

Global Heterogeneity in the Emerging M-Commerce Landscape

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Abstract

Mobile phones, mobile Internet access, and mobile commerce are growing much faster than their fixed counterparts. Several characteristics of mobile networks make them more attractive than fixed networks for less developed countries and for those countries that want to “leapfrog” the leading IT nations. To exploit the new mobile communications infrastructures, companies from developed as well as developing countries are rapidly integrating m-commerce technology into their business models. Countries around the world, however, exhibit considerable heterogeneity in their adoption of mobile phones and m-commerce technology. This chapter examines the current stage of mobile technology and m-commerce diffusion across the world and analyses factors influencing the diffusion process. This chapter reviews the ways in which the m-commerce landscape of a nation – defined by the penetration rate of mobile phones, the specific combinations of different generations of mobile technology, and the blending of various standards within a given generation – is shaped by politico-economic, sociocultural, and policy related factors.

INTRODUCTION

The rapid global diffusion of mobile telephones in the last two decades of the twentieth century laid the foundation for a new type of technology-aided commerce. Going beyond the computer-mediated electronic commerce or e-commerce¹ of the 1990s, this new type of mobile commerce – or m-commerce – was characterized by novel, location-based services delivered by a variety of handheld terminals (Dholakia and Dholakia 2003). By 2000, Japan’s NTT DoCoMo had already established a huge network of m-commerce service providers and users that relied on that company’s iMode platform (Bradley and Sandoval 2002).

Just as networked computers and browser-accessible content provided the preconditions for the take-off of e-commerce, mobile telephones that are data-ready and connected to digital communications networks provide the preconditions for m-commerce. In recent years, other handheld mobile devices such as Personal Digital Assistants (PDAs) and enhanced alphanumeric communicators (such as Blackberry devices) have supplemented mobile telephones. An increasingly diverse array of such mobile devices is anticipated from the research laboratories of telecommunications, computer, and electronic firms.

Drawing on comparative macro data from about 30 selected countries, this chapter explores the heterogeneity of factors that influence cross-national differences in the adoption of mobile communication infrastructure and m-commerce applications. It will be seen, in particular, that the distinction between developed, newly developed, and developing countries does not translate into a corresponding continuum of national leaders and laggards in mobile technology adoption. Instead, comparative analysis reveals interesting features of the emergent global m-commerce landscape:

- Not all global leaders in land-based telecommunications or Internet access are the global leaders in mobile connectivity.
- In terms of mobile commerce applications, multiple dominant designs are likely to coexist and compete for an extended period of time. This is different from most IT fields where dominant designs have converged rapidly to one or two standards.
- Sources and reasons for national leadership in the evolution of mobile commerce applications are likely to be significantly different from the national leadership patterns in Internet, landline telecommunications, and computers.

This chapter provides a framework, derived from macro data and selected case studies, for understanding cross-national and cross-regional variations in the evolution of m-commerce applications. The remainder of the chapter: (1) provides background on the rapid diffusion of mobile technology (2) examines the global diffusion pattern of mobile phones and m-commerce technology (3) identifies a variety of economic, social, and technological factors impacting the diffusion patterns of mobile technology and m-commerce (4) develops a simple typology for tracking future developments in m-commerce.

BACKGROUND: RAPID DIFFUSION OF MOBILE TECHNOLOGY

Mobile technologies – for communications, for accessing the Internet, and for mobile commerce transactions – are growing hyperbolically. Mobile devices have become the fastest adopted consumer products to date. In 2000, more mobile phones were shipped than automobiles and PCs combined (Chen, 2000; de Haan, 2000). In the 1990s, the number of mobile phones worldwide grew by 50% annually compared to less than 10% growth in fixed connections. The proportion of mobile phones increased from 1 out of 50 phone connections in 1990 to 1 out of 3 in 1999 (Wellenius, Braga and Qiang 2000). The number of mobile subscribers worldwide increased from 11 million in 1990 to 318 million in 1998 (Wai, 2001) and is projected to reach 1.2 billion by 2005, with 450 million using some sort of location-based service (Secker, 2001). The fixed telecommunications industry took over 130 years to reach comparable levels of diffusion. An estimate suggests that by 2009, there will be more cellular subscribers in the world than fixed line subscribers (ITU 2000). Another estimate suggests that by 2005, Internet access through wireless devices will outstrip access via personal computers (UNDP, 2001). Furthermore, over 25 % of e-commerce will take place over handheld sets by 2005 (Shaffer, 2000).

To exploit the opportunity created by the meteoric growth of mobile phones, companies around the world are rapidly integrating m-commerce technology into their business models. This is happening as much in developed as in developing countries, often with fascinating cross-border differences in the most prominent initial applications. An exemplary developed-country m-commerce provider is the U.S. online book retailer Amazon.com, which signed deals with wireless providers Sprint PCS, Verizon, Airtouch, and Nextel to leverage m-commerce technology in the company's offerings (Lindsay 2000). Of fast-moving m-commerce firms in developing countries, a notable example is GWCom. This mobile wireless applications services provider in China launched its wireless portal byair.com in 1998 to provide timely information and e-commerce capabilities such as stock trading and banking to users with mobile phone or wireless

palmtop devices. By March 2000, byair.com had over 6,000 subscribers with up to 3,500 daily stock trades and 250,000 page views. It handled over 30 million information requests and 200,000 wireless stock transactions² (Ebusinessforum.com 2000). Wireless users have been using GWCom's application platforms to conduct online trading since 1998 in Shanghai and since 1999 in Shenzhen. In March 2000, 3,000 investors in Shanghai and 100 in Shenzhen were trading stocks over the paging networks managed by GWCom. The average daily volume of 3,000 Shanghai users in early-2000 was \$3.6 million, about 30 times as much as the average trading volume on stockstar.com, the largest and most popular Web-based stock trading company.

Farmers and small business owners from developing countries are also making extensive use of m-commerce applications. They are utilizing the information gathered via mobile phones to eliminate or reduce the role of intermediaries in the value chain and to lower the risk of their profit margins being squeezed by larger firms or firms from developed countries. Bangladeshi farmers employ such phones to find the proper prices of rice and vegetables. Farmers in remote areas of the Ivory Coast share mobile telephones so they can follow hourly fluctuations in coffee and cocoa prices in the international market. Thanks to mobile phones, they can now choose the time to sell their crops when the world prices are in their favor. A few years ago, the only way to find out about market trends was to go to the capital city and the deal making was largely based on often-unreliable information from buyers (Lopez 2000). Similarly, fishermen in India use mobile phones to obtain information about the price of fish at various accessible ports before deciding where to land their catch (Rai 2001).³

PATTERNS OF GLOBAL DIFFUSION OF M-COMMERCE TECHNOLOGY

While the statistics above indicate hyperbolic growth and proliferating applications of mobile technologies, global diffusion patterns vary widely. First of all, uses of mobile phones vary between low and high-income countries. People in the developing countries often use mobile phones because these may be the only kind of phones available readily

(Wooldridge, 1999); and in many regions of Eastern Europe, the mobile phone network is often much more technologically advanced than the older fixed-line network. Thus, while mobile phones represent *supplements* to fixed telephones in high-income economies, they are often *substitutes* for fixed telephones in lower-income economies (ITU, 1997). Likewise, whereas 3G mobile phones provide mobility and efficiency to the users from advanced countries, they are likely to give a large proportion of people from the developing world their first access to the Internet (Banks 2001). In other words, the developing countries are gravitating to mobile phones because of infrastructure issues (Zuckerman, 2000). In some developing countries such as Cambodia and Venezuela, mobile penetration already exceeds fixed line penetration.

For this and for additional reasons examined below, global leaders in mobile technology and m-commerce are not necessarily the richest economies or the leaders in fixed telecommunications and the Internet. Table 1 compares 25 major countries in terms of mobile penetration, fixed line penetration, Internet usage, and per capita income. Portugal and Taiwan, for instance, have incomes that are less than one third of the incomes of Japan, Switzerland and USA, but are far ahead in terms of mobile penetration. Similarly, Italy has one of the lowest rates of fixed line penetration in Table 1 but ranks fourth in terms of mobile penetration. Hong Kong, the economy with the highest mobile penetration in the world, has a relatively low rank in terms of Internet usage. As indicated in table 1, whereas income, fixed telephone penetration and Internet penetration are significantly correlated with each other, none of these variables has a significant correlation with mobile phone penetration in terms of Spearman's rank correlation coefficient.

Nations vary considerably in the penetration of mobile Internet access compared to fixed-line telecommunications and fixed-line Internet access. Whereas USA has been a global leader in overall Internet access, it lags far behind Europe and advanced economies of the Asia-Pacific region in terms of mobile Internet access (Table 2). One reason for this is that fixed-line access is relatively cheap and generally not metered in the U.S., whereas mobile Internet access is more expensive and largely metered. In most other developed countries, the continued prevalence of per-minute-billing of fixed telephone

line usage makes calling plans for mobile phones comparatively attractive. The success of Japan's i-mode, beyond the indisputable technical merits of the service, is attributable in large part to the high cost and modest penetration of fixed-line Internet access. In fact, the adoption of mobile technology does not follow any single universal logic or pattern. While mobile technology in advanced nations is usually a successor or a complement to earlier generations of telecommunications, in developing parts of the world – to varying degrees – it represents an infrastructure alternative to fixed-line communications.

Table 1: Mobile and Fixed Penetrations, Per Capita GNP, and Internet Use

Country	2000 Per Capita US\$		1999 Fixed Phones		1999 Internet Users		1999 Mobile Phones	
	Per Capita GNP	Rank Order	Per 1000	Rank Order	Per 1000	Rank Order	Per 1000	Rank Order
Hong Kong	25950	6	576	10	205	14	726	1
Finland	24900	10	552	13	404	2	667	2
Sweden	26780	5	665	4	445	1	578	3
Italy	20010	18	462	21	158	18	528	4
Taiwan	16100	19	588	7	216	11	521	5
Austria	25220	7	472	20	203	15	519	6
South Korea	8490	24	438	22	213	12	504	7
Denmark	32020	4	685	2	394	3	499	8
Singapore	24740	11	482	18	289	6	475	9
Portugal	11060	23	424	23	80	24	468	10
Japan	34210	3	558	12	162	17	449	11
Netherlands	25140	8	606	6	258	8	435	12
Switzerland	38120	1	699	1	234	10	420	13
UK	24500	13	575	11	255	9	408	14
Ireland	22960	15	478	19	132	21	378	15
France	23670	14	579	9	121	22	364	16
Australia	20530	17	520	15	261	7	344	17
Belgium	24630	12	502	16	180	16	315	18
Spain	14960	20	418	24	91	23	312	19
USA	34260	2	655	5	351	5	312	19
Greece	11960	22	528	14	140	20	311	21
Germany	25050	9	588	7	149	19	286	22
New Zealand	13080	21	490	17	209	13	230	23
Canada	21050	16	682	3	369	4	230	24
Argentina	7440	25	201	25	14	25	121	25

Rank order correlations (significance levels):

Income with Fixed = .685 (.00); with Internet = .507 (.01); with Mobile = .318 (.12); Fixed with Internet = .625 (.00); with Mobile = .06 (.76); Internet with Mobile = .332 (.105)

Sources: International Marketing Data and Statistics, European Marketing Data and Statistics, The World Bank and authors' calculation.

Table 2: A comparison of fixed and wireless Internet users in Western Europe, USA and the World

		2000	2002	2005
World	Internet users, million	414	673	1174
	Wireless internet users, million	40	225	730
	(Wireless as Proportion of Internet users)	(9.7%)	(33.4%)	(62.1%)
U.S.	Internet users, million	135	169	214
	Wireless internet users, million	2	18	83
	(Wireless as Proportion of Internet users)	(1.5%)	(10.7%)	(38.8%)
Western Europe	Internet users, million	95	148	246
	Wireless internet users, million	7	59	168
	(Wireless as Proportion of Internet users)	(7.4%)	(39.9%)	(68.3%)

Source: eTFForecasts and authors' calculation (date: December 2002)

FACTORS IMPACTING THE DIFFUSION PATTERNS OF MOBILE TECHNOLOGY AND M-COMMERCE

Table 3 lays out the primary factors responsible for the meteoric growth rate of mobile phones and m-commerce technologies as well as the highly heterogeneous adoption patterns just discussed. While design issues surrounding portals and interfaces doubtless do influence the short-term uptake of m-commerce services (e.g. the flop of WAP vs. the success of i-mode), the emphasis in Table 3 is on basic economic factors favoring the rapid growth and diffusion of mobile technologies generally.

Table 3: Factors influencing the diffusion patterns of mobile technologies

Factor	Elaboration and Explanation
Inherent diffusion-accelerating attributes	<ul style="list-style-type: none"> ▪ <i>Mobile technologies have inherent diffusion-accelerating attributes:</i> Potential to save time (relative advantage), ability to connect to existing telephone network (compatibility), operation method same as the “regular” phone (low complexity), status-conferral to potential buyers (observability), and possibility to borrow a friend’s cellular phone or handheld device for trial (trialability)

Mobile technology effects	<ul style="list-style-type: none"> ▪ Many factors lower the barriers to adoption: Low fixed and operating costs of mobile networks, ability to operate in areas with no electricity, low social barriers to adoption, infrastructure resources less prone to theft and vandalism, geographical flexibility, and innovative pricing (such as prepaid services)
Rapidly deployable technology	<ul style="list-style-type: none"> ▪ Mobile networks can be deployed rapidly: Ongoing reductions in fixed and operating costs due to progressively cheaper and increasingly powerful components enable rapid deployment.
Infrastructure effects	<ul style="list-style-type: none"> ▪ Large, established fixed-line networks create positive externalities: First and second generation mobile phones in advanced nations benefited from such network externalities. ▪ Relative lack of fixed-line infrastructure favors cellular networks: Mobile networks are more attractive than fixed networks in developing countries that lack fixed-line infrastructures.
Market size and industrial demand effects	<ul style="list-style-type: none"> ▪ Diversity and size of industries affects uptake of data services: The uptake is rapid when there are large, diverse industries likely to use mobile communications and commerce applications.
Income and leapfrogging effects	<ul style="list-style-type: none"> ▪ Income levels influence mobile penetration rates and technology generations: High-income countries adopt early but end up having mixed generations of mobile phones while low-income countries may adopt later with uniformly new generations of technology.
Cultural factors	<ul style="list-style-type: none"> ▪ Culture influences adoption rate and styles: Cultural factors affect the preference for mobile phones over fixed phones. They also influence handset size and style preferences.
Provider competition effects	<ul style="list-style-type: none"> ▪ Competition-driven innovations by providers often unlock latent demand: New marketing or pricing plans sometimes trigger substantial increases in use (e.g. one-rate plans in the US)
Portal design factors	<ul style="list-style-type: none"> ▪ Availability of reliable and user-friendly interfaces: Uptake heavily influenced by the quality of portal design (e.g. WAP, i-mode)
Policy related factors	<ul style="list-style-type: none"> ▪ Government policies influence the mobile sector: Public investment often funds backbone networks. Telecom policy affects competition in and reorganization of the mobile telecom sector.

Table 3 incorporates insights from prior literature on the diffusion of mobile technology and mobile commerce. For example, the inherent diffusion-accelerating attributes are factors underlined by Rogers (1995: 245-6) who sees mobile phones as having an “almost ideal set” of product characteristics:

- Rapidly falling cost and the potential to save time offer *relative advantage*
- Ability to connect to existing telephone network increases *compatibility*
- Same method of operation as the “regular” phone results in *low complexity*

- Status-conferral aspects of mobile phones boost their *observability*
- Possibility to borrow a friend's cellular phone for trial increases the *trialability* of mobile devices.

These classic diffusion-accelerating factors help explain the exceptionally rapid rate of cellular phone adoption. Similarly, Dholakia and Kshetri (2002, 2003) argue that several “mobile technology effects” also act as spurs to mobile technology provision and adoption. These include:

- Low fixed and operating costs of mobile networks
- Ability to have mobile service even in areas with no electricity
- Low social barriers to adoption
- Compared to the expensive copper wiring that is lucrative for thieves, mobile infrastructure is less prone to theft and vandalism
- Geographical flexibility, in terms of covering difficult terrain without the need to lay copper wire
- Innovative pricing such as prepaid service plans.

Rapid developments in mobile technology have made the “mobile technology effects” more prominent and the perceived attributes of mobile phones closer to ideal. A study conducted by Yankee Group found that worldwide wireless prices fell by an average of 38 % between late 1996 and early 1999 (The Economist 1999). Reductions in fixed and operating costs have been more dramatic in some countries. In China, for example, connection fees as well as handset prices halved during 1997-99 (The Economist 1999). These costs are declining further. As James Bond, the head of the World Bank's telecommunications division, points out:

(T)here is a limit to how much cheaper fixed lines can get because they involve heavy investment in labor and materials. Conversely, mobile phones share the propensity of all digital technologies to become both cheaper and more powerful over time (Economist 1999).

Furthermore mobile sets are becoming hybrids between computers and phones. Third and fourth-generation cell phones are bundling the functionalities of a phone, a computer, the Internet and a credit card. These mobile sets allow high-speed data transmission and the costs are likely to be lower than that of a personal computer, making the adoption more

attractive for broad groups of potential users. In the Asia-Pacific region, for instance, the launch of 3G services has potential to fuel the growth of mobile phones:

In the fixed-line network, it is market liberalization among the emerging giants of the [Asia-Pacific] region which is promoting growth; in the mobile network it is the launch of 3G services which promises growth, while for the Internet it is the development of more local language content which will spur growth (ITU 2000).

The emergence of pre-payment pricing structures, one of the “mobile technology effects” mentioned in Table 3, has been a major factor driving the diffusion of mobile telephones. In 2000, prepaid subscribers of Millicom International increased by 70% with a 79% increase in prepaid minutes (MIC, 2000). Similarly, in 1999, 70 % of new users in Thailand and 100 % in Malaysia were prepaid users (The Economist, 1999). In the Czech Republic, Eurotel Praha, a mobile service company is overcoming the lack of a credit culture by providing prepaid services via their mobile phones for shopping online (ITC Executive Forum, 2001).

3G and Other Mobile Technologies

The influence of technological, political, and other environmental forces on recent m-business technologies differs significantly from the mechanisms that influenced the diffusion of earlier cellular phones. While small Nordic nations such as Sweden and Finland pioneered in mobile telephony, large (and affluent) European and Asian nations – Germany, UK, Japan – will probably spearhead the innovation process for next generation mobile technology and business applications. In a cross-sectional study of major economies from Asia, Europe and Latin America, Lehrer, Dholakia and Kshetri (2002) found that the penetration rate of fixed phone has a significant effect on the diffusion of first and second-generation mobile phones but not on leading indicators of m-business technologies, especially investment in 3G infrastructure. Market size (measured by population), on the other hand, does appear to correlate with strong investment in 3G infrastructure. The wide range of possible applications for 3G – advertising, business data, email, information services, SMS, transactions, voice (Johansson 2001) – appears to favor large countries with diversified industrial bases. At the same time, several factors inhibit the move to 3G and 4G technologies. These include

customer behaviors anchored strongly in PC usage and easy availability of “free” or low cost services including voice and Internet access.

Income influences the penetration level of mobile technology as well as the optimum combination of different generations of mobile phones. High income allows potential adopters to afford higher prices while embracing an innovation (Dekimpe, Parker and Sarvary 2000). In an international context, it can be argued that an economy’s standard of living and the level of economic development influence the adoption timing as well as diffusion speed (Antonelli, 1993; Gatignon and Robertson, 1985; Dekimpe, Parker and Sarvary, 2000; Gruber and Verboven, 2001). A certain minimum level of income is therefore a pre-requisite for effective penetration level of mobile technology. For example, third and fourth generation mobile phones are likely to be more attractive for high-income economies than for low-income economies.⁴

In addition to income, the cellular standards adopted by a country are also likely to influence its national m-commerce potential. Given the variety of mobile standards worldwide today⁵ (Table 4), multiple dominant designs can be expected to coexist and compete for an extended period of time in m-commerce applications. Yet adoption of specific standards creates a trajectory of change and growth. South Korea, for instance, with its CDMA standard of 2G will find it less costly to upgrade to the CDMA-based 3G standard than Spain (with its non-CDMA 2G standard) and will therefore be able to adopt 3G more rapidly. CDMA-based networks in the U.S. will benefit similarly.

Table 4: A comparison of different standards of mobile phones in use today

Standard	Description	Where used?	Remarks
<i>First generation (1G)</i>	<ul style="list-style-type: none"> Based on analog technology Became available during the late 1970s and early 1980s. 	Worldwide	
Nordic Mobile Telephone (NMT)	<ul style="list-style-type: none"> First commercially available analog system Introduced in 1979 	Sweden, Norway	
Advanced Mobile Phone Service (AMPS)	<ul style="list-style-type: none"> Considered to be the “most successful” analog standard Introduced in 1982 	Worldwide	
Total Access Communications System (TACS)	<ul style="list-style-type: none"> Based on AMPS. 	Originally specified for the UK	<ul style="list-style-type: none"> Extended TACS (ETACS) is primarily used in Asia Pacific.
<i>Second generation</i>	<ul style="list-style-type: none"> Digital wireless standards that 	Worldwide	

(2G)	concentrated on improving voice quality, coverage, and capacity. <ul style="list-style-type: none"> Designed to support voice 		
Global System for Mobile phone communications (GSM)	<ul style="list-style-type: none"> First commercially available digital standard Relies on circuit-switched data The basic development that supports data at low rates (< 9.6 kbps) has been used for e-mail from laptops. 	Europe, Asia	<ul style="list-style-type: none"> USA accounts for 3% of the worldwide GSM market. USA introduced GSM in 1995. GSM customers estimated to reach 1.4 billion by 2005
Time Division Multiple Access (TDMA)	<ul style="list-style-type: none"> Introduced in 1992 Also known as "North American" digital standard. 	North America, Latin America, Asia, Eastern Europe.	<ul style="list-style-type: none"> Originally it was known as IS-54. Now IS-136 (TDMA IS-136)
Personal Digital Communications (PDC) IS-95	<ul style="list-style-type: none"> Primary digital standard in Japan 	Japan	
	<ul style="list-style-type: none"> Based on "narrowband" Code Division Multiple Access (CDMA) technology. 	South Korea, North America	
Enhanced Second-Generation (2.5G)	<ul style="list-style-type: none"> Builds upon the 2G standards by providing increased bit-rates and bringing limited data capability. Data rates range: 57.6-171.2 kbps. 	Worldwide	
High-speed Circuit-switched Data (HSCSD)	<ul style="list-style-type: none"> Provides access to four channels simultaneously, providing four times the bandwidth (57.6) of a standard circuit-switched data transmission rate (4.4 kbps). 	North America and Europe	<ul style="list-style-type: none"> Marks the first step towards 3G services Predecessor of GPRS
D-AMPS IS-136B	<ul style="list-style-type: none"> Introduced in 1999. The first phase of D-AMPS provided up to 64 kbps. The second phase provides up to 115 kbps in a mobile environment. 	North America, Latin America, Australia and parts of Russia and Asia.	
General Packet Radio System (GPRS)	<ul style="list-style-type: none"> Supports data rates up to 171.2 kbps (about three times faster than today's fixed telecom networks and ten times as fast as current circuit-switched data services on GSM). 	Europe	<ul style="list-style-type: none"> Standard from the European Telecommunications Standards Institute (ETSI).
Third-Generation (3G)⁶	<ul style="list-style-type: none"> Will provide wide-area coverage at 384 kbps and local area coverage up to 2 Mbps. Supplement standardized 2G and 2.5G services with wideband services. Use packet switching instead of circuit switching and hence no need 	Worldwide	<ul style="list-style-type: none"> Each packet contains a destination address and a sequence number so it can be independently routed and reassembled into a complete message

	to establish a continuous connection that dedicates a circuit for each call.		
CDMA2000	<ul style="list-style-type: none"> • CDMA Multi-carrier • Also known as or IS-2000. 	U.S.A.	Expected to be compatible with CDMA and GSM/TDMA.
W-CDMA	<ul style="list-style-type: none"> • Also known as Wideband CMDA • Currently the leading 3G standard • Sub-variants: WCDMA-FDD used in Japan, WCDMA-TDD dominates in Europe 	Europe, Canada, Japan	<ul style="list-style-type: none"> • In Europe, W-CDMA is known as UMTS (Universal Mobile Telephony System)
TDMA-SC	<ul style="list-style-type: none"> • Also known as TDMA Single Carrier • UWC-136 (Universal Wireless Communications) and EDGE (Enhanced Data Rates for GSM Evolution) fall in this standard. • Will provide higher speed without changes in channel structure, frequency, or bandwidth. 	North America	<ul style="list-style-type: none"> • EDGE is a radio-based high-speed mobile data standard with aggregate transmission speeds of up to 384kbps when all eight timeslots are used.
Fourth- Generation (4G)	<ul style="list-style-type: none"> • Planned to have higher transmission rates (at least 100 Mbits/sec) • Technological alternatives to fixed-frequency transmission for achieving such rates include ultra-wideband (UWB) transmission 	Worldwide	<ul style="list-style-type: none"> • Originally anticipated by 2010, but Japan's NTT DoCoMo has announced plans to implement by 2006, possibly using UWB
Fifth- Generation (5G)	<ul style="list-style-type: none"> • Still is speculative phase • Term used by some to refer to "infrastructureless" ultra-wideband (UWB) networks that would use handsets instead of base stations to relay signals (so-called "ad hoc" network) 	Worldwide	<ul style="list-style-type: none"> • Applications of ad hoc UWB networks to date are mainly military; FCC approval for limited UWB use was granted in February 2002

Sources: http://intel.com/technology/itj/q22000/articles/art_6.htm, <http://www.cfo.com>, http://www.etsi.org/frameset/home.htm?/pressroom/Media_Kit/GSM.htm, http://www.mobileinfo.com/3G/3G_Wireless.htm, <http://www.mobile3g.com/GetContracts.asp>, <http://www.cellular.co.za/technologies/3g/3g.htm>, http://www.refreq.com/WAPTech/wap_glossary.htm, <http://www.socketcom.com/pdf/TechBriefMobilePhone.pdf>, Lehrer, Dholakia and Kshetri (2002), and authors' research.

While Table 4 suggests an inexorable evolution towards higher generations of mobile technology, disruptive technologies have begun to emerge. For example, the already uncertain profitability of 2.5G and 3G networks is endangered by the proliferation of so-called Wi-Fi or 802.11 hotspots. These are low-cost LANs that allow multiple wireless

users within the radius of a few hundred feet to share a single broadband connection. Although Wi-Fi does not provide the blanket geographic coverage of wireless networks, it does offer the speed of a fixed-line broadband connection, something that current 3G networks have no prospect of achieving. The technical and commercial disappointments of 3G networks to date raise the possibility that some countries may largely pass on 3G and one day leapfrog to 4G. In addition, the exorbitant cost of 3G spectrum licenses in some countries (UK, Germany) may indirectly favor the emergence of technological alternatives to 3G because of the financial burden they impose on the companies responsible for installation of 3G infrastructure.

Adoption patterns of mobile technology also depend on sociocultural factors. In newly industrialized Asian economies, for instance, people are more comfortable with smaller electronic devices and mobile handsets (Wilson, 2001). In China, on the other hand, the really small wireless phones initially did not sell well because they were “too inconspicuous” – and did not offer adequate opportunity to show off (low “observability” attribute). Later, the public attitude toward these wireless devices changed in China as well. Among the world’s English-speaking countries, commonalities of language and close cultural links appear destined to elevate the UK to a “lead market” for 3G applications (Lehrer, Dholakia and Kshetri 2002).

As with other technologies, policy related factors play an important role in the diffusion of mobile technology and m-commerce applications. For instance, government investment in the telecom sector, government initiatives to encourage mobile phone purchases, and intense competition in and reorganization of the telecom sector are found to be the major causes of China’s rapid mobile telecom network growth (Kshetri and Cheung 2002). The experiences of countries such as South Korea and Sri Lanka confirm the general rule that competition among mobile operators leads to lower prices and rapid mobile network growth (UNDP 2001).

A FRAMEWORK OF FUTURE DEVELOPMENT

The future direction of mobile commerce development is surrounded by considerable economic and technological uncertainty. As the recent history of PCs and the Internet has shown, the growth and success of IT *hardware* depends critically on the availability of attractive *software* packages. Such packages range from specific software applications (so-called “killer apps”) to portal designs that facilitate the user’s overall interface with the technology. Particularly in developing economies, the development of the m-commerce landscape requires the emergence of country-specific mobile portals with specialized sites for Web phones. The evolution of m-commerce in such economies has been hampered to date by the lack of such portals. In developed countries, on the other hand, a frequent lament is that the key “killer application” for m-commerce has yet to be identified, again hampering the penetration of the new technology.

With the caveat of such uncertainties in mind, the framework in Table 5 summarizes some of the major regional differences that emerge from comparative analysis. Turning first to the vertical dimension (the global centrality of nations in developing m-commerce applications), a dichotomy between core (active developers) and periphery (passive adopters) nations seems likely. As shown in the upper right corner of Table 5, countries in the economically most developed regions (North America, Western Europe, Japan) possess ideal supply and demand conditions for pioneering m-commerce applications. On the supply side, they possess the financial and technological resources to invest in high-risk ventures. On the demand side, they possess the high levels of income and sophisticated industrial users to afford and demand novel applications.

Nonetheless, the considerations explored in our prior analysis give some reason to expect an “expanded core” of pioneering nations in m-commerce, including in particular East Asia (upper left corner of Table 5). This is due in part to the mobile Internet handicap of the United States. Traditionally the world’s leader in IT innovation, the U.S. is now saddled with such extensive sunk investments in fiber cables that investment in mobile Internet infrastructure (particularly in 3G) is lagging. The reasons are more general than just the U.S. lag, however. These reasons are captured in the horizontal dimension of Table 5, the distinction between countries where mobile telephony supplements fixed lines and those where it genuinely substitutes for fixed lines. In the

latter, especially certain developing countries in Asia and South America, mobile penetration is much higher than Internet access. Can this be turned to advantage for business and development through m-commerce (ITC Executive Forum 2001)? Particularly in the East Asian Tigers, with their specialization in consumer electronics and computing products, there is good reason to think that it can.

Table 5: Comparative Regional Environments for M-Commerce Development		
Global Centrality in M-Commerce Innovation	Infrastructure Role of Mobile Telephony	
	<i>Substitute for Fixed Lines</i>	<i>Supplement to Fixed Lines</i>
<i>Active Developer</i>	Industrialized East Asia (e.g., Japan, South Korea, Taiwan)	North America, Europe (e.g., U.S., Scandinavia)
<i>Passive Adopter</i>	Developing Countries (e.g., Argentina, Sri Lanka)	“Null Set” (but may be filled for 4G)

Source: Authors' research

Recent contracts awarded by some developing Asian economies to telecom vendors in the United States and Europe indicate that many of the advances in wireless communications are likely to be installed in Asia before North America and Europe. Fiber optic and cable networks enjoyed by consumers in the USA simply do not exist in most Asian countries. Furthermore, contrary to the popular belief that the wireless Internet will only be successful in markets with lower PC penetration, economies with very high PC penetration such as South Korea are also showing phenomenal success in m-commerce⁷. For example, Korea Telecom Freetel launched 1X technology⁸ at the end of 2001 and achieved a 35% penetration rate of wireless Internet use within five months,

with 1X users consuming twice as much airtime as other mobile users (Luna 2002). Furthermore, after introducing Binary Runtime Environment for Wireless (BREW)⁹ applications, data revenue increased by 60%.

Both demand and supply factors influence the potential of East Asian countries to become “lead markets” for m-commerce innovation. The use of wireless communications as a substitute for fixed-line access to the telephone and Internet network creates a demand advantage to the extent it translates into earlier and higher diffusion rates in the population’s use of the new technology than in other advanced countries. Just as important, however, are supply side factors. Like Japan, East Asian “Tiger” countries feature a large number of producers specialized in innovative, high-technology products for global IT markets. Such East Asian countries therefore have the means to translate feedback from behavior in their domestic markets into novel product designs. Having already climbed the ladder from technology imitators to active technology developers, these countries have the requisite understanding of global markets to pioneer innovative m-commerce products, especially in components and hardware.

In contrast, not all developing countries using wireless telephony as a substitute for fixed lines can be expected to be global innovators in the use of the new technology. Developing countries using mobile networks as a cost-effective alternative to fixed lines in large rural areas (Sommermeyer, 2001), for example, will not necessarily be major innovators in using and developing the technology. In the context of the Asia-Pacific region, analyst Frank Yu of Ion Global argues that developing markets like China do not have a need to broaden their existing wireless penetration base by adding more services. He argues: “They have other basic needs they want to work on before they start experimenting with prototype systems. They’ll just let Japan and Korea do that.” (quoted in Stout, 2001). As the earlier example of GWCom illustrates, however, this fact does not preclude countries like China from pioneering innovative uses of existing wireless technologies. Meanwhile, the proximity of the huge Chinese market may provide advantages to Japanese and Korean producers in their exploration of new m-commerce applications.

DISCUSSION AND CONCLUSIONS

Mobile technology, mobile Internet access, and mobile commerce are growing rapidly on the global stage; however, growth rates vary widely across economic regions. The penetration rate of mobile phones, the optimum combination of different generations of telecommunications, and the combination of different technical formats vary according to a wide array of economic, sociocultural, and policy related factors. The ways in which companies integrate m-commerce applications into their business models depend upon numerous environmental factors, particularly the combination of communications technologies previously adopted and the mobile technologies currently diffusing in their domestic economies. Given the scope for technological leapfrogging and alternative national mixes of fixed lines and wireless infrastructure, global heterogeneity in national patterns of m-commerce development – and hence of business models in m-commerce – appears to be a likely prospect for the foreseeable near future.

An interesting consequence of this global heterogeneity is the tenuousness of the distinction between “leading” and “lagging” countries. Nations that “lag” in fixed-line telephony or Internet use stand to benefit proportionately more from mobile technologies and may in some cases be better positioned to innovate their use; though it is always dangerous to speculate, there is some indication that industrialized East Asian countries may fall into this category. Yet not all nations that rank as “leaders” in m-commerce necessarily have cause to celebrate; many European countries, for example, are concerned that their carriers have exhausted their financial resources in the development of 3G and may be unable to follow through in infrastructural development of mobile technologies. By the same token, the US “lag” in m-commerce may not prove to be a long-term handicap; in fact, the US lag in 3G may accelerate the exploration of technological alternatives like Wi-Fi or UWB. Thanks to NTT DoCo Mo’s i-mode, Japan is assuredly a “leader” in m-commerce; yet this leadership position is partly conditioned by the fact that i-mode represents, to a significant extent, a Japan-specific substitute for fixed-line

Internet usage; the industrial and export benefits of this leadership position are far from certain.

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Endnotes:

¹To simplify usage, the term “e-commerce” is employed for electronic commerce transactions carried out via fixed, wired terminals and the term “m-commerce” for electronic commerce transactions carried out via mobile, wireless terminals. In the larger sense, both are variations of electronic transactions, but using the prefix “e” for fixed/wired and “m” for mobile makes it easier to contrast these two types of electronic transactions.

² See <http://www.gwcom.com/html/news0303.htm>

³ The examples in the foregoing paragraph are of using mobile phones as aids for regular commerce. The step to m-commerce, however, is a short one – when reliable and easy-to-use data-ready phones become widely available.

⁴ Leapfrogging effects of developing countries adopting the latest mobile technologies are going to taper off as the developing countries accumulate sizable segments of mobile users. With 3G, and especially with 4G, only the poorest and most backward developing nations are apt to engage in leapfrogging. In other developing nations, the “mixed generation” pattern of the affluent economies will begin to take hold.

⁵ A variety of standards can be found even in a continent. For example, at the end of the first quarter of 2001, Latin America had 32 million TDMA subscribers, 15.9 million users had CDMA handsets and 4.9 million had GSM handsets (Petrazzini and Hilbert, 2001).

⁶ The standards mentioned here are from the recent IMT-2000 (International Mobile Telecommunications-2000) recommendation.

⁷ PC penetration in South Korea is about 50%, similar to levels in the USA (Luna 2002).

⁸ 1X (or CDMA2000 1X) is the name that identifies the 3G technology that upgrades CDMA networks and wireless devices to 3G features and services.

⁹ BREW platform, designed by QUALCOMM, is a thin application execution environment providing an open, standard platform for wireless devices. Carriers’ BREW-based services enable wireless users to

customize their handsets by downloading applications over the air from a carrier's application download server.