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Rym E. Méliane
AUTEUR DE LA THÈSE / AUTHOR OF THESIS

M.Sc. (Systems Science)
GRADE / DEGREE

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FACULTÉ, ÉCOLE, DÉPARTEMENT / FACULTY, SCHOOL, DEPARTMENT

North American M-Commerce Adoption
Impact of the Technological Environment : A Comparative Analysis to Western Europe and Japan

TITRE DE LA THÈSE / TITLE OF THESIS

Dominique Ferrand
DIRECTEUR (DIRECTRICE) DE LA THÈSE / THESIS SUPERVISOR

CO-DIRECTEUR (CO-DIRECTRICE) DE LA THÈSE / THESIS CO-SUPERVISOR

EXAMINATEURS (EXAMINATRICES) DE LA THÈSE / THESIS EXAMINERS

A. El Saddik

Liam Peyton

Gary W. Slater
LE DOYEN DE LA FACULTÉ DES ÉTUDES SUPÉRIEURES ET POSTDOCTORALES /
DEAN OF THE FACULTY OF GRADUATE AND POSTDOCORAL STUDIES

NORTH AMERICAN M-COMMERCE ADOPTION
Impact of the Technological Environment:
A Comparative Analysis to Western Europe and Japan

By

Rym E. Méliane

Supervised by

Dr. Dominique Ferrand

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Abstract

The explosion of the Internet and the exponential growth of cellular phone users have converged into Mobile Commerce Technology. Companies and markets focus have shifted to M-Commerce technology by adding the ability to surf the web and conduct a transaction from anywhere. M-Commerce environment is quite complex. It involves many different players in many different fields. These players, including marketers, operators, service providers, are all eager to get their piece of the pie for the potentially large M-Commerce revenues. They let us believe that it was just a simple transposition of the fixed Internet on wireless devices. As a result, M-Commerce technology might have been rushed into the market as it sometimes emerged with several issues keeping potential mobile Internet users from rushing into M-Commerce. These issues can be related to very different factors due to environmental complexity and numerous players involved.

The wireless market is essentially dominated by three poles: Western Europe, Asia Pacific – more specifically Japan, and North America. We notice that the response to Mobile Commerce varies from one pole to another. Surprisingly, North America, which was the lead-market of the wireless world until the advent of 2G technologies, and which has encountered the largest Internet growth, is lagging behind Europe and Japan where M-Commerce is more popular.

This work focuses on the technological environment of M-Commerce, and highlights some technological reasons slowing the penetration of this technology in North America[1]. The purpose is to provide some closure and present a potential solution that would improve the North American M-Commerce adoption level.

The determined research hypotheses are:

- Lack of adequate government regulations;
- Lack of adequate spectrum;
- Lack of adequate technologies;
- Lack of adequate standardization process.

An analysis and a comparison of these variables in the respective poles – Western Europe, Japan, North America - using their respective technology - GSM, I-Mode, CDMA is conducted.

More specifically this in-depth comparative analysis helps determine if and how these variables impact the QoS[2] and therefore the M-Commerce adoption outcome. The lack of adequate spectrum and the lack of adequate standardization process, in North America show to be the primary reasons for the slow adoption of M-Commerce. Hence, the conclusion of this work proposes an alternative solution. This proposal provides a new revised model of the North American M-Commerce value chain.

[1] North America: We define North America by Canada and The United States. However throughout this work we often used cases and examples related to the United States. The reason being, that the United States is leading the wireless telecommunication in North America.
[2] QoS: Quality of Service

This model would eliminate the identified issues and increase the Quality of Service, as well as the customer's satisfaction, resulting in higher adoption level. Furthermore, this potential new strategy gives North America the opportunity to reposition itself.

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PURPOSE AND SCOPE OF THE THESIS

1- Need for this Study

M-Commerce is a very prominent market combining two big and fructuous markets: Internet, and Wireless Telecommunications. M-Commerce service provision involves a variety of players (including, marketers, operators, service providers), contributing to the complexity of the environment. These players are essentially responsible for the creation of the hype around M-Commerce, with their strong intent of being part of this innovative money making business. However, the integration and interoperability of these competitors and/or partners accompanied by other environmental factors have translated into related issues discouraging potential mobile Internet users from switching to M-Commerce. More specifically, we notice North American response to M-Commerce is lower and slower than its major counter parts. To our knowledge, no previous research addressing and focusing in similar details on the technological environment has yet been conducted. There is a need for such a study which can be very beneficial to marketers, regulators, developers and other players in the service provision. It provides a different view of the problem allowing the parties to better identify the potential issues, understand and recognize the importance of communicating and working together, while offering a potential solution . The current literature also shows that high-tech managers

predominantly focus on technological capabilities when developing and launching an innovation. However, concentrating only on the technological aspect can isolate the new product/service and therefore set it to failure. Other aspects, such as strategic, marketing, business analysis are also very important when developing an innovation. They contribute to the elaboration of a product/service custom made for a targeted consumer. Business and Technology are very much linked and cannot be separated when launching a new technology/service. These two aspects addressed as a whole enable better focus and understanding of consumers' needs, which results in higher adoption of the technology – in this case higher adoption of M-Commerce. Through an in-depth technological analysis, this thesis shows how an exclusive focus on the technological capabilities of M-Commerce cannot insure its success, but requires a solid business model.

2- Statement of the Problem

The wireless market is dominated by three poles: North America, Western Europe, and Japan. Today, the wireless world is entering the 3rd generation of wireless telecommunication also known as the multimedia era. This new era represents the fusion of Mobile and Internet. M-Commerce, which is the activity of conducting transaction

over mobile networks, also defined as e-commerce over wireless networks, is a subspace of Mobile Internet. We notice that the response to M-Commerce varies from one pole to another. More specifically, we notice that M-Commerce in North America is less popular than in its main competitive markets; which results in North America lagging behind Western Europe and Japan. However, this has not always been the case. North America was actually leading the wireless world throughout the pre-cellular and 1G eras, but lost its lead with the introduction of 2G systems. North America is also known as the leader of individual Internet usage. In this line of thinking the following questions arise: What caused North America to lose its leadership? Why isn't North America (which holds the biggest Internet growth) taking back the lead in this mergence of Mobile and Internet that represents M-Commerce? What can be done to increase M-Commerce adoption and prevent North America from lagging behind Western Europe and Japan? These questions can be addressed through different aspects including: sociological, technological, business. We noticed that the current literature doesn't include a complete detailed analysis of the wireless technological environment of M-Commerce. A similar analysis would contribute well to the available literature. Likewise, we recognize the complexity of M-Commerce environment as well as the variety of factors that could enable or hinder the adoption. These potential factors can vary from geo-cultural (including geography, transportation, culture, business) to technological. However, the strategy used by most high-tech companies focuses on the technological capabilities of the product/service while paying little attention to the consumer's behavior and needs. Their belief is that the most powerful and efficient technology will be the most successful, and therefore achieve the highest level of adoption. In this line of thinking, we decided to limit this study to the

technological environment of M-Commerce, more specifically the wireless technological environment of M-Commerce.

This results in the following research problematic:

In what conditions does the wireless technological environment explain the slow adoption of M-Commerce in North America?

This research consists of an in-depth comparative analysis of North America with the other poles. We will address this problem by identifying and analyzing the potential reasons slowing M-Commerce adoption in North America while providing a potential solution.

3- Objective of the Thesis

The objective of this thesis is to provide some closure on why M-Commerce adoption is slower in North America (compared to Western Europe and Japan) and present a potential solution that would result in a higher North American M-Commerce adoption. The research focuses on the wireless technological environment of M-Commerce while identifying the main wireless technological factors impacting the success of M-Commerce. This in-depth comparative analysis of North America with Western Europe and Japan is conducted through an analysis and a comparison of these factors in the respective poles.

4- Research Methodology

We started by developing a model identifying the different players involved in the service provision of M-Commerce, and how they interact with each other to provide the service to the end-user. We identified mobile operators as being the proxy of the service provision. They are responsible for the technologies deployment, service provision and content delivery to the end-user. In some cases they even sell the devices and choose freely the technology to be deployed. Therefore, this analysis and comparison of M-Commerce adoption by the North American end-user, with respect to the Western European end-user and Japanese end-user, focuses on mobile operators. We notice that the mobile operator's central role in the service provision of M-Commerce is similar to its central role in the service provision of traditional wireless telecommunication services. This suggests that M-Commerce technological environment faces obstacles similar to the ones faced by traditional wireless systems. These obstacles are related to the following key factors: Government regulations, Spectrum Division and Licensing allocation, technical functionality of the system, and standardization of use. These factors have an impact on the wireless technological environment and might therefore impact the adoption of M-Commerce. Hence, we translate and analyze these fore mentioned variables in four hypotheses. We later propose a solution remedying to potential rejected hypotheses, and to the slow adoption of M-Commerce in North America.

5- Research Contribution

Based on the fore mentioned factors, identified as potential reasons for the slow adoption of M-Commerce in North America, we develop the following research hypothesis:

Hypothesis 1: ***The regulatory reforms process had a negative impact on the North American M-Commerce adoption.***

Hypothesis 2: ***The lack of adequate spectrum has a negative impact on the North American M-Commerce adoption.***

Hypothesis 3: ***The lack of technological innovation has a negative impact on the North American M-Commerce adoption.***

Hypothesis 4: ***The lack of adequate systems and service standardization has a negative impact on the North American M-Commerce adoption.***

We analyze individually each of these hypotheses while comparing North America to Western Europe and Japan. Once we have established what factors are truly impacting the North American M-Commerce, we first develop a model showing how these factors interact and affect North American current value chain, before providing an improved model that would provide higher consumer satisfaction; and therefore result in higher M-Commerce adoption.

6- Organization of the Thesis

This thesis is divided in five chapters. Each one represents a specific stage in the research analysis. Hence, the document is organized as follows:

Chapter 1: M-Commerce Adoption Evolution: A market perspective.

To better visualize and understand the research problematic we first looked at and identified the position occupied by North America in the global wireless evolution. Then we showed the level of popularity of M-Commerce in North America compared to its popularity in the other poles.

Chapter 2: Wireless M-Commerce Adoption Process.

M-Commerce is a new technology. Therefore in order to understand M-Commerce adoption process, we started by understanding and analyzing the adoption process of any new technology. We then extended this analysis to M-Commerce. The goal is to identify factors that could potentially influence the adoption lifecycle a new technology such as M-Commerce. This chapter also addresses the limitations of the thesis and shows how the research analysis exclusively focuses on the wireless technological environment of M-Commerce.

Chapter 3: Impact of the Technological Environment: Issues & Hypotheses.

This chapter first identifies factors potentially influencing the wireless technological environment, and how they might impact the adoption of M-Commerce in North America. Then, based on this fore mentioned analysis we formulate our research problematic as well as our research hypothesis.

Chapter 4: M-Commerce Adoption Comparative Analysis.

This chapter analyses and compares respectively each hypothesis.

1- We determined that the slow adoption of M-Commerce in North America is not a direct consequence of the regulatory reforms process.
2- We determined that the slow adoption of M-Commerce is a direct consequence of the North American mobile spectrum insufficiency.
3- We determined that the slow adoption of M-Commerce is not attributed to a technological inferiority of North American systems.
4- We determined that the slow adoption of M-Commerce in North America has been caused by a lack of standardization.

Chapter 5: Conclusions: North American M-Commerce Adoption.

This chapter first presents a synthesis of the fore mentioned hypotheses analyses, while demonstrating how the combination of lack of spectrum and lack of standardization affect negatively the quality of the services provided to the end-user, which result in consumers' slow adoption of M-Commerce in North America.

Then, we propose a recommendation aiming at eliminating spectrum and standardization issues, and enhancing the Quality of Service provided to the end-user, which will increase and speed up the adoption of M-Commerce in North America.

Chapter 1

M-COMMERCE ADOPTION EVOLUTION: A Market Perspective

1- Introduction

The global wireless telecommunication market is dominated essentially by three poles: North America, Western Europe, and Asia Pacific – more specifically Japan. When it comes to M-Commerce products and services, we notice that North America has the slowest market penetration of the three poles. The following chapter presents a global wireless market perspective, from the early pre-cellular era to today's multimedia era. It provides a good market analysis – including the evolution of each pole's market position, and a presentation of the market players involved in M-Commerce service provision. The goal is to show M-Commerce market adoption differences, and how North America is lagging behind Western Europe and Japan. This will give the necessary ground to later, in subsequent chapters, identify potential factors responsible for the North American slow M-Commerce adoption, formulate the research problematic and research hypothesis, and conduct the research analysis.

2- Wireless Adoption Problem Space

By the mid-1980s it became clear to wireless industry leaders that in order for their respective organizations to be competitive and prosper, they would have to gain and maintain a good position in the key markets. These markets, which are the United-States of America (US), Western Europe (WE) and Japan, represented approximately 80 percent of the worldwide wireless needs (Ohmae, 1980s).

Today, with the arrival of multimedia in 3G networks, we notice that M-Commerce has a slow penetration in North America (NA) compared to Europe and Asia Pacific (AP). However, this has not always been the case. Until a slowdown in their market growth cost them their head position, there was quite a long period of time in the wireless evolution where North America was the leader of the wireless industry (Steinbock, 2003). Questions are, "What happened? What made North America lose its leadership? Why are they still lagging behind Western Europe and Asia Pacific, even with the advent of 3G? Why is North American M-Commerce adoption inferior to the adoption of the same in Asia Pacific and Western Europe?" In order to better identify, analyze, and compare the potential reasons keeping M-Commerce from taking off in North America, we primarily address the question of how the North American wireless market share has evolved in the wireless world. This study will consist of an analysis of the North American wireless leadership, of the North American leadership loss, and finally, the breakthrough in the 3G and M-Commerce.

First, we define the term market leader, as well as characteristics that would make us consider an entity as a leader in this particular study.

3- Market leader

For the purpose of this study, we define industry leader as lead-market. It is understood that one cannot be the industry leader without holding the lead-market - that is the biggest market share. Technological innovation and market share are two inseparable elements. Being a technological core alone cannot decide on the success or the failure of a technology. For instance, if we take a close look at Finnish (Finland) companies, we realize that despite the fact that they are very advanced in terms of wireless telecommunication Research & Development, they have not been successful in translating that success into dollar value. The apparent reason is bad economies of scale. This has defined Finland as a technological core, but not a lead-market. Whereas, France which doesn't hold the most advanced Research & Development sites, is not considered as a technological core. However, its substantial population base is a great catalyst promoting it as a lead-market (Steinbock, 2003).

The global evolution of wireless markets can be segmented in three phases: The pre-cellular era, the 1st generation era, and the 2nd generation era. During its stint as a leader in mobile communications, North America was a technological core as well as the number one lead-market.

4- North American Wireless Market Leadership Loss

The first two phases of the global evolution of wireless markets were marked by the technological advancement and leadership of North America.

4.1- Pre-cellular era

Wireless market evolution first started in the maritime sector and continued during the 2nd world war, followed by the introduction of emergency services. During this period, markets were controlled by national Post Telegraph Telecoms (PTTs), which monopolized the market until the introduction and implementation of new public policy and regulations (Berresford, 1989).

In the pre-cellular period, the United-States experienced an earlier technological development and competitive growth. This can partly be attributed to the fact that, although controlled by the American government, AT&T – the national PTT - was managed as a private sector corporation. It gave the company certain flexibility, allowing it to develop and innovate freely while conforming to government regulations. Hence, the United States was the only country where there was a separation of the regulatory powers (Steinbock, 2003). Other countries waited until the 1980s and 1990s before they followed the American model.

After World War II, AT&T acquired a technological superiority with the deployment of the first MTS - Mobile Telephone Service (Peterson Jr, 1947).

They preserved this technological advantage through 1964 by launching a more advanced, more sophisticated version of the service called IMTS - Improved Mobile Telephone Service (O'Neill, 1985). North American firms, particularly AT&T, as well as some other vendors and carriers were pointed out as good practical examples in most mobile markets, while the rest of the world struggled to catch up. This relative, yet absolute superiority made North America the technology core of the pre-cellular era (Simon & al, 1984).

4.2- 1G era

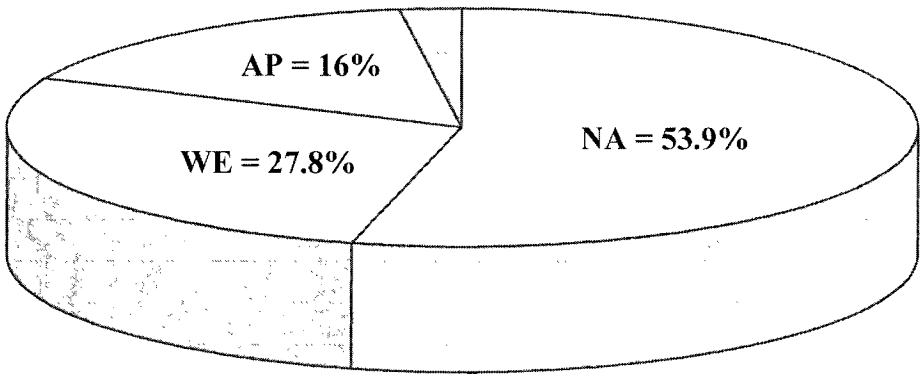
The 1st generation of wireless telecommunications, also referred to as analog systems – Information is sent through a phone as a continuously varying waveform and can only be used for voice with highly variable call quality - started in the early 1980s (Funk, 2002). With this era came a regulatory reforms process, which resulted in the loss of monopoly of most national PTTs[3]. It began with the privatization of British Telecom in the United Kingdom, encouraging other European countries, primarily Nordic Countries, to follow the same model.

In 1984, AT&T launched its first 1G service with the introduction of the Advanced Mobile Phone Service - AMPS - standard technology. AMPS was a tremendous success, offering the company the highest market penetration world wide. That same year, AT&T had its break-up with the government;

[3] PTT: Post Telegraph Telecoms

hence, becoming a private company. A year later the Japanese followed the American example and privatized NTT-Japan.

Figure 1
1G Wireless Telecommunication Leadership



In 1991, at the peak of the 1st generation, North America was first in the lead with more than half of the worldwide mobile market share (figure 1). North America (NA) held 53.9% of the worldwide market, leaving behind Western Europe (WE) with 27.8% and Asia Pacific (AP) with 16% (EMC, 2003). This was largely attributed to the triumph of AMPS, which was the first and only 1G standard deployed in North America.

North America was the world leader of the wireless industry during the 1st generation era.

5- North American Leadership Loss

With the arrival of 2G systems, the ratio force and the market division were about to change, resulting in the North American loss of leadership in the sector.

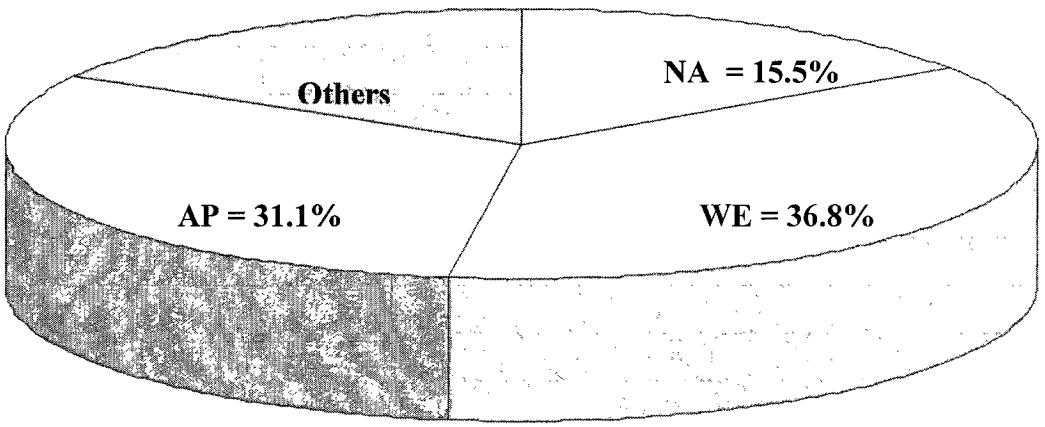
5.1- 2G era

The 2nd generation era started in the early 1990s with the introduction of the wireless-digital technology. This set the stage for several innovations in wireless services. Most of the developed countries introduced different licensing methods and policies which, in most cases, had an impact on the spectrum policies and on the standards deployed. During this period most developed countries had completed their regulatory reforms - hence this third phase can be identified as the competitive phase since the old monopolistic model was replaced by a competitive industry which evolved toward a market of mass consummation. This is largely due to the increasing demand for data communications.

Until the transition to the digital-wireless of the 2nd generation in 1992, the United States was the most lucrative country for wireless products and services (Steinbock, 2003). It held the biggest market penetration in the world. This rapid growth first migrated to the Nordic Countries, and then to all of Western Europe. This phenomenon can be described as the breaking point in the competition.

Prior to this migration Western Europe had experienced many difficulties due to the numerous 1G technologies that were implemented. These technical problems were essentially one of compatibility. In response, the European commission decided to join forces and to have one mandatory 2G system, GSM - Global System for Mobile Communication. The purpose of this merger was to remedy to the technological and compatibility issues.

Figure 2
North American 2G Wireless Telecommunication Leadership Loss



The year 2000 was the peak of the market evolution of the 2G era. Western Europe (WE) experienced the biggest worldwide market penetration (figure2) as it held 36% of the global market, followed closely by Asia Pacific (AP) with 31.1%; whereas North America (NA) was lagging far behind with 15.5% (EMC, 2003).

In retrospect, North America had not only lost its leadership but fell to the 3rd and last rank among the big players of the wireless industry.

5.2- 3G's Arrival

Today we are in the process of crossing into the 3rd generation of wireless telecommunication – the multimedia era comprising M-Commerce activities - as few operators have already deployed 3G services. In 2002, there were close to 2.6 million 3G users around the world.

M-Commerce is a breakthrough technology, combining two big prominent concepts: Wireless and Internet. However, North American ratio force doesn't seem to be changing, as it appears to be a continuity of their 2G state.

Statistics forecast no major noticeable changes. Predictions are that North America will keep lagging in third position behind Asia Pacific and Western Europe (UMTS Forum, 2004). In fact, according to future forecasts provided by UMTS Forum, by 2010, the leader of the 3rd generation of wireless communication will be Asia Pacific with an impressive market share of $ USD 241, 000, 000. Europe is predicted to fall to 2nd position with a significant share, estimated at $ USD 196, 000, 000. Finally North America will preserve the last rank with an estimated $ USD 129, 000, 000 (UMTS Forum, 2004). This last amount is quite inferior to what the competitors are expected to generate and far lower then the market potential.

M-Commerce, or Mobile E-Commerce, is a subspace of Wireless Internet. Its adoption in North America appears to follow the same pattern as Wireless Internet and data communications. The following two sections will further illustrate this affirmation.

6- M-Commerce Industry Players

With the introduction of wireless data services, it became possible for E-Commerce designed for the wired world, to be implemented on wireless handsets. It has evolved into the fusion of two gigantic markets: Mobile telephony and Internet technology (Baertschi, 2003). This fusion gave birth to new services, new applications and a new business model. In other words, it paved the way for mobile commerce, defined as "any transaction with monetary value that is conducted via a mobile telecommunication network" (Durlacher, 2000).

The basic purpose of M-Commerce is to reach customers, suppliers, and employees no matter where they are. It is about delivering the right information and/or service to the right place at the right time. The user can theoretically get on the Internet from any location at any time, access information when requested and required, receive updates on information and data previously required, and even locate a mobile terminal. Mobile devices characteristics and constraints provide M-Commerce with a different operating environment than traditional E-Commerce. Moreover, M-Commerce is enabled with features not available in wired E-Commerce.

For instance, M-Commerce offers ubiquity, reachability, personalization, localization and dissemination.

- Ubiquity is the most important advantage allowing users to get their information through their Internet-enabled devices, regardless of their location.

- Reachability allows users to contact or be contacted by others. This could allow businesses to dispatch information to consumers anytime anywhere.

- Localization provides the physical location of the user at a specific time allowing the provision of location based applications.

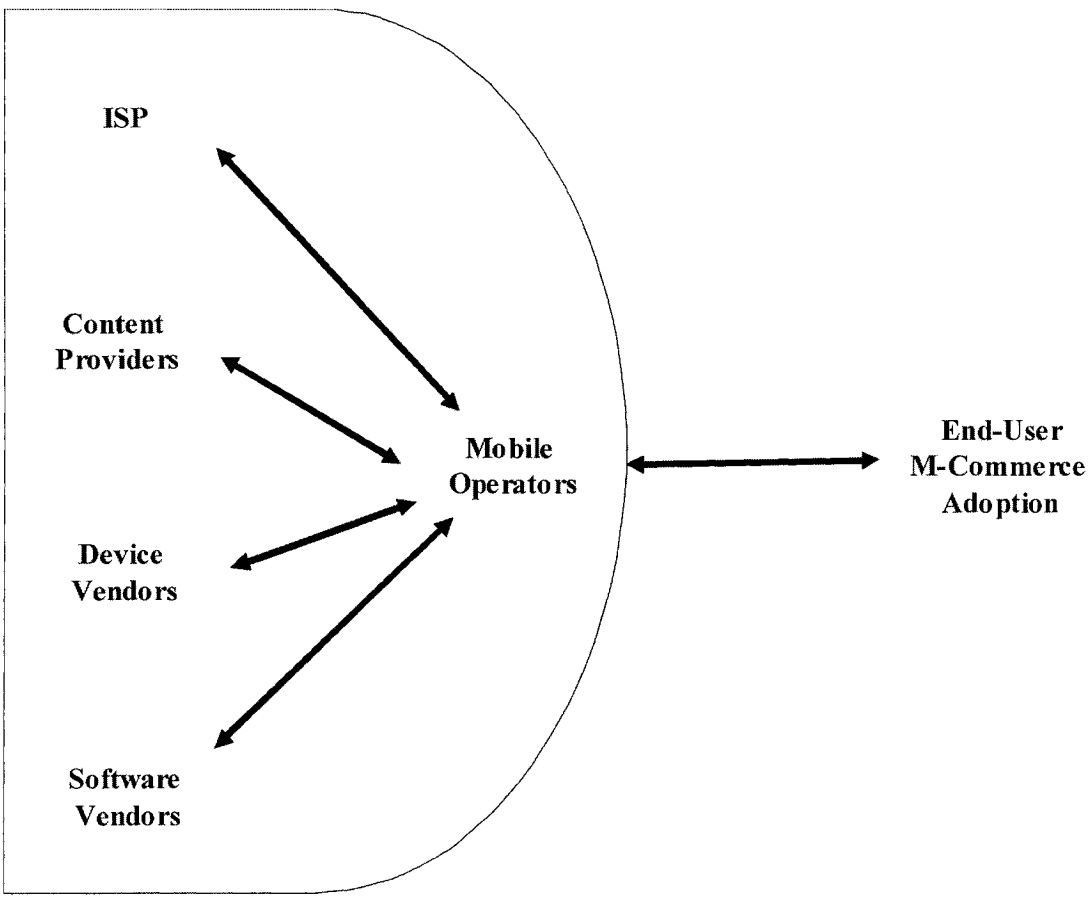
- Personalization enables M-Commerce applications to be personalized with respect to the needs and interests of the users.

- Dissemination provides a more efficient way of disseminating information to a large mobile population, when required.

M-Commerce is a new mean of exchanging information and making purchases. This new advent in the world of communications is perceived by customers as potential convenience. Merchants and service providers see it as considerably large potential earnings as well as the possibility to increase their market share through this new market. For government, it could be a viable and productive mean of reaching and conducting public services with their citizens and residents (Siau, Lim & Shen, 2003).

M-Commerce can be beneficial to a very broad population. The provision of Wireless Internet services involves a variety of players from different domains. Moreover, the players with the biggest stake and opportunity, in this convergence of mobile communications and Internet, are also the ones expected to sustain and improve their market position in this dynamic environment of technological innovations.

Figure 3
M-Commerce Service Provision Value Model



The primary players constituting the value model to provide M-Commerce services to the end-user are: Mobile device and infrastructure vendors, Internet service providers (ISP), software vendors and communities, Content providers, and Mobile operators (Polyzos & al, 2003).

In Figure 3, the parties have respectively very specific roles. However, their respective outcomes must be seamlessly integrated together in order to provide the convenience and qualities of mobile commerce services (Rulke & al., 2003).

- Mobile device vendors (e.g. Nokia, Ericsson, Palm) are responsible for the creation of devices that are attractive, easy and convenient for the end-user. These devices must also be equipped with the capability to handle the deployed applications, and to enable users with high quality services.
- Wireless/Internet Network/Server providers and vendors (e.g. France Telecom, AT&T Wireless/ CNET, Avalon Networks, Rogers/ Cisco, Compaq) must respectively build the proper infrastructure to support the deployed applications and to reach a high Quality of Services and scalability.
- Other vendors, such as software vendors, and communities (e.g. Microsoft, Symbian, Linux) must develop enterprise solutions enabling more advanced and improved applications for the provision of high Quality of Services; therefore, increasing corporate demand.
- Content providers (e.g. ABC News.com, The Weather Network.com) whose goals are to reach mass market consumers, are bound to develop rich, efficient, convenient and compelling services facilitating the provision of high services quality to the end-user.
- Mobile operators (e.g. NTTDoCoMo, Vodafone Group, Telus, T-Mobile) are responsible for the provision of this combined value proposition to the end-user. Mobile operators are the core of this value chain, making the seamless integration of applications and services, a reality.

The needs and satisfaction of the M-Commerce users are of primary importance, and mobile operators constitute the bridge between users and the other members of the value model. Mobile operators have the ability to coordinate this value map in order to provide the best Quality of Services. This could result in an increased usage of M-Commerce services. The anticipated end result is a higher adoption of M-Commerce (Figure 3).

The focus must be on mobile operators. The latter take a central role and act as proxy. They are the ones using the infrastructure, deploying the technologies, providing the services and delivering the contents to the end-users. In some cases, such as in North America, they sell the devices, choose the technology, and provide services and applications through their adopted technology, hoping for a good market response. Hence, comparing and analyzing M-Commerce adoption by the American end-user - with respect to the Japanese and Western European end-user – implies focus on the mobile operator.

7- M-Commerce in North America

Today, it is possible to state that Americans are less enthusiastic about M-Commerce than the Japanese or the Europeans. In 2001, only 33% of Americans have a cellular phone compared to 90% of the population in some European countries (Lamont, 2001). The arrival of 3G and M-Commerce doesn't appear to be heavily impacting American wireless usage.

Table 1
Mobile Multimedia Top 10 Nations.

Top 10 Nations	**Percentage of the Population using Mobile Internet (December 2004)**
Japan	29.5
South-Korea	24.8
France	10.5
Singapore	7.1
Sweden	7.1
Germany	6.1
United-Kingdom	5.0
Finland	4.1
Norway	3.9
Spain	3.4

In fact, according to the latest TMG report aiming at identifying the 10 leading mobile multimedia nations in the world, the United States is not ranked among the leaders (TMG, 2004).

Japan holds the first position with 29.5% of its population using mobile phones to access Internet. Following is South-Korea with 24.8% and France with 10.5 %. Actually, among 7 out of the 10 nations is European. A recent survey conducted by Jupiter Communications over a sample of 1700 Americans shows that the majority of those surveyed would not use or would not pay for M-Commerce. In fact, the details of the study were that 56% of those who do not own a cellular telephone have no interest in M-Commerce and that 48% of those who own a cellular telephone also have no interest in it. Only 10% would be interested in making a purchase on the wireless web. This lack of interest can be attributed to variable reasons, such as slow mobile Internet, poor Quality of Service and incompatible standards.

North America - more specifically the United States - has encountered the biggest penetration for the Internet but one of the lowest for mobile data (Executive Summary, 2003). M-Commerce transactions are not very popular in North America compared to Europe and Asia. Currently only one to two percent of mobile phone users in the United States take advantage of data services (SVWIC, 2001). Mobile telephony standardization has given Europe and Japan an 18 months head start over the United States (Heath & Wingfield, 2003).

This brings us to a paradox that begs the question: Why is North America with the biggest market share of individual Internet usage, not taking back the lead of the wireless industry when it comes to the convergence of wireless telecommunication and Internet?" The following chapter will provide some closure to the above question in the analysis of the M-Commerce adoption process and in the identification of some potential factors that would lead to a strong or weak market adoption.

Chapter 2

WIRELESS M-COMMERCE ADOPTION PROCESS

1- Introduction

Wireless M-Commerce is a new technology; therefore its adoption and implementation have similar characteristics to any new technology. New technologies are usually chosen and implemented by companies who will try to push them on the market through the provision of products or services in order to have them adopted by the mass population. Therefore, in order to understand the M-Commerce adoption process, one must also define and understand new technology adoption.

This analysis of new technology adoption will provide a good insight to any adoption process enabling the extension of this analysis to the M-Commerce adoption process. The purpose is to identify factors influencing the adoption lifecycle of any new technology, and determine the ones that could potentially impact M-Commerce adoption, more specifically North American M-Commerce adoption.

The following chapter highlights the role held by organizations in the adoption life cycle, as well as the importance of good strategic development, marketing development, timing, diffusion and implementation processes for any new technology adoption. The target result is to gain better understanding and control of specific environmental factors affecting the technology and its subsequent adoption.

2- Adoption Life Cycle Framework

Technology is an essential factor in all organizations. Since the beginning of time, technology innovation has had an impact on people's everyday lives. The outcome of early technology adoption has been higher standards and thus better quality of life (Rouse, 2000). This remains the primary idea behind implementing a new technology. Nowadays, aggressive competition has pushed technology to become a very strategic tool (Moore, 2002).

The analysis of the adoption life cycle and adoption process of a new technology is of primary importance, it gives the opportunity to develop the appropriate model that would better fit the market and therefore have better acceptance. Overly optimistic valuations as well as miss-understandings of the technology by companies can create more confusion in the market.

As such, misconception of M-Commerce marketing campaigns resulted in overexcitement around M-Commerce before people realized that it wasn't just a simple derivative of E-Commerce (M-Commerce, 2003).

Across the world, there is a large fan of factors affecting and involved with the provision of M-Commerce services. These factors can sometimes translate into issues keeping Mobile Internet users from rushing into M-Commerce services. These issues can include factors such air time costs, lack of coverage and applications, lack of user-friendly interface, privacy and security concerns, or even consumer's habits and reluctance to change (SVWICmC, 2001).

Surprisingly enough, the response to Mobile Commerce varies from one continent to another. For example, Mobile Commerce is more popular in Asia and Europe than in North America which is struggling behind (Tarasewich & al, 2003).

This section presents and explains the major driving forces in the adoption life cycle of any new technology and how they can be transposed in the M-Commerce adoption process.

2.1- Organization Innovative Approach

New product/service/ technology adoption starts at the organization level. Successful consumer adoption is just the outcome of successful strategic development, introduction and deployment of an innovation. Global competition's increasing pressures have motivated large organizations to adopt a more dynamic business approach.

It translated into making innovation a focusing point to improve and achieve better market profitability. Innovation and new product/technology adoption is the process of first elaborating and then commercializing new products/services ideas (Government Of Canada, 2000). This is usually performed by companies aiming at attracting and capturing consumers to adopt their innovation. Therefore a company's strategic approach when choosing and deploying an innovation is a determining element for the successful adoption of any product/service. If a company is able to reach its incentive goals and develop competitive advantages through the innovation while avoiding potential obstacles, chances are that consumers' adoption will be successful.

Organizations advantages:

The major advantages that organizations seek when introducing a new product/service/technology include (Government Of Canada, 2000):

- Increase in competition: Increase in market share, gain new consumers, market recognition of the product/service value.
- Birth of faithful clientele: Build consumer trust with specific consumers; work closely with them on strategic project.
- Perspective enlargement: Acquire a clear vision of the future and of the position occupied on the global market.
- Build trust with external potential investors: organization is perceived as trustworthy, reliable, progressive, useful, and worth backing up.

- Improve quality decisions: Implementation of knowledge management, problem resolution, risk evaluation, and process control methods, for clear and improved decision making.
- Increase in business: Ability to control and progressively improve management systems efficiency and most recent technologies use.
- Increase in employee efficiency: Attract, train, and keep the best employees and allow them to participate in building the organization's strategy and vision.

Organizations potential obstacles:

The successful adoption of an innovation is not certain, but it depends on many different factors. Some of these factors might translate into potential obstacles impeding the deployment and adoption of the new product/service/technology.

Four main factors have been recognized as major sources of innovation barriers (Acad-Can-Genie 1997; Government Of Canada 2000; Couadal 2002):

- Financing problems: Incapacity to attract external financing sources, difficulty to direct and manage the organization's available money to finance the innovation.
- Organizational barriers: Poor internal communication, employees' resistance to change and to the innovative idea. Poor relationship with the external environment (consumers, providers, investors) which is also resistant to change, and therefore not accepting the innovation.
- Stagnating or non-existent process: incapacity to provide a process of continuous improvement and progressive innovation. Incapacity to implement a risk management and continuous control process.

- Technology: Lack of vision and understanding of the future technological needs. Incapacity to identify potential new technologies. Incapacity to appropriately design and implement new technology to enhance, improve and innovate product and service provision process. Lack of efficiency of the deployed new technology.

These factors combine two key elements that could affect the adoption process: Technology, and Management (including financing, organizational, and processing factors). Thus, acquiring advantages and minimizing obstacles risks while developing a new product/service model can rely on the following two dimensions: Technological capabilities of the product/services and management innovation (development of a good business model). These dimensions are of crucial importance in the innovation success and its successful subsequent adoption.

Organization can choose to focus on one or both of these dimensions in the new product development. Therefore addressing efficiently and accurately one or both of these aspects requires developing a good strategic approach from organization managers.

2.2 Strategic Development

Establishing market success and competitiveness with a new product/technology does not only rely on the qualities and characteristics of the product/service. It also relies on other key factors such as price, advertisement, and distribution channels (Porter, 1980).

Analyzing the potential of a new technology as well as the emerging market drivers can be a very difficult task, especially when companies lack experience with the product and the technology in general (Shwirn, 2003). Market players must use all their skills and assets to stay successful and competitive. Thus, they must develop a competitive advantage when introducing a new technology – or any type of business (Stengel, 2003). This implies developing a good strategic plan in order to maximize consumers' use and therefore achieve high level of adoption. Two strategic approaches stand out. The first one is based on the manager's perspective and therefore focuses on the product/technology. The second one is based on the consumer's perspective and focuses on the consumer's needs and expectations.

1- Manager's perspective:

Many companies, particularly high-tech companies, focus on the product/service technological capabilities (Dugal & Schroeder, 1995; Marcus & Segal, 1989). Their strategy is based on the technological innovation and not on the consumer behavior and needs. The idea behind this approach is that "if we build it they will come" (Rosen & al., 1999). In other words, consumers don't know what they want and cannot be trusted to express the needs and expectations related to the product development. For instance, when designing the i-Mac, Steve Jobs explained, that no consumer research was developed since the majority don't know what they really want until it is presented to them (Newsweek, 1998).

Many authors in the product development literature have argued that the superior – the most advanced and most efficient – product/technology will dominate the market place while out casting its competitors (Gruenwald 1985; Cooper 1987; Kleinschmidt & al. 1991). However, some authors disagree with this theory stating that some products/technologies although superior in their functionalities have not been successful on the marketplace (Loudon & al., 1994).

2- Consumer's perspective:

This approach focuses on consumers' behaviors and needs, to develop a product that will be well accepted and a business model that will target and attract potential users. Successful new product/new technology development involves close relationship with consumers (Rosen & al., 1999). This enables the provision of innovative solutions that will be welcomed and embraced by potential users, resulting in high and rapid adoption. Therefore, understanding the consumer's customs, routine, and sometimes problems is a key element complementing and completing the innovation process. This approach helps setting profiles of consumers likely to purchase and adopt the product/technology. It helps identifying the target market with more accuracy. In fact, targeted products have shown to diffuse more rapidly than non-targeted ones (Lunn & al., 1992). New technology product/service target marketing is not an activity to be performed once; rather it's an ongoing process throughout the life cycle of the product. New technology life cycle is usually parsed in different segments,

each representing a different stage in the diffusion process. Each stage represents a market segment with a different consumer profile (Davidow, 1986).

Target marketing becomes more of a necessity in dynamic environment such as technological markets. This is due to fast moving technologies (as well as their products and services). Rapid technology changes translate in shorter life cycle, and the need for rapid and efficient decision making process (Kalish & al., 1991). These dynamic markets – such as new technology adoption – include an increasing strong competition and increasing consumers' needs and expectations (Saunders & Doyle, 1985), therefore leading to a more complex environment.

Strategic approach based on consumer focus implies a good marketing development to accurately target the market, and diffuse successfully the innovation.

2.3 Marketing Development

Technological markets are mainly driven by product/service technical innovation. However, marketing development is of primary importance throughout the innovation and adoption process (Nystrom, 1990). Nevertheless, consumers' needs and expectations are often ignored by companies. Numerous studies in the literature show that marketing remains a theoretical concept yet to be developed (McGee & al. 1988; Webster 1988; Cahill & al. 1994).

Knowing the potential consumer and his perception of the technology and products is essential since it can have a major impact on the use of the technology.

This knowledge is an invaluable tool in making the right choices when installing the systems (BMS&C, 2003). Some of the technical information can be provided by the systems vendors, their agents and, of course, the technicians installing and implementing the systems. However, this is not enough because the technicians do not necessarily have the complete knowledge of the needs and expectations of the potential customers. Technological innovation and management are two linked aspects that should be addressed as a whole, meaning that the technological world and the business world should work closely together, in order to achieve success when launching a new technology. Marketing strategy involves a close knowledge of the consumer to ensure that product and service provision appeal to his/her needs and desires. Moreover, marketing development helps determining the appropriate model for new product development and adoption process.

It helps transiting smoothly and accurately the innovation through different critical development phases. These phases include: product idea generation, idea screening, concept testing, business analysis, marketing mix development, test marketing, and commercialization (Rosen & al., 1999). Marketing development integrates the consumer in the new product development process as each phase provides additional information to better understand and identify consumers' needs and expectations. The process of going entirely through each phases, and not skipping any one of them, should, in theory, eliminate the risks of potential failure. In other words, new technologies should evolve through different stages starting with the demonstration in Research and Development to finally attaining a full commercial deployment (Market Barriers, 2003). For instance,

efforts should be made on improving the user-friendliness of interfaces as well as the information available to operators (BMS&C, 2003). The first barriers technologies face are usually technical. These can be overcome at the R&D level. As technologies get closer to the market, they usually start to face market barriers, such as consumer's reluctance to change. This can sometimes infringe their market deployment. However a good marketing approach can help overcome or even avoid some of these barriers. As mentioned earlier a marketing development is a consequence of a strategy based on consumer focus. Consumer knowledge implies a close relationship with the potential consumer. This allows accurate target market as well as the development of a good promotional strategy. The purpose is to educate and convince the target market of innovation benefits, and make sure that it is well understood and appreciated (Rosen & al., 1999).

Target Market:

Accurate target market is of crucial importance in marketing development of new product technology. It implies getting to know the consumer, including its behavior, habits, needs. The purpose is to set a true detailed consumer profile to determine:

- the type of consumers to target: characteristics that would make them want to buy the product,
- what segment of the product life cycle they belong to,
- how to reach and attract our potential consumers : promotional strategy including product education, distribution strategy, and pricing,

- when to start diffusing (timing) to a specific segment,
- when to re-evaluate the target market to move to the next segment.

Once introduced on the market, a product can diffuse through a chain reaction effect, also referred to as the word of mouth. In other words, adoption is achieved through customers referencing each other. The more self-referencing is the market, the tighter the communication channels are, resulting in a higher level of adoption (Moore, 2002). However, when it comes to new technology products and services we notice fundamental customers' differences. Consumers do not reference each other. Reaching a large fan of consumers as a whole is difficult, and becomes almost impossible to achieve. Therefore, the need for market segmentation is called for (Moore, 2002).

Market segmentation:

Individuals can grow far apart in term of the way they perceive and welcome innovations. The lack of communication between each other can disable the traditional chain-reaction diffusion effect, resulting in bigger challenges for successful adoption. Organization managers and marketers must find a way to communicate pertinent information to potential consumers and make them adopt the new technology. Market segmentation helps dividing the potential consumer population in different categories. Each one represents a specific market segment in the adoption life cycle. Potential users are classified in a specific segment, through customer profiling, based on their potential time of entry in the adoption life cycle.

Technology life cycle compounds five market segments (Rahman 1992; Rosen & al. 1999; Moore 2002):

1) Innovators: Also referred to as technology enthusiasts. They are the first ones to adopt any new technology. Innovators represent the smallest segment of the adoption life cycle, but they are the first ones to acknowledge the potential in any new product technology. Therefore, new technology marketing starts with them.
2) Early adopters: Also referred to as visionaries. They don't make their choice based on references; but rely on intuition and vision. Therefore matching new technology to strategic opportunity. Early adopters constitute a potential early source of revenues as well as a good market visibility. They are the ones giving the first big break to new technologies.
3) Early majority: Also referred to as pragmatists. They are driven by a sense of practicability (how will they benefit from this product and how will their life be affected by the adoption). They are not interested in being the market pioneer of a technology, and like to see well established references from within their market segment. Early majority represents approximately one third on the adoption life cycle. Their business constitutes a substantial source of profit and growth.
4) Late majority: Also referred to as conservatives. They constitute a tough market to gain, don't have a particular interest in new technologies, and are not willing to invest substantially in a technological product. They like to wait until the product becomes a 'well established standard', and will more likely purchase from a 'well established company'.

Late majority market segment also represents approximately one third of the adoption life cycle, making it a potential substantial source of profits.

5) Laggards: Also referred to as skeptics. They have no interest what so ever in new technology. The only time they will acquire a technological product is when it is deeply integrated in another product their purchasing and they don't even know of its presence. Laggards are very resistant to change, and are not familiar with technologies in general. Efforts to win them over and train them are too time consuming, therefore too costly. This market segment is often considered not worth pursuing, and tends to be disregarded.

Each of the fore mentioned segments represents a quite different and relatively independent market. The transition from one segment to another is not a smooth continuum. Geoffrey Moore describes it as a gap between each segment.

Therefore transiting from one segment to another requires rethinking and readjusting the target market or target-customer characterization (Rosen & al. 1999; Moore 2002). This is achieved based on sound consumer profiles, thus good customer knowledge. Moore emphasizes on the difficulty to transit from early adopters to early majority. He defines the gap between these two market segments as the "chasm". Meaning that accurate target marketing is even more of a necessity for "Crossing the chasm" (Moore, 2002).

In this line of thinking, we conclude that marketing development can play a very important role in new product technology development.

It provides the necessary tools to target the market, and helps elaborate (from the design to the commercialization) a product custom made for target customers' needs and expectations.

Good strategic plan combining efficient product and technological capabilities with a good consumer knowledge enables better environmental understanding and control. This provides good information on how the adoption process can be impacted positively/negatively. Reaching for this type of information provides additional potential solutions enabling better more accurate target market.

To minimize the risks of adoption failure, avoid potential obstacles or acquire the necessary information to overcome potential obstacles (be better prepared and react effectively when confronted with them), it is important to try to identify and define specific adoption factors that would attract potential customers or in some cases push them away.

2.4- Specifics Factors that Influence M-Commerce Adoption

The desire and willingness of a company or an individual/consumer to adopt a new technology is usually driven by arising opportunities in their operating environment.

These factors and opportunities include variable environmental issues (More, 1992), such as modification in the product life cycle, competition pressure, innovation in the production process to reduce costs, quality/productivity enhancement.

There are several factors that can at different degrees affect the level of adoption of M-Commerce (SVWICmC, 2001).

These factors varying from geo-cultural to technological include: transportation, geography, culture & style, privacy and security, business, infrastructure. These can impact the consumer's willingness to move to M-Commerce.

- Transportation:

  The type of transportation used by the consumers can have an impact on their habits. If a person spends hours a day in public transportation, he/she would be more likely to use his/her cell phone to call a friend, play games, pay bills etc... Whereas a driving person usually spends less time in transportation, and even while driving would be more concentrated on the road than on using a cell phone. These behaviors are noticeable in Japan, Europe, and the United States:

  - In Japan, most people spend hours a day in public transportation. To keep themselves busy they will use electronic gadgets like cell phones.

- In Europe, public transportation is also very popular, which might explain the high use of wireless devices.
- However, in the United States there is much less public transportation. Most people drive to work (Mollman, 2002), making the usage of cell phone devices while moving not very convenient.

Transportation might be one of the reasons explaining M-Commerce differences of adoption.

- Geography:

In large rural areas and mountain countries, it's more feasible to implement wireless networks than fixed telephone networks (Sommermeyer, 2001). Japan is 80 percent mountain, which can be an indicator of the popularity of handheld devices. Similarly, Europe is a very mountainous continent. This can explain some of the difficulties encountered by wired telecommunication, as some mountainous areas have no fixed infrastructure built in (Wooldridge, 1999). The lack of required infrastructure in some of these older European cities makes cell phone usage a popular alternative (Zuckerman, 2000). On the other hand, North American cities are urbanely well planned as PSTN (Public Switched Telephone Network) installations are an integral part of city planning – this can in some cases diminish the need for a cell phone. Moreover, in some countries requesting a phone line can be very time consuming. This can sometimes push individuals to use a cell phone as wireless lines are easier and faster to acquire (Dholakia & Kshetri; 2002 & 2003). In some European countries, requesting a phone line can be a long administrative process.

While in North America the phone line is usually installed within 24 hours of the request, and fixed line access is relatively cheap (Lehrer & al., 2003) making wireless devices less of a necessity.

The convenience of the fixed network infrastructure might be one of the reasons for M-Commerce differences of adoption.

- Culture & Style:

Japanese people are known to be gadget lovers, and cell phones are not an exception (InfoTech, 2004). There is a huge market for cell phone accessories and even jewelries such as gold chains attachable to wireless devices (Wilson, 2001). Similarly, in Europe in Europe cell phone market penetration is superior the US market penetration (Simpson, 2001). Cultural differences might be at the base of such market penetration differences (meaning that there might be less of a need for handset devices in North America). However, some authors are argue that these differences in cell phone market are attributed to differences in handsets designs and features (for instance, cell phones are much attractive, fun, and easy to operate in Japan than in the US) (Hall 2001; Mollman 2002; Nicholas 2002).Culture and style might be one of the reasons explaining M-Commerce differences of adoption.

- Confidentiality, Privacy and Security concerns:

These three elements can impact the success of M-Commerce adoption. A study made by Forrester stated that $ 15 billions USD would be lost by online merchants due to confidentiality (Forrester, 2001).

The skepticism and the lack of trust towards Internet confidentiality laws would likely make the path for M-Commerce successful adoption even more difficult.

To this day there is no system in terms of security and information protection which would allow the user to specify which information should be collected by the platform or the application used. According to Forester, if they didn't have to worry about privacy, 34 % of Internet users who have never made an online purchase would do it, and 37 % of online customers would spend more money. Many individuals don't want to give up information – such as name, date of birth, etc...- that would disclose their identity, and their location for mobile phones, identifying them to a third party. Privacy and security concerns can be dangerous for the adoption of M-Commerce (SVWICmC 2001; SVWIC 2001). These elements would less likely be the reason for M-Commerce differences of adoption.

- Business:

Today's online businesses are Business-To-Business (B2B), Business-To-Consumer (B2C), Consumer-To-Consumer (C2C), and Government-To-Consumer (G2C). These types of businesses were originally designed for Internet purposes and infrastructure. They were not developed for mobile users or for the mobile infrastructure requirements. Their deployment to conduct wireless business might not be well appropriate as some technologies are better suited for certain functionalities than others. The so-called "killer application" which would make M-Commerce usage unique (with no other alternative or substitute to it) has not yet been identified (Simpson 2001; Lehrer& al. 2003).

This lack of availability of business application designed specifically for the wireless world might in some cases hinder M-Commerce adoption, as individuals would rather continue to conduct their business through their traditional Internet.

- Infrastructure:

Lack of appropriate infrastructures can have an impact on the low market penetration of M-Commerce applications (M-Commerce, 2003). Most networks in place have been built to allow voice transmission, and not for the simultaneous transmission of voice and data (especially when it comes to large amount of data), increasing the risks for connection problems. These problems can have a negative impact on M-Commerce adoption: if a call – such as a transaction – is interrupted, the transfer must be restarted. A lack of adequate infrastructure might affect the penetration of M-Commerce in North America.

These are many aspects impacting M-Commerce adoption. We recognize the complexity of M-Commerce environment as well as the numerous factors that could potentially influence its adoption. However, this research focuses on the technological environment of the wireless networks used to deploy M-Commerce, as we will later show in this chapter.

We live in a changing society where habits and needs are evolving through time. Adoption factors that are influential at the time can soon become obsolete, so the timing of a new technology is of primary importance to achieve successful adoption.

2.5- New Technology Adoption Timing

As stated above, a technology adoption can be a very complex process. Technology development is rapid and the market is very competitive. This can sometimes make companies adopt and implement new technologies before their full acceptance on the market (Rouse, 2000). In some cases, companies face what is referred to as a technology lockout. This phenomenon happens when, for instance, due to technology standards, a company is not capable of penetrating – developing and selling products competitively – a certain market (Shilling, 1998). A strategy that is adopted by many companies in order to evaluate the success of that technology and early market response is to wait until it is introduced by another innovating company that is willing to take the risk. (Mariotti, 1992). This method, called the waiting game, can sometimes be very costly since it takes away the possible competitive advantage and involves profit losses due to the wait. The timing of competition can significantly reduce the initial delay in the adoption process of a new technology (Hoppe, 2002).

Adopting a technology requires its acceptance, followed by its repetitive use by the decision makers and the entire population. There is a huge delay between the time a technology is accepted and the time of its repeated subsequent implementation in industrial organization and their market consumers (Riddle, 1984). This delay raises many concerns due to the fact that it can seriously affect the success or failure of the technology performance as well as the market response.

A key to a successful introduction is to identify the right time for the introduction of a technology. If a technology misses its window of opportunity for market adoption, the latter will follow a curve with a shallow slope. It is subsequently very important to understand the adoption process of the innovation to better design strategies leading to better rates and level of technology adoption. The challenge does not, however, stop at the introduction of a product. It follows through out its lifetime.

As mentioned earlier, adopting a new technology can be a very complex process. New technology development, including wireless telecommunication, is very rapid and the market competition is very strong as well as aggressive. One consequence is companies implementing M-Commerce prematurely before its full market acceptance and before it was ready to be introduced (Rosen & al., 1999). Due to the pressure and willingness to achieve competitive advantage, this premature deployment entices the players involved to skip some steps and not follow some important elements which will later translate into technological environment issues - compatibility, user-friendliness, standardization, regulation, etc... Moreover, these issues will likely result in a technology lockout, as defined earlier in this sub-section (Schilling, M.A. 1998). Therefore, causing a slow penetration of M-Commerce in North America.

A technology well accepted today by a group in the society can easily die tomorrow if it does not evolve beyond this group to other groups and even to the entire society. Therefore, the adoption process involves a diffusion process aiming at spreading the product/service to the largest spectrum of possible users.

2.6- New Technology Diffusion

New technology diffusion is the process of spreading the existence of a new technology and innovation among a population that would eventually adopt it. In the diffusion process some new and innovative characteristics tend to, either encourage, or slow down the adoption. These characteristics can vary with respect to the technology involved. However, some of the commonly identified characteristics are (Tornatzky and Klein, 1982):

- The advantage of adopting the new technology over adopting another alternative technology,
- The compatibility of the innovation with what is already available and what is required for the organization,
- The complexity of the innovation or new technology – a new technology that is better defined and easier to understand will have a more rapid adoption,
- The trial ability of the innovation – the possibility of testing a new technology diminishes adoption risks and therefore motivates the adoption process,
- The ability to observe the innovation or its outcomes – adoption of intangible innovation is inhibited by the fact that it is hard to measure and observe, compared to more visible innovations who will encounter a more rapid growth.

These fore mentioned characteristics are common to the diffusion process of any new technology. We have therefore transposed each of these points in the context of M-Commerce adoption process.

It resulted in the following characteristics analysis:

- Advantage of M-Commerce adoption: No other technology provides similar benefits/services as M-Commerce. Therefore it is difficult to compare it to another technology and no other technology can be recognized as an alternative to it.
- Interoperability of M-Commerce with legacy systems: M-Commerce is the first technology of its kind, combining Wireless Telecommunication Technology with Internet Technology. Operators perceived it as a simple projection of E-Commerce into mobile handsets. The technology is faced with many compatibility problems, more specifically in North America, in terms of infrastructure, standards, services, etc…
- Complexity of M-Commerce innovation: M-Commerce is far from being as simple as it was pretended to be. Describing it as E-Commerce on Mobile handsets is a very simple analogy. This might have caused the omission of some very important key elements in process definition and understanding, and thus the rush into the implementation. This lack of definition and understanding of the M-Commerce technology might have influenced its slow adoption.
- Product & Market verification: It might be difficult to have an M-Commerce test bed prior to market launch since it requires:
    - A huge sample of people mobile and distant from each other in order to test the location and the mobility,

- People using it at the same time - connecting and/or transacting with the same website to test the speed, the connection quality, the memory capacity, user-friendliness, etc…

Moreover, if conducted, this demonstration activity could be more difficult to achieve accurately in North America because of the infrastructure and standards variety.

The diffusion process is a crucial step in any new product development and adoption life cycle. Accurate identification and analysis of the above factors can provide very pertinent information for a better understanding of the product technological capabilities and the market (including consumer knowledge and market target). This enables accurate consumer profiling and market segmentation in order to determine the appropriate timing to diffuse the innovation and to what segment. As established earlier consumers' perception of the innovation as well as their product needs and expectations are different from one segment to another. A good analysis of the diffusion process, meaning a complete analysis of the diffusion main characteristics, is of great importance. It can contribute to choosing the best mode of implementation, of the new technology, that would appeal to, and satisfy all potential users.

2.7- Implementation of a New Technology

New technology adoption is introduced in two steps:

1. Decision to adopt the new technology;
2. Implementation - deployment and market delivery through the provision of new service offerings.

The successful adoption of a new technology depends on the willingness of the people to accept this innovation and the quality of the mode of implementation which can be evaluated by the convenience and value added provided to the customer. In other words, even if the population is ready to accept the innovation, if its usability and implementation is not properly designed to fit and compel with their needs, user interest will drop as consumers will continue to use their conventional technology.

Rahman has formulated adoption into the following formula (Rahman, 1992):

$$\textit{Adoption} = \textit{Acceptance} + \textit{Mode of Implementation}$$

Once accepted, the adoption outcome of this equation depends on the mode of implementation.

The mode of implementation can be determined with the help of a technological analysis. Sometimes changes are necessary in the technological environment for the new technology to settle. In this case, the implementation will be postponed until full readiness.

Adopting a new technology is a multistage process. According to Rahman's equation (Rahman, 1992), the adoption degree will vary based on implementation decisions. This is to say that implementation decisions are crucial to the continuity of adoption. A sane implementation normally relies on a good technological analysis aiming at identifying the possible gaps and imperfections in the technological environment. These elements may lead to a delay in the M-Commerce adoption. The ones that could prevent a widespread adoption of mobile business services are (Rulke & al., 2003):

- Market fragmentation and high costs;
- Technological uncertainty: including uncertainty with respect to the available resource – such as radio spectrum;
- Uncertainty towards complex deployment of technology, application and services;
- Uncertainty towards the complexity to coordinate service providers together and to provide homogeneous and seamless integration of applications and services.

Implementation is critical to the successful adoption of any technology. It's a complex process, starting at the early stage of the new product development. Strategic development and marketing development help set a proper environment for the technology to be well communicated to, and well accepted by the population. It provides the organization with the right information and necessary tools to acquire a clearer vision of the market and the entire external environment. This includes identification, better understanding and control of some random variables (for instance in the case of M-Commerce: transportation, geography, economic viability, or even culture & style)

affecting, potentially, the adoption of the new technology. However, implementing (choosing the right mode of implementation) requires a good knowledge of the technological environment.

Technical capabilities of the technology are at the fore front of the service provision. In fact, as mentioned earlier in this chapter, many high-tech companies, and some authors, believe in product focus and innovations in technology to achieve product leadership (Moore 1995; Dugal & Schroeder 1995). Therefore, attaining a successful level of adoption. The technology must be sophisticated and efficient enough, while being easy to operate, to provide the consumer with the Quality of Service promoted by the marketing department. If the technology fails to achieve the level of sophistication and performance expected by the end-user, then he/she will disregard adopting it. For instance, encountering potential wireless issues, such as slow speed, connection problems, interference, and/or call drops, can discourage consumers to use M-Commerce services.

Similarly to any new technology, M-Commerce development and successful adoption can rely on the following two dimensions: Technological capabilities of the product/services and management innovation.

This research focuses on, one of these dimensions, the wireless technological environment of M-Commerce. The purpose is to determine if the differences of adoption can be explained by specific factors in the wireless technological environment of M-Commerce, and how to modify the potential negative impact of these factors. To our knowledge, no previous research, focusing entirely on the impact of the wireless technological environment on M-Commerce adoption, has yet been conducted.

Chapter 3

IMPACT OF THE TECHNOLOGICAL ENVIRONMENT: Issues & Hypotheses

1- Introduction

This work aims at analyzing specific factors in the wireless Technological environment of M-Commerce to determine if the differences of adoption are attributable to technological differences. The core of the service provision of the M-Commerce Value Model (Figure 3) is the mobile operator. Thus, this research is conducted with a special focus on mobile operators. This enables, in the following chapter, identify specific wireless technological factors that could potentially affect M-Commerce adoption, and explain the slow penetration of M-Commerce in North America. As a result, we will be able to formulate the research problematic as well as the research hypotheses, to proceed, in the subsequent chapter, to the hypotheses analysis.

2- Technological Factors Influencing Mobile Commerce Adoption

Similarly to any new technology, M-Commerce adoption starts at the organization level. New technologies are, usually, chosen and implemented by market players (such as high-tech companies). The purpose is to provide quality products and services, and have them adopted by the largest possible number of users. The provision of wireless M-Commerce services involves a variety of players from different domains (Chapter 1, Section 6). However, this research focuses on the proxy of the service provision: the mobile operator. Similarly to the provision of traditional wireless services (1G and 2G services), mobile operators take a central role in the provision of Mobile Commerce services to the end-users. Their role involves the following tasks:

- Use of infrastructure,
- Decide what technology to choose (North America),
- Deploy the technologies,
- Provide services and applications,
- Deliver contents to end-users,
- Sell the devices (North America).

For 1G & 2G services, and for M-Commerce, this player is responsible for the homogeneous and seamless integration to provide high Quality of Services through direct communication and information exchange with the end-user.

This suggests that M-Commerce wireless technological environment faces obstacles similar to traditional wireless systems. These potential obstacles and issues are technological as well as political, and are related to the following key factors:

- Government regulations,
- Spectrum division and licensing allocation,
- Technical system functionality - standards, bandwidth, performance, handoff efficiency, etc…,
- Standardization of use - compatibility, homogeneity, etc….

The fore mentioned factors have a direct impact on wireless technological deployment, and might, therefore, affect the adoption of M-Commerce.

These factors might explain the differences in adoption between the three poles; more specifically they might explain the North American position in the global wireless telecommunication market.

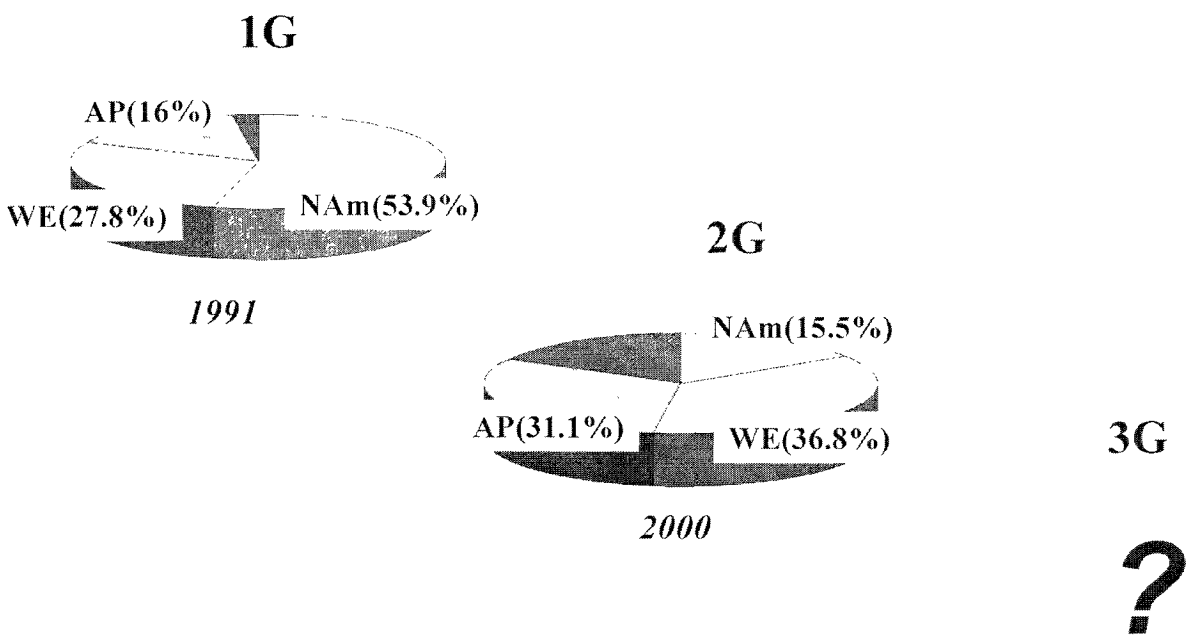
3- Effect of M-Commerce Adoption:

A North American Case

The continued problems of organizational acceptance and the difficulties in implementation had adverse and direct effects on global market share (Figure 4).

Figure 4

North American Dynamic Market Share



We conjecture that in addition to the above mentioned reasons, the convergence of mobility and Internet has caused negative effects where it normally should bring positive contribution, as it brought in multiple potential obstacles, with varying degrees of effect.

This cascading effect dragged throughout the 2nd generation and into the 3rd generation of wireless telecommunication – resulting in the weakest market share, among the three most influential poles in the worldwide wireless industry.

The following section will define and analyze the potential obstacles mentioned in the previous paragraph - government regulations, spectrum division and licensing allocation, technical system functionality, standardization of use - in order to understand their respective level of importance and how their presence can sometimes strengthen the wireless M-Commerce environment, whereas their absence or inappropriate use and implementation can destabilize and transform M-Commerce into a very uncertain environment This analysis will provide the necessary ground to question the potential impact these factors might have on the North American M-Commerce environment - hence to formulate appropriate research hypothesis.

4- Wireless M-Commerce

Strengthening & Weakening Factors

This section will present different aspects that strengthen or weaken the case of M-Commerce. Knowing the user experience is at the base of all of these factors, we explain the effect of regulations, spectrum, technology innovation, and standardization.

4.1- Regulations

We conjecture that market regulations potentially affect market behavior. Governments normally intervene in communications, and related technologies that affect citizens. Such interventions affect consumers and services providers alike.

As new products/ services evolve and enrich service offerings with more and more complex features and capabilities. For the mass population to embrace them comfortably, they must provide a good level of usability. Integration is a key element in today's fast moving environment. In other words, these products and technologies must be implemented in a homogeneous, convenient way to adapt to the physical, psychological, and social characteristics of the user (Brangier&Barcenilla, 2003).

The benefits are numerous and include a reduction in training costs, a lower and limited risk for the user, and an enhanced level of performance.

These result in one thing: high level of adoption. A close alliance between the industry leaders and government would make integration easier and the customer more confident. The task of the government would include building a communication bridge between the different industry and market players to ensure a homogeneous market evolution and a protected and satisfied consumer. A government regulation would remedy to a market fragmentation – the market would evolve in the same direction allowing the players - mobile operators - not only to be competitors, but at a lower level, to be partners – and increase consumer trust which would result in an increased adoption.

However, many would argue that the presence of the government goes against the fundamental principals of free competition and would compare it to taking a step back since the goal of the regulatory reforms was to make the government step aside.

Therefore it is possible that the lack of appropriate regulation has a negative impact on the North American M-Commerce adoption. This reason can be exclusive or can be accompanied by others such as inadequate spectrum availability.

4.2- Spectrum

Spectrum is a scarce resource. This makes its allocation a critical element for the procedures and for the efficiency results of competition in mobile communications (TRP, April 2003). The radio spectrum is the stack of all frequencies that range from 0-10Ghz. Higher frequencies radio signals become closer to light signals. There are a limited amount of frequencies that can divide the spectrum.

It is infeasible to have an unlimited number of channels because they would interfere with each other. The closer channels are to each other, the greater are chances of interference. Think about it as a ruler, how many horizontal lines one can divide the ruler in.

Not only the spectrum is a physically scarce resource, but also many of its segments have already been allocated to other uses. In fact, the government has already assigned almost the entire spectrum made available today to other activities (e.g. US military). This makes the management of rights of the spectrum an issue. Therefore, this concept of "spectrum allocation" is mostly defined as the allocation of property rights for the use of a specific part of the spectrum.

Spectrum is costless - no economic resource is spent to make it available, and its utilization will not diminish its future quantity. However, from a mobile operator's perspective (spectrum predators), the scarcity and consumption rivalry increases the opportunity costs. This results in an increase in fees.

The availability of more or less spectrum is a determining factor in the success of a mobile operator. Moreover, the amount of spectrum on hand can considerably impact an operator's production costs as the well as the Quality of Service and the pricing to the end-user.

Therefore it is possible that the lack of appropriate spectrum has a negative impact on the North American M-Commerce adoption. This reason can be exclusive or can be accompanied by others such as inadequate technology, as described in the next section.

4.3- Technology Innovation

Inadequate technology means, the technology deployed is dated. It lacks efficiency and is technically inferior to what is available.

Exclusive focus on technical aspects, independently from other environmental factors, have shown to be very viable and successful. The user adapts and adjusts to these Innovative systems and the way they were designed. In this sense, the most advanced technology is the most efficient with the highest performance.

As the needs of the consumer increase (thriving for newer developments and more applications with better performance and higher efficiency), the technologically superior system becomes the most demanded. Therefore, it is also the most successful system. In other words, the technology that can achieve the most would better compel with the consumers expectancies. Hence, it would have the highest level of adoption.

Therefore it is possible that the lack of appropriate technology innovation has a negative impact on the North American M-Commerce adoption. This reason can be exclusive or can be accompanied by others such as inadequate standardization of the system.

4.4- Standardization of the deployed Technology and Services

Standardization is defined as the process of implementing a homogeneous, easy to use system that would respond to user needs.

When designing technical tools, the focus must not only be on application design and performance, but also on what the people will use it for and what they will do with it. Does it fit their life, needs, and cultural environment? It is also about the design of the usage and social functions that can be associated with these tools. Sometimes, regardless of the fact that the user does not know how the technology works, the interface, the convenience, and the homogeneity of the application/service can still either capture him/her or drive him/her away. A technology/service that is perceived as easier, safer, simpler, more enjoyable, more comfortable, more satisfying, will be the most successful. As a result, it would achieve the highest level of adoption.

Therefore it is possible that the lack of appropriate standardization has a negative impact on the North American M-Commerce adoption. This reason can be exclusive or can be accompanied by others such as the ones identified above.

These elements – market regulations, spectrum, technology innovation, standardization - are of great importance for the basic functionality and development of M-Commerce. Inappropriate use or lack of availability of one or more of these key elements can contribute and have a big impact on the lack of adoption of M-Commerce services. Hence, they are identified as being potential reasons deterring M-Commerce from taking off in North America. The subsequent part of this work presents an analysis of the impact on M-Commerce adoption in North America by each of the following factors – regulation reforms, radio spectrum allocation and licensing, innovation and efficiency of the deployed technologies, standardization. The following sub-section presents the hypotheses formulated to conduct this analysis.

4.5- M-Commerce Adoption Research Hypotheses

M-Commerce, the product of the mergence of two very profitable industries: Mobile and Internet, is an activity with great potential. In today's moving society and with markets globalization, bringing high speed and Internet services to wireless mobile handsets is becoming a necessity. This multimedia phase is the latest evolution in the wireless world.

Here is a recap of the determining facts that would lead to the formulation of the research problematic:

> *Three poles have and still are dominating the wireless industry: North America, Western Europe and Japan. Surprisingly, North America, who was the leader of wireless telecommunication during the pre-cellular and the 1G eras, has lost its leadership when transiting to the second generation. North America is still today with the advent of 3G and M-Commerce services lagging behind Western Europe and Japan. More specifically, we notice a slow adoption of M-Commerce in North America, compared to Western Europe and Japan.*

Therefore, the research problematic is defined as follows:

In what conditions does the wireless technological environment explain the slow adoption of M-Commerce in North America?

The goal of this work is to try to understand the true reasons causing the slow M-Commerce adoption in North America. With respect to the potential problematic factors identified earlier, the following questions are asked in order to define the research hypotheses:

1 - Did the regulatory reforms process impact North American M-Commerce adoption and is it at the origin of the slow adoption of M-Commerce in North America?

> Hypothesis 1:

The regulatory reforms process had a negative impact on the North American M-Commerce adoption.

2 - Did the availability and regulation of the spectrum impact the North American M-Commerce adoption?

> Hypothesis 2:

The lack of adequate spectrum has a negative impact on the North American M-Commerce adoption.

3 - Did the technologies deployed in North America impact North American M-Commerce adoption and are these technologies less efficient, less powerful and inferior to the technologies deployed in Western Europe and Japan?

> Hypothesis 3:

The lack of technological innovation has a negative impact on the North American M-Commerce adoption.

4 - Did the lack of standardization impact the North American M-Commerce adoption and is at the origin of the slow M-Commerce adoption in North America?

> Hypothesis 4:

The lack of adequate systems and services standardization has a negative impact on North American M-Commerce adoption.

In order to identify if all or any of these factors caused the slow M-Commerce adoption in North America, the following chapter is consecrated to the analysis of each of the above hypothesis, while comparing North America to Western Europe and Japan.

Chapter 4

M-COMMERCE ADOPTION COMPARATIVE ANALYSIS

1- Introduction

The following chapter analyzes respectively the fore mentioned hypotheses. First, we determine whether the slow M-Commerce adoption in North America is a direct consequence of the 1980s regulatory reform process. Second, we estimate whether the slow M-Commerce adoption in North America is a consequence of an insufficiency of available spectrum. Third is a presentation/comparison of the technological systems capabilities of Europe, Japan and North America in order to determine whether the slow M-Commerce adoption in North America is a consequence of North American technology inferiority. Finally, the last hypothesis analysis is to find out whether the slow adoption of M-Commerce in North America is a consequence of an absence of homogeneity and standardization efforts.

This chapter is the core of our work as it will enable recognizing which factors truly impact the North American M-Commerce and in what way. This part provides the necessary tools to later show how some or all of these factors puzzle together allowing us to propose an alternative model that would remedy to the fore mentioned research problem therefore increasing North American M-Commerce adoption.

2- Impact of the Regulatory Reforms on North American Adoption Process

Hypothesis 1:

The regulatory reforms process had a negative impact on the North American M-Commerce adoption.

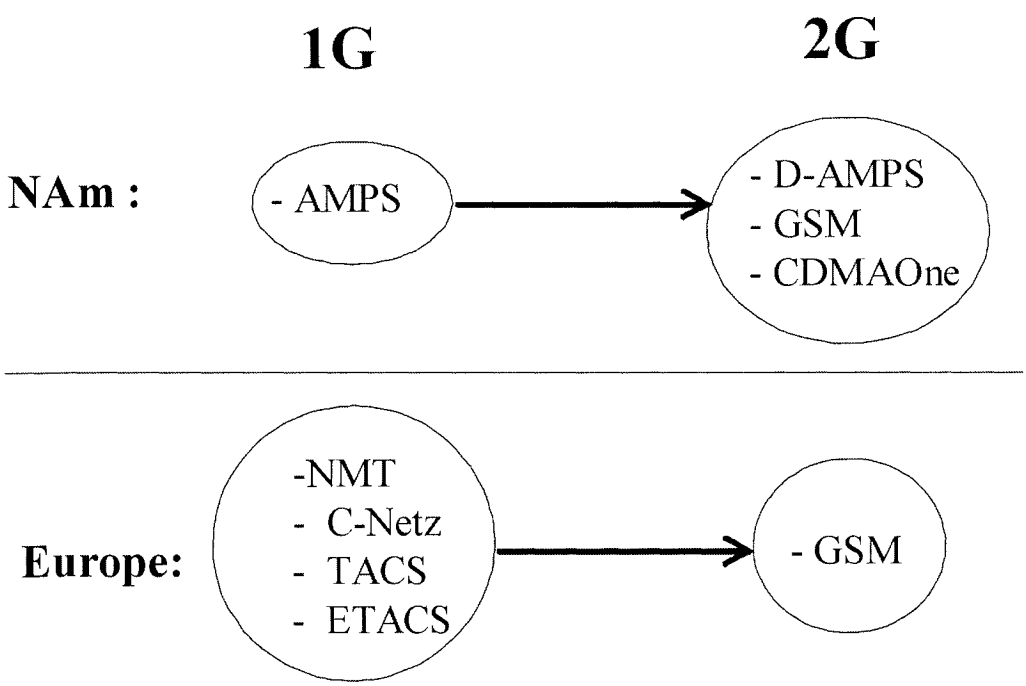
Until the regulatory reform process took place, AT&T in the United States was the leader in terms of technology advancement and was therefore the technological core of the wireless industry.

Moreover, in 1984, just before the deregulation and its total privatization, AT&T introduced AMPS – Advanced Mobile Phone Service – standard, which was the first 1st generation standard deployed in North America. AMPS had a great reception, resulting in a great market penetration. That same year the regulatory reforms process took place in America and AT&T had its break up with the government making it totally privatized.

This regulatory reforms process enabled the future birth of other mobile operators from the private sector.

However, due to the initial rapid explosion of AMPS, it was easier for new comers to conform to the present norm - and implement AMPS – than to try to change something – AMPS technology - that was already working fine, well absorbed and very profitable. This was amplified by the fact that other developed countries were experiencing many issues with their respective 1G standard.

Figure 5
1G to 2G Evolution



These difficulties were mostly technical (Steinbock, 2003) – notably compatibility issues. For example, Europe was dealing with compatibility issues mainly due to the multitude of 1G technologies deployed (Figure 5). Unfortunately, with the arrival of the 2nd generation of wireless telecommunications, North America did not preserve the fore mentioned homogeneity of standard. There was no regulation and standardization of the technologies to be deployed. Governments stepped aside leaving operators to decide on what technology to deploy without boundaries. The strategy was that the strongest and more efficient of all the deployed technologies would take the lead and erase all the others.

However, this strategy was proven wrong since to date there are still many different 2G systems implemented in North America. North America has lost its wireless world wide leadership and is still today holding the third position behind Western Europe and Japan. On the other hand, Western Europe did not want to extend the difficulties faced in 1G. In order to remedy to the technical problems such as incompatibility, the European Union decided to join together and have one unique 2G standard and made GSM – Global system for mobile communications - mandatory (Figure 5).

Even though the loss of the American leadership might be linked to the absence of regulation and standardization – as suggested by the 4th hypotheses and will be analyzed later in this chapter, the regulatory reforms process is not a direct cause for this leadership loss and it did not have an immediate impact on the North American position. This process has definitely influenced indirectly the subsequent events, however, at this level, it would be incorrect to say that the slow North American M-Commerce adoption is due to the regulatory reforms process that started in the early 1980s.

Hence, the first hypothesis as presented above is not true. The 1980s regulatory reforms process did not have a direct negative impact on M-Commerce and cannot explain the slow adoption of M-Commerce in North America.

3- Impact of Spectrum Availability on North American M-Commerce Adoption

Hypothesis 2:

The lack of adequate spectrum has a negative impact on the North American M-Commerce adoption.

3.1- Spectrum Allocation and Licensing

The spectrum is under the governance of the United Nations and the body responsible for it is the ITU (International Telecommunication Union). The ITU holds on a regular basis a WRC (World Radiocommunication Conference) Conference. This four weeks summit is intended to converse and debate on radio spectrum.

The WRC is a global cooperation for regulating, enhancing and solving radio spectrum issues. Collaterally, some countries collaborate in smaller regional group, at a lower level. The most popular one is the EU (European Union), which regularly submits its members with legally binding directives instructing them what spectrum to license for what service (Dornan, 2001). This is quite the opposite of the FCC (Federal Communications Commission) who allows US operators' free deployment of any technology they want.

3.2- Licensing Methods

To date, when it comes to the spectrum licensing, no agreement defining the way spectrum should be divided and allocated exists. Even the EU does not interfere with the number of operators splitting the spectrum and the identity of these operators, leaving these decisions to national regulators discretions. Governments are free to choose their method to award licenses, such as:

1- First Come First Serve

2- Lotteries

3- Auctions: In this case the government can decide not to award the license if the bided price is not considered high enough.

4- Beauty Contest: Each company or operator submits a proposal regarding what they intend to do with the spectrum, what kind of services will be deployed, what will be the prices, etc... The best proposal gets the spectrum. The government can also decide not to award the license if none of the proposal is considered good enough.

5- 'Discretionary – Decision Making': This method is rarely used. It can occur in countries where governments have too much power and the licenses are given to a well connected group of people.

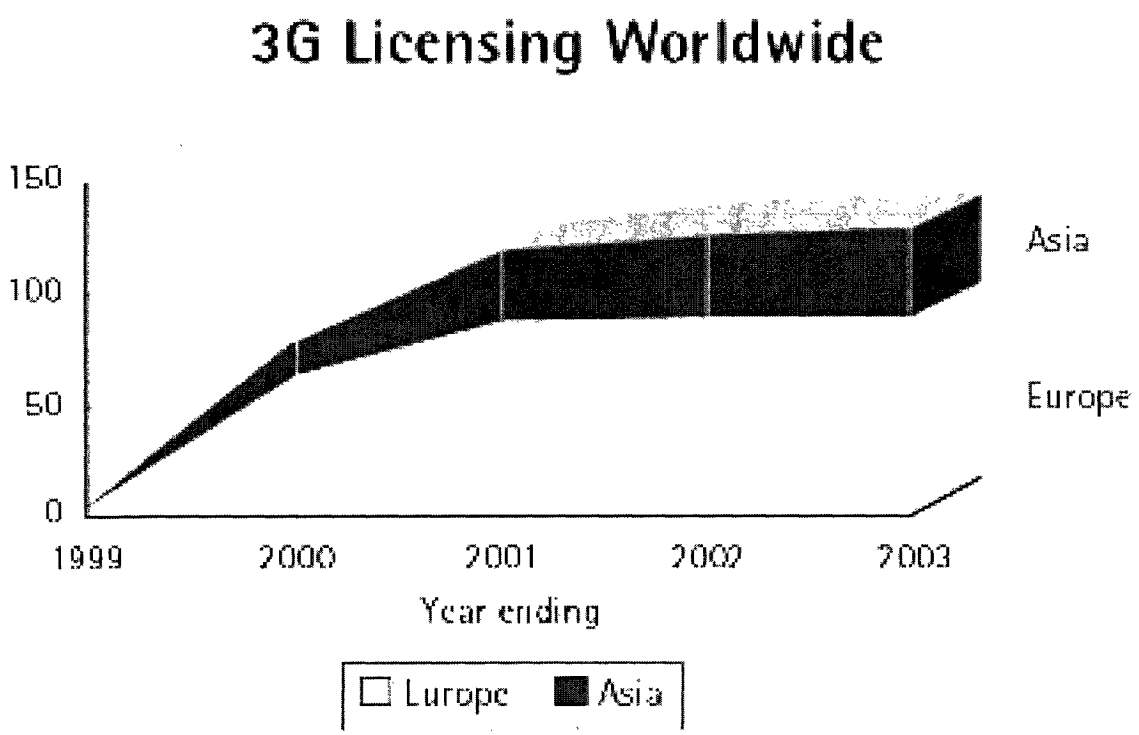
Some of these spectrum licensing methods such as First Come First Serve or Discretionary Decision Making are rarely and almost never used today, while other such as Beauty Contest and Auctions have been widely used in Europe (Kruse, 2002; Orange-EK/OST, 2004) for awarding 3G licenses.

3.3- 3G Licensing

The advent of 3G wireless technology requires the availability of more spectrum, thus the allocation of new spectrum for the *exclusive* deployment of 3G services.

By mid-2003, nearly 120 licenses had been awarded to operators worldwide for the use of IMT-2000[4] spectrum to offer 3G mobile services. Many European countries, such as France, Finland, Portugal and Spain have awarded their licenses using the Beauty Contest method. Other European countries such as Austria, Belgium, Germany and the United Kingdom have used the Auction methods (Kruse, 2002 & Orange-EK/OST, 2004.).

Figure 6
3G Licensing



Y-axis shows the number of licenses awarded.
source: UMTS, 2004

[4] IMT-2000: International Mobile Telecommunication – 2000 is the global standard for 3G wireless communications

In October 2000, former US President Bill Clinton stated that he was "directing federal agencies to work with the Federal Communications Commission and the private sector to identify the radio spectrum needed for the third generation of wireless technology". Adding "these so called 3G systems will allow Americans to have mobile, high speed access to the Internet and new telecommunications services anytime anywhere" (Clinton, 2000). However, to this day in North America, no licenses have yet been awarded for 3G (Figure 6).

The deployment of 3G services was scheduled in existing spectrum, but due to many operators complains, the FCC might start allocating new licenses as of next year (WSJ, 2004).

3.4- Spectrum Division

Radio Spectrum is crucial to the provision of mobile communication services. Due to bandwidth limitations, the available spectrum can only handle a limited number of users simultaneously. Due to this constraint, governments divide the radio spectrum into non-overlapping blocks (ITU, March 2004). The management of the spectrum requires two steps: First, allocating these blocks of frequencies to specific users, such as mobile operators, broadcaster, military, etc…, and then assigning precise frequencies in the

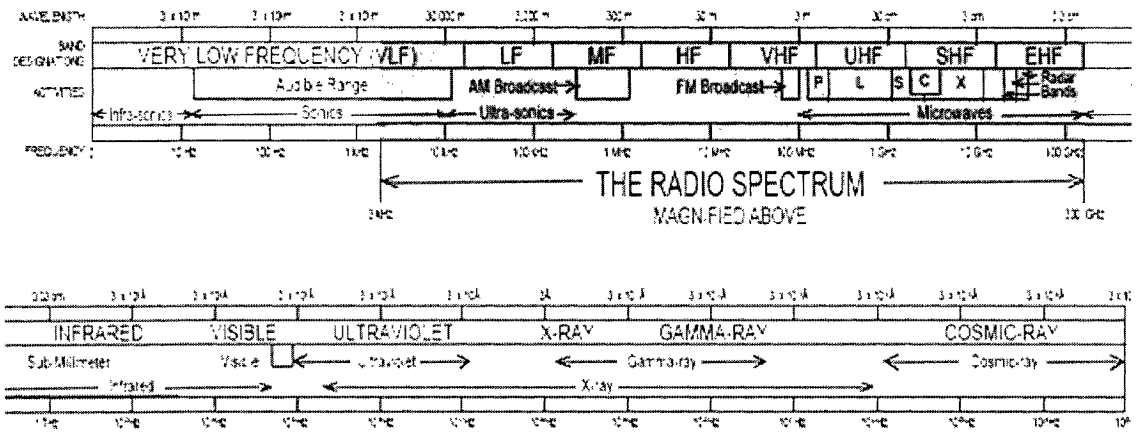
allocated blocks to diverse licensees. These licensees normally have the exclusive usage of these frequencies for the provision of specific services.

The following paragraph provides an analysis of the radio-spectrum available for the provision of mobile services in the US and its usage in order to determine whether the slow adoption of M-Commerce in North America is due to its spectrum.

3.5- North American (United-States) Radio-spectrum

Today, worldwide radio spectrum usage ranges from 30 KHz to 300 GHz. North America and more specifically the United States enjoys the same amount of spectrum as the rest of the world (Figure 7) with frequency bands allocations ranging from 30 KHz to 300 GHz.

Figure 7
The United-States Radio-Spectrum



Source: NTIA, 2003.

The FCC has recently reallocated 30 MHz of spectrum for 3G services that were previously allocated to the US Mobile Satellite Industry (WirelessWeb, May 2003). More precisely, the FCC has reallocated the following three frequency bands: 1990-2000 MHz,

2020-2025 MHz, and 2165-2180 MHz bands. Nevertheless, most of this spectrum will not be available for the usage of 3G for a while since the bands must first be emptied of all current users and then be auctioned to potential mobile operators. The amount of spectrum reserved to Television Broadcast (Dorman, 2001) and Military in the United States is significantly larger than most other countries. Furthermore, with the advent of 3G services, the US is experiencing an insufficiency in term of spectrum.

The amount of spectrum available for mobile telecommunication in the US is considerably less than in most of Europe. In their efforts to reduce the amount of congestion over airwaves, the United States government is beginning to make spectrum use more flexible. The choice of technology deployed in the majority of the licensed mobile spectrum bands is no longer controlled by the FCC[5]. In other words, mobile operators are free to provide 2.5 or 3G services over their existing 1G or 2G spectrum. Last but not least, the FCC is now permitting mobile satellite operators to provide ancillary terrestrial component (ATC) services to surmount the difficulties associated with serving mobile users from a satellite in urban areas and inside buildings (WirelessWeb, May 2003). All of these flexible policies, although appearing as an efficient solution, present major risks of potential interferences to adjacent cells as well as potential reductions in capacity and service quality. Some of these decisions are being debated in Europe and at the ITU[6]. This could have an impact on the use of spectrum throughout Europe, even though most of Europe's spectrum regulators have already retained specific frequency bands for UMTS services.

[5] FCC: Federal Communications Commission
[6] ITU: International Telecommunication Union

Spectrum availability is a vital element for the provision of mobile services and therefore a decisive factor in the success of any wireless technology. Concerns such as interferences, reduced capacity and reduced Quality of Services affect considerably the user's experience and therefore the adoption level of the wireless technology. The second hypothesis is sustained; the lack of adequate spectrum in North America does have a negative impact on M-Commerce adoption.

4- Lack of Adequate Technology

Hypothesis 3:

The lack of technological innovation has a negative impact on the North American M-Commerce adoption.

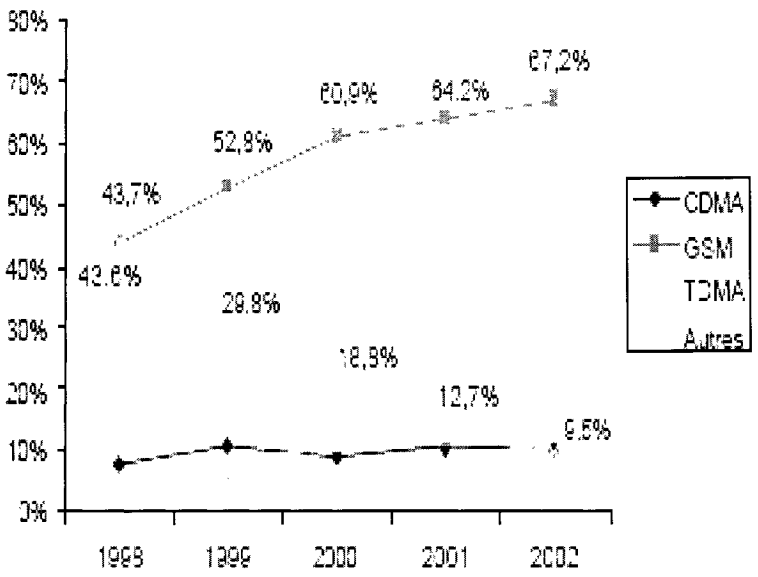
In order to provide a better overview, the third hypothesis is divided in two stages: First, an analysis of the deployed 2G systems, followed by an in depth look at the deployed 3G systems. This analysis will offer a comparison between the efficiency and performance of North American technologies with the ones deployed in Western Europe and Japan. The goal being to determine if the slow M-Commerce adoption in North America is attributable to 2G and/or 3G technological inferiority.

4.1- 2G Systems

The level of adoption of 2G systems differs from one geographical area to another. Similarly, we notice that the type of deployed 2G technologies can vary from one

geographical area to another. The figure below shows the level of adoption of 2nd Generation GSM and CDMA world wide.

Figure 8
2G systems Market Adoption



In order to determine whether the slow M-Commerce adoption in North America is due to the inferiority of the deployed technology compared to the technologies available in Western Europe and Japan, our starting point is the analysis and comparison of these 3 poles with respect to their main technologies – that is the technologies mainly used in these markets. To describe the technological advancement of Western Europe we will use

its mandatory technology, GSM - Global Systems for Mobile Communications, which is the most popular standard in the world (Figure 8). Japan also has only one standard deployed by all the Japanese operators, PDC - Personal Digital Communication, which is the second most popular standard after GSM. However, this popularity is mainly due to the amazing success of I-Mode service. Therefore we focus on PDC and I-Mode in order to explain the technological advancement of Japan. Finally, since North America has implemented more than one 2G standard, we will use the most popular standard in America, CDMA - Code Division Multiple Access, which is also the core technology for all future 3G systems – to analyze the technological advancement in North America.

The following section describes the features, functionalities, particularities and differences of each of the 2G technologies in order to understand their respective success and impact on M-Commerce adoption.

4.1.1- 2G Technologies Presentation

The following table presents the technological features, powerfulness and efficiency of GSM – for Europe, PDC – for Japan, and CDMAOne – for North America.

Table 2
2G Technologies Features and Performance

	GSM		PDC	CDMAOne / IS-95	
Bandwidth per Channel (KHz)	200		25	1250	
Calls per Channel	8		3	± 15	
Speed rate per call: Kbps/call	14.4		9.6	16	
Maximum Data Speed (Kbps)	GSM	14.4	14.4	IS-95a	64
	HSCSD	57.6			
	GPRS	115.2		IS-95b	240
	EDGE	384			
SMS Message length (Bytes)	160		160	256	
Networking Protocol	GSM-MAP			ANSI-41	

GSM Systems:

GSM got its name from the committee who invented it, Groupe Special Mobile, before adopting the name Global Systems for Mobile Communications. In 1999, the number of people who switched to GSM reached an increased rate of one million users per week. Today, more than half of the world's mobile population is on GSM. GSM was first standardized by the ETSI[7] in 1989. The early standardization of GSM by the European Governments as well as the very high quality provided by these systems had a tremendous effect on the popularity of GSM (Zvonar & al., 1999).

GSM is easily upgradeable to higher data rates, which explains its four frequencies bands (Schiller, 2003):

- GSM 900: In order to reuse the spectrum previously allocated for Europe's analog TACS networks, GSM was first designed in the 900 MHz.
- DCN 1800: These systems were adapted for the1800 MHz frequency bands that were licensed in Europe for GSM. Digital Communications Networks is the name sometimes given to higher frequency using GSM.
- PCS 1900: These systems were also later upgraded to the 1900 MHz frequency bands for a variety of American digital systems.
- GSM 450: These frequency bands are used by recent GSM upgrades.

GSM uses a modified and a more efficient version of TDMA. It keeps the idea of time slots and frequency channels. The RF channels are 200 KHz wide (table 2) and data is

[7] ETSI: European Telecommunication Standard Institute

encoded into waves using GSMK (Gaussian Minimum Shifting Keying) - a type of phase modulation that can be defined as a system using different parts of a waveform to represent information (Dornan, 2001). The bit rate for each of these RF channel is 270.8 kbps, and each channel is shared by eight voice transmissions. Similarly to TDMA, the mobile transmitter operates only during its allotted time slot (1/8 of the time compared to 1/3 with TDMA). In terms of spectral efficiency, GSM works out to 200/8 = 25 KHz per voice channel (Table 2), and every time a person sends or receives data, the data rate is theoretically 270.8/8 = 33.9 Kbps.

In order to meet the growing needs and demand for efficient new wireless services without having to upgrade or switch the systems to 3G technologies, GSM created the following new standards: HSCSD, GPRS, EDGE.

HSCSD:

HSCSD stands for High Speed Circuit Switched Data. It was standardized by the ETSI in 1997, before becoming available for commercial purposes in 2000. It's a GSM upgrade that provides the user with more than one time slot in the multiplex. The capability of this system is actually equivalent to tying two or more phone lines together and aggregating their capacity (Dornan, 2001). Each HSCSD channel has a data rate of 14.4 Kbps and the system allows up to four systems to be tied together, providing a 14.4*4 = 57.6 Kbps (Table 2).

The purpose of HSCSD was to bring data into the mainstream of GSM through (Garg, 2002):

- Faster web-browsing,
- File downloads,
- Mobile video-conferencing
- Vertical applications
- Telemetry
- Bandwidth-secure LAN,
- Etc…

However, HSCSD uses too much bandwidth, which makes it is very costly (4-8 times the cost of a regular call) and presents an overheating problem with the terminals – some of the early full-rate terminals were reported to have burst into flames (Dornan, 2001). These factors made the standard very unpopular among users and operators.

A few years later, GSM launched a new, more efficient standard, GPRS - which contributed to the provision of quality high speed services and subsequently, to the popularity of GSM standards.

GPRS:

GPRS stands for General Packet Radio Service, and when it comes to Wireless Internet, it's the most popular among operators. It was originally designed for data. It promised to provide every user with a permanent and high capacity connection to the Internet –

reaching a theoretical maximum of 115.2 kbps (Table 2), using TCP/IP or X.25. This standard was originally supposed to be an upgrade to all TDMA-based systems; instead it only functions with GSM. It actually extends the packet capabilities of GSM to higher data rates and longer messages as well as supporting point to point and point to multipoint messages. A very important technical aspect of GPRS is that it uses packet switching, which is more efficient than circuit switching for most data applications used by regular GSM and HSCSD systems. More specifically, with GSM and HSCSD, users must have a full circuit of at least 9.6 kbps open for the entire time their online – which does not really make sense when we know that users spend more time reading web pages than transferring information (Dornan, 2001). Although circuit switched is known to ensure better QoS – Quality of Service – the process lacks efficiency for the user who ends up paying for idle connections, as well as for the operator who ends up losing on other opportunities due the non availability of this amount of spectrum. On the other hand, packet switching allocates data only when needed, while emptying gaps in the data stream to make them available for other potential users. Furthermore, GPRS allows a 14.4 kbps to be shared by hundreds of users as long as they do not try to use it all simultaneously. Each user has a continuous connection at a very low data rate-maximum of 0.1 kbps- and when one receives, sends, or tries to access information this data rate escalates to higher speed. The very high level of efficiency of this system requires devices to be able to handle all eight time slots at once. In other words, GPRS requires operators' substantial new investments, including new terminals and the construction of an entire new backbone network. The result is a modification of the existing telephone system into a system more similar to the Internet (Dornan, 2001).

Surprisingly, these heavy investments have not discouraged operators to adopt GPRS technology - primarily because 3G technologies is supposed to be mostly based on packet switching, meaning that these GPRS investments can later be reused. So far, there are 166 GPRS networks in service worldwide (WEI, 2003), including in Canada Microcell Telecom and Rogers AT&T Wireless who respectively launched GPRS services in September 2001 and January 2002.

GSM has extended its capabilities by recently introducing an even more powerful upgrade: EDGE standard. It makes the provision of 3G services over the existing 2G GSM network infrastructure a reality.

EDGE:

EDGE stands for Enhanced Data for Global Evolution, a technology that gives GSM the capacity to handle services for the 3rd generation of mobile telephony. It offers 3 times (Edge Platform, 2004) the data capacity of GPRS, allowing GSM operators to actually present high speed Mobile Internet services over the existing infrastructure, with a bit rate that may exceed 384 kbps for a good quality of a radio transmission link. As such, EDGE operators can handle three times more subscribers than GPRS while presenting each one of them with three times their available data rate or even add extra capacity to their voice communications. This system uses the same TDMA frame structure, logic channel, and 200 KHz carrier bandwidth as today's networks (EDGE, 2004), allowing

the existing cell plans to remain intact. To date, 5 operators have already launched EDGE (GSM Association, 2004), including the AT&T Wireless group in the U.S.

The early standardization of GSM, as well as its continuous standard upgrades – for the provision of better quality and services – combined with the fact that these upgrades are all backward compatible have made service usage over GSM networks quite convenient to the end-user.

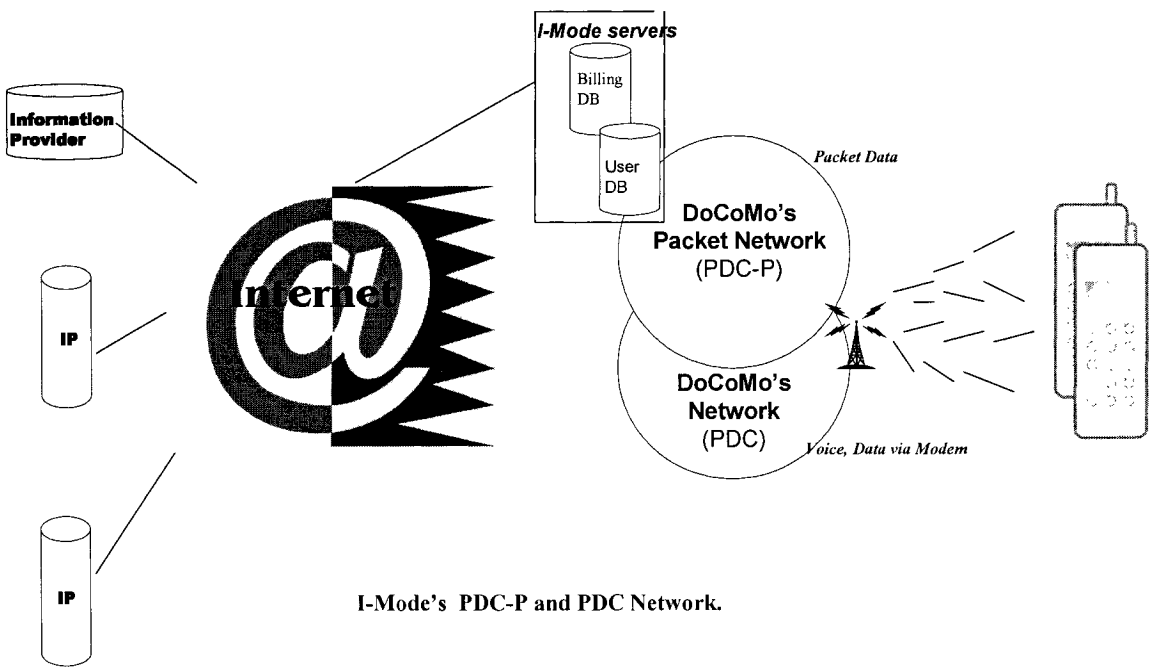
European countries are not the only ones using a very popular TDMA-based system. Japan has also implemented a TDMA-based standard, PDC - Personal Digital Communication, which is the only 2G standard deployed by Japanese operators. PDC is the second most popular standard in the world; however, as it will be demonstrated below, this huge popularity is essentially due to the amazing success of NTTDoCoMo's I-Mode service.

PDC:

PDC, Personal Digital Cellular or JDC, Japanese Digital Cellular is a Japanese standard that was originally designed based on D-AMPS or TDMA, making it backward compatible with the Japanese J-TAC analog system. This standard is the second most popular standard in the world, after GSM. This huge popularity is mostly due to the amazing success of I-Mode. Japan is a very crowded country; therefore, the deployment of small cells is not perceived as a problem but more as an alternative. In fact, operators try to make cells as small as possible in order to provide the highest density coverage.

However, the downside is risks of interferences and bad handovers restrict the cell size of any system to a minimum practical limit. As a result, PDC systems had already run out of capacity by the year 2000. To counter this, operators, such as NTTDoCoMo, introduced packet switching to use the existing capacity more efficiently. To better understand this mechanism, a closer look at NTTDoCoMo's I-Mode Network functionality, portrayed in the figure below is needed.

Figure 9
I-Mode's Network Functionality



I-Mode's PDC-P and PDC Network.

The radio network linking the subscriber to I-Mode uses a packet switched network (*packet-based network,* PDC-P) and a circuit switched network (*circuit-based network,* PDC), respectively (Natsuno, 2003) for data and voice transmission.

Hence, the packet switched network allows the user to always have a connection, but to pay only for what he/she sends or receives.

The I-Mode network also allows the user to receive information from a service to which he/she has subscribed. This particular information is sent from the content provider to the I-Mode server, who validates the request before delivering it to the recipient through the packet switched network (Figure 9).

The amazing popularity of PDC is attributable to the way Japanese operators – primarily NTTDoCoMo with its I-Mode service – have custom made the standard to better fit their respective needs and customer's expectations (to provide the best standardized and homogeneous experience to the end-user), and not to a technical superiority (Table 2) of the PDC system.

To follow along these lines the next section presents an analysis of the North American 2G technologies – and the potential impact on M-Commerce adoption, through a completely different system than the ones presented above. Although North America deployed many 2G systems, 2G CDMA – that is CDMAOne - represents the continent's dominant 2G technology.

2G CDMA:

CDMA, a North American initiative, stands for Code Division Multiple Access. It has been around for a long time; even before mobile phones and computers. However, it was not before the late 1990s that it was used for cell phone networks.

These innovations in CDMA networks were first essentially initiated by Qualcomm and are now under the supervision of the CDG (CDMA Development Group) Group (CDG, 2004). The only CDMA system that was used during the twentieth century - which is also the only 2nd generation of CDMA - is CDMAOne or IS-95. This standard was deployed in two steps, first there was IS-95a, followed by IS-95b (Black, 1999).

- IS-95a:

The basic idea behind CDMA systems is that each signal is sent individually. In order to allow the receivers to identify the proper signal, each signal has a separate unique coding. The RF channels are 1.25 MHz wide (Table 2). In order to provide high transmission data rate, it uses respectively for downlink and uplink, QPSK (Quadrature Phase Shift Keying) and OQPSK (Offset Quadrature Phase Shift Keying) - two phase modulation techniques. The raw speed for downlink is a regular 19.2 kbps. Whereas the uplink raw speed must be higher because it requires more forward correction error, since phones cannot coordinate their transmission as base stations would. This extra correction raises the uplink to 28.8 kbps. A remarkable specification of CDMA systems is that they present no slot or frame structure. Every phone transmits and receives all the time, sending many duplicates of the same information to ensure that at least one gets through. The gain – the name given to the number of duplicates - depends on the channel bandwidth and the length of the code used. CDMAOne uses the Walsh codes, a set of 64 numbers, each 64 bits long, which have been calculated to cancel each other out (Blake, 2001; Dornan, 2001). This means that every bit is sent 64 times, making the overall data rate for the phone 64*19.2 = 1228.8 kbps.

At first, the process of sending each bit 64 times might appear to be extremely costly, but a closer look demonstrate that the same channel can be used by several different phones and by every base station. This means that adjacent cells can use the same frequencies, unlike TDMA, PDC and GSM systems – allowing an operator's entire allocation to be used by each cell. This last point is enough to consider CDMA as incredibly efficient in terms of spectrum use.

The second step of CDMAOne was to bring data into the mainstream of IS-95a, resulting in IS-95b.

- IS-95b:

IS-95b - an improved version - was developed shortly after IS-95a. Basically, IS-95b systems offer 64 kbps packet-switching data in addition to IS-95a voice services. This system reaches in practice a maximum of 240kbps (Table 2) and is therefore categorized as a 2.5 G technology. IS-95b was first deployed in 1999 in Korea.

This evolution from IS-95a to IS-95b, and the technical features and functionalities of CDMAOne makes the standard quite interesting to wireless telecommunication organisms and mobile operators who find it efficient and powerful enough to adopt it as core technology of all 3G systems.

Now that the technological functionalities of each standard have been presented and defined:

- GSM for Europe,
- PDC/I-Mode for Japan,
- CMDAOne/IS-95 for North America,

a comparative analysis of these 2G systems can be conducted, in order to determine whether the North American leadership loss and the slow adoption of M-Commerce is attributable to a lack of appropriate technology, compared to Europe and Japan.

4.1.2- 2G Technologies Comparative Analysis

From a market penetration perspective, comparing and rating these three major second generation technologies would give the following results: GSM is the most popular one, PDC is the second, and CDMAOne is the last.

However, from a technological environment perspective, comparing which one is really the best, and identifying the advantages that they respectively have to offer, would exclude PDC and narrow the competition to GSM and CDMA systems. In fact, PDC is similarly to GSM, a TDMA-based technology, and as was shown in the above section, this Japanese standard has reached its maximum capacity a few years ago, making it unfit to compete with GSM and CDMA. The fact that PDC is still spreading is due to the way Japanese operators individually modified and complemented the original system, through packet switching, in order to use more efficiently their existing capacity. Particularly, PDC's success is primarily due to NTTDoCoMo's I-Mode. This amazing 2G mobile Internet system provides users with access to thousands of web pages with interfaces that were specifically designed and modified to perfectly fit the mobile screen phone through a simple data connection of approximately 9.6 kbps. However, I-Mode is a product, a business model, and does not fit in the same category of technologies as GSM and

CDMA.Therefore, it would be inaccurate to directly compare the technological capabilities of this service to the technological capabilities of the other two standards: GSM and CDMA.

The tremendous success of GSM can be attributed to the fact that it is easily upgradeable to higher data rates and all of these upgrades are backward compatible. GSM is also reputed for providing a very high voice quality as well as better roaming and better coverage than most of the other systems. Another key element in the popularity and convenience of GSM is the replaceable and transportable SIM card (table 3). This last point provides convenience and ease of use to the GSM subscriber allowing him/her to freely change and switch phones when and where he/she likes, without the operator's involvement.

On the other hand, there is 2G CDMA, which is mainly used in North America and which did not encounter a success even remotely close to GSM's. However, when analyzing CDMAOne's technology, we can see that it is quite powerful. It offers many advantages on certain technical aspects that make it in some cases appear superior to the other technologies (Table 3).

Actually 2G CDMA is more efficient in terms of spectrum than any TDMA-based system. The system is generally faster than GSM due to its higher data speed.

Table 3
2G Systems Quality of Service Comparison

	GSM		PDC	CDMAOne / IS-95	
Width per Channel (KHz)	*200*		*25*	*1250*	
Calls per Channel	*8*		*3*	*± 15*	
Speed rate per call: Kbps/call	*14.4*		*9.6*	*16*	
Maximum Data Speed (Kbps)	*GSM*	*14.4*	*14.4*	*IS-95a*	64
	HSCSD	*57.6*			
	GPRS	*115.2*		*IS-95b*	240
	EDGE	*384*			
SMS Message length (Bytes)	*160*		*160*	*256*	
Networking Protocol	*GSM-MAP*			*ANSI-41*	
Quality of Service & Advantages	**Easily Upgradeable**			**Efficient Spectrum Use**	
	BackwardCompatibility			**Faster Speed (High speed data)**	
	Better Roaming			**Less calls dropped (Soft-handoff)**	
	Better Coverage			**Long run: Cost-effective**	
	Replaceable & transportableSIM Card				

Furthermore CDMAOne allows for fewer calls to be dropped (Table 3) due to the fact that it uses soft handoff to handover calls – allowing the user to use bandwidth on multiple base stations at the same time. This ensures that a link is setup to the base station in the new cell before the old one is torn down; enabling a seamless handoff process without service interruption. At the other end of the spectrum, GSM and TDMA use other types of handovers – such as hard handoff where the user is using bandwidth on only one base station at a time. This requires a phone to break its connection with one base station before connecting to another and making it less reliable than soft handoff since the phone is not always able to establish a new connection. As a result, there is an increase in the risks of noticeable interruption in service. CDMA's initial investment might seem very expensive, but on the long run it all appears to be cost effective.

It is obvious that both 2G GSM and 2G CDMA are great technologies - from a technical point of view very comparable, and it would be erroneous to state that GSM is anywhere near superior to CDMA.

Nevertheless, the popularity and the respective number of users using these technologies show otherwise. Why and what causes the adoption of GSM to be such a success and CDMA to lag behind? One of the reasons is the fact that GSM was commercially available for more than a decade prior to CDMA, and by the time CDMA was deployed, GSM had already spread around and moved on. Another very important aspect that was determining in the success of GSM is its early standardization by European governments. GSM is basically the only 2G standard in use all around Europe.

The European Union watches closely what is provided by the operators, providing them frequently with legally binding directives on what services should be offered and how. This behavior, although denounced by some people as protectionism from EU – European Union - is working to the advantage of the GSM technology as well as to its subscribers - Two different European users, from different countries, with different carriers, will have similar Quality of Service and user experience; whereas for CDMA, although a great technology, is one of the many standards deployed in North America. The North American freedom value and the continuous search for a pure and perfect competition put the government on the side, leaving operators the freedom to use what they wanted, the way they wanted. There has not been any standardization efforts raising many different issues including many compatibility problems - People must change phone when switching operators and two individuals, subscribed with two different carriers are more likely to have different user experiences from similar services. This confused and messy environment is definitely playing to the disadvantage of a great technology like CDMAOne.

Based on the above 2G analysis, one can conclude that North American 2G systems are not technologically inferior to European and Japanese 2G systems, and therefore, are not the reason for North American leadership loss and slow M-Commerce adoption. Nonetheless, M-Commerce is deployed over 3G network infrastructure. It's a 3G technology providing 3G services.

Hence, to determine whether the slow M-Commerce adoption is attributable to technological inferiority- that is to sustain or reject the 3rd hypothesis, we must also conduct a technological analysis and comparison of 3G systems deployed in North America, Europe and Japan.

4.2- 3G Systems

Today, the wireless telecommunication industry's goal is to provide users with access to any service, anywhere, anytime, leading to a 3rd generation of systems. In fact, 3G networks aim at offering wireless services with better performance, greatest cost effectiveness, and substantially more content. The following section starts by describing the major 3G systems first deployed world wide. Then, it compares these systems to establish whether they have an impact on the adoption of M-Commerce.

4.2.1- Technologies Presentation

This discussion is narrowed to the four most popular 3rd G standards that have already been deployed by a limited number of operators. Three of these systems – CDMA2000 and its upgrades - are an American initiative following 2nd generation CDMAOne. The fourth one is a European initiative, also known as 3GSM.This 3G technology is also the one deployed by Japanese mobile operators, such as NTTDoCoMo.

All of these standards are based on CDMA - Code Division Multiple Access, and support 3G services as defined by the ITU for the IMT-2000 - the global standard name given to all 3G standards (IMT 2000, 2004).

North America welcomed the transition to the 3G era with the upgrade of CDMAOne into 3G systems. In other words, the creation of new 3G standards. These standards presented below are an American initiative but their deployment is not mandatory in North America.

CDMA 2000:

CDMA2000, a North American initiative, is a 3G technology that has evolved from CDMA 2G technologies (3GPP2, 2004) – it's an upgrade of CDMAOne. CDMA2000 is supposed to be deployed in 3 phases: phase 1: CDMA2000 1X, also known as IS-2000 standard (CDMA2000, 2004); phase 2: CDMA2000 1xEV, which comprise CDMA2000 1xEV-DO; and finally phase 3: CDMA2000 1xEV-DV.

CDMA2000 1X:

1X refers to CDMA2000 implementation within spectrum allocations for CDMAOne (Phone Scoop, 2004). It reuses the same 1.25 MHz (Table 1) carrier as CDMAOne. 1X stands for 1*1.25MHz. This system has a maximum packet data speed of 144kbps and its voice capacity is twice the one previously offered by IS-95.

CDMA2000 1X can be implemented in existing or new spectrum allocations. In September 2003, there were over 60 commercial networks worldwide.

CDMA2000 1xEV:

EV refers to the evolution of CDMA2000 beyond 1X and is divided in two steps:

- CDMA2000 1xEV-DO:

1xEV-DO stands for 1X Evolution Data Only. It requires a separate carrier to handoff to the1X carrier - if simultaneously voice and data services are needed. Moreover, by allocating a separate carrier for data, operators will be able to provide excess of 2Mbps to their customers (Airvana, 2003). To date, four wireless operators have already launched 1xEV-DO service.

- CDMA2000 1xEV-DV:

1xEV-DV stands for 1X Evolution Data and Voice. This system is expected to bring data and voice services for CDMA2000 back into one carrier. 1xEV-DV carrier will provide simultaneously high speed data and voice, as well as the ability to deliver real-time packet services.

Both 1xEV evolution standards also use a common 1.25 MHz carrier for the provision of advanced services in CDMA2000. So similarly to CDMA2000 1X, they reuse the same 1.25 MHz (Table 1) carrier – as in CDMAOne (Ganesh & al., 2000).

Each of these 3G CDMA standards is an upgrade of the 2G CDMA systems that were previously launched. In other words, all these systems are CDMAOne upgrades. They are all backward compatible with each other - and any evolution with CDMA2000 will continue to be backward compatible (CDG, 2004).

CDMAOne and CDMA2000 upgradeability and backward compatibility is a big strength and advantage for North American 3G systems. On the other hand, Europe has welcomed the transition to the 3G era with the creation of a new 3G standard – WCDMA - compatible with 2G GSM. WCDMA is based on CDMAOne, and has CDMA as its core technology. However, to avoid any confusion with North American 3G standards, CDMA2000 has recently adopted the name 3GSM. WCDMA's implementation is not exclusive to Europe, Japan – notably NTTDoCoMo has also launched W-CDMA technology for the provision of 3G services.

W-CDMA or 3GSM:

W-CDMA, Wideband CDMA – a European initiative - is known as the most popular 3G system within operators trying to obtain new spectrum (3GPP, 2004). It was designed to be compatible with GSM and to allow handovers with GSM. However, it is not an upgrade of GSM, but a completely different system. Nevertheless, some GSM components such as GPRS backbone can be reused in W-CDMA.

Wideband refers to a channel bandwidth of 5MHz, which is quite impressive since it represents 4 times CDMAOne and 25 times GSM. A down side is that even with the best available conditions, operators who have deployed W-CDMA believe they can, in practice, only reach a maximum speed of 384 kbps. W-CDMA uses the same core technology as CDMAOne with some different specification and parameters, making it more advanced and efficient. Actually, unlike CDMAOne who automatically sends every bit 64 times, W-CDMA adjusts the gain – the number of duplicates - depending on the signal strength. Every bit is sent between 4-128 times, which means that greater bandwidth is available in areas with stronger signal. Since W-CDMA is a CDMA-based system, each channel is reused by every cell - increasing the spectral efficiency, and allowing soft-handoff. This makes handovers quite difficult with 2G GSM, since it does not support soft-handoff. This last element can represent a future problematic factor of 3GSM as the demand for 3G services will increase.

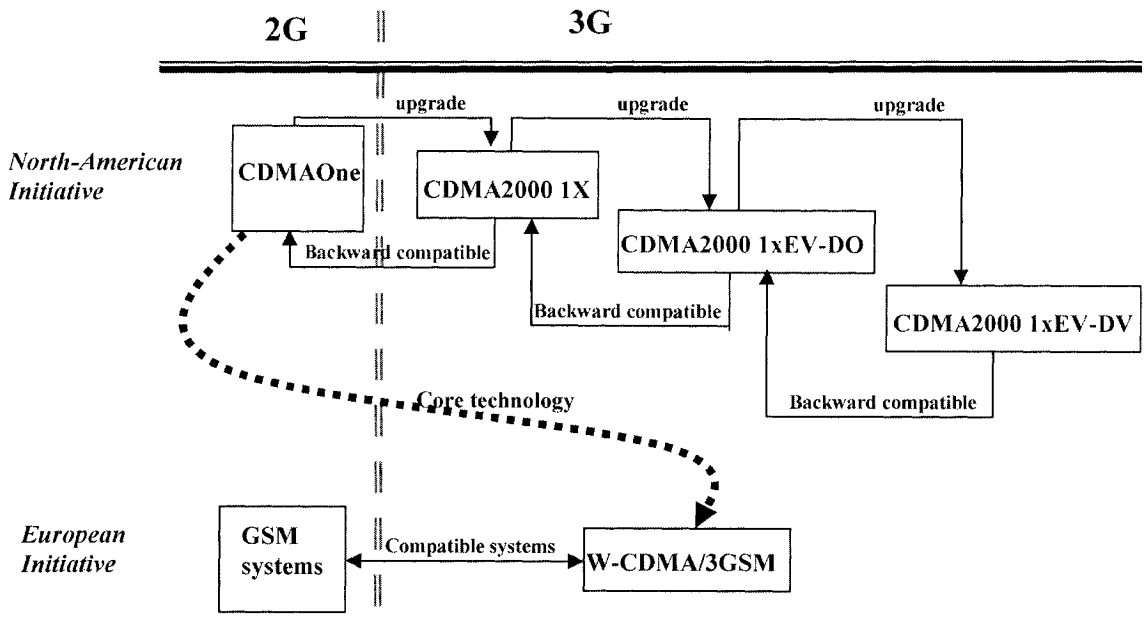
Presently, 11 W-CDMA networks have already been deployed (WEI, 2003).

This above 3G technology description enables a better understanding of the systems implemented in North America, Europe and Japan. We notice some technological similarities as all of these systems are CDMA-based. In order to determine if the North American 3G standards are technologically inferior to European and Japanese 3G standards, a comparative analysis of CDMA2000 and W-CDMA (3GSM) needed to be conducted. The results and conclusions are as follows.

4.2.2- 3G Technologies Comparative Analysis

When comparing the market penetration of these 3G standards, one will notice that W-CDMA or 3GSM is far more popular than CDMA2000 systems. Actually, out of the 120 licenses awarded worldwide for 3G, 118 operators have already declared that they will deploy W-CDMA.

Figure 10
3G Technologies Functionality Scheme



However, from a technical point of view, 3GSM is definitely not superior. In fact, W-CDMA is not an upgrade of 2G GSM. These are two separate and different systems that were designed to work together and to be compatible. Cdma2000 is an upgrade of CDMAOne. It is the same system that has been enhanced and is backward compatible (Figure 10) - which makes it less likely to encounter problems with CDMA 2000 than with 3GSM.

Another important aspect is the fact that 3GSM - like any other CDMA-based technology - allows soft-handovers, whereas 2G GSM does not allow soft-handoff. Although, this might not appear to be a serious problem now, the risks and number of call drops will increase as the number of users will increase. This will raise serious concerns with the 3G European system: when a voice call is dropped although very unpleasant to the user, it is still easy to call back and continue the conversation where it was left off. Whereas when a data call, such as a transaction, is dropped - despite the fact that an interruption is less likely to be noticed due to the bursty nature of data - one must resend it from scratch. This can be a relatively big inconvenient and concern to the user.

However, it is less likely to happen with CDMA2000 or even CDMAOne systems, as they support soft-handoff, which minimizes the risks of any call drops.

Surprisingly, W-CDMA is already experiencing a great popularity compared to CDMA2000. This can be attributable to the fact that GSM was already experiencing the biggest 2G market penetration, making W-CDMA's early popularity a normal continuation since it makes more sense to 2G GSM operators to naturally adopt 3GSM. A great example of a W-CDMA system's success is the Japanese service, NTTDoCoMo's FOMA.

FOMA:

In October 2001, NTTDoCoMo launched FOMA (FOMA Technology, April 2004) - a W-CDMA service system, providing the end-user with mobile video and high-speed data transmission. Actually, 3G FOMA uses a high speed packet transmission with a reception speed of up to 384 kbps, which adds significant convenience to web-browsing and e-mail. Also, the data transmission of 64kbps is quite appropriate and convenient when sending high-volume data in real time - such as sending an image. Nevertheless, FOMA also provides high quality of voice and services through a speed rate of up to 12 kbps.

I-Mode's services are also more advanced with the use of FOMA technology. In fact, 3G FOMA has made I-Mode quite faster and able to handle larger volumes of data (FOMA Service, 2004), such as the ability to write e-mails with a maximum size of 10, 000 characters as well as attaching files of still images and melodies.

So the question asked is whether the success of FOMA is due to the fact that it uses a W-CDMA technology – hence a technological superiority of W-CDMA - or because it is an initiative of NTTDoCoMo. Once again, like with I-Mode, the Japanese operator has developed this amazing product, and business model, enabling the provision of standardized, homogeneous, and convenient services, better fit to the end-user. In other words, this success is not due to the technology alone, but also to the environment and model around it.

The answer to the above question is that the success of FOMA is obviously due to NTTDoCoMo's efforts to provide standardized, homogeneous, and convenient services, better fit to the end-user needs, and not to the technological superiority of W-CDMA.

Based on these above 2G and 3G analyses, one can confidently conclude that North American systems are not inferior to the ones deployed in Europe and Japan. M-Commerce slow adoption in North America is not linked to the efficiency, performance, and/or powerfulness of the technologies; hence, the 3rd hypothesis is rejected.

Part of the success of a technology is the way it is implemented. No matter how innovative, a technology must be delivered to the consumer within a solid business model. In addition, it is a safe assumption to say that the best available technology is not necessarily the most successful.

Through these hypotheses analysis, one factor keeps on coming back: standardization and homogeneity. The findings of this study keep showing that North American technology and services lack standardization. Western Europe has standardized and regulated its technologies and services providing users with homogeneous, convenient usage experience. The same can be said about Japan, where NTTDoCoMo's I-Mode – which is not a standard – has standardized its technology and services with its partners to allow the provision of standard high Quality of Services to all its subscribers. Whereas, in North America, there has been no real standardization and regulation process of the deployed technology and services. There is no high authority truly controlling what type of technology should be used, in what manner services should be offered, and what specific spectrum should they be deployed over. Hence, there is a technological uncertainty in North America caused by the technical complexity, mainly multitude of devices,

networks, standards and protocols, and architectures (Gartner, 2001).This lack of standardization appears to be one of the main reasons for the slow adoption of M-Commerce in North America.

The following section will provide an analysis of the 4th fore mentioned hypothesis, by evaluating the importance of the standardization process and whether its presence or absence can determine the success or failure of technologies and services.

5- Lack Of Standardization In The Deployed Technologies and Services

Hypothesis 4:

The lack of adequate systems and services standardization has a negative impact on North American M-Commerce adoption.

The term standard technology, in the world of global telecommunications, usually refers to an official document, meaning that the technology has been officially recognized by the United Nations. The traditional definition of the standardization process of a telecom technology will begin when ITU members (members of the United Nations) who represented by their respective governments and or major industry players –

FCC, AT&T, Qualcomm, France Telecom, British Telecom, etc... - negotiate and agree on a standard. This means that they develop a scheme to achieve this standard. However, standardization does not only refer to the process of standardizing a technology to make it a standard. Standardization occurs when organizations decide to standardize upon specific things, which means that they have agreed to certain things and specifications. These specifications define the environment in which a technology or service will be offered in order to coordinate and integrate seamlessly the role of the different players and the different activities involved. This affects and impacts the successful deployment of this technology or service. The purpose is to satisfy the new adopters of this technology/service and to attract potential new users through the provision of high Quality of Services, hence facilitating a high level of adoption. In other words, the process of standardization does not exclusively apply to official ITU standards, and a standard technology recognized by the United Nations can lack adequate standardization if its deployment is not well studied and regulated – that is if it lacks appropriate specifications to meet the customer's needs, expectations, and concerns. In this section, emphasis will be put on the importance of a complete and accurate standardization process in order to determine the level of impact it could have on the successful adoption of a technology/service, such as M-Commerce in North America.

In this line of thinking, the following section is a comparative analysis of two well known systems: WAP – which is an official standard recognized by the ITU, and I-Mode – which is not a standard but a service provided by the Japanese mobile operator NTTDoCoMo.

5.1- 2G Internet-enabled Systems Presentation

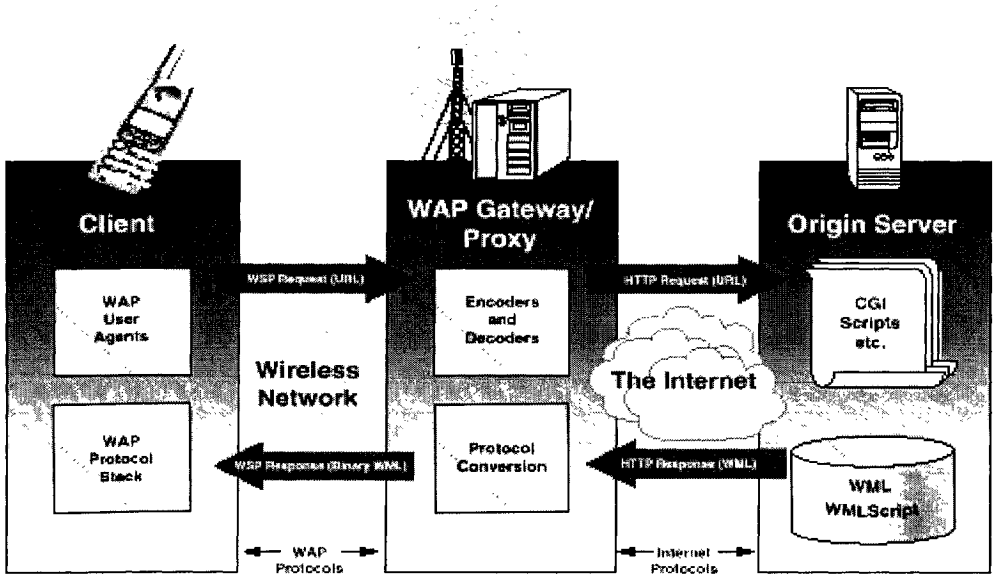
These two 2G systems – WAP and I-Mode - although different with respect to their technological functionalities, are on other levels very similar since they both intend on enabling the user with Internet based services through an always on connection.

WAP:

In 1997 Ericsson, Motorola, Nokia, and Unwired Planet took the initiative to create the WAP Forum. The purpose was to bring the convenience of the Internet into the wireless population. This forum has expanded in the industry - as some of the world's leading telecommunication companies have joined in, and today the number of members exceeds 500. WAP - Wireless Application Protocol - is actually a specification to present and interact with information on wireless devices.

The WAP Forum (WAP Forum, 2004) tried to develop a standard scaling through a wide range of networks and devices. This is done by trying to address the wireless environment constraints and trying to meet these constraints while modifying and adapting the existing Internet telephony.

Figure 11
WAP's Network Architecture



Source: WAP Forum, 2003

WAP's network functionality is based on regular Internet. In fact, it uses the same technology as wired Internet but modifies and adapts it to fit and adjust with the mobile Internet environment (Figure11).

It modifies Internet's TCP and HTTP protocols to handle low bandwidth and high latency. Internet's web pages and services are developed using HTML markup language. However, the limited size of mobile device screen restricts HTML's applications from being properly displayed and made available to the end-user. Therefore, WAP forum invented WML – Wireless Markup Language, a markup language based on HTML but modified to better handle Internet content display on wireless devices. WML simplifies traditional web navigation process by reducing the number and size of input facilities.

Furthermore, WAP enables more efficient bandwidth usage by encrypting WML in compact binary language. This encryption is conducted through the WAP Gateway/Proxy which is responsible for connecting the wireless domain to the Internet. WAP also enables the provision of more advanced features and functionalities - similar to those handle by Internet's JavaScript HTML – through the WML Script. This last entity extends WAP based service capabilities through procedural logic and computational functions addition.

From a pure technological perspective, one will notice that in the WAP network design, functionality and capability are very advanced and efficient. But this great technology did not reach the expected level of popularity and this lack of success is attributed to other aspects of WAP environment. In fact, when looking at the standardization efforts deployed to spread this standard, it becomes apparent that the process is quite incomplete and presents many flaws which could be the reasons behind the slow adoption of WAP. For instance, the implementation of commercial services using WAP in Japan is quite different than in Europe - The user experience, commercial models and handset characteristics are different. WAP cannot be recognized by one specific implementation. The user experience involves factors that are specific to a particular implementation and not dependent on WAP specification (Pentikousis, 2001). The current WAP content tends to be carrier specific since there are no strict guidelines on the deployment, and handset compatibility issues arise (ACM, June 2000). These concerns, resulting from the lack of standardization, affect the level of adoption of WAP technology and services by users. Another important aspect that might play to the disadvantage of WAP technology is its billing system – which can be attributed to inadequate control and regulation,

and therefore to the lack of standardization. WAP provides similar services to the ones offered by I-Mode (Batista, 2002), messaging services, banking, news, games, etc... The standard also offers a specialized category of services called WAT - Wireless Telephony Application. WAT permits a direct access to Telco primitives such as call management and messaging. This application gives users the ability to decide the way each call, including text and voice messages, is to be handled. This also gives the ability to determine how these text and voice messages are accessed in a unified manner. The primary purpose of WAP is to utilize these great features and services in order to provide a constant connection to the Internet. However, WAP's billing system is time-based (Boulton, 2001), and there is no billing specification or price regulation since mobile operators can freely decide on the amount to be charged. Once again, the user experience can differ from one mobile operator to another as the prices for the same accessed/requested information can substantially differ.

Furthermore, the fact that most billing is time based might discourage user from launching into WAP services as they end up paying for idle connections – which is not logic for an always on service connection.

At this point, it is tempting to conclude that the lack of popularity of WAP is due to its lack of standardization. However, before making this affirmation, in order to determine and compare WAP and I-Mode failure/success factors, we must look at I-Mode - which is encountering an amazing success through the provision of services similar to WAP's. We will analyze I-Mode's standardization process and the impact it has on its popularity.

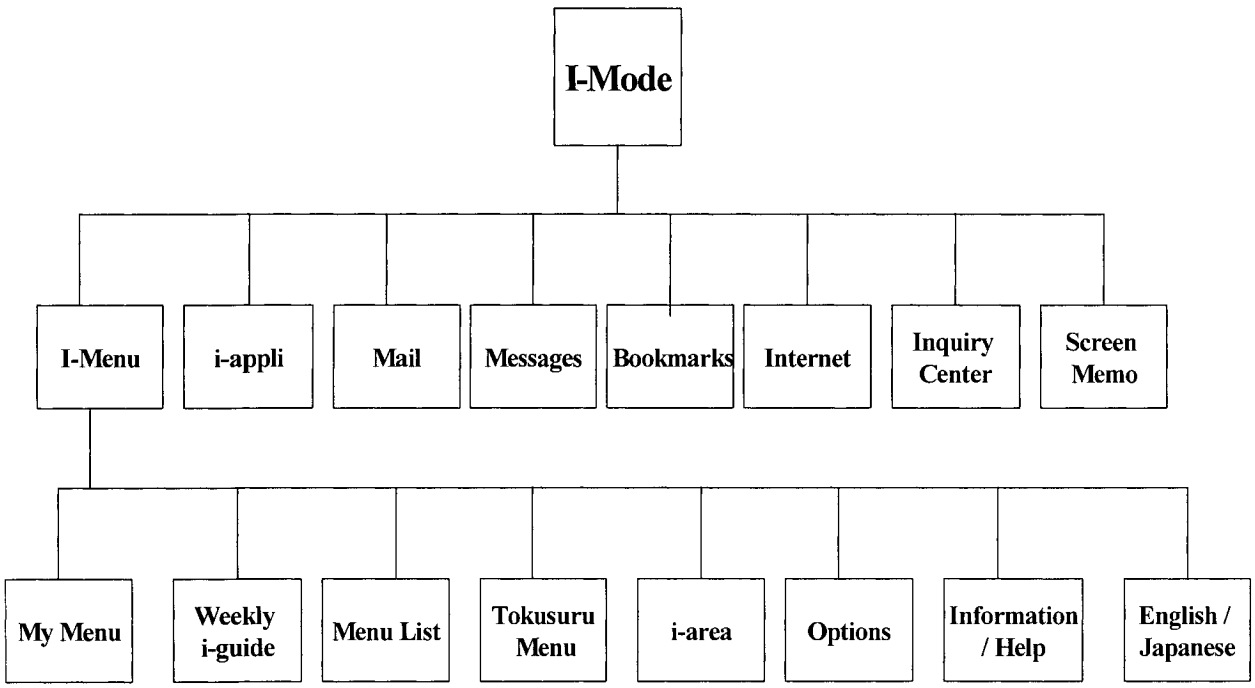
I-Mode:

I-Mode is not a standard. It is referred to as a product and a business model. I-mode is a mobile Internet service launched in March 1999 by Japanese operator NTTDoCoMo. Nowadays, it amounts to 30 million subscribers, which represent 60% of the Japanese market, which is also 80% of the world market (Megler, 2003). This number is increasing at a rate of 50,000 users a day (as more and more services are available). In terms of its business model, I-Mode has a clear advantage through synchronization of content and services with the handsets. Not only does NTT have regulations on content, but it strictly defines how much these services may cost users.

Due to their relationship with handset manufacturers NTT was able to impose handset specifications to complement the design approach they were adopting for I-Mode.

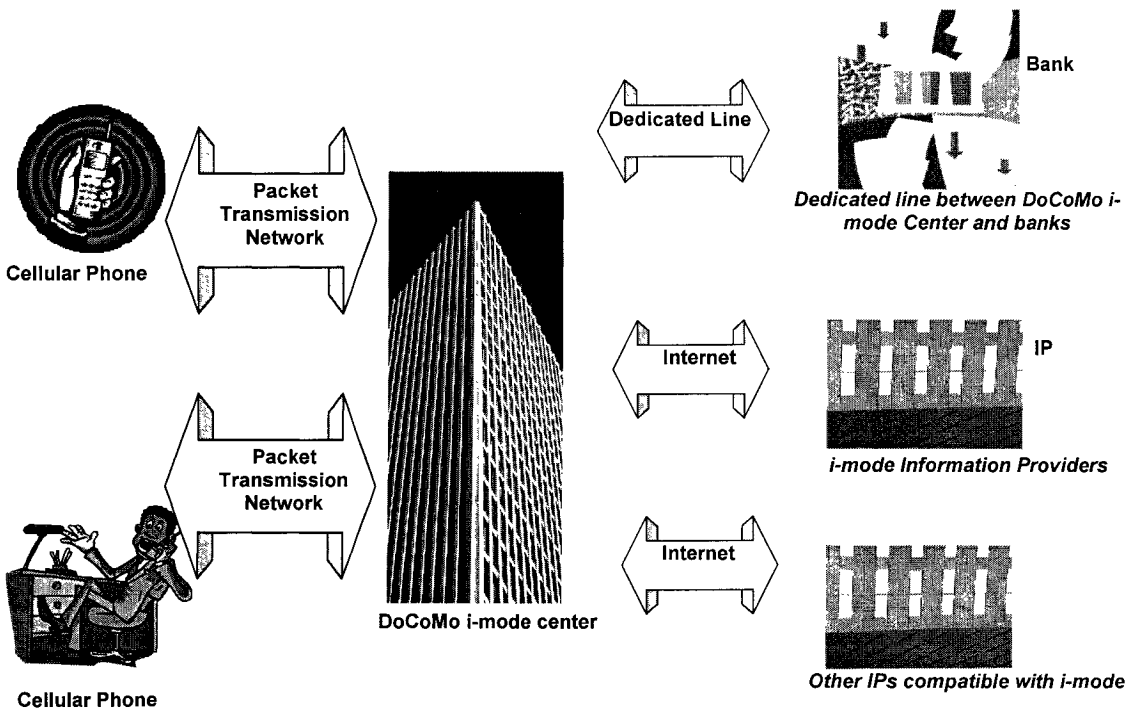
I-mode connects its mobile subscribers to a big number of online services (Figure12) varying from e-mail, e-banking, stock markets, local, international news, etc... In order to connect to the NTTDoCoMo I-Mode portal (where all the services are listed), the user (who has an always on connection) will have to press on the 'i' button of the mobile device and the Internet menu of the I-Mode portal will appear (Figure12).

Figure 12
Graphical Representation of I-Mode's Basic Service



I-Mode system is proprietary; however, the content providers can create their own I-Mode site, which will be accessed through an Internet URL. This last element is very important since it allows the consumer to have access to a large fan of services and products. The users are not limited by the sites available on the I-Mode portal. It is also to be noted that every subscriber has an e-mail address which is the phone number followed by the extension "@docomo.ne.jp".

Figure 13
I-Mode's Network Structure



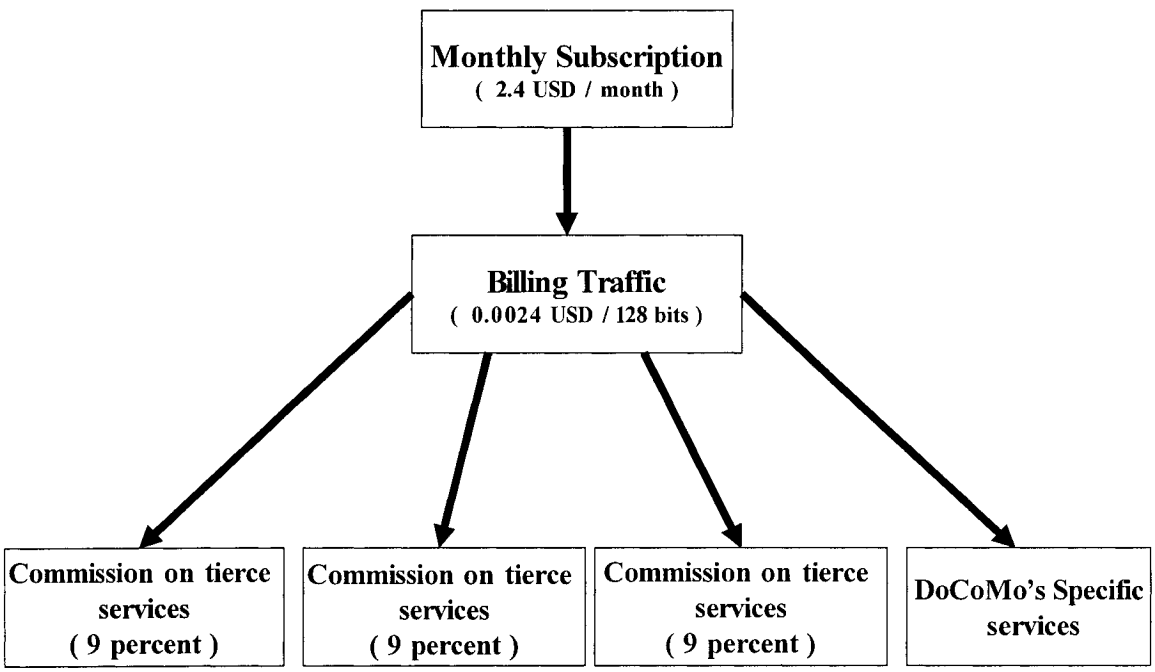
NTTDoCoMo's I-Mode center conducts all the functionalities, such as connecting to sites, receiving messages, transmitting e-mails, running programs (NTTDoCoMo, 2004). In addition, I-Mode's system presents three types of providers (Figure 13):

- Banks: with whom the I-mode service establishes a secured and dedicated connection,
- I-Mode service providers: who are listed on the I-Mode portal (they have partnership contracts with DoCoMo),
- Independent content providers: who have adapted their web sites to the I-Mode standard and can be reached through their Internet URL.

Initially the strategy was to target young people through the affordable use of services like short messaging, horoscope, ring tones etc ... It has penetrated the youth culture through personalized devices, changeable phone face, customized services etc ...

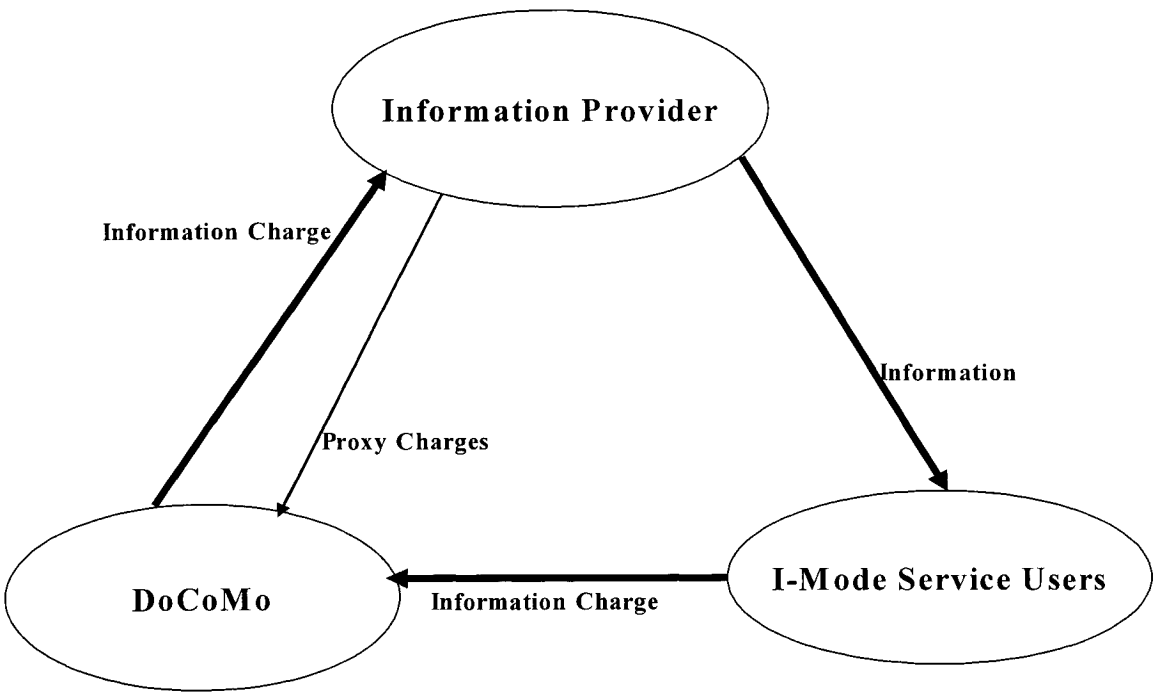
However, the success has also emerged on the adult market as the business world saw I-Mode become a workplace tool as well as a toy for personal use. An increasing number of companies offer their employees I-Mode devices for the purpose of interoffice and external communications.

Figure 14
I-Mode's Layered Billing System



A key factor in the success of I-Mode was the integration of the content providers in the money cycle. NTTDoCoMo does not commercialize many items, but instead relies on the creativity and innovation of the content providers to come up with catching content and applications. These 'services' can later be sold individually or through a subscription, and I-Mode takes 9% of all transactions (Figure 14).

Figure 15
I-Mode's Money Cycle



The subscriber pays NTTDoCoMo for the service he/she wants to use. NTTDoCoMo transfers that amount to the content provider who transfers back the 9% commission fees, and finally the content provider sends the content to the consumer (Figure 15).

This seamless integration provides convenient use that satisfies subscribers who end up using more service. This allows NTTDoCoMo to generate roughly 9 billion dollars from all fees and commission related to I-Mode – this includes revenues related to hardware sales (Gupta, 2001).

5.2- Comparative Analysis of WAP and I-Mode

WAP and I-Mode are two 2G Internet service based technologies who offer similar services. However, the first one deployed (WAP) experienced a very slow adoption, whereas I-Mode's number of adopters is increasing continuously. Moreover, WAP – which is a standard defined by the United Nations – lacks standardization. Actually, due to this lack of standardization, compatibility is a big issue of the WAP world. While creating this amazing standard, the WAP Forum missed the most important element in the success of such a technology: standardization. The system is inconsistent since it fails to achieve proper interoperability (which is due to the lack of proper standardization). Users cannot have the same convenience and user experience from one operator to another and they may not have the same display accessing a web page. There are no guidelines specifying how things should be done. Once again, similarly to the North American CDMA, this absence of rules and control is playing to the disadvantage of a great technology like WAP. Whereas, a technology such as I-Mode (which is not a standard) - who offers services similar to what WAP intended to do - is a huge success.

This is definitely due to the amazing standardization effort provided by NTTDoCoMo. DoCoMo does only rely on technology, but it creates an entire environment to make the user's experience as smooth, homogeneous and convenient as possible. The impact of standardization extends to other factors affecting the level of adoption of new technology or service. The lack of focus on the customer's needs concords with the lack of standardization of WAP. In fact, this resulted in a misalignment of needs and implementation. Otherwise, as we mentioned earlier, it would not have implemented a time-based billing system – which is an important aspect in the lack of popularity of WAP.

Once again, the WAP Forum has ignored a very important aspect when launching the standard. The focus was only given to technical elements, turning away from very important elements such as the economical viability of this system as well as the way it could appeal and attract consumers. After all, they are the ones deciding on the success/failure of a technology or a product by choosing to adopt it or not. It is quite contradictory to decide to revolutionize the wireless world by offering constant connection to the Internet, but on the other hand provide a time-based billing system. Subscribers end up paying even when they are not using the service, such as for idle connections. Whereas I-Mode's standardization focuses on the customer's needs. Services were adapted to the Japanese environment and way of life as NTTDoCoMo has pushed his I-Mode model beyond the technology. The fact that I-Mode's Internet access is far less expensive than wired connection in Japan, and its volume based billing system – that is the consumer only pays for what is being used - encourage repetitive usage.

WAP is not technologically inferior to I-Mode, but it lacks in popularity when compared to the amazing success of I-Mode. The reason being: its lack of standardization.

On the other side, I-Mode's standardization process aims at integrating seamlessly the different applications to provide the best Quality of Service. Therefore, it provides a higher level of customer satisfaction resulting in a higher level of adoption.

This study begs to conclude that standardization is a mandatory aspect for the success of a technology. Therefore, the 4th hypothesis is accepted; the lack of standardization of the systems in North America has a negative impact on the adoption of M-Commerce.

Based on this chapter hypotheses analysis, we can safely state that the regulatory reforms process that happened in the early 80s might have indirectly contributed to the North American 2G leadership loss but it is not the cause for the slow M-Commerce adoption in North America. Similarly, we find that the technology advancement in North America are not inferior to its primary competitors – Western Europe and Asia Pacific (more specifically Japan) – therefore the slow M-Commerce adoption in North America is not due to a lack of innovation and efficiency of the deployed systems. However, we notice that North America lacks adequate spectrum. The amount of spectrum available for the provision of today's myriad services – such as multimedia services - is insufficient to deploy the high Quality of Services expected by the North American wireless population. This results in the slow adoption of M-Commerce services in North America. Similarly, we find that the lack of standardization in North America is also hindering the provision

of high Quality of Services. This also contributes to the slow adoption of M-Commerce services in North America.

The following chapter presents a synthesis of the above discussion, through an analysis of today's North American M-Commerce adoption model and the proposition of an improved model that would remedy to the slow adoption of M-Commerce, and therefore conclude this work.

Chapter 5

CONCLUSIONS: NORTH AMERICAN M-COMMERCE ADOPTION

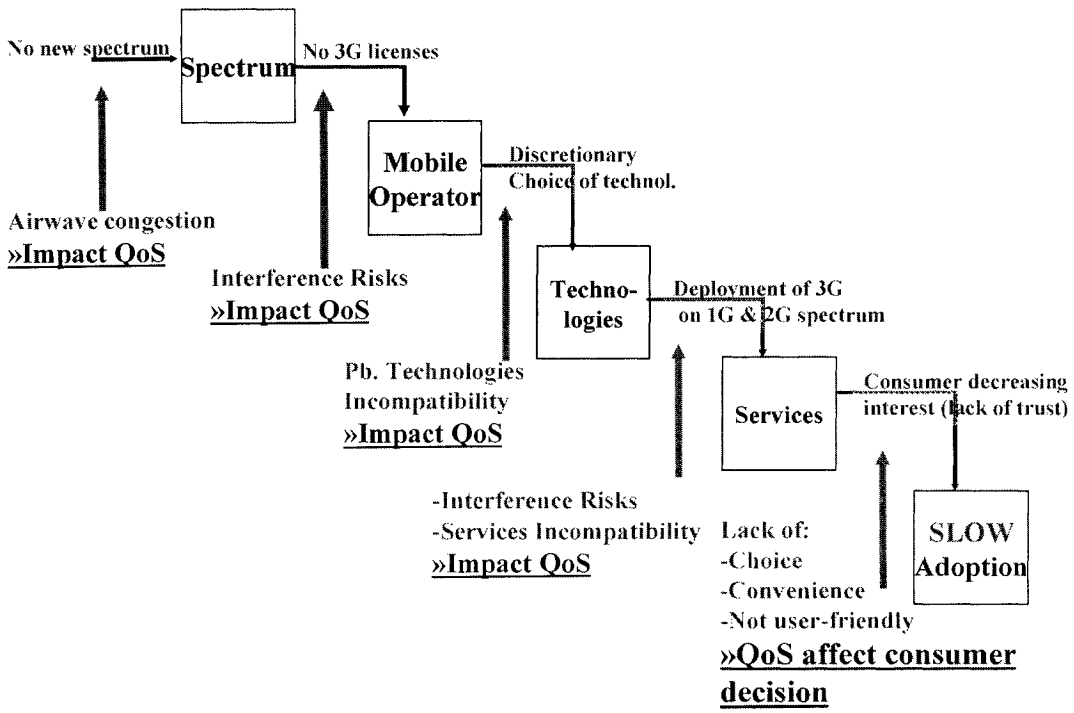
1- Introduction

The previous chapter identifies inadequate spectrum and inadequate standardization as being the reasons deterring M-Commerce from taking off in North America. The following synthesis shows the level of importance and impact of these factors on the adoption value chain. The first section analyses the current M-Commerce adoption value chain model. The second section presents a revised version of this model while remedying to the above problems; in order to provide a high Quality of Services to the end-user, and therefore increase the adoption level of M-Commerce in North America.

2- North American Current M-Commerce Adoption

Today's adoption of M-Commerce is very slow in North America compared to Western Europe and Asia. The previous chapter identifies separately two hypotheses as being true. The lack of popularity of M-Commerce in North America is due to a lack of adequate spectrum and a lack of adequate standardization. However an analysis of the current M-Commerce adoption value chain will give a better understanding of the effect of these factors in North America (Figure 16).

Figure 16
North American Current Value Chain Model



Consumers will adopt a product/service if it simplifies and enhances their quality of life. In other words it must provide a unique experience with a quality and convenience that outcasts the traditional way, such as in this case e-commerce.

The North American M-Commerce adoption value chain shows that the fact that the FCC has not allocated new spectrum for the deployment of 3G has caused airwaves congestion. Therefore, it has had a negative impact on the QoS of M-Commerce services. Moreover, this absence of new spectrum, specifically 3G spectrum licenses, led the FCC to allow mobile operators to provide 3G services on their existing 1G and 2G allocated spectrum(s). This flexibility of use big downside is the high risks of interference, which have a negative impact on the Quality of Service provided to the end-user. Furthermore the FCC also gives mobile operator total freedom to choose the technology they want to deploy. This lack of standardization results in the deployment of a myriad of different 1G, 2G, and 3G technologies that often do not communicate with each other causing many issues such as compatibility issues. These technological issues translate into service provision issues as they have a big negative impact on the Quality of Service offered to the end-user. This is even worsened by the high risks of interference.

All these concerns affecting the Quality of Service accompanied by the consumer's lack of choice impact negatively his/her decision. In fact, the mobile operators freedom to decide on which technology and services and how to deploy them, and the absence of regulations results in too many differences, making it difficult for the end-user to compare what is being offered in order to choose the best offer. Furthermore the user's experience is affected as it lacks convenience and user-friendliness.

These crucial factors – ability to choose, convenience of use, and user-friendliness – have a definite impact on the consumer's decision. In North America, these factors would impact negatively M-Commerce adoption.

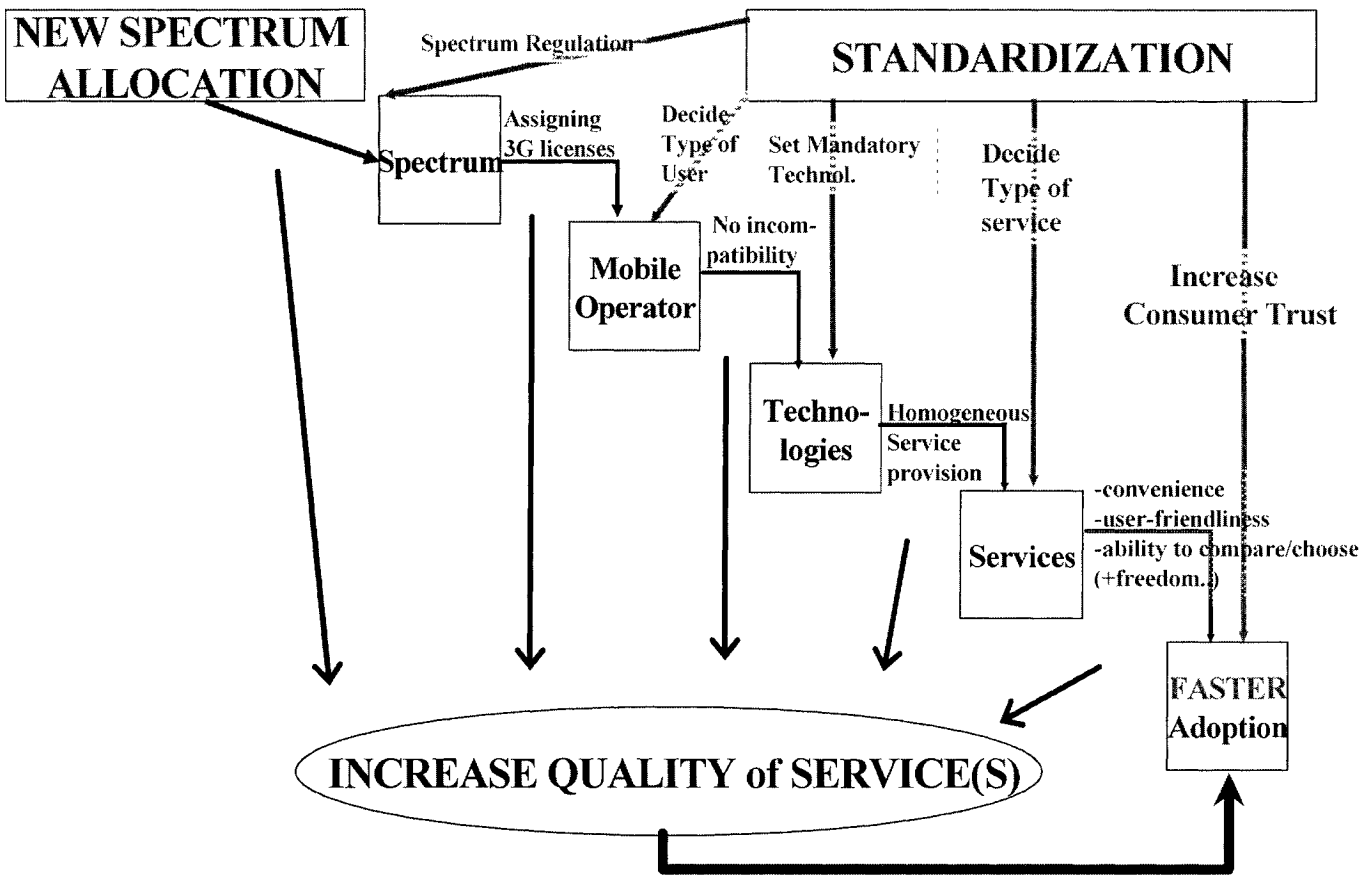
The rate of adoption of M-Commerce in North America is less likely to increase unless major issues affecting the Quality of Service as well as the user's decision are being dealt with. Furthermore the following section shows how the eradication of these problems would turn around the adoption outcome.

3- North American M-Commerce Adoption Recommendation

The slow adoption of M-Commerce is due to the lack of adequate spectrum and the lack of adequate standardization. Therefore we conclude this work by the following proposition to speed up the adoption rate.

New spectrum should be allocated for the provision of 3G allowing the assignation of 3G licenses to mobile operator - such as in Western Europe and Japan. This action would considerably diminish the risks of interferences and therefore increase the QoS. Also most importantly, a process of standardization of 3G technologies should be launched.

Figure 17
North American Revised Value Chain Model



The industry should agree upon one unique standard technology (such as in Japan); or the North American governments should make one technology mandatory and specify what service should be deployed, how it should be deployed, and on what specific spectrum (such as in Western Europe). This action would radiate many issues such as compatibility and enhance the provision of homogeneous services, and therefore increasing the Quality of Service. Both of these actions enable a better environment and user-experience.

Respectively, the user has the ability to compare and choose between operators as they offer similar services with similar technologies, and applications are more user-friendly. The increasing Quality of Service as well as the increasing consumer trust result in the consumer's decision to adopt the technology and therefore making the North American adoption of M-Commerce faster. This new strategy is a good mean for North America to catch up with the other poles – Western Europe and Japan, and possibly reposition itself as second in line or even re-gain the leadership it once had.

4- M-Commerce Adoption Potential Research

This work focused on the wireless Technological environment of M-Commerce. The purpose was to bring some clarity as to why M-Commerce adoption is slow in North America compared to its competitors, Western Europe and Japan. Also, the aim was to provide a contribution suggesting what can be done in order to over-come this problem and increase the North American M-Commerce level of adoption. However, as shown in chapter 3 of this document, M-Commerce market adoption and success is quite complex. It involves many different variables such as: consumer's behavior and his/her willingness to change, geography and urban planning, the overall infrastructure and transportation commodities, the cultural differences, the population density, the size of the countries, the salaries (economic viability of the people), the business opportunities, the security of the systems …

These variables are very important factors that could translate into very interesting research topics as M-Commerce is an activity with great potential revenues. We hope that this work will inspire other individuals to extend our findings and explore some of these variables in future works.

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