Commerce without cords: An exploration and consideration of the realities and possibilities of mobile commerce in a 3G world

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Introduction

The first mobile telephones, installed in automobiles, were introduced in the late 1940s. The technology behind mobile phones has come a long way since its conception. Additionally, they have since been utilized for a myriad of applications outside the realm of simply making phone calls. Globally, these applications encompass a host of activities that already have and possibly could take shape in the American market. Imagine being able to sit on the train with your friends in a city that you have not visited before and watch movie trailers for the latest releases on your mobile phone. You and your friends decide you would like to go see one of the movies. You look up the show times at local movie theaters. Then you get directions to a movie theater that is near the train stop closest to your hotel and order tickets.

With fifteen minutes left in the train ride, one of your friends receives a video conference call from one of his clients. Bored, your other friend starts to play a game that she downloaded the day before, while you were all visiting a museum. So, you decide to listen to some new songs you downloaded while waiting for your friends to come down to breakfast that morning. Twenty minutes later, you and your friends arrive at the movie theater. You approach a ticket machine, swipe your mobile phone in front of the reader and the three tickets that you ordered while on the train are printed out. While waiting in line to get some popcorn, an alert lets you know the milk in your refrigerator back home has expired and asks you whether you want to order more. Laughing to yourself, you say no, get some popcorn and enter the theater to enjoy the movie.

All of these activities, performed with use of your mobile phone, are considered part of mobile commerce, or m-commerce. M-commerce is a business sector that has seen a large boost over the past decade. Many of the applications and services mentioned in the example above are already a reality for some mobile phone

subscribers throughout the world and others are on the horizon; however, much of these are not yet available to the American subscriber. In order to shed some light on the potential for the American market, some of the most advanced applications and services offered on today's most advanced networks will be showcased after a look at the networking technology that makes m-commerce possible. An exploration of the current state and future possibilities for America's gradually growing m-commerce field and mobile phone technology will follow. Finally, a global consideration of the future of m-commerce and mobile networks, from a global perspective, will be presented.

The progression of wireless networks

Before one can begin an exploration into the realities and possibilities of mobile commerce, a brief discussion of wireless communication networks, or radio networks, is in order. These networks provide service to mobile phone customers, enabling the distributed applications that make mobile commerce possible. Today, mobile telephone systems are cellular in nature; coverage for large geographic areas is achieved by splitting the area up into small, interconnected radio areas, or cells, that roughly resemble a honeycomb. Each cell contains a base station that has a wired connection to a mobile switching center (MSC).

Base stations act as bridges between mobile stations, mobile phones in this case, and the existing wired network, like the public switched telephone network (PSTN), or another base station. Each base station houses both a transmitter and receiver. The transmitter consists of four major components – a transducer, an oscillator, a modulator and an antenna – and is responsible for adapting electrical signals that come into the base station from the MSC into radio signals. They can then relay these radio signals to mobile stations. In a similar vein, the receiver contains four primary elements – an antenna, an oscillator, a demodulator and an amplifier. It is responsible for receiving

radio signals from mobile phones, converting these to electrical signals and transmitting these electrical signals to a MSC.

Mobile switching centers are like base station control centers. They are full-availability switches, able to connect any inlet with any outlet. They adapt the signals that are received from connected base station so that they can be switched to other base stations or to the PSTN. MSCs manage the set up, maintenance and tear down of connections that exist between a mobile phone and a host connected to the PSTN, as well as between mobile phones. They are also responsible for coordinating handoffs, or handovers, that allow mobile phones to stay connected as they move from cell to cell. Today's MSCs are processor controlled and can handle several functions besides switching such as "customer validation, call monitoring, system diagnostics, and interconnection with other cellular switches and base stations."[1]

This cellular structure is a departure from the very first mobile phone networks. The earliest networks consisted of very few high-powered transmitters, which served very large geographic areas with a severely limited number of radio channels. This meant that these networks could only serve an extremely limited number of customers, an extremely limited amount of the time. To combat this shortcoming in light of significant public interest in this technology, the cellular topology of today's networks was produced.

A cellular network structure allows for the use of two key radio channel control techniques that are crucial to the success of a network in the current ever-growing mobile phone market. In a cellular system, the same channel frequencies can be reused many times within a single geographic coverage area. Each cell is assigned its own set of radio frequencies and those cells that utilize the same frequencies are spaced far enough apart that the interference is minimized as much as possible, thus enabling a limited number of radio channels to provide coverage of a wide geographic area. This

technique of reusing frequencies within a single coverage area is known as cellular frequency reuse and is the first of the two control techniques.

No matter how well planned a mobile phone network is planned, however, it is inevitable that the network will find itself overloaded with users in this ever-increasing mobile phone market. This translates into dropped calls and blocking, especially during high traffic times. Customers are not willing to pay for this kind of service. Cell splitting, the second of the two control techniques, can help to alleviate this by gradually expanding network capacity.

Cell splitting is the technique of adding more cells with smaller coverage areas into the already established network. To accomplish this, the coverage area of an already established cell (or cells) is reduced by decreasing its power level or by lowering the height of its antenna; additional small cells are then added to fill the gaps between the shrunken cell and it's previously neighboring cells. By increasing the number of cells within a given geographic area, more radio channels are made available, thus allowing for higher network capacity.

First Generation (1G)

The first cellular mobile phone networks appeared in the 1980s and are referred to as first generation wireless telephone technology, which is abbreviated 1G. Among the many 1G networks that were deployed, there is not a single dominant standard. Some of the more prominent systems are: the Advanced Mobile Phone Service (AMPS), which was originally deployed in the United States during the early 1980s; the Total Access Communication System (TACS), which was originally introduced in the United Kingdom in 1985 and later modified for use in Japan, known as JTACS; and the Nordic Mobile Telephone (NMT), which had two different versions (NMT450 and NMT900) that were introduced in 1981 and 1986, respectfully, and were used in a number of European countries such as Denmark, Sweden, Norway and Finland.[2]

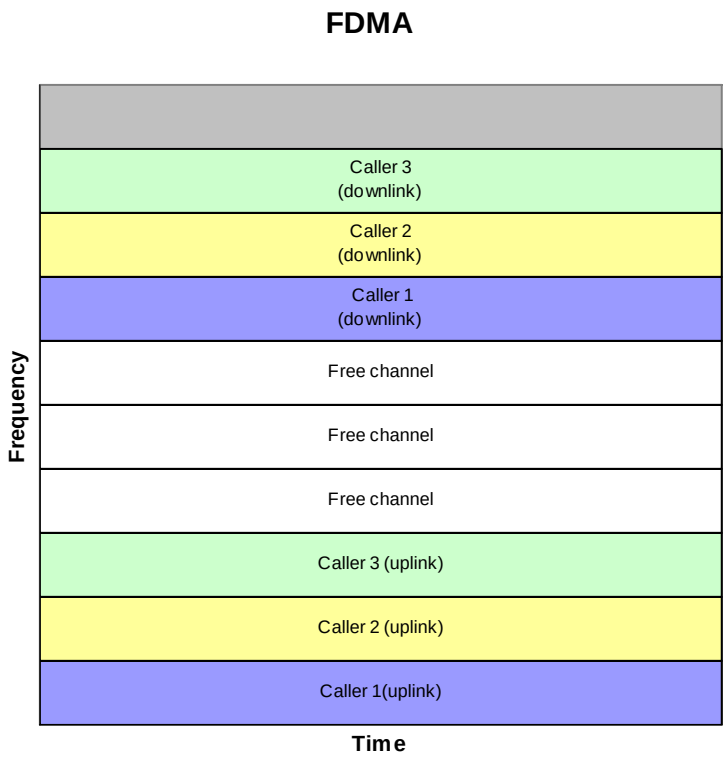

Figure 1 In FDMA, two small radio channels (one uplink and one downlink) are dedicated to each caller.

These networks are full-duplex, circuit-switched analog systems that use very narrow radio channels, varying from 10kHz to 30kHz, and frequency-division multiple access technology (FDMA). FDMA is a multiple access scheme in which each mobile station utilizes its own radio channel to communicate with the base station (see Figure 1). A radio channel is chosen each time a mobile station has an outgoing or incoming call; channel selection is controlled by the exchange of control messages between mobile stations and base stations over dedicated control radio channels. To achieve full-duplex operation, 1G networks assign both an uplink (communication from mobile station to base station) and downlink (communication from base station to mobile station) channel to each call; these channels are typically separated by 45MHz to 80MHz. 1G networks were built for voice transmission only and, while most 1G networks have been replaced or overlaid with digital alternatives, some are still in use today.

Second Generation (2G)

The late 1980s and early 1990s saw the introduction of the next generation of wireless telephone technology, the so called second generation (2G). Although 2G

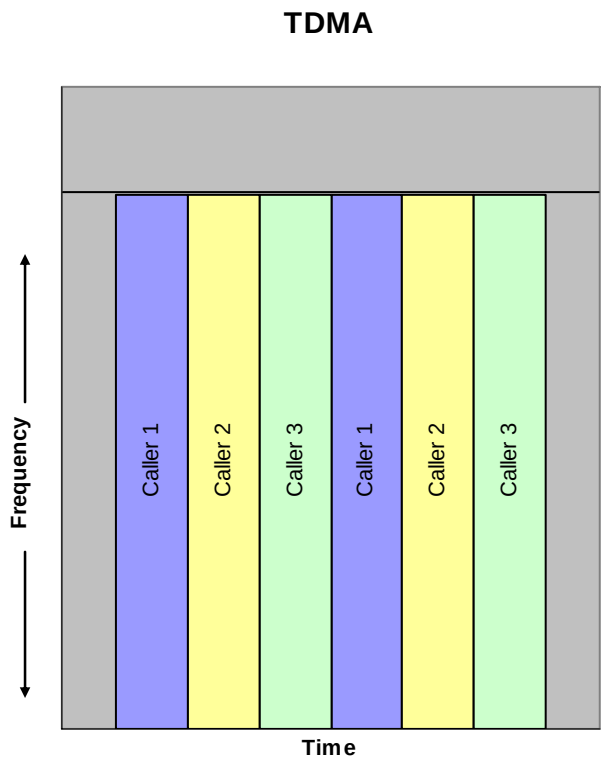

Figure 2 In TDMA, each radio channel is timeshared by a certain number of callers.

systems are still full-duplex, circuit switched networks, they differ greatly from their predecessors in that they use digital signals instead of analog. There are two different access technologies that are utilized in 2G networks – time-division multiple access (TDMA) and code-division multiple access (CDMA). Those systems that use TDMA still split a cell's available bandwidth into different radio channels, typically ranging between 30kHz and 200kHz depending on the standard, that carry signals either exclusively from the mobile station to the base station or vice versa. These channels are then time shared by the mobile stations by splitting time into frames. These frames are further partitioned into a sequence of *n* time slots, usually up to a maximum of eight per channel, and each mobile station is assigned to a time slot in the sequence. This means that each mobile station receives all of the available bandwidth of the channel during every *n*th time slot (see Figure 2).

CDMA, on the other hand, takes quite a different approach from either FDMA or TDMA, using a frequency hopping spread spectrum radio technique. In 2G systems that use CDMA, a cell's available bandwidth is split into rather large radio channels, typically 1.25MHz, and these channels are shared by all mobile stations within the cell at the

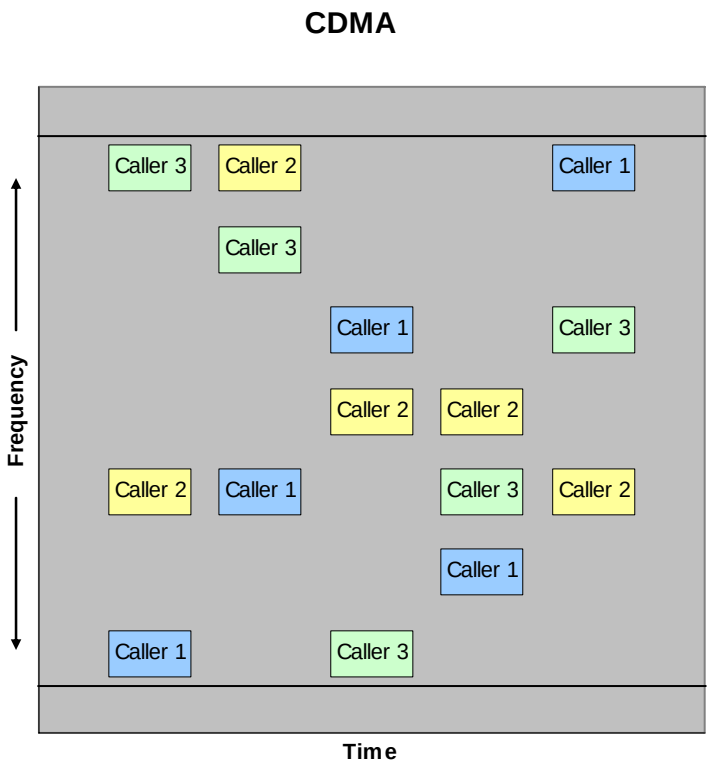

Figure 3 In CDMA, each radio channel is shared by a number of users by applying a frequency hopping spread spectrum

same time. Rather than splitting up the bandwidth into lots of small individual channels or time slots, CDMA signals are randomly spread across a channel's entire bandwidth. The mobile stations and base stations uses distinct bit-code sequences, or chipping sequences, to distinguish between each mobile station's signal within a cell. These chipping sequences are allocated to the mobile stations by the cell's base station (see Figure 3). Because different signals are distinguished by code sequences instead of by specified frequency allocation, there is less frequency interference at the receivers and frequency reuse can happen at much closer distances than with systems based in FDMA and TDMA. It also allows for higher data rates than are realized on FDMA and TDMA systems.

When it comes to 2G systems, there are four main standards. These include: IS-54/IS-136, otherwise known as digital AMPS (DAMPS), which was introduced in North American in the early 1990s and uses TDMA frequency allocation; Personal Digital Cellular (PDC), which was first deployed in Japan in 1993 and utilizes TDMA; IS-95, also known as cdmaOne, a CDMA system whose first commercial service was launched in 1995 in Hong Kong; and the Global System for Mobile Communication (GSM), an open

standard utilizing TDMA that saw the launch of its first commercial network in 1991. GSM is arguably one of the most successful 2G systems and perhaps the most popular mobile phone standard in the world, with an estimated 75% of worldwide digital mobile telephone users subscribed to a GSM service and a worldwide user base of almost 1.37 billion at the end of the first quarter of 2005.[3]

Despite the fact that they utilize digital signals and different access technologies, 2G systems, like their 1G predecessors, are still optimized for carrying voice transmission; however, they do offer some data transmission options that gave them two other advantages over 1G systems. The first advantage is the ability of a digital mobile telephone to validate its identity more securely than its analog counterpart through a process known as authentication. The second of these advantages was the ability, on some standards, to support data transmission for short message service (SMS), more popularly known as text messaging or texts. This ability allowed the mobile telephone to be seen as more than just a device to make phone calls for the first time. Both of these advantages were an important first step into the use of mobile phones as tools of commerce, an idea that would be taken to the next level in the new generation of mobile telephone technology, the third generation (3G).

Third Generation (3G) Technology and Standards

Unlike their forerunners, 3G systems have been developed in order to handle both voice and data transmission. Like 2G networks, 3G networks are full-duplex, digital systems; however, 3G networks are based on packet-switching technology. Because of the on-demand nature of resource use in a packet-switched network, 3G networks are able to handle non-voice wireless transmission, such as image, video and data transfer, in addition to voice transmission and all at much faster rates than their 2G counterparts. This quality alone makes 3G networks an attractive breeding ground for the development of many kinds of m-commerce applications.

Before exploring these applications though, having a basic understanding of the technology and standards behind these enabling networks is important. The International Telecommunications Union (ITU), through their International Mobile Telecommunicatins-2000 (IMT-2000), called for a worldwide standard for mobile telecommunications that supports “high-speed data transmission, Internet Protocol-based services, global roaming and multimedia communications.”[4] Out of all the proposals that came forth from IMT-2000, three standards have taken center stage.

Universal Mobile Telecommunication System (UMTS)

UMTS is the 3G standard that has been proposed and advanced by both European and Asian countries. The development of this standard is currently overseen by the Third Generation Partnership Project (3GPP) whose principal membership is composed of standards agencies from many European countries as well as from Korea, China and Japan. The 3GPP also oversees the development of the GSM standard; the UMTS standard is designed to succeed GSM. Because of this, UMTS has gained much popularity among those countries that have already deployed GSM networks.

The UMTS standard is based on an access technology known as wideband code division multiple access (WCDMA), which was originally developed by the Japanese company NTT DoCoMo for their Freedom of Mobile Multimedia Access (FOMA) system. WCDMA uses a spread spectrum technology that is similar to that used in IS-95, except that the signal is spread over much wider radio channels. Typically, the network utilizes a pair of channels, each 5MHz, one for uplink and one for downlink; the uplink channel usually in the 1900MHz range and the downlink in the 2100 MHz range. The specific technology that is used in WCDMA is a direct sequence spread spectrum technique. In this technique, the original data is multiplied by a binary pseudorandom spreading code, or spreading sequence, of a much wider frequency than the original data. In this way,

the original signal is converted into a signal that has a frequency range as wide as the spreading sequence, yet still carries the data of the original sequence.[5]

UMTS networks are able to achieve very high data transfer rates, with most real-life networks offering rates of about 384kbps, out of conceptual rates on the order of almost 2Mbps. These rates have made it possible, for the first time, to provide practical and inexpensive access to the World Wide Web on mobile telephones where all mobile stations can be active all the time, providing an ideal environment for a host of new m-commerce applications and services. UMTS has enjoyed several real world implementations, including but not limited to networks in Australia, Austria, Denmark, Hong Kong, Israel, Italy, Japan, Portugal, the Republic of Ireland, Sweden and the United Kingdom. In the United States, AT&T Wireless successfully launched UMTS networks in six major cities – Seattle, San Francisco, Detroit, Phoenix, San Diego and Dallas – under an agreement that it signed with NTT DoCoMo, before AT&T became part of Cingular.[6] The fact that UMTS already has networks placed around the world and that each of these networks can interoperate means that UMTS is poised to allow for global roaming capabilities, if the operators can make commercial agreements.

Code Division Multiple Access 2000 Evolution (CDMA2000 1xEV)

CDMA2000 encompasses a family of standards that are the true successor to the CDMAone, or IS-95, networks. The main premise of the CDMA2000 1xEV is to provide backward compatibility with the existing IS-95 networks that they are to overlay, while still offering 3G level high data transfer rates. There are primarily two phases in the deployment of CDMA2000 1xEV. The first of these is CDMA2000 1xEV-DO, or Evolution-Data Optimized. CDMA2000 1xEV-DO, like its predecessors, utilizes a frequency hopping spread spectrum radio technique with two radio channels, one for uplink and one for downlink. In CDMA2000 terminology, the downlink is known as the forward link and the uplink as the reverse link. These two channels are each 1.25MHz

and are coupled with an existing voice structure, which is why this is known as Evolution-Data Optimized. Thus the two channels carry only packet data and are able conceptually to reach transfer rates of 3.1Mbps on the forward link an 1.8Mbps on the reverse link.

The second phase of CDMA2000 1xEV is known as CDMA 2000 1xEV-DV, or Evolution-Data and Voice. As the name implies, these networks will be able to carry voice and data on the same channels. More specifically they will be able to carry older standard voice and data signals as well as the new high speed 1xEV-DV data on the same radio channel while still providing the same data transfer rates of 1xEV-DO. In general, CDMA2000 1xEV has seen very few real world implementations, none of which are based on CDMA2000 1xEV-DV. The most notable implementations have been the one by the Japanese carrier KDDI, which began its launch in November of 2003 under the name CDMA 1X WIN, and the one by American carrier Verizon Wireless, which is marketed under the name Ev-DO and was launched in 2004 and provides coverage in about 30 cities nationwide.[7] [8] Despite the lack of deployments thus far, CDMA2000 1xEV stands to make a large impact in the near future as it is specifically designed to make an easy transition from the CDMAone networks that are prevalent in the United States and Canada.

Time Division Synchronous Code Division Multiple Access (TD-SCDMA)

TD-SCDMA, created by the China Academy of Telecommunication Technology, is the last of the primary 3G standards. As the name implies, this scheme utilizes both time division and code division multiple access techniques. TD-SCDMA breaks time on each radio channel in a cell into 5ms time frames. Each of these frames is then split into seven normal time slots, 675μs in duration, and three control slots. The normal time slots are then allocated to either uplink or downlink activity. Time slot 0 is always

assigned to the downlink and time slot 1 to the uplink; however, the other five normal slots – time slots 2 through 6 – can be allocated to either.

This allocation is based on what type of signal needs to be processed: "symmetrically for services such as speech or asymmetrically for data services where the bit rates in the two different directions of transmission may differ significantly."[9] Each time slot is then shared by up to sixteen mobile stations with each signal being distinguished by spreading codes, or spreading sequences, using code division multiple access technology. The best advantage of this standard is that it can utilize narrower radio channels than its other 3G counterparts. While it has many proponents in China and is planned for deployment in 2005 after field testing, TD-SCDMA will most likely remain exclusively in China, leaving WCDMA and CDMA2000 1xEV to battle it out in the global arena.[10]

3G Superstars of m-Commerce

The significantly increased data rates that are possible on 3G networks have opened the door for many new and improved applications. Those applications associated with mobile commerce arguably stand to gain the most from the 3G movement. M-commerce, generally defined as the conducting of business communication and transactions over networks via a mobile telephone, encompasses three broad groups of applications. The first set are composed of transaction management applications include online shopping that is adapted for use on mobile devices, micro transactions, ticketing and digital cash. The second group of applications is associated with digital content delivery. This group of applications is many and varied including downloading software like games, transferring of images or videos, multimedia applications and information browsing or mobile internet usage.

The last group of applications focuses on telemetry services. This group includes activities such as: "transmission of status, sensing and measurement

information; communications with various devices from homes, offices or in the field and activation of remote recording devices or service systems."[11] Out of the three groups, telemetry services are the newest form of m-commerce and though it is currently a small section of the market, the number of services that fall under this heading is growing. While it can offer many of the same applications as fixed terminal electronic commerce, m-commerce is unique because its applications and services can be location-based and in real time. Forms of m-commerce exist on both 2G and 3G networks with a variety of services being offered by carriers around the world; however, this paper will now explore the realities of m-commerce today by spotlighting some of the most mature applications and services available on the most advanced mobile networks in the world.

NTT DoCoMo

The mobile phone market in Japan, perhaps more than in any other country, has enjoyed a great deal of growth and success. Consequently, Japan is home to many of the most advanced mobile radio networks and the most extensive array of m-commerce applications and services. According to the Bureau of Statistics for the Japanese Ministry of Internal Affairs and Communications, the number of mobile phone subscribers overtook the number of fixed phone subscribers in the year 2000 and the gap has been growing ever since.[12] Currently, there are about 87.7 million mobile phone subscribers in Japan, which is about 63% of the country's population, and about 86% of those subscribers "use their handsets to exchange e-mail and gain access to information on the Internet in their everyday lives."[13]

The Japanese carrier NTT DoCoMo, with its host of innovative applications and services and commitment to continued research and development, is a world leader in the mobile phone market and the m-commerce arena. The company pioneered 3G technology and launched the first commercial 3G network in the world, which they call FOMA, in October 2001. FOMA is based on the principles of WCDMA and is able to

achieve actual data transfer rates of 64kbps to 384kbps. Utilizing asynchronous transfer mode (ATM) network protocol, FOMA is able to support symmetric and asymmetric data services by independently managing the characteristics of the uplink and downlink connections. Besides providing flexible connection options, ATM supports both point-to-point and point-to-multipoint connections.[14]

Roughly two and a half years prior to the launch of its 3G network, on February 22, 1999, NTT DoCoMo deployed its Internet service, known as i-mode. The i-mode service, with its plethora of varied content, is known worldwide and has played a large part in NTT DoCoMo's success in the mobile phone market. Unlike the typical Wireless Application Protocol (WAP) stack that is used by the majority of wireless service providers today, i-mode utilizes a proprietary set of protocols. Most notably, i-mode's application programming language differs from the more commonly used Wireless Markup Language (WML). This language is known as iHTML, which is a subset of HTML, and as a subset of HTML, it is easy to convert previously programmed HTML content into content suitable for i-mode – either manually or with conversion software. In addition, i-mode also supports Java-based applications, which are becoming increasingly prevalent on the Internet.

As of June 2005, there were more than 92,000 Internet sites available through i-mode, all of which were especially designed for the service, and there were approximately 44 million i-mode subscribers in Japan. A large amount of applications and services are offered through i-mode, including games, news, database services such as restaurant guides, product sales, credit card information, money transfers, videos, email, text messaging and much more. NTT DoCoMo's newest, most innovative and perhaps most exciting use of i-mode to date, however, is the i-mode FeliCa service, which is sometimes referred to as the Mobile Wallet program. This service, which NTT DoCoMo markets as a way to "make your wallet more slim", represents a combination of

the i-mode network with Sony's contactless integrated chip (IC) smart card technology, FeliCa.

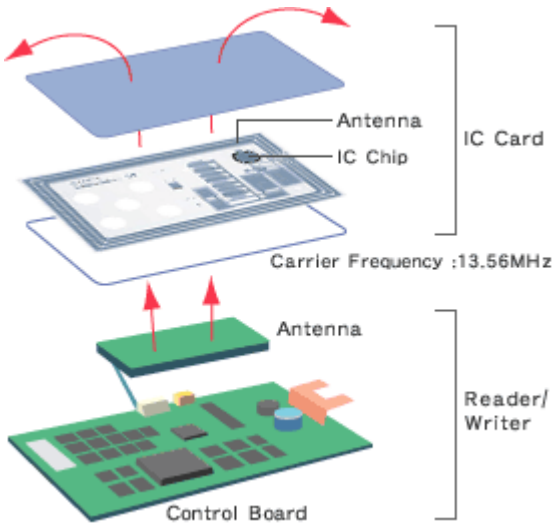

Figure 4 Sony FeliCa's IC card and reader/writer system.

Source: "FeliCa." *Sony Global*. 22 December 2004. 12 August 2005. <http://www.sony.net/Products/felica/index.html>

FeliCa cards allow for fast and secure contactless communication with a compatible reader/writer. The card, which consists of an IC and an antenna, is activated and powered by electromagnetic waves that radiate from a powered reader/writer (see Figure 4). A card and a reader/writer communicate over a standard carrier frequency of 13.56MHz and have data transfer rates of 212kbps. FeliCa provides a high level of transaction security by utilizing dynamically generated encryption keys, mutual authentication between chip and reader/writer and by keeping transaction speed high; most transactions are completed within 0.1 second.

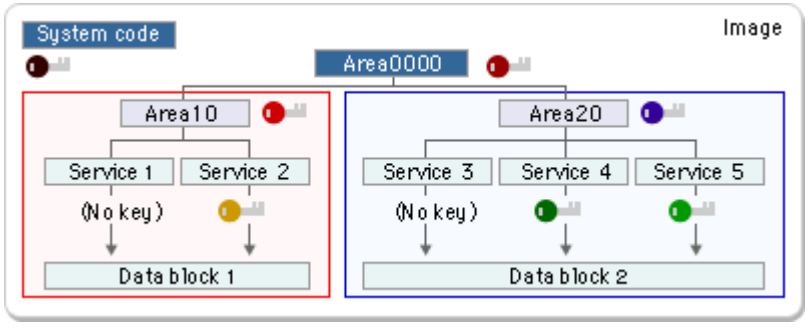

Figure 5 Sony FeliCa's IC card and file system.
Source: "FeliCa." *Sony Global*. 22 December 2004. 12 August 2005. <http://www.sony.net/Products/felica/index.html>.

Another important feature is the ability of FeliCa to manage several data sets on the same card, allowing the card to be used for multiple types of transactions for multiple purposes. The card's file system is managed in a tree structure using "Areas",

which are similar to folders, and “Services”, which define a method to access data entities (see Figure 5). “Access keys serve as application firewalls that prevent unauthorized access to the services of other providers. By organizing these keys in a specific manner, authentication can be done for multiple services at once.”[15]

The integration of this technology with the pre-existing i-mode network has allowed NTT DoCoMo to offer a variety of new m-commerce services, which can be broken down into five broad categories. By storing e-money in an account using i-mode and the Edy e-money application, users can pay for merchandise at a vending machine or store by swiping their mobile phone across the reader/writer. Users can check their account balance and transaction history at any time using the mobile phone. i-mode FeliCa enabled handsets can also be used for ticketing purposes in both the transportation and entertainment arenas. To accomplish this, an e-ticket, purchased using i-mode, is stored on the IC card and then the handset is swiped across a reader/writer to check-in or pass through a gate. Currently, this type of application is utilized by airlines, railways, ticketing agencies and movie theater chains.

The third category of services that is presently available with i-mode FeliCa is use of the mobile phone as a set of membership or point cards. By swiping their handset, users can do things like accumulate points or receive discounts when purchasing merchandise or services at participating vendors. Users can sign up for membership subscriptions as well as manage subscriptions, including activities such as checking point balances and promotions, through the mobile phone. i-mode FeliCa enabled mobile phones are also utilized as keys/ID cards, enabling the locking and unlocking of doors through the handsets and reader/writers. Far from a simple key, this application of i-mode FeliCa provides an array of physical management tools. A user “can issue a spare key by email, receive a notice when someone enters [his]…home, and check door status from a remote location.”

The final category of services currently provided by NTT DoCoMo combines i-mode FeliCa with one of the most popular devices to be incorporated into a mobile phone, a camera. This category focuses on allowing users to instantly purchase products that they find in catalogues and magazines. The handset's camera can read QR codes that can be found in the catalogues and magazines. The user can then use the code that has been extracted, or a manually entered code, to order the item online through i-mode. Items can be paid for using Edy e-money or a previously approved credit card service such as those available from Sony Finance International, Inc.[16] While it is evident that NTT DoCoMo has made and will continue to make advances in all areas of m-commerce, other companies have also made significant inroads in specific sectors of the m-commerce market.

KDDI

While NTT DoCoMo dominates the mobile phone market in Japan, Japanese carrier KDDI runs a close second. As stated earlier, KDDI launched its 3G network, CDMA 1X WIN based on the CDMA2000 1xEV-DO standard, in November 2003. Although their m-commerce offerings do not come close to meeting the sheer numbers of their local competitor, KDDI has made some great developments in the areas of digital content delivery and telemetry services. November 19, 2004 saw the launch of KDDI's EZ Chaku-uta Full service, the first music distribution service of its kind in the world.

EZ Chaku-uta Full allows users to download an artist's song in its entirety, achieving transfer rates of 2.4Mbps. Users can currently select to download songs from a selection of about 10,000 from seven Chaku-uta Full-supporting websites. Music that has been downloaded can then be played through the mobile phone's stereo speakers or a set of attached headphones. A user can search the database of songs available for download manually though KDDI's EZ Music! music portal site or can automatically search for a song that is currently playing on the carrier's EZ FM radio service through

its EZ FM On-Air Check application. Handsets with better quality stereo speakers and larger capacity data folders have been are being developed in order to help users take maximum advantage of this service.[17] EZ Chaku-uta Full has proven to be very popular; on January 5, 2005, less than two months after the service's launch, the Chaku-uta Full service reached its 1 millionth download.[18]

Far from being narrowly focused on its success in the field of digital content delivery, KDDI has also made significant advances in telemetry services with the introduction of their EZ NaviWalk service on January 2004. EZ NaviWalk is a personal navigation service, similar to those navigation systems found in cars, that uses a global positioning system (GPS) to provide a number of functions that are designed for use by pedestrians. The functions provided by this service are varied. At its most basic level, it can be used to display maps of a specified area. Combined with KDDI's databases of points of interest such as restaurants, movie theaters, shops, parks and cultural sites, EZ NaviWalk can provide a map with an overlaid route from a user's point on the map (located using GPS) to the destination chosen from the database by the user. This map updates as the user moves along the displayed path toward the chosen destination. Other functions that are provided by the service include traffic information and local public transportation information such as schedules and commuter alerts. There are also projects being developed to use EZ NaviWalk, and other similar services that have been introduced since, to help tourists plan pedestrian and bicycle tours that would help them to visit personal points of interest while taking into account their unique restraints such as time restrictions.[19]

M-commerce in America

While it is easy to see that many advances have been made in m-commerce since the introduction of 3G mobile radio networks, America has unfortunately lagged behind some other industrialized nations when it comes to deployment of 3G networks

and innovative m-commerce applications. Mobile phone use finally surpassed fixed line use in the US at the end of 2004; the margin was not very large. The US Federal Communications Commission reports that by the end of 2004 there were roughly 181.1 million mobile telephone service subscriptions as compared to 178 million fixed line subscriptions.[20] Despite the fact that mobile phones seem to be gaining in popularity, the network technology has not kept pace. There are currently only six mobile carriers in the US that offer 3G networks – Verizon Wireless, Alaska Communications Systems, Cingular, Alltel, Midwest Wireless and Sprint.

All of the networks, with the exception of the UMTS-based system offered by Cingular, are based on the CDMA2000 1xEV-DO standard. Additionally, these networks are not yet deployed on a nationwide scale; instead, the networks have only been installed in very few major metropolitan areas. At present, most networks in America use what has become known as 2.5G and 2.75G technology. These technologies utilize packet-switching for non-voice data services to some extent. Most of these networks overlay the packet-switching domain on top of an existing 2G system, which is still used to carry the voice data in a 2.5G or 2.75G network. Offering rates of around 100kbps, these networks do offer increased data transfer rates over 2G networks but not on the order of those found in 3G networks. [21] [22] [23]

The lack of 3G network penetration in the American mobile phone market has also spelled the slow development of m-commerce. The range of m-commerce applications and services available from US carriers is severely limited. The use of SMS makes up the largest chunk of monthly consumption of mobile phone content and applications, followed by use of email and retrieving news and other information via a mobile web service (see Figure 6).[24] The m-commerce applications and services that are currently available in America are still in their infancy when compared to the offerings of other 3G carriers and are limited mostly to the area of digital content delivery.

US Mobile Subscriber Monthly Consumption of Content and Applications

Activity	Projected Monthly Reach (Thousands)	Percent US Mobile Subscribers	Change from Previous Survey
Sent or Received Text Message	67,479	37.28%	3.2%
Retrieved News and Information via Browser	22,828	12.61%	-2.1%
Used Personal E-mail	19,849	10.97%	14.2%
Downloaded Ringtone	17,301	9.56%	*
Used Photo Messaging	16,973	9.36%	19.7%
Used Mobile Instant Messenger	16,143	8.91%	12.4%
Used Work E-mail	9,643	5.33%	7.9%
Purchased Wallpaper or Screensaver	6,577	3.63%	*
Downloaded Mobile Game	5,954	3.29%	-0.6%

Figure 6 Results of a survey of US mobile subscribers for June of 2005 by M:Metrics. (n=40,110)

* Due to a change in definitions on the survey, historical ringtone and graphics data is not noted, and the n=13,792 for the ringtone and wallpaper/screensaver purchases. Source: M:Metrics. "What your carrier says about you: benchmark survey shows that mobile carriers are distinct in demographic make-up and content consumption." Seattle, Washington: 25 July 2005. 13 August 2005. <http://www.mmetrics.com/press/PressRelease.aspx?article=20050725-carriers>.

Some of the more notable contributions have been made by Sprint and Verizon Wireless. Sprint's PCS Vision service was launched on August 12, 2002, significantly ahead of the launch of their 3G network on July 7, 2005. Currently, PCS Vision provides users with access to three areas of functionality, many of which were not available at launch. Users are able to retrieve news, sports and weather in the form of both web pages and short video clips. It also provides users with communication functions including text messaging, email, picture and video mail, instant messaging and chatting. The last area of functionality offered by PCS Vision is the ability to download games, wallpaper and ringtones directly to a mobile phone.[25] [26]

Verizon Wireless offers a similar range of functionality with their V CAST and Get It Now! services, which they launched in February 2005. While it does offer video clips of news, sports and weather segments like PCS Vision, V CAST also makes regularly-updated streaming video clips of music videos, movie trailers, stand-up comedy routines,

celebrity interviews and videos based on popular television programming, even children's programming available to users. In addition, the games that are available from the Get It Now! service include a selection of games with 3D graphics and famous names from the video game industry. Although the offerings that are available through Verizon Wireless's V CAST and Get It Now! services are very similar to those offered from PCS Vision, they have decidedly stronger focus on the mainstream entertainment industry.[27] [28]

It is easy to see from this look at the best that America has to offer and the previous look at the most advanced applications and services available in today's 3G mobile market that the American m-commerce field has a lot of room for growth. The ability to implement more advanced services similar to those that are already offered by NTT DoCoMo and KDDI will grow as more 3G networks are installed throughout the US. The questions really becomes whether or not American carriers will move out of the area of digital content delivery. In order for the operators to break out of this area, users will have to show a greater interest than they currently do in the services and applications that have already been deployed. Considering the already substantial success of online shopping through personal computer and laptops in America, it is likely that the next set of services and applications that US carriers will tackle will be in the area of transaction management.

An eye on the future

While mobile phone technology and m-commerce struggle through development in America, these fields march along the path of advancement at a global level. There are several companies that are already pioneering development of fourth generation (4G) mobile radio network technologies. The aim of 4G technology is to produce much higher data transfer rates and flexible, pervasive networks. Many developers hope that a worldwide standard can be reached to increase interoperability among mobile radio

networks, and perhaps other types of networks such as wireless LANs, and allow for truly global roaming.[29] One of the technologies currently under development by NTT DoCoMo is known as Variable Spreading Factor-Orthogonal Frequency and Code Division Multiplexing (VSF-OFCDM), which promises incomparable transmission rates of 100Mbps outdoors and 1Gbps indoors. Perhaps farther in the future, mobile stations will be ale to interconnect directly, eliminating the need for many base stations.[30]

When considering the future of mobile commerce, there are two key areas that are likely to see a lot of growth – transaction management applications and telemetry services. What better way to look at the upcoming possibilities of m-commerce than through the eyes of a world leader. NTT DoCoMo imagines an interconnect world where a mobile phone proves to be a useful lifestyle tool rather than a machine that allows you to make phone calls without a landline. The company hopes to usher in an era of truly ubiquitous communications. They have plans to increase the number of business tools available through their service, including video conferencing and remote access to company databases and other networked resources. NTT DoCoMo provides this glimpse into the future that they imagine:

> "On the way home from work, customers will connect to home automation systems and turn on appliances such as lights and air conditioners, or control their home security systems by displaying security monitor images on their cellular terminal displays. Users will check the contents of their refrigerators and the expiration dates of products on the shelves and order supplies as well as pay for them with electronic wallets. In their leisure hours, they will watch concerts or sports events in real time, download favorite movies and games, or enrich outdoor field trips by checking a rare plant or bird against photographs in an electronic encyclopedia."[31]

From this ambitious vision alone, the continued existence, growth and success of mobile telephone technology and m-commerce are apparent. There truly are many innovations yet to come.

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