

The Internet model has proved to be one of the most cost-effective ways for p.c. users to gain access to new services and applications. With the introduction of WAP, wireless subscribers will now be able to realize the same advantages. (Asian Communication Magazine, 1999.)

4.1.2 WAP Forum Visions

MexE (Mobile Execution Environment) is a protocol proposed by ETSI to enable web browsing to take place from wireless mobile terminals. The timescales for its implementation are currently further than WAP.

It is foreseen that MexM will use a powerful programming language based around Java, currently used by web content providers. This has implications for the terminals as Java requires high processor power, not normally associated with today's mobile terminals, and could possibly prove more expensive for the subscriber as the file size will be larger, leading to long download times and so greater expense.

MexE does not form an extension to WAP; rather a parallel implementation to standardize the mobile execution environment. There maybe a case for terminals manufactured in the future to provide WAP as a standard protocol on all handsets and MexE to use on the high end user terminals, to provide greater functionality.

4.1.3 Market Stimulation

Suppliers believe that the data explosion and the proliferation of data traffic will not happen instantaneously with first release of higher speed data services, such as GPRS. The killer application, if there is one, will probably not rely on data speed for its market acceptance. To generate a new data market, Operator should consider 'seeding' the market TODAY by selecting specific subscriber types (e.g. specific corporate clients) and providing them with enhanced data service and range of user-friendly applications. Supplier believes that this 'seeding' of the market can facilitate through the implementation of WAP technology.

Wireless Application Protocol (WAP) will provide data services and information to the end user independent upon the physical bearer. Operator could provide WAP to their high tier subscribers via SMS and circuit switched technology today. This provision of service would allow Operator to test the acceptance of the data market and gradually evolve those users and the mass market into utilizing their handsets for enhanced data services (i.e. more than voice communications). Supplier will provide a complete WAP solution including terminals (with WAP running over SMS, circuit and GPRS). (Mobile Communication International Magazine, 1999.)

4.2 The General Packet Radio Services (GPRS)

4.2.1 The key to significant new revenue streams for PLMN operators

This topic will:

(1) Show that GPRS is the key to significant new revenue streams that would otherwise be inaccessible to the operator.

(2) Show that GPRS is a one-stop-shop data service for most data applications for the year 2000 and beyond.

(3) Show that by taking an IN like designs approach, the GPRS standard is highly economical, offering operator choices designed to reduce financial risk and fixed operating costs.

(4) Show that the independence of the GPRS network platform, the GPRS Support Node, from a particular radio interface solution offers a migration path to new technologies like DECT and UMTS.

4.2.2 Accessing a new market sector of great potential

The GSM standard, as witnessed by over 100 operating networks worldwide, has achieved great success. Largely this success based on two far-reaching insights; cellular telephony was a huge new market, and only the development of the best contemporary technology would offer the opportunity for sustained market dominance.

Today, it is evident again that a large new market is being born. It is the market of mobile packet data. This market will reflect the extraordinary growth of fixed network packet data Local Area Networks (LANS) and Wide Area Networks (WANs). For example, there are now around 50,000,000 (fifty million) Internet (IP) subscribers in the world. Demand continues to grow at such a pace that a new version of the standard, IP version 6, has developed giving a vastly larger addressing space, removing a major limitation of the existing IP standard. With the equally impressive growth of wireless computers (Laptops, Personal Digital Assistants) and falling prices, there is a clear market need for wireless connectivity.

The General Packet Radio Service (GPRS) is the wireless version of a LAN or WAN. It is a new, unique service on GSM. Customers will only be charged for the communication resources they use, unlike GSM's circuit-switched services where users are charged even if they have no data to send. The operators' most valuable resource, the radio-spectrum, can be "sold" many times over because it can support many more data users-all of whom would pay additional monthly subscriptions fees. Without GPRS, it is very clear that only a limited number of wealthy customers would be accessible; the mass-market would be suppressed, inaccessible and potentially lost.

4.2.3 The "G" stands for the General — Packet Radio Services

The number of existing and planned data applications is already very large. These applications' communication characteristics are:

(1) The data transfer time per unit of data (packet) must be short.

(2) Data volumes per unit of transfer may vary from a few bytes to several kilobytes.

(3) For each subscriber, there may be frequent and prolonged idle periods between successive data transfers.

These idle periods may vary from a few seconds to many minutes. Many other users may use the same radio-path spectrum. Compared to existing circuit-switched services, where for the vast amount of time, the radio-path is often idle and wasted, valuable radio-path spectrum can be re-sold many times over by the operator.

Table 4.1. The General Packet Radio Service (GPRS) at a glance. (http://www.motorola.com, 2003.)

Service Types	Service features	Data transfer rates and radio-path usage	Interfaces supported
Point-to-point (PTP)	One-to-one packet data transfer capability with five qualities of service levels meeting variable application requirements- and charging opportunities.	Approximately data transfer: Low..100kbits/sec (1.8 TDMA timeslots) Spectrum only reserved when there is data to send, otherwise, other users can reuse spectrum. Compared to circuit-switched data services that waste most capacity — the spectrum resold by the operator may times over.	Most worldwide industry interfaces easily supportable within the GPRS design. Example include, Internet (IP), X.25, Frame Relay, ATM.
Point-to-multipoint (PTM)	One-to-many broadcast & group data transfer capability with the unique features; universal geographical routing function and a transmission scheduling of packets.	As above. Note: Unlike Short Message-Cell Broadcast, PTM offers a vast range of data transfer rates.	Unique, feature rich PTM application interface

The exploding demand of data networks in general and falling equipment costs, a mobile data service that meets the packet data requirements of the vast majority of applications, a worldwide mass-market and a simple interface conforming at the outset to world-wide standards will ensure that GPRS is quickly adopted by third party application developers. Adoption of the standard by third party developers, e.g.

MICROSOFT®, and their concentration on one single, un-fragmented, standard are keys to success and will make GPRS an innovation catalyst.

4.2.4 Standardization of GPRS: A Status Report

The requirements and service description phase of GPRS is ending. This represents the combined efforts of 20 to 30 individuals representing many major GSM operators and manufacturers over a 2 to 3 year period. The elaboration of the detailed technical specification is also well underway and good progress has been made in a series of SMG2,3,4 ad hoc meetings held over the last 2 years about once every 6 to 7 weeks. This demonstrates the high level of sustained interest, commitment, and the high level of broad agreement and co-operation in the GSM community on GPRS.

In order to expedite the technical standardization of GPRS for the purposes of pan-European Traffic Telematics, and to emphasize the importance placed on GPRS for the European telecommunications industry in general, the European Union's DGXIII has designated funds to and ETSI GPRS Project Team. ETSI have drawn up a project plan and terms of reference and these have endorsed at the SMG plenary level and fully accepted by DGXIII. The project team aimed at producing the detailed GPRS standard as soon as possible, perhaps July 1996, in order that manufacturers can begin implementation quickly. The GPRS project team has issued a "call for experts" and this has been enthusiastically answered.

The elaboration of GPRS over 2-3 years is moving towards a conclusion in 1996. GPRS places the GSM standard once more in the forefront of competing technologies at the beginning of the new market.

4.2.5 The good economics of the technical solution of GPRS

Technical issues are of concern to the operator since they can have a direct impact on the investment and the financial risk associated with any new endeavor. With this in mind, GPRS designed within the following broad guidelines.

(1) GPRS builds on the existing GSM architecture, phase 1 and 2, using the design philosophy of Intelligent Networks (IN). In this, core functionalities used as black box services by new value-added services. This maintains the stability of the existing PLMN investments and gives GPRS considerable design flexibility and implementation speed. This lessens the technical risk of introducing new services. It is at the leading edge of current engineering design methodology and accurately reflects ETSI's own new development process with its focus on a standard time-to market.

(2) Operator and manufacturer's choice is the most important issue. Clean, well-defined functions and interfaces are a priority in GPRS. This approach allows GPRS functionality to implement within existing equipment, if so desired, and more quickly in new equipment. It is up to the operator and manufacturer to choose the combination that suits his or her own circumstances. GPRS fully supports operator choice.

(3) The network subsystem (NSS) of GPRS, including the GPRS Support Node (GSN), MSC and Location Register are functionally separate from the base station subsystem (BSS). A GSN is a specialized, very efficient packet switching node best suited to GPRS's data packet traffic. This means, for example, that if the GSN implemented as a standalone unit as recommended the NSS of the GPRS would from a migration path to new technologies, e.g. DECT, UMTS and FPLMTS requiring little or no modification. This gives great technical and commercial flexibility.

(4) NSS backbone tanking requirements are optimized, because GPRS's inters backbone is also based on a packet technology, IP (v6), leased lines can share between many active users simultaneously. This significantly reduces the number of leased lines required by the operator. This represents real savings in operators' fixed costs.

(5) The BSS radio path flexibility should be fully understood. The radio interface may be different in different parts of a PLMN. In locations of low packet data traffic, a simpler but less efficient radio-interface can be implemented if so desired. In areas of high packet data traffic, a more advanced technological solution could be deployed. Again, the operator has the choice.

(6) If the PLMN operator chooses to implement the NSS functions in a specialized, efficient packet-switching node, the GSN, then investments can be carefully scaled in proportion to demand. There is no need for the operator to force or heavily upgrade all NSS nodes in order to begin service. The operator's financial risk in introducing GPRS is greatly reduced.

(7) If the PLMN operators choose to implement in the BSS a simple but less efficient radio-interface for an interim period to begin service quickly, then there is a clear migration path to follow to a more efficient technique. Again, the operators' financial risk in introducing GPRS is greatly reduced. The packet data market is exploding, providing a high level of investment confidence. GPRS will support the vast majority of existing and foreseeable data applications in one single service. The operators need only implement one new data service up until the year 2000 and for some years beyond, maximizing profits. GPRS is nearing the conclusion of technical elaboration

(in 1996) and has been well supported by many leading PLMN operators and major manufacturers. Very favorable worldwide press interest in GPRS emphasizes its appeal. It offers the operator scaleable implementation options and clear technological migration paths proportional to their own levels of confidence in the financial risk. Finally, GPRS opens significant new revenue streams for operators in terms of maximized network usage and highly profitable value-added services, making accessible new revenue streams that would otherwise be inaccessible and probably lost.

4.2.6 Target Applications

GPRS is the enabling technology for Operators who wish to take advantage of wireless data business opportunities. A wide range of software applications in GPRS is the enabling technology for Operators who wish to take advantage of wireless data business opportunities. A wide range of software applications e.g. TrueSync can run over GPRS using tools such as Wireless Application Protocol (WAP) and SIM Toolkit. GPRS offers fast, flexible and cost-effective development of distinctive services. It implemented as an overlay to the existing GSM network. (Wireless Asia Magazine, 2000.)

4.3 UMTS (Universal Mobile Telecommunications System)

UMTS (Universal Mobile Telecommunications System) is the European member of the IMT-2000 family of Third Generation cellular mobile standards. The goal of UMTS is to enable networks that offer true global roaming, and can support a wide range of voice, data and multimedia services offered at competitive prices in a dynamic marketplace.

These new UMTS networks will build on the success of GSM and on an Operator's existing investment in the development of customer base and infrastructure.

The first stage of service and network evolution is from today's GSM systems, through General Packet Radio System (GPRS) in 1999 and 2000 to commercial UMTS systems from the end of 2001. UMTS will support full interworking with GSM systems and will reuse investment in GPRS.

UMTS will enter the market at a time when fixed-mobile integration is becoming a reality, the telecoms, computer and media industries have converged on Internet Protocol (IP) as a shared standard and data accounts for a significant proportion of the traffic carried by mobile networks.

In order to take advantage of this situation and to increase competition in the market, EU telecoms policy encourages a new commercial model for UMTS where a number of enterprises work together in both competitive and co-operative relationships to provide services to the subscriber, Service Providers as a point of contact to the subscriber and Value Added Service Providers (including content providers), offering improved, information-based services to the user.

4.3.1 There are three independent components of the UMTS Systems Architecture:

(1) A service platform that offers end-users the same services features regardless of the underlying access technology, thus providing a "Virtual Home Environment" - UMTS Client/Server solutions will evolve from Client/Server solutions based on the SIM Toolkit, Wireless Application Protocol (WAP) and Mobile Execution Environment (MexE) standards.

(2) A transport network that supports voice and data efficiently and provides mobility management and other core functions - The transport network will be a single packet based network supporting both voice and data services with unified management control. Interworking functions such as

transcoding and data modems will move to the edge of the network thus improving utilization, management and quality.

(3) A series of access networks including the new UMTS air interface and other wireless and wire-line interfaces.

4.3.2 Third Generation Systems

The international telecommunications Union (ITU) began its Third Generation mobile communications initiative in 1985 with the vision that there would be a single global standard. However, market conditions and drivers have proved to vary so widely in different regions that the ITU have now moved from this concept of one single system to a vision that accommodates a family of systems. The goal is now to establish global roaming among the various Third Generation technologies.

This family of systems known as IMT-2000 explains the evolution paths from the first two generations of cellular standards ("1G" and "2G") through intermediate standards ("2.5G") to the Third Generation family of IMT-2000 standards ("3G").

Regional choice of a Third Generation standards is based on a number of factors including customer requirements, existing investment in Second Generation systems and desire to support local industry.

Japan has been very active in Third Generation developments. Capacity is a key driver in this region, with NTT DoCoMo expecting to run out of spectrum for basic services by 2000. Japan has submitted W-CDMA to the ITU as their proposal for IMT-2000 however DDI and IDO have been trailing cdma200 as they require a Third Generation system, which will be compatible with their Second Generation cdmaOne system.

In Korea, ETRI has established a consortium to develop Korean IMT-2000. There are two proposals under development: Global CDMA I - is similar to cdma2000 and Global CDMA II is similar to DoCoMo's W-CDMA.

In the Americas, there are three proposals for the Third Generation system — cdma2000 for migration from cdmaOne, UMTS for migration from GSM1900 and UWC-136 for migration from IS-136 TDMA.

In Europe, the technology choice is UMTS with UTRA (UMTS Terrestrial Radio Access) defined as the air interface. Key Drivers are the implementation of advanced services (to develop the European Union's concept of the "Information society") and to introduce increased competition through a new business model.

UMTS is the European member of the IMT-2000 family of Third Generation standards. The UMTS standards developed within the ETSI SMG committees that originally developed GSM. UMTS requirements include:

(1) Small, low cost pocket terminals

(2) Worldwide roaming

(3) A single system for residential, Office, Cellular and Satellite environments

(4) High Speed Data

UMTS will support data rates of up to 2Mb/s and new multimedia applications over al new wideband air interface based on CDMA techniques. Services will supported by a wide range of terminals tailored to the requirements of voice, data and multimedia services.

UMTS will encompass more than just cellular systems, evolving from GSM and embracing fixed networks and other wireless and wire-line access technologies. Services will be globally available, delivered over the mobile, satellite or fixed networks that provide the best accessibility for the consumer's specific location.

The key elements of UMTS are:

(1) New services including mobile multimedia.

(2) More spectrum (using a new air interface).

(3) Evolution from and internetworking with second generation systems.

(4) A new commercial model to increase competition and increase the range of services available. Advanced networking capabilities with PSTN, packet based and advanced Internet based networks.

UMTS networks will evolve from today's GSM networks, encompassing both existing and new network elements working together to provide seamless service delivery to customers whether they are using GSM or UMTS air interface. There will be smooth integration of GSM and UMTS services with consumers using handsets that automatically switch between the available networks.

This will enable Operators to build on their existing GSM network investment and customer base will provide users with a smooth upgrade path from GSM to UMTS.

4.3.3 Operator Benefits of UMTS

(1) New spectrum - As the demand for data and multimedia services grows, the existing GSM spectrum available to Operators will not provide sufficient capacity.

(2) New services - Rapid service creation, new multimedia and high-speed data services all lead to increased competitive position, increased minutes of use and increased revenues.

(3) Leverage investment in GSM - As UMTS builds on both the Operator's investment in GSM and on that in GPRS, it offers the opportunity to generate new revenue from existing investments and an existing subscriber base.

4.3.4 User Benefits of UMTS

In line with subscribers' increasing expectations of GSM systems, UMTS will of course provide a very high quality of service in all environments. This will further enhanced by the implementation of the Adaptive Multi-Rate (AMR) codex.

In addition, users will benefit from:

(1) Seamless global roaming

The implementation of the Virtual Home Environment will give users the same seamless service regardless of serving network type. This means that users can access their personalized service profile through any network from any terminal, optimize the display of information and simplify access to the key services that they use most. This programmable personality will be stored in the SIM card, and this will allow the same user interface to be available on any phone anywhere in the world.

(2) High speed data services

The UMTS network will provide cost-effective data transmission with the flexibility to remain on-line at all times, whilst only paying for data received or transmitted. Terminals will always connect to the network, e-mails could receive as soon as they are sent and access to the Intranet and Internet will be immediately be available all the time with no set-up delay. All this will be available at even higher data rates than those offered by GPRS systems.

(3) Multimedia services

New multimedia services will include video conferencing, interactive entertainment, and video transport in the case of emergency or disaster. Multimedia technology will also make it possible to offer electronic magazines or newspapers complete with graphics and video clips.

(4) New innovative applications

The involvement of new Valued Added Service Providers in the UMTS commercial model provides the opportunity for a wide range of new applicants to offer. Examples are supplementary features for traditional voice callers such as location-based services.

(5) Telematics

Building on GPRS services, UMTS will support machine-to-machine communications in applications such as vending machine monitoring.

(6) Increased integration between fixed and mobile technology services

The increased integration of these services offers users both an increase in ease of use and increased affordability.

(7) Increased choice of services

The opening up of the market for service provision and the simplification of service creation will provide users with an increased range of services from which to select. The increase in competition in the market is also expected to ensure that these services offered to the user at an affordable price.

4.3.5 UMTS Market Environment

Fixed Mobile Convergence

Liberalization in Europe has already allowed some operators to offer a combined subscription for fixed and mobile services. Whilst this is primarily limited to billing at present, we can expect the more innovative Operators and Service Providers to offer converged services through both access methods.

Industry Convergence on Internet Protocol

The convergence of the Computer, Media and Telecommunications industries is becoming apparent, characterized by the adoption of Internet Protocol (IP) as a common standard.

The computer industry is already extensively IP based, with both business and consumer applications that built upon IP. The industry is now looking for mobility to extend the reach of computing to people on the move, and demanding ever-faster access speeds to allow more complex multimedia to interchange.

Other wideband telecommunication services based on IP such as videophone applications using H.323 are becoming more of a business reality as mobility and higher data rates introduced into the mobile marketplace. Use of IP in the media industry is emerging as technologies such as Real Audio now allow the use of the net to listen to a local radio station that may be located on the other side of the globe.

All three industries are looking for mobility services at increased bandwidth. The UMTS network can seen to be more than just another mobile network — it is really the convergence of these three industries, and the key enabler to this happening will be IP.

Growth in Data Services

Demand for GSM services today is low — between 1% and 3% of operator revenues in Europe, and significantly less than 1% in most of Asia. However data, is considered a 'must have' capability for most high-end business subscribers. With the advent of GPRS, several factors will positively influence the demand for data services. These include:

(1) New smart phones enabling highly portable and usable mobile data applications.

(2) Continued growth of the Internet, leading to greater use of data in everyday life.

(3) Near instant access to data.

(4) Tariffing which can be based on volume and quality of service (QoS) rather than time.

Because of these factors, even conservative industry viewers expect data to reach at least 20% of an operator's traffic within five years of GPRS adoption. Several market forecasts (Ovum, Analysts, and Strategy Analytics) support exceeds this figure.

4.3.6 UMTS Enterprise Model

A key objective of EU telecommunications policy is to increase competition within the market. UMTS envisages a new commercial model where a number of enterprises work together in both competitive and co-operative relationships to provide services to the subscriber UMTS commercial model.

This does not preclude an enterprise from fulfilling more than one role i.e. existing cellular Operators can continue to provide services as they do today. However, the market opened up to new entrants to specialize in one of the roles and offer services in competition to those already existing in the market. The roles include:

(1) Network Operators — responsible for the core UMTS network: Indication is that all-existing GSM operators are candidates for UMTS spectrum licenses. The expanded range, and flexibility, of services offered by UMTS to subscribers will bring increased revenue potential for both Network Operators and Service Providers. Some Operators may decide to specialize in providing extremely efficient bulk transport much like Internet Service Providers today. However, most existing Network Operators are likely to

act as UMTS Service Providers in addition to their role as UMTS Network Operators.

(2) Service Providers — responsible for the relationship with the customer: The Service Provider's role in UMTS commercial role model is quite different from today's definition. This is no longer simply a reseller role, but involves developing products and services to offer via various different serving networks. Many Service Providers expected to be new entrants to the mobile marketplace. These could include any organization with good customer care facilities such as Credit Card Companies, Banks, Supermarket Chains and Utilities.

(3) Value Added Service/Content Providers — offering new services: Including this role in the UMTS commercial model recognizes the importance of additional services and features to the end user. The new role allows for existing services such as messaging, but intended to provide for a vast new range of applications and content from a wide range of suppliers. The market entry as a Content Provider should therefore be as easy as setting up a website on the Internet. Many of the concepts and solutions that developed for the Internet may apply in the UMTS environment.

4.3.7 System Architecture

The key objectives of the architecture proposal outlined here are:

(1) Smooth, commercially successful migration path for current GSM operators, allowing for continued interworking with other GSM and fixed networks.

(2) Cost effective implementation (both capital and operating cost).

(3) Fast, flexible development of distinctive, operator-specific features for market differentiation.

The system outlined here would be built on a common modular high availability hardware and software platform, creating a distributed peer-to-peer network solution where functions may be located to best address the needs of a particular network. The system would enable features such as Local PSTN Interconnection, Optimal Routing and advanced wireless enterprise solutions for corporate customers.

The platforms are scaleable that allows Operators to deploy networks where core equipment is centralized or highly distributed allowing operators to reduce their backhaul and interconnect charges. Motorola's cell site equipment would be designed so that, over time, operators will be able to deploy both GSM and UMTS system is designed so that it can be blended seamlessly at standardized interfaces with existing equipment from other suppliers.

4.3.8 Service Platform

(1) Requirements

Requirements are Rapid service creation; differentiated services and global roaming. In solutions deployed in GSM, networks today are largely proprietary. These have been good at offering solutions that involve simple number translation, such as One Number services or Virtual Private Networks but have been less successful at delivering the wider variety of services and flexibility originally envisaged. Movement to the CAMEL standard will improve service portability while roaming but still will not offer operators the flexibility they require.

Operators are now keen to buy Service Capabilities, or toolkits, from which they can build their own unique services, and free themselves from the constraints of new feature development on the switch itself.

In addition, the Service Provider's role will require rapid development and deployment of personalized telecoms services, service management and control and features which are transparent to the underlying serving network.

Motorola believes that a Client/Server solution, moving the service control logic to the edges of the network (handset/SIM card and HLR/server) will meet this need in the most effective manner, allowing rapid new feature development and thus promoting competition and increasing network use.

(2) Implementation

In this Server-based architecture, the network providers reliable transmission pipes only. A common Application Programming Interface, or API, allows a software program running on the Service Provider's computer (the Server) to communicate with the User's terminal (the Client). Services now run at the edge of the network independent of the underlying infrastructure and new services can rapidly developed and deployed without the need to make expensive and time-consuming changes to the core network. The transport pipe can provide a mobile network, such as GSM or UMTS, or the fixed network. The only requirement is that the network supports the common API. The same services can easily be deployed on both fixed and mobile networks facilitating the transition towards Fixed Mobile Convergence. Enhancement of WAP, the Wireless Application Protocol can provide this critical enabler for enhanced service delivery on UMTS networks.

4.3.9 GSM Interworking and Migration

Including this role in the UMTS commercial model recognizes the importance of additional services and features to the end user. The new role allows for existing services such as messaging, but intended to provide for a vast new range of applications and content from a wide range of suppliers. The market entry as a Content Provider should therefore be as easy as setting up a website on the Internet. Many of the concepts and solutions that developed for the Internet may be applied in the UMTS environment.

In order to meet requirements for rapid service creation and true global roaming, UMTS Client/Server solutions will evolve from Client/Server solutions based on the SIM Toolkit, Wireless Application Protocol (WAP) and Mobile Execution Environment (MexE) standards.

These standards should be seen as complementary with each having the potential to fulfill a separate role. SIM Toolkit provides the secure mechanism for authenticating applications and content, accessing service profiles and encrypted access to electronic commerce features, whilst the SIM stores the bookmarks and service parameters for the language to bind these to the phone. MexE provides the core API hooks as part of the distributed environment.

(1) SIM Toolkit

The current SIM toolkit standard (GSM 11.14) allows the SIM to be used to intercept all calls made from the mobile, and block or change the number dialed. The SIM can also directly manipulate the menu structure of the in terminal's user interface, adding new menu options tailored dynamically to the serving used. Over The Air, activation and download also supported through existing mechanisms.

(2) Wireless Application Protocol (WAP)

WAP is currently being developed to provide a standardized way for a Server based application to interact with the terminal user interface. It provides a script-based language, which can be downloaded into the mobile to control the terminal's user interface, mostly for access to information and content services. WAP is not GSM specific. The scope for the WAP Forum is to define a set of standards to use for developing applications over wireless communication networks.

(3) Mobile Execution Environment (MexE)

MexE will extend the capabilities of WAP by adding security and flexibility. It is likely to be based on Java Applets, which will enable MexE to offer a more powerful range of features, a range of security levels and privileges depending on their authorization and greater control of the telephony features than those currently exist within WAP. SIM Toolkit, WAP and MexE will be key enablers for UMTS. Migration from GSM is possible by adopting a migration strategy that does not change the user's perceptions of their service. In other words, introducing new features is part of a total service package rather than mere technological changes. If this service independence can be offered today, many of the goals of UMTS can become immediately possible.

A simple example of a Stock Quote application serves to illustrate this. Today, using very simple SIM Toolkit and short messages, a user can provide tailored content on their top five shares of interest. As WAP introduced, giving more control over the machine interface, and greater bandwidths available, this information can be updated quicker or more historical information can be provided. Moreover, as GPRS and UMTS introduced profit and loss details or even live video feeds can be provided.

As far as the user is concerned this is still the original stock quote program but now with greater content depth. To the network operator the user has been migrated towards UMTS seamlessly, via GSM and GPRS, with the operator controlling when additional features are provided. The operator is also attracting more revenue through the "depth" of the service not the merits of the technology.

(4) Benefits

The real power and inherent flexibility of Client/Server can be seen when considering how leading edge services delivered when roaming. Current approaches only deliver the enhanced service while the user is on the home network. This is due to a dependence on the specific service logic implemented in the visited network. The Client/Server approach is independent of the underlying network and delivers the service in the same way wherever the user may be.

4.3 . 1 OTransport Network

Packet Network Requirements

(1) Efficient data transport

(2) Efficient voice transport

(3) Unified network management

Smooth migration path for data and voice.

The benefits offered by the Client/Server approach

(1) Flexible and cost-effective development of distinctive services

(2) The ability to target the cost of complex features directly to those using them (SIM cards issued to those who need them)

(3) Can be implemented as overlay to existing GSM (or other) networks, with minimal changes to MSC components

(4) Excellent response time compared to IN when roaming

(5) Enables true global availability of services when roaming

GSM Integration and Migration

At present GSM, supports circuit switched traffic only. The first step in the evolution path towards packet-switched UMTS networks will be the introduction of the General Packet Radio Service (GPRS) to GSM.

GPRS is a GSM Phase 2+ feature that provides packet-switched network architecture to handle data services in parallel with the circuit-switched network architecture for voice. The network expansion builds on many of the best features of GSM, such as the MAP mobility scheme and SIM-based security, and communicates with existing GSM network nodes such as the HLR. It also uses extended GSM billing records to allow the commercial procedures for roaming, billing and accounting to operate.

In order to provide interworking with circuit-based networks such as the PSTN for both voice and circuit data calls, a Shared Interworking Function (SIWF) connected to both the circuit-switched and packet-switched networks on the mobile side.

GPRS will provide efficient support for a wide range of data services. As higher network capacity becomes necessary to support high volumes of data traffic, UMTS implementation enables Operators to build on the existing investment in GPRS and offer users higher bandwidth data services with lower delay.

The new UMTS BSS will support an evolution of both A and Gb interfaces and so can connect to existing GSM/GPRS networks to offer voice and packet data services. This will also be supported by dual-mode mobiles that can handover seamlessly between the two air interfaces. Key GPRS enhances will include support for Quality of Service and a connection-oriented call control model, thus allowing support for multimedia calls through the GPRS network.

The underlying transmission protocol used for the new air interfaces will be ATM-based rather than Frame-Relay. This will require the low-level transmission systems to upgraded or replaced. SGSN and GGSN control nodes can continue to use to control this traffic because the control and transmission paths may separate through the network.

Further enhancements to the GPRS Network will support voice traffic through the packet-based network, moving the GSM voice transcoding function to the edge of the network. This "Circuit Gateway" will provide voice transcoding and echo-cancellation functions.

By upgrading the GPRS network to offer quality of service levels appropriate for voice traffic, Operators will have the choice to migrate some or all of their voice traffic from circuit-switched equipment to more efficient packet-switched systems over a period. UMTS voice calls could route either through existing GSM voice circuits, or more efficiently through the packet network and the Circuit Gateway.

In the early stages of UMTS, circuit based voice traffic is likely to continue to use the MSC and, as UMTS matures, voice will migrate to packet.

Benefits

(1) Reduced core costs — by enabling multiple users to share a single channel, up to ten times the revenue, can be generated from the same network resources as would be generated from a circuit-switched data channel.

(2) Rapid call set-up — UMTS can provide a permanent virtual connection. This means that the user can connected all day without consumption of network resources.

(3) Lower transmission costs — encoded voice sent through to the edge of the network (or directly to a target device). There are lower costs for interworking functions due to aggregation (centralized sharing).

(4) Reduced network management costs — a single integrated transport network handling both voice & data is easier to manage and provision than two independent networks (this already happened in wired Private Networks).

(5) Increased network reliability — there is potential to use packet-oriented re-routing techniques to increase availability due to link failure or equipment outage.

(6) Improved voice quality — tandem-free operation will be common on all mobile-to-mobile calls, thus noticeably improving the perceived voice quality.

4.3.11The future is now on Mobile Commerce

Any place, any time the mobile phone is becoming a dynamic new market channel right in customers' hands. It is happening now.

Consumers will come to use their mobile phones as they now use their wallets. Cash, credit services, tickets, loyalty points, medical records — all this information and more would be held on their mobile phones in electronic format. Information would be updated and shared securely by the touch of a button.

The implications of, and opportunities offered by these developments are staggering. For the consumer they will mean a familiar, convenient, inexpensive and reliable channel for accessing goods and services — one it will undoubtedly be chosen to use. For banks, mobile phone operators, retailers and other providers, this could spell phenomenal success or long-term disaster.

Demand for M-Commerce will be great. That demand could have significant impact on more traditional market channels. You need to know how these changes will affect your business. The alternative is to sit back and ignore the inevitable-with inevitable consequences.

Working closely with the retail banking and mobile communications sectors to allow their customers to use mobile phones as a banking and payment device. (http://www.erricsson.com, 2003.)

4.3.12Securing your success in retail banking

Retail banking is changing fast. The race is on to attract new customers and defend market share from intense competition. Innovative new services and new market channels are vital for success but the window of opportunity is small.

It is a huge challenge — especially as most IT systems are not designed to handle the diversity of services that modern banking demands. Customers demand a single view of all their information, reliably up to date and across all delivery channels. Outdated legacy systems or multiple platforms for hardware and software make it expensive and time consuming to provide that consistency or to introduce new services.

Cost-effective entry to new customer channels and maximizing the efficiency of existing channels is essential alongside a low risk, controlled transition from existing legacy systems.

4.3.13A reputation for delivering success

An excellent company renowned for its systems integration, constancy skills and specifically designed to meet the challenges facing retail banking: (http://www.nokia.com, 2003.)

(1) Multiple delivery channels

(2) Multiple data sources

(3) A single customer view

(4) Internet banking

(5) Mobile phone banking & commerce

(6) ATM and PoS management

(7) Transaction switching & authorization

(8) Card management — issuing & acquiring

(9) Merchant processing

(10) Branch banking

(11) Corporate banking

(12) E-Commerce

(13) Fund transfer via SWIFT

(14) Card transaction handling for call center

4.4 SWOT Analysis on Mobile-Commerce

4.4.1 Strengths

(1) Rapid implementation of new channels

(2) Provision of information-rich content

(3) Reduced time to market

(4) Low cost of ownership

(5) Low risk migration path from existing legacy systems

(6) Protection of investment

(7) Cost-effective implementation industry standard technology

(8) Secure, robust turnkey solutions

(9) Ability to gain competitive advantage

(10) Single supplier for multiple solutions

(11) Global company with local delivery

(12) Increase revenue from new data services

(13) Wide range of wireless Data Applications

4.4.2 Weaknesses

(1) Rapid implementation of new channels

(2) Slow speed (9.6Kbps)

(3) Reputedly low payers

4.4.3 Opportunities

(1) Corporate customers have become more international

(2) One-stop shop with a single carrier offering the latest technology

4.4.4 Threats

(1) Low GSM market share consequently few production economies of scale

(2) Economic crisis (Especially in Thailand)

(3) Money devaluation

(4) More expensive product

4.5 Competitive Strategy

4.5.1 Motorola

Motorola's Value Added Service strategy being tailored to suit particular market/service types: e.g., Secure Corporate & mobile professional services would be treated differently; open generic information services and differently again to secure electronic commerce applications for the mass market.

Relating specifically to mobile electronic commerce, Motorola has spent the past 2 years developing a European team, leveraging competencies within Motorola in secure silicon and encryption, smartcard system design and communications system design. The team has consulted widely with the Visa's, MasterCard's, Banks, Card-Bancaire's of this world handling, encryption and secure device entry, Zoned end to end

encryption, message and protocol customization for GSM, liability rules changes for mobile remote transactions are areas that have been addressed.

The first example of this mobile commerce team's activity is the recent launch of the StarTAC D dual slot smart phone, the world is 1st in a new category of mobile device specifically designed and developed for the banking market. With this device, a GSM SIM controls access to third party payment networks and service networks. Lessons learned from this programme such as the handling of secure keys within the SIM, messaging and encryption optimization for GSM etc. are being taken into WAP to ensure that the standard is secure enough to handle transactions.

4.5.2 Ericsson

Ericsson intends to use WAP as an integral part of their network solution for future releases. Ericsson has recently announced the introduction of a WAP enabled gateway known as Jambala. Initial applications for the WAP Gateway are access to Intranet and e-mail, personal information management, push alerts and notifications, as well as customer care services. Future applications include advertising, e-commerce, location-based services, info services and dispatch services. The platform's open architecture makes it possible for service providers and third parties to develop their own applications using Java.

Ericsson plans to conduct field trials of the JAMBALATM WAP Gateway in the second quarter of 1999 with commercial availability scheduled for the second half of the year. (http://www.microsoft.com, 2003.)

4.5.3 Nokia

Nokia have as yet not made public their solutions regarding WAP, although all indications are that they will deliver their own WAP enabled gateways and servers.

They currently offer the ARTUS product family of platforms that maybe developed and enhanced to offer WAP based applications.

Nokia introduced its new WAP capable phone. The phone has a larger display to allow for greater text and graphics capabilities and supports a WML microbrower, giving greater credence to their data solution story. (http://www.up.com, 2003.)

4.5.4 Wireless knowledge (Microsoft/Qualcomm)

Microsoft and Qualcomm have created a new joint venture company named Wireless Knowledge LLC, and equally held company whose charter will be to bring convergence to the computing and wireless communications industries in direct competition with the WAP forum. Wireless Knowledge's operating strategy includes forming strategic partnerships with computing, software and telecommunications companies as well as with wireless carriers including AirTouch Communications, AT & T Wireless Services, Bell Atlantic Mobile, Bell Mobility (Canada), Bellsouth, GTE Wireless, Leap Wireless International, Sprint PCS and US West Wireless.

Wireless Knowledge services are built on an end-to-end architecture based on industry standard technologies including the Microsoft Windows CE operating system, the Microsoft BackOffice family and Microsoft Commercial Internet System (MCIS). Wireless Knowledge will be accessible over all digital wireless wide area networks, including those based on CDMA technology, GSM, TDMA, CDPD and Mobitex.

The intention is to allow services, brought to subscribers by their wireless carriers, to connect to the Internet and their own business networks from digital phones, desktop and laptop computers running the Windows CE, Windows 95, Windows 98 or Windows NT operating system, smart phones, pagers and Web access terminals (e.g. smart TVs, Web kiosks).

In addition to the joint venture and as part of the broader strategic alliance, Microsoft and Qualcomm have stated they will also pursue the following:

Windows CE integrate with a future Qualcomm ASIC (Application Specific Integrated Circuit) chip which is the integration of Windows CE into a wide range of voice and data-enabled wireless devices. A collaboration to accelerate innovation and adoption of wireless Internet capabilities incorporating existing and developing standards such as XML, HTTP, VoIP, and CDMA IS-95B and IS-95C specific standards and between the evolution of voice and data over Internet capabilities, utilizing Windows NT and Qualcomm's innovative and scalable infrastructure architecture.

Initial service offerings, available on an OEM basis to carriers in early 1999, will include data services to maintain messaging, e-mail, calendaring, contact list and basic information services through the Internet, plus access to Exchange-based corporate networks. Additional features and services will add over time. All of this could be seen as a move by Microsoft to gain a stranglehold over the wireless data access market. (http://www.siemens.com, 2003.)

4.5.5 Unwired Plant (UP)

Unwired Planet was one of the founding members of the WAP forum and continued to support the introduction of this open protocol standard. UP are currently the number one providers to the cellular industry of psuedo-WAP technology and already have a suite of software and hardware to support web browsing within wireless networks.

UP currently have alliance agreements with Alcatel and Siemens, Motorola still to confirm whether they will use the UP browser for GSM networks. (http://www.alcatel.com.France, 2003.)

4.5.6 Siemens

Siemens and UP have recently signed a partnership deal, which affords Siemens the ability to integrate UP server suite into their switching network. This again highlights a different paradigm to that of Motorola, of continuing to tie operators into switch-based networks. With Siemens able to provide UP based solutions Motorola are effectively complementing their solution by the introduction of Motorola terminals with UP browsers. (http://www.nortel.com, 2003.)

4.5.7 Alcatel

Alcatel are currently partnered with Unwired Planet and will make use of UP's server and gateway with the possibility of linking in their own IN applications. The current products from UP are not fully WAP compatible although UP say they will be made backward compatible for future WAP development.

Alcatel have already signed a major contract with Cegetel for the supply of a full turnkey solution enabling access to a range of online interactive services. These mobile Internet services will be accessible directly from a GSM phone featuring a dedicated micro browser.

Alcatel has designed and integrated the network gateway platform (believed to be supplied by UP), and has provided the GSM phones as well as One Touch TM POCKET, Internet Ready version is able to run a web browser based around UP's current product offerings and protocols.

This service not designed to only "surf' on the web with a mobile phone, but to access multiple dedicated servers that answer anytime to specific needs of the subscribers (e-mail, agenda, weather information, flight reservation).

Alcatel says this solution will be compatible with the specifications of the WAP Forum. The solution retained by Cegetel, based on WAP principles, will be the first

large-scale commercial offer in the GSM world. Commercial service planned for early 1999.

4.5.8 Generic Competitor Strengths

Ericsson 's strengths: (http://www.microsoft.com, 2003.)

(1) Market leaders in Wireless

(2) Most cosmopolitan (only 6% of Telecom sales in Sweden)

(3) Part of Keiretsu-like conglomerate (The Wallenburg Group)

(4) Huge financial resources, which used to gain a foothold in strategic markets and follow through the strategies

(5) Low cost structure and benefit from Production Economies of Scale

(6) Telecoms wide product portfolio

(7) Focus on largest operators and contracts

(8) Use the shotgun approach to contracts but are not resource limited

(9) Strong Research, Development, and further pushing their Time to Market advantage

(10) Industry advanced outsourcing and third party supplier system

(11) Using their landline supply agreements as leverage against PTT's

(12) Close collaboration with learning institutions.

(13) Sell themselves as a 'one stop shop'

Ericsson's weaknesses:

(1) Perception in the media that CEO is not up to the job

(2) Behind in data networking

(3) Market does not perceive as leaders in GSM1800

(4) Under increasing pressure to perform financially

(5) Reducing Market Share in Latin America

(6) Focus upon wireless defocusing on wire line

(7) Few Integrated applications

(8) Do not generally go for PTT operators (Nokia and Motorola do)

(9) Can be seen as arrogant in 1st and 2nd world countries

Nokia 's strengths:

(1) Compact and highly flexible company

(2) Take advantage of opportunistic situations

(3) Focused strategies (select then win their desired contracts often largest operator/value) implemented via a highly centralized organization

(4) Good financial rating and profit focused

(5) Marketing oriented and excellent Marketing ability

(6) Low cost structure and good production economies of scale

(7) Strong in data applications market

(8) Quick Time to Market ability

(9) Nokia seen as a 'safe choice' and perceived leader in GSM1800

(10) Developing personal relationships with key operator personnel

Nokia 's weaknesses:

(1) Inadequate Nokia Multi-vendor dual band offering

(2) Very centralized culture and operation, which can cause problems, the further from Finland the customer is the less support they get

(3) In-house resources are small and heavy reliance on suppliers prone to over-stretch

(4) Prioritization of certain accounts neglects others

(5) Reputedly low payers

(6) Often don't keep to deadlines

(7) Weak in fixed Telecoms

(8) Weak in data networking

Alcatel's strengths: (http://wwvv.lucent.com, 2003.)

(1) Skilled at Operator and Standards Political processes

(2) "One stop shop": system solutions — fixed & mobile, BSS, NSS, Microwave, transmission options

(3) Large install switch base

(4) Significant links with the French Government.

(5) Improved handset offering

(6) Restructure now complete appears to be having beneficial results.

Alcatel's weaknesses:

(1) Poor BSS technical performance led to them being weak in key networks in SFR, Paris; FT, Chalon, Mobikom, Austria; Strained relations in KPN, NL. Alcatel's poor reputation with Technical personnel has seen them ripped after winning the contract with aggressive pricing and political influence

(2) Compete on Price in GSM in 1998

(3) Have suffered corruption allegations e.g. ascend in USA, Bangladesh etc.

(4) Coming under increasing pressure from financial community

(5) Low GSM market share consequently few production economies of scale.

(6) Historically seen as slow moving in the industry

(7) Conflict in strategies between Telecoms and Telecom Cables and Components division

Nortel's strengths: (Mobile Communication International Magazine, 1999.)

(1) GSM 1800 Reputation

(2) Image in Data Networking (with the acquisition of Bay Networks) as a credible player

(3) Large fixed install base, which will be used as a lever in fixed mobile convergence

Nortel's weaknesses:

(1) Disposed of Matra Nortel handsets

(2) Limited number of GSM contracts and experience

Siemens' strengths: (http://www.nortel.com, 2003.)

(1) Respected Engineering Image

(2) Large Switch install base

(3) Huge conglomerate employing 300,000 people with resources to match

(4) Large fixed install base, which would be used as a lever in fixed mobile convergence

Siemens' weaknesses:

Traditional engineering focused slow moving conservative company

Very centralized culture

Disparate Portfolio but restructure looks to change

In period of upheaval thus financially stretched

Competing more and more on price only in GSM

Reliance (although reducing) on Italtel for GSM BSS

Huge inventories (GSM)

Low GSM market share consequently few production economies of scale

Lucent Technology's strengths:

(1) Bell Labs

(2) Huge Financial Resources — cash rich

(3) Data Networking capability

(4) A late entrant to GSM

(5) Dissolved partnership with Philips on Handsets

(6) Low GSM market share consequently few production economies of scale

(7) Small install base of GSM contracts not inherited from Phillips

4.5.8 Network solution partnership

(1) Motorola — Cisco & Sun Network

(2) Ericsson — Microsoft Co., ltd.

(3) Nokia — Newbridge alliance

(4) Nortel Networks — Bay Networks

(5) Alcatel — Xylan

(6) Siemens — Casio company (Japan)

(7) Lucent — Ascend Network

4.6 Analysis of Mobile Commerce in Asia Pacific focusing in Thailand

4.6.1 Basic Information of Thailand Mobile Market

(http://www.aic.or.jp, 2003.)

Table 4.2. Thailand mobile subscribers (millions).

	1998	**1999**	**2000**	**2001**	**2002**
Analog	1.40	1.15	1.00	0.80	0.60
Digital	0.35	0.95	1.85	7.10	10.92
Total	1.75	2.10	2.85	7.90	11.52

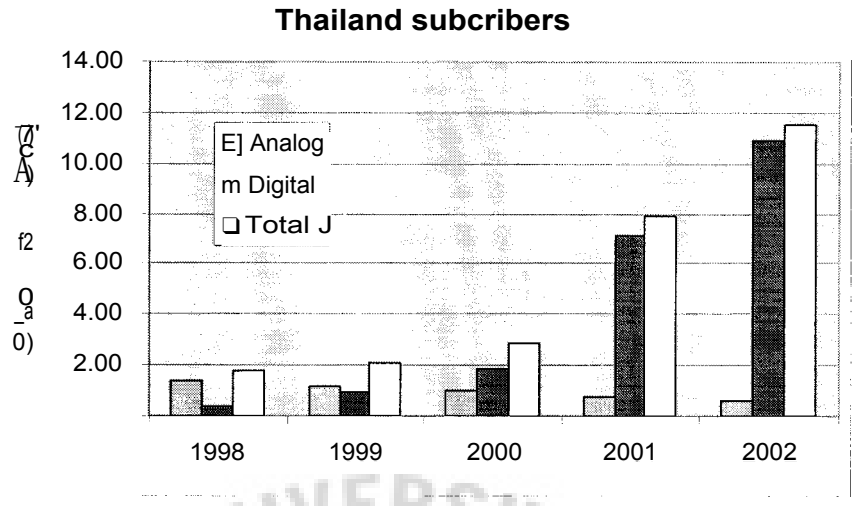

Figure 4.1. Thailand mobile subscribers.

4.6.2 Linear Regression Analysis of Trend in Thailand Mobile Market

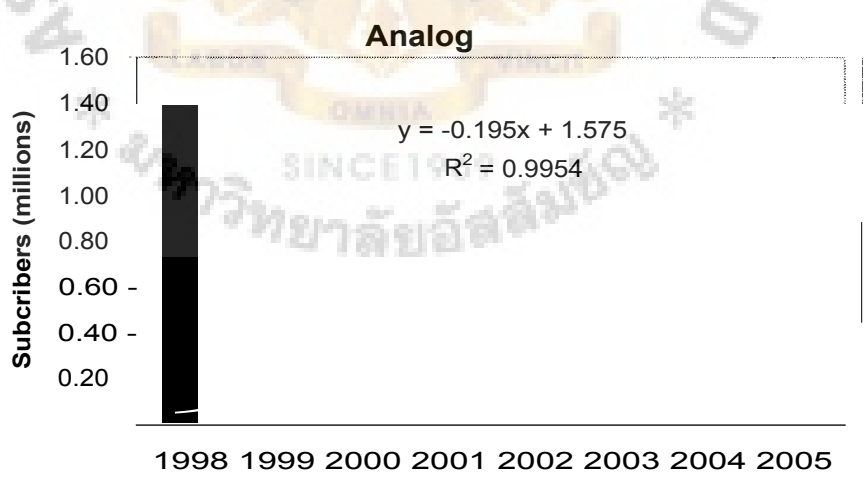

Figure 4.2. Forecast of Thailand subscribers (Analogue).

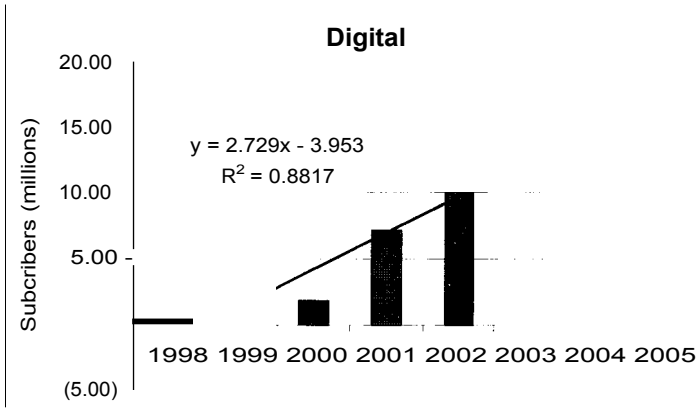

Figure 4.3. Forecast of Thailand subscribers (Digital).

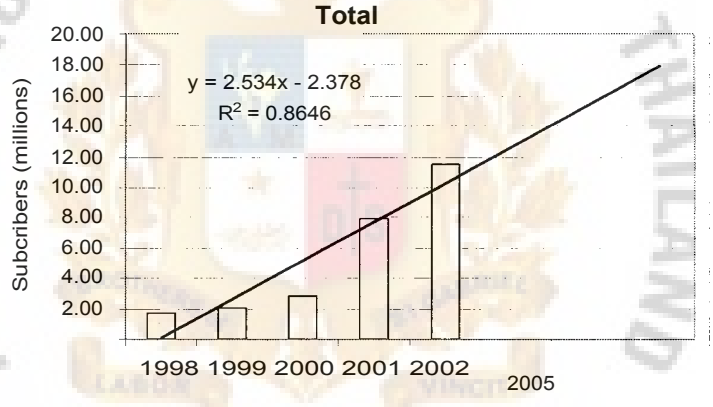

Figure 4.4. Forecast of Thailand subscribers (Total).

Table 4.3. Forecast of Thailand subscribers.

Forecast	2003		2004		2005	
	Users	Growth	Users	Growth	Users	Growth
Analogue	0.41	-32%	0.21	-65%	0.02	-97%
Digital	12.42	14%	15.15	39%	17.88	64%
Total	12.83	11%	15.36	33%	17.89	55%

4.6.3 Analysis of mobile commerce in Asia Pacific focusing in Thailand

According to the Figure 4.2, the user rate of the analogue system has been decreasing since the year 1998, compared with the result of the digital system in Figure 4.6.3, which has been increasing. This shows that the development of the telephone system has impact on the usage of subscribers. Due to the limitation the traditional telephone network has been innovated from the lower bandwidth than digital system which speed of data transmitting via mobile is higher than the analogue system.

In addition, Figure 4.3 of digital mobile phone system has increased in terms of number of subscribers in Thailand according to the bar chart data that indicated the increased of Thai subscribers. Moreover, the linear graph forecast of Thailand subscribers of digital system is going up in the next few years. The digital is slightly increasing in terms of number of subscribers since the year 1998. In the analogue system growth rate compared with the base year 2002 is decreasing on year 2003 by -32%, year 2004 by -65% and year 2005 by -97%.

The early analogue system has developed in each country for its own system, which was incompatible with everyone else's in equipment and operation. This is the limitation of the analogue system, which is limited to operation within national boundaries. In addition, the limitation of market of each type of equipment probably used in global market as a single market leads to the economies of scale and the subsequent savings could not be realized. Furthermore, the linear regression of the data tends to decrease in number of subscribers using analogue system as the higher percentage is decreasing.

The mobile data market in Asia is in the early stages of deployment with number of key technologies (General Packet Radio Service, I-Mode, and Unified Messaging) that are launched by Asian operators. Asian mobile commerce (m-commerce) will

achieve US $20 billion in revenue by 2004. Short Messaging Services (SMS) will continue to accelerate. For example, in the Philippines, text message already dominate the traffic by a factor of 8 to 1. Despite initial frustrations and disappointments of WAP applications in Asia, users believe that mobile will become a vital part of their daily lives. For example, 70 percent of Asians expect to use their handset as their primary mode for sending e-mails and getting news, and 61 percent expect these devices to become payment gateway.

Thailand has yet to become a major player in the global new economy, and now does not seem poised to be a good investment for foreign companies looking for telecommunications infrastructure. It placed dead last among 47 WECIM countries in this category. The country also does not score well in credit cards issued, connection to the Internet, or retail sales per person per year. There is encouragement coming from the educational front, where Thailand placed first in higher education enrollment, a positive sign for future economic literacy and growth. In addition, sciences and technology do seem to arouse the interest of the nations' youth. There is one consistent brisk market: mobile telecommunications are very popular in Thailand, as in most of the Asia Pacific Countries.

Moreover, the most important issue is that the total cellular phone subscribers in the early years in Thailand tend to grow in the near future. According to the year 1998, it is about 5 times lowers in the number of subscribers using cellular phones than in the year 2002. In addition, the forecast trend of the total number of cellular phone system tends to be slightly up in the next couple of years.

4.7 Analysis of Global mobile market

4.7.1 Basic Information of Global Digital Mobile Market by Systems

Table 4.4. Growth of the Global Digital Mobile Market by Systems (millions).

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CDMA	0.0	0.0	0.0	0.0	1.0	7.4	22.4	52.6	80.3	110.9	144.1	186.7
GSM	0.2	1.4	5,0	13.0	32.8	71.1	138.4	258.4	456.1	626.2	790.6	991.8
iDEN	0.0	0.0	0.0	0.0	0.3	1.4	3.1	5.1	8.2	11.1	13.6	16.5
PDC	0.0	0.0	0.5	3.3	13.9	26.8	38.1	44.8	50.8	56.8	60.1	61.8
TDMA	0.0	0.0	0.1	0.7	2.6	6.3	15.9	38.0	67.6	94.1	108.1	109.7
3GSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.7
Global Digital Mobile	0.2	1.4	5.6	17.0	50.6	113.0	217.9	398.9	663.0	899.1	1,116.7	1,369.2

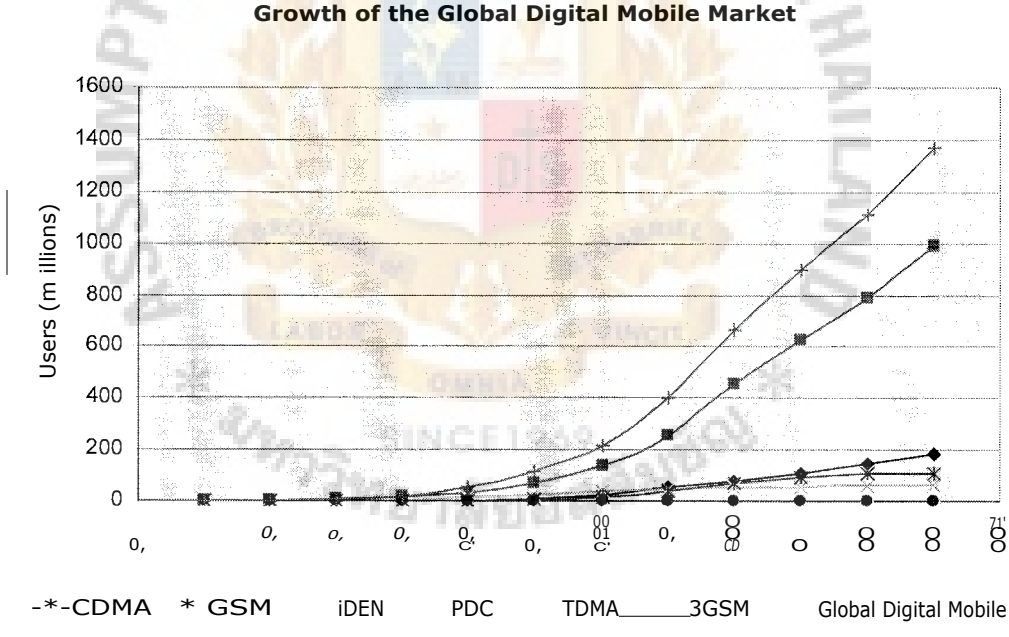

Figure 4.5. Growth of the Global Digital Mobile Market by Systems.

4.7.2 Linear Regression Analysis of Global Mobile Market by Systems

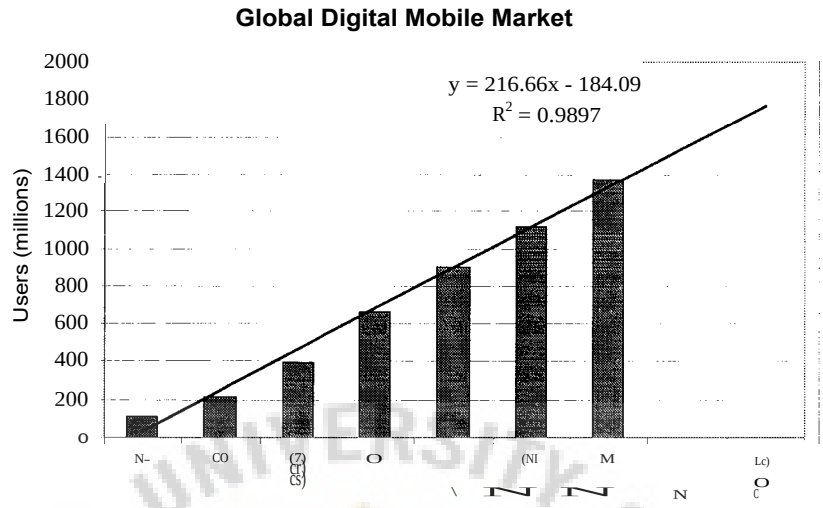

Figure 4.6. Forecast of Global Digital Mobile Market (Total).

Table 4.5. Forecast of Global Digital Mobile Market (Total).

Forecast	Users (Millions)	Growth rate
2004	1549.2	13.14%
2005	1765.8	13.99%

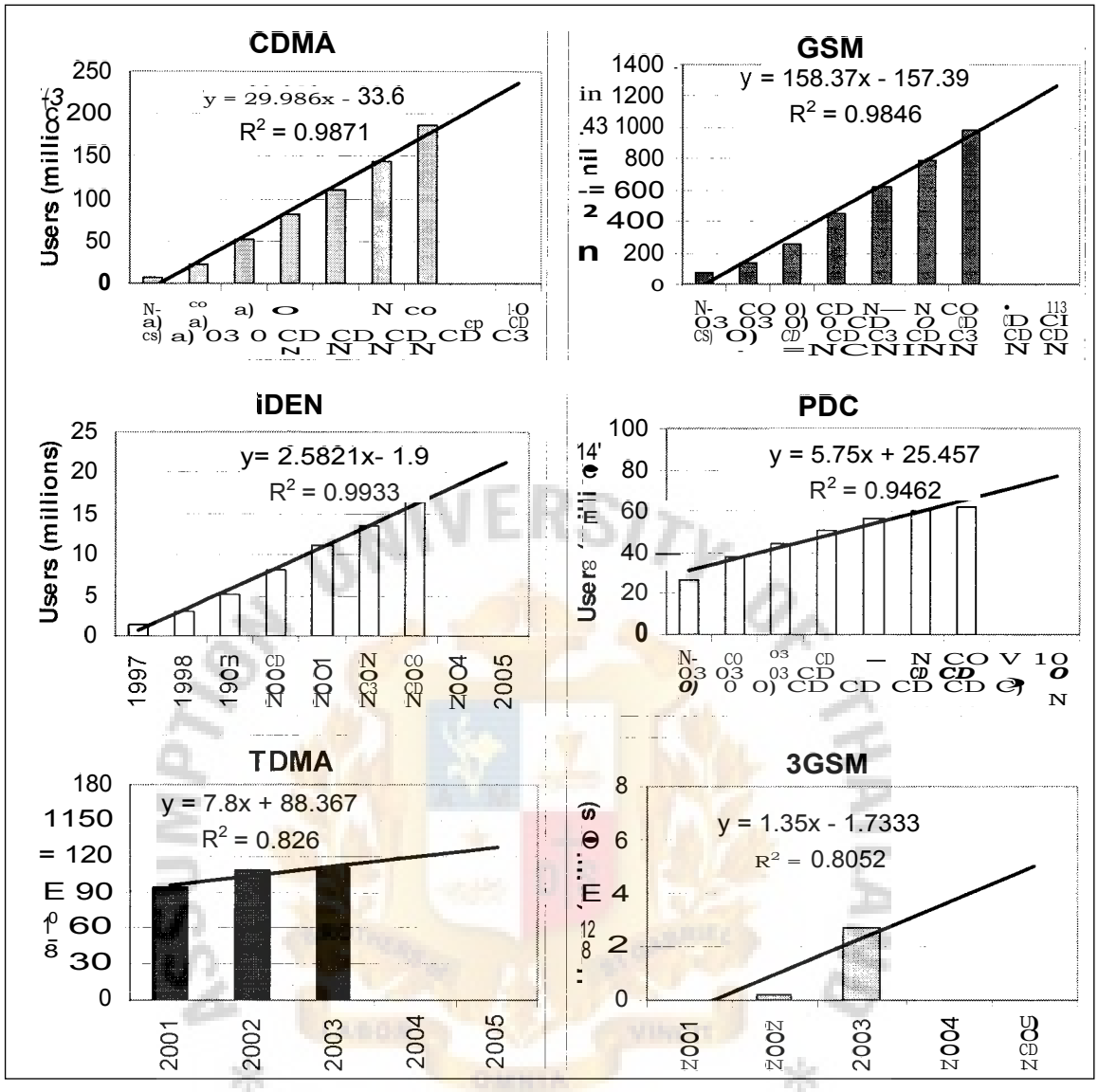

Figure 4.7. Forecast of Global Digital Mobile Market by Systems (6 systems).

Table 4.6. Forecast of Global Digital Mobile Market by Systems (6 systems).

	2004		2005	
	Users (Million)	Growth rate	Users (Million)	Growth rate
CDMA	206.3	10.49%	236.3	14.54%
GSM	1,109.6	11.87%	1,267.9	14.27%
iDEN	18.8	13.68%	21.3	13.77%
PDC	71.5	15.63%	77.2	8.05%
TDMA	119.6	8.99%	127.4	6.52%
3GSM	3.7	35.80%	5.0	36.82%

4.7.3 Basic Information of Global Digital Mobile Market by Regions

Table 4.7. Global GSM by Regions (Users: millions).

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Africa	0.50	0.89	1.62	3.00	5.60	10.20	16.20	23.70	36.10
Arab World	0.26	0.73	1.43	2.40	4.40	10.30	17.20	24.40	34.10
Asia Pacific	1.94	6.42	16.09	34.40	69.11	135.10	219.80	300.40	369.10
Central Asia	0.02	0.05	0.18	0.60	1.00	2.20	4.20	6.60	10.60
Europe	10.19	24.13	49.54	93.40	169.30	281.40	339.70	382.50	430.70
India	0.05	0.25	0.78	1.10	1.60	3.10	5.50	10.50	22.00
Latin America	0.00	0.00	0.00	0.20	0.70	1.70	3.60	7.10	21.30
North America	0.05	0.31	1.36	3.10	5.90	9.60	12.50	18.80	32.60
Russia	0.01	0.03	0.12	0.30	0.80	2.40	6.60	16.50	35.30
Global GSM Total	13.02	32.81	71.12	138.50	258.41	456.00	625.30	790.50	991.80

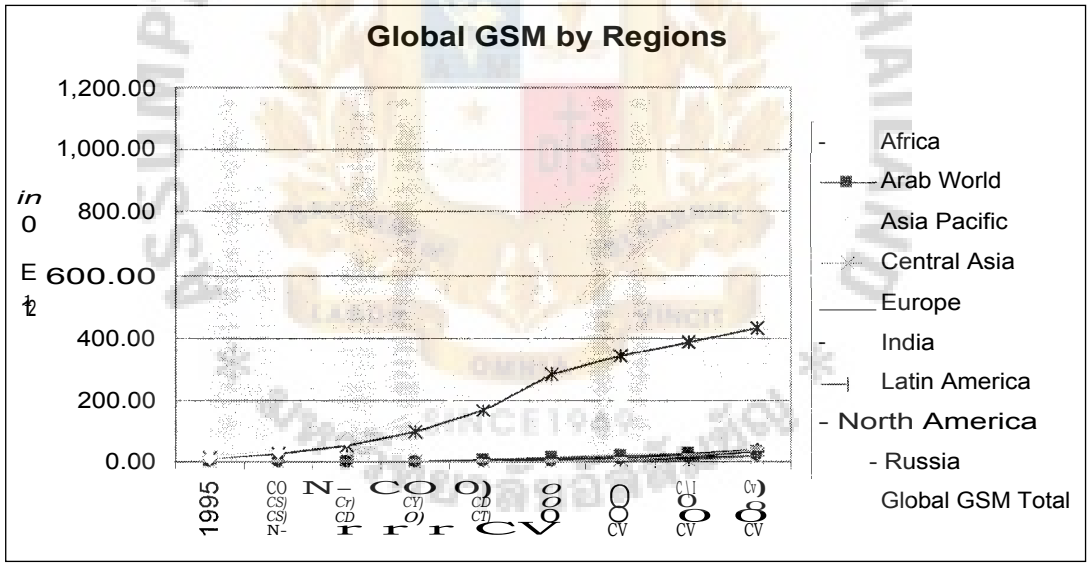

Figure 4.8. Global GSM by Regions (Users: millions).

4.7.4 Linear Regression Analysis of Global GSM by Regions

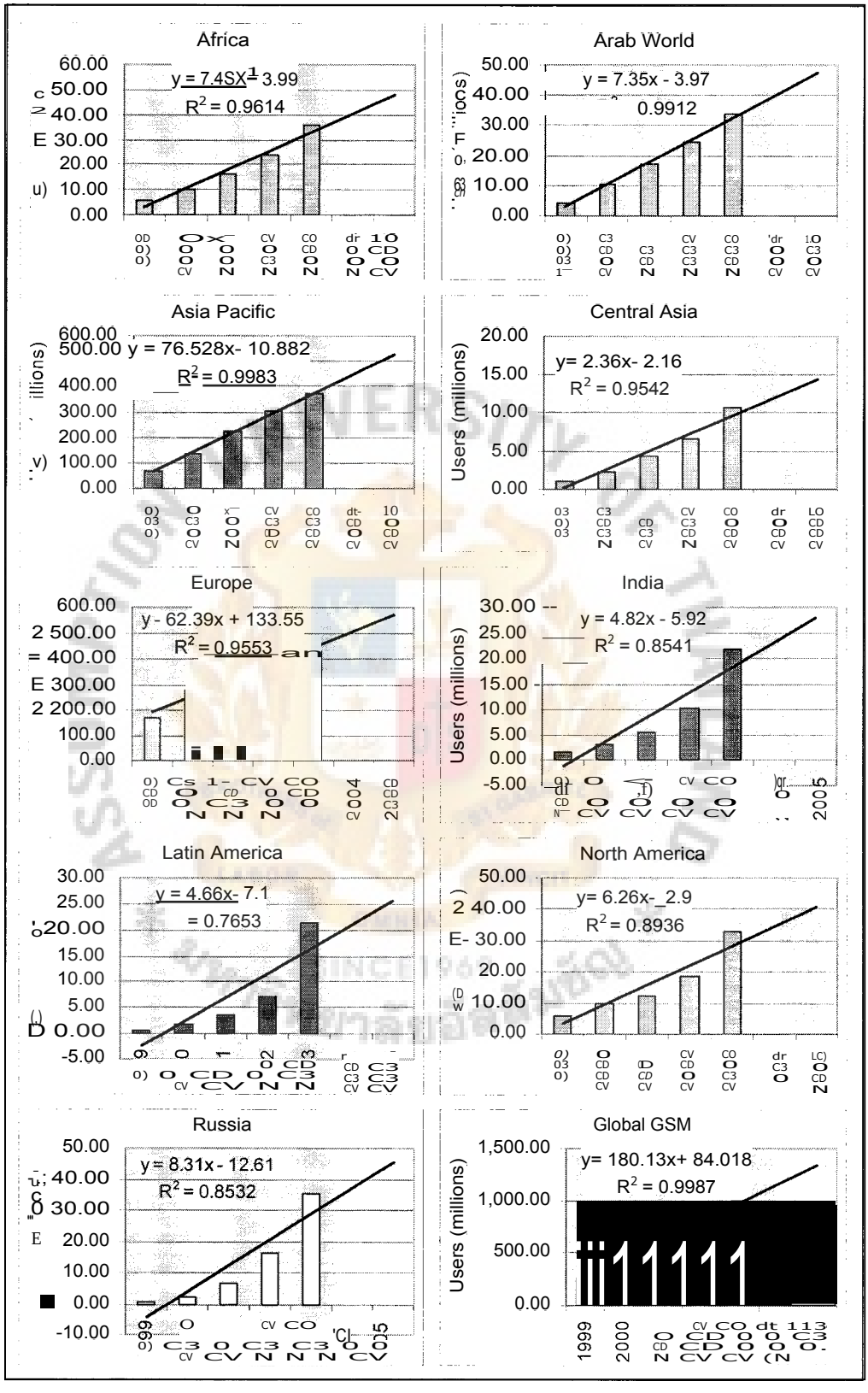

Figure 4.9. Forecast of Global GSM by Regions.

Table 4.8. Forecast of Global GSM by Regions.

	2004		2005	
	Users (Million)	Growth rate	Users (Million)	Growth rate
Africa	40.71	13%	48.16	18%
Arab World	40.13	18%	47.48	18%
Asia Pacific	448.29	21%	524.81	17%
Central Asia	12.00	13%	14.36	20%
Europe	507.89	18%	570.28	12%
India	23.00	5%	27.82	21%
Latin America	20.86	-2%	25.52	22%
North America	34.66	6%	40.92	18%
Russia	37.25	6%	45.56	22%
Global GSM Total	1,164.79	17%	1,344.91	15%

4.7.5 Analysis of Global mobile market

The analysis of Global mobile market is divided into two major parts as macro view by the mobile systems and by the regions.

For the part of global mobile market of systems (Figure 4.7), have six different systems as CDMA, GSM, iDEN, PDC, TDMA, and 3GSM. Since the year 1992, all the different systems are increasing as it launches the system to the market. The CDMA system is increasing since the year 1996 and 3GSM is increasing by number of growth in million units from the year 2002. Compared between the systems, the GSM system is growing the most since the year 1992 as it entered the market, which has less cellular systems than the present. In addition, the total of global digital mobile slightly increased from year 1992 to 1996 and rapidly increased from the year 1995.

The linear growth of others except 3GSM systems increased less compared to the 3GSM system. The forecast result of 3GSM system will reach 35.80% in the year 2004 and will reach 36.82% in the year 2005 according to the new technological development that offers more transactions and many more types of multimedia to attract the

subscribers and also the content service providers companies. It indicates that the technology developed for end users benefits such as international roaming; recently 3GSM offers the consumers daily life convenience and converge to the rapid change of technology at the present. The figure shows an important of digital mobile phone market during year 2004 that was the emergence of the 3GSM with the growth of more than 100%. Still, for the overall of the global digital mobile market increased in terms of number of users (millions). The forecast result of the global digital mobile market by linear regression is increasing in the next few years, which the growth rate of the year 2004 will be 13.14% and the year 2005 will be 13.99%.

The part of global digital mobile market by regions (Figure 4.9) is divided into nine regions as Africa, Arab World, Asia Pacific, Central Asia, Europe, India, Latin America, North America, and Russia. While the global GSM user base is initially entering the market by European market but it is increasing, by only 12.9% compared to the Asia Pacific, which is continuing the growth to 20.9% and able to close the gap on Europe as the largest GSM market. This indicates the growth of market of GSM in global and Asia Pacific in the near future. The development of technology formed by GSM and the convergence of across business sectors in many industries allows large business opportunities in mobile technology industry. As the number of new users of GSM grow by region, by year 2003 increased the most in Asian Pacific and % GSM growth by region on the year 2003 reach 215% growth is in Latin America according to the deployment of GSM networks with the TDMA technology is the fastest growing GSM market.

In addition, the number of GSM Association Membership by region as changes in the total number is positively large as 76 in the year 2003. The total overview of the

Global Mobile Digital is increasing as in the number of new users increasing in each region in percentage of the past data and continue to increase in each region.

V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Value Added Service — offering new services for the customer

The main business of Mobile Commerce is to make the most use of mobile phone system for the customer in the near future, the future wireless data market and the mobile value added services.

Including the role in the Mobile Commerce, commercial model recognizes the importance of additional services and features to the end user. It allowed for existing services such as messaging, secure corporate & mobile professional services and intended to provide for a vast new range of applications and content from a wide range of suppliers. The market entry as a Content Provider should therefore be as easy as setting up a website on the Internet for the consumer. Many of the concepts and solutions that are developed for the Internet may apply in the mobile commerce environment.

5.2 Consumer satisfaction

One of the important aspects of communication systems is the consumer satisfaction. The customer satisfaction is achieved by serving the customer when it is needed. Mobile Commerce is one of the wireless telecommunication systems, which gives useful applications to consumers. The development of the Mobile Commerce will let consumers send and receive electronic cash, electronic tickets, and electronic keys from their mobile phone.

5.3 Future wireless data market

It is expected that the early adopters of advanced data technology are managerial and professional workers. To capture this market, Operator and Supplier should need to:

(1) Target promotional campaigns at high interest professional groups.

(2) Provide solid benefits messages, such as strong messages on coverage, roaming and cost effectiveness.

(3) Make it easy for individuals to trial data services.

(4) Provide applications packages match the capabilities of the GSM network.

(5) End users will expect a high degree of integration with their existing applications.

For the mass market, Operator and its data solution partner (Suppliers) should ensure that: applications are scalable across a number of users and usage volumes in terms of both performance and management. It will be imperative to ensure that service packages are flexible enough to accommodate rapid rises in usage without creating a barrier to further growth.

5.4 Conclusion

Mobile Commerce is the new innovative idea for doing business pass through the Internet via mobile phone. It would make the business model change, even the small business. Any business must reshape their own as fast as the competitors must. Customer Relation Management is the big issue for the mobile commerce since the business model would become customer-driven. In order to satisfy customers, privacy statement is the main important issue. As this research shows, security is one of the great risks affected by this problem. Even the security is the problem. There must not necessarily be a danger but only opportunities.

Mobile Commerce is the effective delivery of electronic commerce into the consumer's hand, using wireless technology. The current generation of mobile phones is not just tools for making phone calls. On the contrary, it can used to send personal messages via SMS and to access additional services, such as weather forecasts and financial information. Among the factors spurring the increase in demand for these

mobile services are the explosive growth of the Internet and the increasing popularity of mobile terminal equipment. Another aspect is that demand is no longer limited to the `high-end' market. A growing number of customers in the mass market want to have mobile access to information services. Another benefit of the mobile devices is that they can be used anywhere in the world and at any time. In short, already major companies have begun to establish partnerships with banks, ticket agencies and top brands to take advantage of the retail outlet in the consumer's hand. The mobile phone is the optimal personal assistant for use in electronic commerce.

This means that the number of mobile services will also increase in the near future. As a result, it is expected that the current market situation in both the mobile phone and the Internet sectors would change. Customer's demands will increase in terms of both usability of mobile end-devices and number of applications. All companies in all sectors will have to adapt if they are to maintain customer loyalty. In the future, continuous availability will be the key factor in a company's factor ability to compete. The high number of mobile phone users and emerging new technologies such as WAP and GPRS open up new opportunities for mobile commerce.

5.5 Recommendations

Nowadays mobile commerce business is currently expanding and growing very fast and it is a very efficient business to invest in this type of business. There is also high demand for mobile services that encourages operator and subscribers' sector, as well as the globalization of the mobile commerce market; it attracts the business people to invest in this market. Therefore, there will be more opportunity for the newcomer business as well as the existence to stay competitive in the market. It means that mobile commerce market has large potentials for the new venture to come in. This will make the business became more sophisticated and product service shall be more innovative.

For the large advantages of this opportunity, the new technology and the telecommunication systems should develop the same conformity. This offers a large market for the mobile operators to capture the larger markets. This would lead to the rapid growth in the mobile market.

This will have a positive and negative effect on this. For the positive effect, there will be more facilities for the consumer as every company compete each other, thereby it will provide the most benefits to their consumers in order to stay competitive. For example, special promotion package such as monthly mobile fee paid by credit card- get reward points from the credit card. It means that the consumer can buy the mobile for a cheaper price but can get the most benefit from it. From my point of view, as I am a consumer, I think that this offer is very effective but on the other hand, it badly effects the mobile company as their market share has divided more operators. New competition helped boost lower prices and tempting offers for the consumers.

Apparently, joint venture concept can be applied to major operators in the market, beneficiary of its gaining economy of scales and saving product cost. For instance, it can see that Thailand market is one of the dynamic mobile commerce markets; currently the TOT-CAT joint venture is one of the examples.

In addition, mobile commerce market encourages the cross business sectors to be a joint venture in order to capture more market segments of their business opportunities. Existing the service providers may need innovative products for retaining the market shares. For example, a mobile operator has been installed in some models of the Mercedes Benz. It offers convenient and safety while driving the car hand free. The driver can talk through the speaker or the car-wheel. The mobile networking has initially been installed in the car. From this point of view, this facility has high

probability to adapt to any type of cars. The middle to lower class of people would have chances to enjoy these facilities of the mobile commerce.

Furthermore, the mobile itself would be more multi-functional such as presently, the mobile has the camera added which has higher prices than the previous mobile function. However, in the future, the price would decrease adversely to their technological functions.

On the other hand, negative sides of the mobile commerce market such as the lack of uniform standards in the m-commerce value chain, is a barrier to development of the next generation market space. Standardized issues will need to be resolved to realize the full potential of mobile commerce. Since the numerous standardization bodies and standards exist internationally, the uniformity issue is a complex one to manage. As such, the security of transmitting data while commencing is one of the issues to be concerned. The development of interworking and interconnectivity arrangements, including end-to-end quality of service and security are the key issues for the telecommunications sector. Therefore, the government should be concerned by issuing laws and the regulations, which covers the mobile commerce transactions.

Overall, the mobile business is going to be a very effective and have more growth. It will be one part of daily life for both business and ordinary people. Because of the latest technology, this kind of business will always surprise the consumers with newly high innovative mobile services.

APPENDIX A

GLOSSARY OF ACRONYMS

AMR	Adaptive Muti-Rate
API	Application Programming Interface
BER	Bit error rates
BRAN	Broadband Radio Access Network
BSC	Base Site Controller
BSS	Base Station Subsystem
BTS	Base Transceivers Station
CDMA	Code Division Multiple Access
EC	European Commission
ETSI	European Technical Standards Institute
EU	European Union
FDD	Frequency Division Duplex
GPRS	General Packet Radio System
GSM	Global System for Mobile communications
IN	Intelligent Network
IP	Internet Protocol
ITU	International Telecommunications Union
MexE	Mobile Execution Environment
MSC	Mobile Switching Centre
OMC	Operations and Maintenance Centre
QoS	Quality of Service
RNC	Radio Network Controller
SGSN	Serving GPRS Support Node
SIM	Subscriber Identity Module
TD-CDMA	Time Division CDMA

TDD	Time Division Duplex
UMTS	Universal Mobile Telecommunications System
UTRA	UMTS Mobile Telecommunications System
VHE	Virtual Home Environment
WAP	Wireless Application Protocol
W-CDMA	Wideband CDMA

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